4.0 ENVIRONMENTAL ANALYSIS

The environmental consequences of constructing and operating the JCE & PCGP Project would vary in duration and significance. Four levels of impact duration were considered: temporary, short term, long term, and permanent. A temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to three years following construction. Impact was considered long term if the resource would require more than three years to recover. A permanent impact could occur as a result of any activity that modifies a resource to the extent that it would not return to preconstruction conditions during the life of the Project. We considered an impact to be significant if it would result in a substantial adverse change in the physical environment.

In this section, we discuss the affected environment, general and site-specific construction and operational impacts, and proposed measures to avoid, reduce, or mitigate impacts. Our discussion encompasses Project-related impacts associated with the construction and operation of Jordan Cove's LNG export terminal and associated facilities, and Pacific Connector's pipeline and associated aboveground facilities.

Jordan Cove and Pacific Connector, as part of their proposals, agreed to implement certain measures to avoid, minimize, or mitigate impacts on specific resources. We evaluated these proposed measures to determine if they would adequately mitigate impacts. In cases where we felt the proposed measures were less than adequate, where no mitigation measures were proposed, or where final design details requiring Commission review have yet to be developed, and to ensure that appropriate design requirements are implemented, we have added our recommendations to reduce impacts. These additional measures appear as bulleted, boldfaced paragraphs in the text. We will recommend that these measures be included as specific environmental conditions attached as an appendix to any Commission Order authorizing this Project.

This EIS represents our independent analysis of the proposed action and the data submitted by the applicants. It includes the review of the proposal by the federal agencies cooperating in the production of the EIS: the Forest Service, COE, EPA, Coast Guard, BLM, Reclamation, DOT, and FWS. Conclusions in this EIS are based on our analysis of environmental impacts, given the following assumptions:

- Jordan Cove and Pacific Connector would comply with all applicable laws and regulations;
- the proposed facilities would be constructed as described in chapter 2 of this EIS; and
- Jordan Cove and Pacific Connector would implement the mitigation measures included in their respective applications and supplemental filings to the FERC.

To facilitate requirements of the federal cooperating agencies, we have modified the structure of this section of the EIS from the standard format of other documents issued by the Commission. In all cases, the modification has been inclusion of agency-specific needs. In particular, the Land Use section includes analysis of resources as they relate to BLM and Forest Service proposed LMP amendments for the Pacific Connector pipeline.

4.1 LAND USE

4.1.1 Jordan Cove LNG Terminal

4.1.1.1 Land Ownership, Existing Land Use, and Zoning

Virtually all of Jordan Cove's upland elements are on privately owned lands. No federal lands would be utilized for the Jordan Cove Project. However, Jordan Cove proposes to acquire one parcel from the Port as part of its *Habitat Mitigation Plan*. In addition, some components are situated within waters of the State of Oregon. The majority of the waterway for LNG vessel marine traffic, the access channel to the terminal, and the eelgrass mitigation area would be located in Coos Bay. The bay is considered waters of the State, with the bottom of the bay managed by ODSL. Part of the waterway for LNG vessel traffic and the existing dredge disposal Site F are located in the Pacific Ocean offshore of the North Spit.

The Jordan Cove LNG export terminal would be located on the bay side of the North Spit, about 7.5 miles up the existing Coos Bay navigation channel, approximately 1,000 feet north of the city limit of North Bend, in Coos County, Oregon. The various elements of the Jordan Cove Project, except for the waterway for LNG vessel traffic in Coos Bay, are illustrated on figure 4.1-1. The land at the LNG terminal is currently covered by open grasslands (58 acres) and brush (including wetlands) and forested dunes (57 acres, see figure 4.1-2).

The LNG terminal would be within Section 5, Township (T.) 25 South (S.), Range (R.) 13 West (W.), shown on Coos County Assessor's map as tax lots 100/200/300. The LNG terminal, slip, and access channel are located within the aquatic and shoreline segments of the Coos Bay Estuary Management Plan (CBEMP). The access channel and inter-tidal portion of the slip fall within zoning districts 5 and 6 – Development Aquatic (5-DA and 6-DA). The purpose of the 6-DA zone is to provide areas for navigation and other water-dependent uses. The upland portions of the LNG terminal are located within the Coastal Shorelands Boundary and are designated districts 5 and 6 - Water Dependent Development Shorelands (5-WD and 6-WD). The purpose of zoning district 6-DA is to protect the shoreline and provide areas suitable for water-dependent industrial uses. On July 25 and September 17, 2012, the Coos County Planning Department approved Jordan Cove's request for fill within the 6-WD zoning district. The Port obtained a permit from ODSL for dredging the portion of the access channel to the terminal within Coos Bay.

Historically, the LNG terminal tract was once part of the Henderson Ranch, dating back to the 1860s. In the 1880s, the Henderson Ranch was acquired by the Luse family, who later sold it to the Southern Oregon Improvement Company. The Peterson family operated a dairy farm in the area in the early twentieth century, and continued to run cattle on the North Spit until the late 1950s (Byram 2006a). The terminal tract, then referred to as the Ingram Yard, was acquired by the Menasha Wood Ware Corporation, and was sold to Weyerhaeuser in 1981. The Ingram Yard was used for log sorting and disposal of debris from operation of the mill. In the early 1970s, the

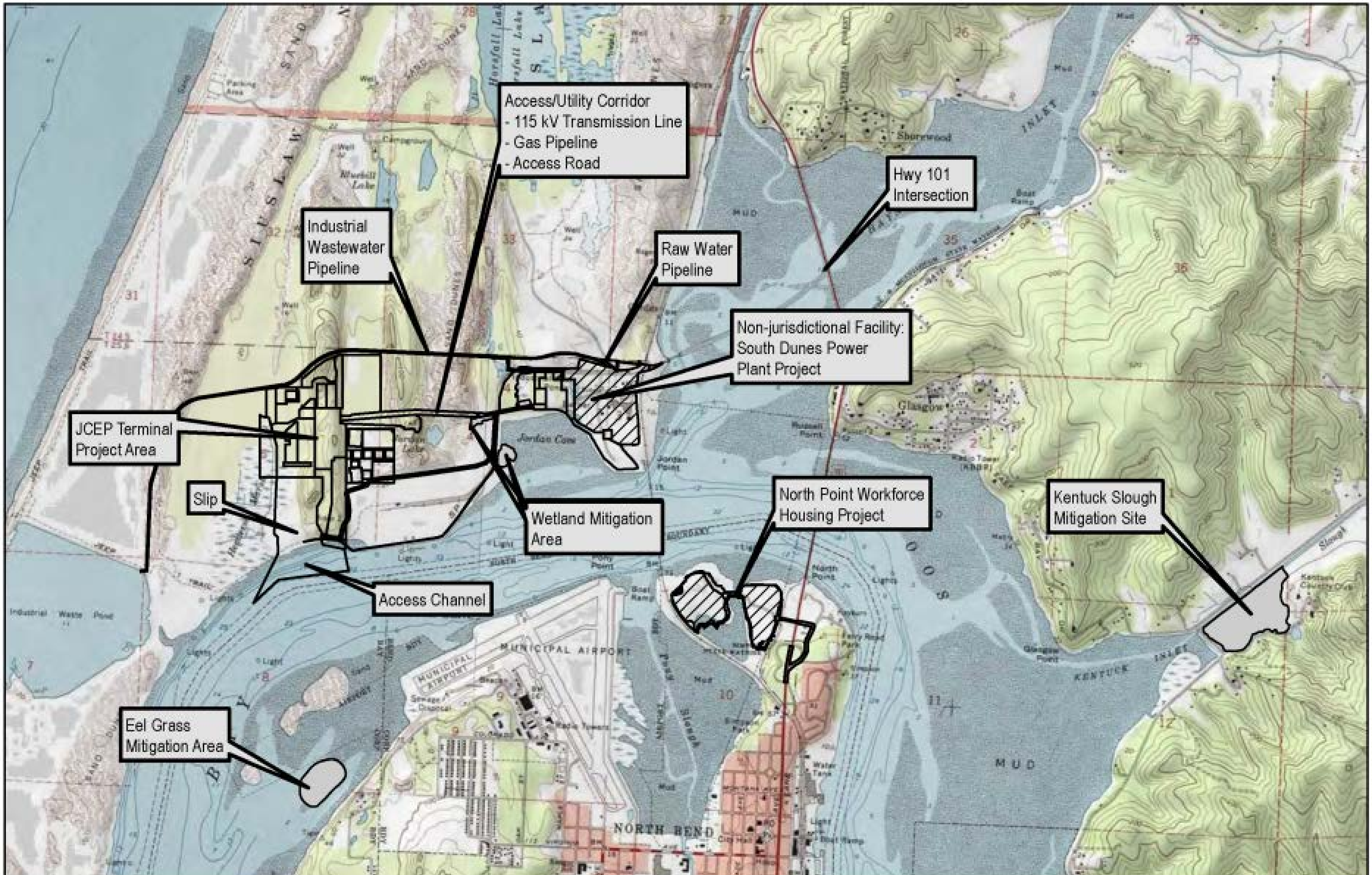


Figure 4.1-1

USGS Topographic Map of the Jordan Cove LNG Terminal Project Site

0 500 1,000 2,000 Ft

1:36,000

Source:
ESRI, Black and Veatch

Created by: TRC

3/28/2014

Figure 4.1-2

Existing Land Use of the Project Area

COE deposited materials dredged during maintenance of the Coos Bay navigation channel at the Ingram Yard.

Jordan Cove proposes to construct and operate a 1.5-mile-long utility and access corridor between the LNG terminal and the South Dunes Power Plant, in the Northeast (NE) Quarter of Section 5, T.25S., R.13W., and Northwest (NW) Quarter of Section 4. This corridor would be north of the existing Roseburg Forest Products property, on land Jordan Cove acquired from Weyerhaeuser. On the south side of the utility-access corridor, adjacent to the eastern boundary of the terminal tract, Jordan Cove would install support buildings, including the terminal control building and the warehouse and maintenance building. Combined, the utility-access corridor and terminal support buildings area encompass about 19 acres. This would include about 10 acres of forest, 5 acres of industrial land, and 4 acres of open shrub/grassland (see table 4.1.1.1-1). Historically, this parcel was once part of the Henry Barrett and Sam Crawford Ranch and the James Jordan Ranch, established in the 1860s, and consolidated by the Luse family in the 1880s.[1]

TABLE 4.1.1.1-1

Types of Land Uses Affected by Construction and Operation of the Jordan Cove Project

	Acres of Impact a/							
	Open Water		Open Land (including shrubs and grasslands)		Forest		Industrial	
Project Element	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Jurisdictional Facilities								
Access Channel and Marine Slip	29	29	20	20	17	17	0	0
Terminal Site Access	0	0	2	2	2	2	0	0
Refrigerant Storage Area	0	0	1	1	1	1	0	0
LNG Loading Berth/Platform and Transfer Line	0	0	0	0	9	9	0	0
Liquefaction Process Area	0	0	0	0	20	20	0	0
LNG Storage Tank Area	0	0	21	21	7	7	0	0
Terminal Fire Water Ponds	0	0	4	4	0	0	0	0
Ground Flare	0	0	<1	<1	1	1	0	0
Barge Berth	2	2	0	0	1	1	<1	<1
Gas Processing Area	0	0	1	1	<1	<1	12	12
Stormwater Pond	0	0	10	10	0	0	1	1
PCGP Meter Station b/	0	0	0	0	0	0	0	0
Utility Corridor and East Access Road	1	1	4	4	6	6	1	1
Terminal Operator Building and Warehouse	0	0	0	0	4	4	4	4
Industrial Wastewater Pipeline Relocation	0	0	0	0	<1	0	12	5
Raw Water Pipeline Extension	0	0	0	0	0	0	3	1
North Point Workforce Housing Complex Bridge	0	0	0	0	0	0	<1	<1
Total Impacts	***32***	***32***	***63***	***63***	***67***	***67***	***33***	***24***
Non-Jurisdictional Facilities								
South Dunes Power Plant	0	0	5	5	1	1	51	51
Southwest Oregon Regional Safety Center (SORSC)	0	0	0	0	7	7	1	1
Total Impacts	***0***	***0***	***5***	***5***	***9***	***9***	***52***	***52***

[1] William Luse was the son of H.H. Luse, who founded the first saw mill at Empire in 1856 (Dodge 1898). William Luse, John Henderson, Henry Barrett, Sam Crawford, and James Jordan were all acquaintances who married native Coos women, sought refuge on the North Spit, and were tangentially involved in the operation of the stage line from Jarvis Landing north along the beach to the Umpqua River.

TABLE 4.1.1.1-1

Types of Land Uses Affected by Construction and Operation of the Jordan Cove Project

Project Element	Acres of Impact a/							
	Open Water		Open Land (including shrubs and grasslands)		Forest		Industrial	
	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Temporary Construction Areas c/								
Construction Offices at Roseburg Forest Products Property	0	0	0	0	0	0	1	0
Parking at Roseburg Property	0	0	0	0	0	0	<1	0
Craft Areas at Roseburg Property	0	0	0	0	0	0	<1	0
Warehouse/Storage at Roseburg Property	0	0	0	0	0	0	1	0
Fabrication Areas at Roseburg Property	0	0	0	0	0	0	4	0
Open Areas	0	0	0	0	0	0	11	0
LNG Vessel Berth Dune	0	0	0	0	14	0	1	0
Northern Terminal Sand Dune Area	0	0	0	0	7	0	0	0
Laydown Area at Roseburg Property	0	0	0	0	0	0	13	0
Laydown Area	0	0	7	0	14	0	0	0
Gas Processing Plant Laydown Area	0	0	0	0	0	0	4	0
Heavy Equipment Haul Road at Roseburg Property	0	0	0	0	0	0	8	0
Slurry and Return Water Pipelines at Roseburg Property	0	0	0	0	0	0	1	0
North Point Workforce Housing Complex d/ e/	0	0	0	0	0	0	48	0
Total Impacts from Temporary Construction Areas	***0***	***0***	***8***	***0***	***35***	***0***	***93***	***0***
TOTAL PROJECT AREA	**32**	**32**	**76**	**68**	**111**	**76**	**178**	**76**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Values may not sum exactly due to rounding of significant digits.
b/ Acres impacted by the Pacific Connector Meter Station are accounted for by the Pacific Connector pipeline and associated aboveground facilities in section 4.1.2.2.
c/ The values reported for Temporary Construction Area impacts exclude areas that overlap with permanent facility impacts.
d/ Jordan Cove indicated that 2 additional acres of construction impact may occur to areas classified as "industrial" for the NPWHC, which would bring the total to 50 acres.
e/ Jordan Cove would also use existing paved or graveled parking areas within the Mill Casino Parking Lot (approximately 15 acres) and former Myrtlewood RV Camp Parking Lot (approximately 6 acres) for off-site worker parking during construction.

The jurisdictional gas processing plant, and non-jurisdictional South Dunes Power Plant and SORSC, would be located east of existing Jordan Cove Road, north of geographic Jordan Cove. This tract, encompassing a total of about 101 acres, was acquired by Jordan Cove from Weyerhaeuser. Now known as the former linerboard mill site, historically, it was once part of the Jordan Ranch, dating back to the 1860s, later acquired by the Luse family, and conveyed to the Southern Oregon Improvement Company. In 1961 Menasha built a sulfate pulp and paper mill on the property, which was sold to Weyerhaeuser in 1981, and converted to a recycled paper mill in 1995. The mill was closed in 2003. Between 1981 and 1992, Weyerhaeuser leased the southern portion of the tract, adjacent to geographic Jordan Cove, to a fish hatchery. The buildings for the mill and fish hatchery have been removed.

The power plant tract includes portions of Sections 3 and 4, T.25S., R.13W., within tax lots 04/100 and 03/200. It is zoned as Industrial (IND) land within the Beach and Dune Area with Limited

Developmental Suitability according to the CBEMP. On October 4, 2012, the Coos County Planning Department granted Weyerhaeuser's request for a fill conditional use permit. The former linerboard mill property, including the Jordan Cove natural gas treatment plant, South Dunes Power Plant, and the SORSC, would cover about 5 acres of open land, 9 acres of forest, and 52 acres of industrial land (see table 4.1.1.1-1).

In addition, Jordan Cove would lease about 40 acres of industrial land within the existing 229-acre Roseburg Forest Products property for temporary construction staging activities. The haul road and dredge slurry and return water lines from the slip, to be used temporarily during construction of the terminal, would also cross Roseburg Forest Products industrial land. The proposed relocations of the CBNBWB industrial wastewater pipeline and the raw water pipeline would be routed along the existing Trans-Pacific Parkway, on the north side of the terminal. The relocations of the water lines would impact about 15 acres of industrial land and less than half an acre of forest land during construction.

Jordan Cove has proposed mitigating the loss of wetlands through three sites in the vicinity of the Project: Kentuck Slough, West Jordan Cove, and West Bridge. Two sites are located on the east side of the Roseburg Forest Products property—3.7 acres of wetlands for the West Jordan Cove Mitigation Area, and 2.0 acres of wetlands at the West Bridge Mitigation Area. Additional information about wetland impact and mitigation is presented in section 4.4.3.

Construction of the LNG terminal, South Dunes Power Plant, SORSC, and associated facilities would affect a total of approximately 397 acres, of which 178 are currently industrial land, 111 acres forest land, 76 acres open land (including shrubs and grasslands), and 32 acres of open water. Permanent operation of the facilities would affect approximately 251 acres, of which 68 acres are open land, 76 acres industrial, 76 acres forest, and 32 acres open water. See table 4.1.1.1-1 for acres affected by construction and operation for each Project element.

Various areas associated with Jordan Cove's proposal are geographically separate from the LNG terminal-power plant complex on the North Spit. At disposal site F, in the Pacific Ocean about 1.8 miles northwest of the mouth of Coos Bay (figure 2.1-1; figure 2.1-12), Jordan Cove proposes to dump materials dredged during maintenance of the access channel and marine slip at the terminal. This is an existing EPA-approved offshore placement site, covering about 3,075 acres, primarily used by the COE's Navigation Branch and the Port. (see chapter 2 for further details).

The waterway for LNG vessel marine traffic would traverse 7.5 miles of the existing navigation channel within Coos Bay. The navigation channel is zoned "Deep-Draft Navigation Channel." in the CBEMP. The navigation channel, which is generally 300-feet-wide and 37-feet-deep, is maintained by the COE on behalf of the Port. It is used by deep draft commercial ships and barges, a commercial fishing fleet, and recreational boats (as described in sections 2.1.1, 4.8.1, 4.9.1, and 4.10.1 of this EIS). The Coos Bay navigation channel does not need to be improved for the Jordan Cove Project. Also within Coos Bay, adjacent to the Southwest Oregon Regional Airport, would be the eelgrass mitigation area, covering approximately 7.5 acres of open water and bay bottom (see section 4.6).

On the north side of the McCullough Bridge, Jordan Cove would make improvements to the intersection of Highway 101 with the Trans-Pacific Parkway, in accordance with its Transportation Impact Analysis (DEA 2012; see also section 4.10.1.2 of this EIS). On the south side of the McCullough Bridge, in North

Bend, Jordan Cove proposes to build the NPWHC and parking lot, covering about 48 acres. This land is owned by Al Pierce Lumber Company, and would be leased by Jordan Cove. It is zoned for heavy industry according to the North Bend Municipal Code and is classified as industrial land. The site was formerly used for log staging. Jordan Cove proposes to use the site for worker housing, and an associated road, transit, utility corridor, bridge crossing, parking area, and staging area (see section 2.4.1.1). In March and April 2014, the City of North Bend Planning Commission issued a Conditional Use Permit to Jordan Cove to allow for the NPWHC.

Jordan Cove proposes to use two temporary off-site parking lots during terminal construction for commuting workers not residing at the NPWHC. One lot, approximately 15 acres, would be at the Mill Casino in the city of Coos Bay. The other lot, approximately 6 acres, would be at the former Myrtlewood RV Camp along Highway 101 near the community of Hauser.

The Kentuck Slough Wetland Mitigation Area would cover about 43.6 acres of uplands on the western shore of Coos Bay at the mouth of Kentuck Slough, to the west of NCM 11 along the Coos Bay navigation channel, including parts of Sections 6 and 7, T.25S,R.12W., tax lots 100/799 and Sections 1 and 12, T.25S.,R.13W. tax lots 400/100. Formerly, this was the Kentuck Golf Course, zoned for Recreation (REC) and Forest (F). However, on September 23, 2009, the Coos County Board of Commissioners, responding to an application from the Port, rezoned this land to Exclusive Farm Use (EFU), and amended the Coos County Comprehensive Plan for this tract from Recreation and Forest use to Agriculture. Also, the County granted the Port's request for conditional use to allow for mitigation and restoration within Segment 15-RS of Rural Shorelands identified in the CBEMP. This property, which is open land including grasslands and wetlands, is currently owned by Jordan Cove.

Lastly, Jordan Cove has identified three parcels it would like to acquire and preserve as part of its Habitat Mitigation Program. Two parcels (P and W) are on the North Spit. The other parcel (S) would be on land owned by Roseburg Forest Products along the Coquille River (see section 4.6.1.1).

Construction and operation of the Jordan Cove LNG terminal, the South Dunes Power Plant, and related facilities should have no significant adverse impacts on existing land use. Jordan Cove's facilities would be consistent and compatible with existing zoning. The LNG terminal tract is zoned for water-dependent industrial use and the adjacent South Dunes Power Plant property as well as the workers camp are zoned for industrial use. Jordan Cove has obtained or is in the process of obtaining local and state permits necessary for use of the Project component areas (see table 1.4.1-1).

4.1.1.2 Coastal Zone Management

The Jordan Cove LNG terminal would be located within the Oregon coastal zone (figure 4.1-3). The coastal zone is formally defined as extending from the Washington border on the north to the California border on the south; seaward to the extent of state jurisdiction as recognized by federal law (i.e., the territorial sea, extending 3 nautical miles offshore); and inland to the crest of the Oregon Coast Range. The Oregon Coastal Management Program of the ODLCD coordinates management of the state's coastal zone and reviews project-specific compliance and consistency with the CZMA. Procedures for ODLCD coastal zone reviews are specified in federal (15 CFR 930) and state regulations (OAR 660-035).

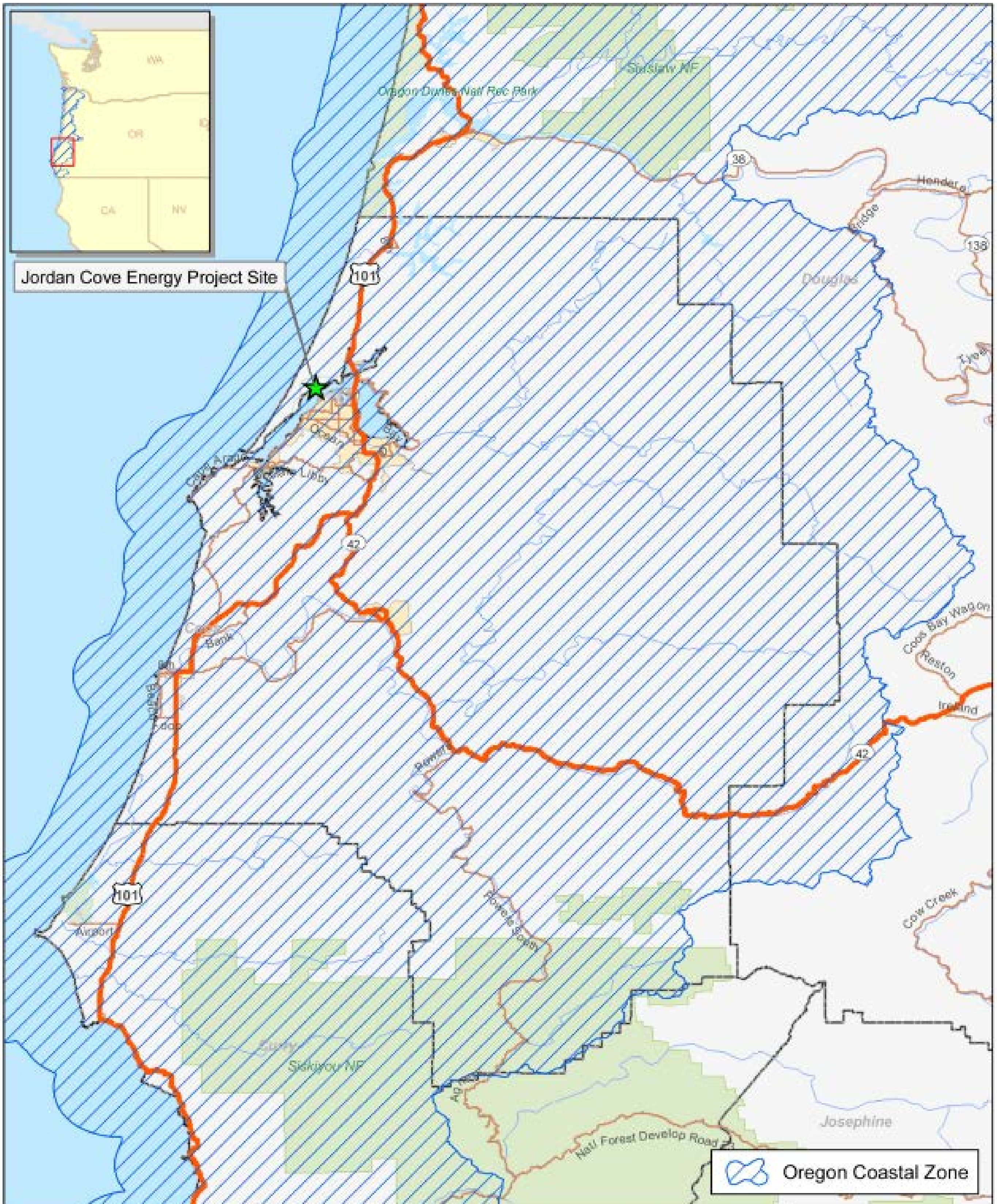


Figure 4.1-3.
Coastal Zone Management Area

On August 1, 2014, Jordan Cove and Pacific Connector submitted their applications to the ODLCD for certification of consistency with the CZMA. The CZMA allows for a six-month review of the applications, with extensions upon agreement. On July 8, 2015, the ODLCD signed a stay agreement that delays their review to January 9, 2016. Therefore, **we recommend that:**

- **Jordan Cove and Pacific Connector <u>should not begin construction of their respective facilities</u> until the companies each file with the Secretary a copy of the ODLCD's determination of consistency with the CZMA.**

4.1.1.3 Existing Residences, Commercial Buildings and Planned Developments

The nearest residential structure to the LNG terminal is about 1.1 miles to the southeast. The closest commercial buildings are part of the existing Roseburg Forest Products industrial operation adjacent to the Jordan Cove LNG terminal. All structures, including businesses, residences, schools, churches, and government buildings, within 2 miles of the LNG terminal site are summarized in table 4.1.1.3-1 below and shown on figure 4.1-4.

TABLE 4.1.1.3-1

Structures Within Two Miles of the Proposed Jordan Cove LNG Terminal

Structure Type	Number of Structures
Businesses	49
Residences	1,438
Schools	2
Churches	6
Government Buildings	70
Total Structures within 2 miles	**1,565**

There are currently no planned residential or commercial developments identified within 1.0 mile of the Project site. However, we are aware that the Coos County Airport District is planning to extend one of the runways at the Southwest Oregon Regional Airport. Ocean Terminals, located at approximately NCM 11 on the Coos Bay waterfront in North Bend is planning to expand its storage yard and extend its pier and wharf on the east side of North Bend. This would be about 3 miles southeast of the Jordan Cove terminal.

Within the City of Coos Bay, a private company, Ocean Grove Development LLC, broke ground in 2013 on a subdivison on 69 acres south of Ocean Boulevard. Eventually, the developer would like to build 676 housing units at the Ocean Grove subdivision.[2] The Coos Tribes are considering construction of a museum and cultural center, and a 30,000-square-foot hotel and convention center at the Hollering Place in Empire, and a new 10,000-square-foot casino on Ocean Boulevard in Coos Bay. The City of Coos Bay is considering the redevelopment of four buildings and the McAuley Hospital as part of its Downtown Revitalization Project. The Hollering Place is about 2 miles south of the proposed Jordan Cove terminal, and the Ocean Grove subdivision and downtown Coos Bay are situated about 3 miles away.

[2] See Thornton, E., 6 August 2013, "Breaking Ground, Ocean Grove Development Group Plans to Build 676 Houses in Coos Bay," *The World*. Although the newspaper article website indicated that the subdivision could supply housing for Jordan Cove construction workers, in fact there is no agreement between Ocean Grove Development and Jordan Cove.

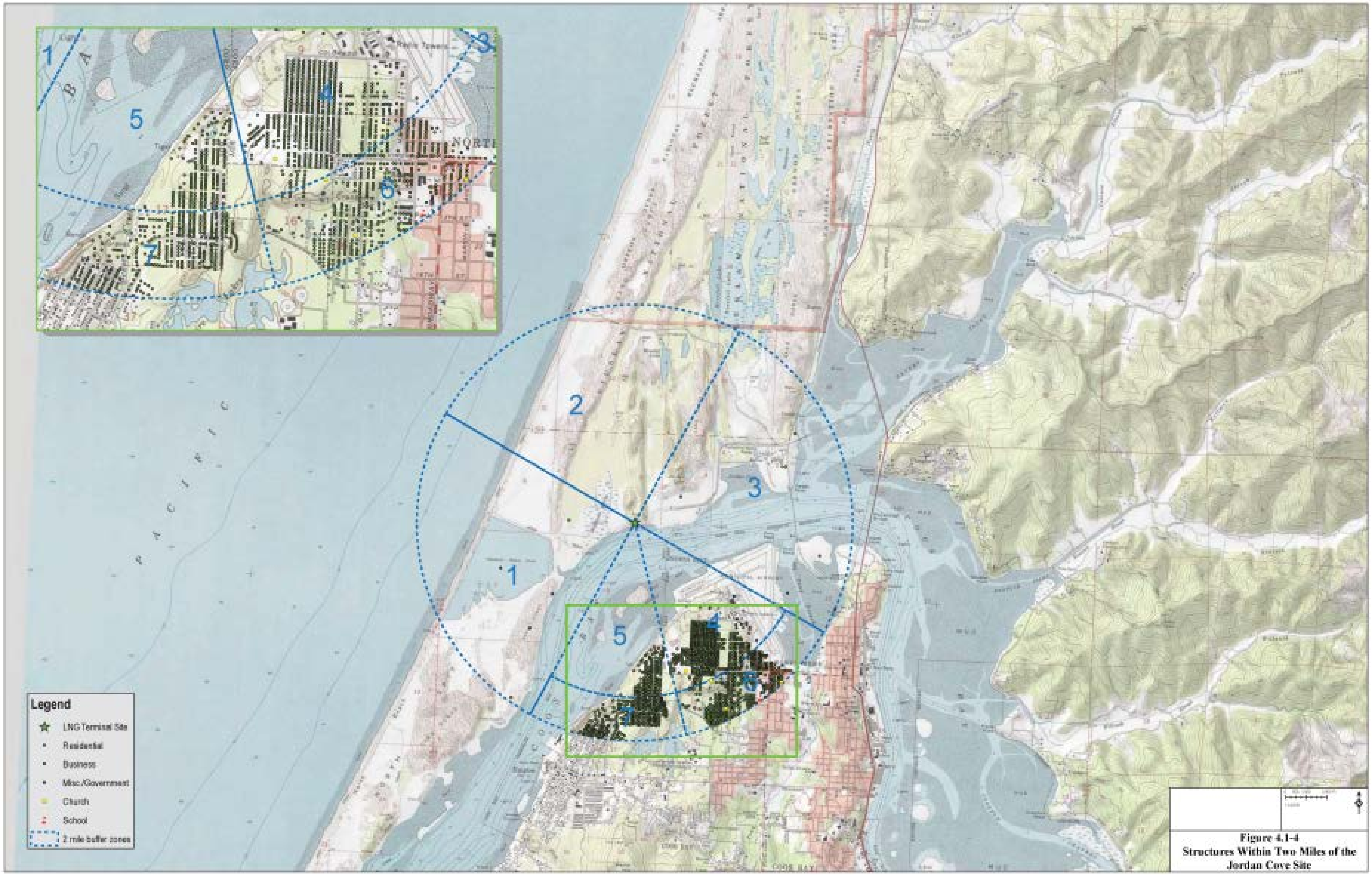


Figure 4.1-4
Structures Within Two Miles of the Jordan Cove Site

4.1.2 Pacific Connector Pipeline and Associated Facilities

4.1.2.1 Land Ownership

A variety of public and private lands would be crossed by the Pacific Connector pipeline, as is summarized in table 4.1.2.1-1. Land ownership along the pipeline route is approximately 31 percent federal, 68 percent private, and 1 percent state lands. No tribal-owned lands or county lands would be crossed. Federal lands are more fully discussed below in section 4.1.3.

TABLE 4.1.2.1-1

Land Ownership Crossed by the Pacific Connector Pipeline a/

County	Federal Land		State Land		Private Land		Total
	Miles	%	Miles	%	Miles	%	
Coos	10.8	4.66	2.9	1.25	35.3	15.23	**49.0**
Douglas	21.0	9.06	0.0	0.00	45.1	19.46	**66.1**
Jackson	30.1	12.99	0.2	0.09	25.6	11.04	**55.9**
Klamath b/	9.3	4.01	0.2	0.09	51.3	22.13	**60.8**
Total	**71.2**	**30.72**	**3.3**	**1.42**	**157.3**	**67.86**	**231.8**

Note: Rows and columns may not add correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

a/ In the GIS database, 0.24 miles in Klamath County was identified as "unknown" and have been added to the State Land column for the crossings of the Klamath and Lost rivers.

b/ To account for Reclamation facilities on private lands, 0.34 miles was manually added to the federal lands and subtracted from the private lands column in Klamath County.

4.1.2.2 Existing Land Use and Zoning

Pacific Connector is proposing to construct and operate an approximately 232-mile-long, 36-inch diameter interstate natural gas pipeline between Malin and Coos Bay, Oregon. Section 2.1.2 provides a detailed description of the pipeline and aboveground facilities. Approximately 95.3 miles, or 41 percent, of the pipeline route would be constructed within or adjacent to existing utility and transportation corridors (see table D-1 in appendix D of this EIS for a listing of co-locations by MP).

Land Use

Pipeline

Approximately 62 percent of the land that would be crossed by the pipeline is classified as forest, 16 percent is agricultural land, 12 percent is rangelands, and about 8 percent is urban or built-up lands. The other land types combined (water, wetlands, barren lands) comprise about 2 percent of the proposed route. A summary of existing land uses crossed by the pipeline facilities is presented in table 4.1.2.2-1. For tables detailing the location of access roads, hydrostatic discharge sites, topsoil salvage areas, TEWAs, UCSAs, rock source/disposal sites, land ownership by MP, and pipe storage yards see appendix D, tables D-2 through D-9 in this EIS.

The pipeline centerline would cross a combined total of about 145 miles of forest, including deciduous forest, evergreen forest, mixed forest (containing both deciduous and evergreen trees), clearcut forest, and regenerating forest (see section 4.5.1.2 for more details about forested lands). About 37 miles of agricultural lands would be crossed, mainly cropland and pasture. The pipeline would cross about 27 miles of rangeland, including grasslands, shrub, and brush. Urban and built-up lands, crossed by the proposed route for about 18 miles, including about 2 miles of residential areas, commercial areas, and industrial areas combined, and about 16 miles of transportation, communication and utility corridors (including roads, railroads, telephone lines, powerlines, and pipelines). The pipeline would cross about

5 miles of water and wetlands combined.[3] Water includes bays and estuaries, lakes and reservoirs, rivers and streams, and ditches and canals. Wetlands include forested and non-forested wetlands. Less than 0.1 mile of barren lands would be crossed, including beaches, exposed bedrock, strip mines, quarries, and gravel pits, transitional areas, and mixed barren lands.

TABLE 4.1.2.2-1

Land Uses Crossed by the Pacific Connector Pipeline Right-of-Way

U.S. Geological Survey Land Use Classification			Project Total (miles)	Percent of Total
Urban or Built-Up Land	Residential		0.2	0.13
	Industrial		0.3	0.12
	Transportation/Communication		16.4	7.08
	Other Urban or Built-up Land		1.2	0.52
		Subtotal	***18.1***	***7.73***
Agricultural Lands	Cropland and Pasture		37.2	16.18
	Orchards, Groves, Vineyards, etc.		<0.1	0.01
		Subtotal	***37.2***	***16.19***
Rangeland	Herbaceous Rangeland		7.9	3.40
	Shrub and Brush Rangeland		14.9	6.43
	Mixed Rangeland		4.2	1.81
		Subtotal	***27.0***	***11.65***
Forest Land	Deciduous Forest Land		4.9	2.12
	Evergreen Forest Land		50.4	21.57
	Clearcut Forest Land		11.0	4.75
	Regenerating Forest Land		49	21.15
	Mixed Forest Land		29.6	12.77
		Subtotal	***144.8***	***62.35***
Water	Streams		1.0	0.43
	Ditches and Canals		0.3	0.15
	Bays and Estuaries		2.5	1.07
		Subtotal	***3.8***	***1.65***
Wetlands	Forested Wetland		0.2	0.08
	Nonforested Wetland		0.6	0.25
		Subtotal	***0.8***	***0.35***
Barren Land	Beaches		<0.1	<0.01
	Mines, Quarries, Gravel Pits		<0.1	0.01
		Subtotal	***<0.1***	***0.01***
		Project Total	**231.7**	**100**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

A summary of acres affected by the construction and operation of the Pacific Connector pipeline is presented in table 4.1.2.2-2. Installation of the pipeline would require the clearing of vegetation within the construction right-of-way. The impact of pipeline construction on vegetation is discussed in section 4.5.1.2 of this EIS. Excluding areas along the pipeline route that have been clear cut recently and storage areas where trees would not be cleared (UCSA), about 2,055 acres of upland forest would need to be cleared during pipeline construction activities. Less than one acre of forest would be permanently removed for access roads. During operation of the pipeline, a 30-foot-wide corridor centered on the pipeline would be kept in an herbaceous

[3] This value is limited to the pipeline centerline. Length of wetlands crossed is approximately 9.4 miles total for all Project elements. See section 4.4 for results of wetland delineation and discussion of project impacts to wetlands.

TABLE 4.1.2.2-2

Acres of Land Affected by Construction and Operation of the Pacific Connector Pipeline

	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest	Streams	Ditches/Canals	Bays and Estuaries a/	Forested Wetlands a/	Nonforested Wetlands a/	Beaches	Strip Mines, Quarries, Gravel Pits	Total
CONSTRUCTION DISTURBANCE b/																							
Construction Right-of-Way	4	<1	4	161	14	424	<1	91	175	47	58	580	346	124	571	7	4	74.2	3.0	5.9	0.2	1	2,694
Hydrostatic Discharge Sites c/	0	0	0	0	0	<1	0	<1	<1	0	0	0	<1	0	<1	0	0	0	0	0	0	0	1
Klamath CS	0	0	0	0	<1	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	32
Temporary Extra Work Areas	4	<1	23	77	31	226	<1	44	52	54	19	118	91	37	214	1	3	2.0	1.0	4.7	6.6	23.0	1,030
Uncleared Storage Areas	<1	0	0	18	0	1	0	3	8	3	7	180	223	63	168	<1	0	0	<0.1	1.5	0	<1	676
Rock Source/Disposal	0	0	0	2	0	3	0	2	7	0	0	3	3	0	6	<1	0	0	0	0	0	61	87
Contractor and Pipe Storage Yards	9	0	315	12	2	325	0	114	0	0	0	0	7	0	33	0	<1	0	0	0	0	206	1,024
Access Roads (TARs/PARs) d/	<1	0	<1	<1	0	5	0	2	2	<1	<1	<1	5	<1	<1	<1	<1	0	0	<0.1	0	0	21
Total	**17**	**1**	**342**	**270**	**48**	**981**	**<1**	**256**	**276**	**104**	**84**	**881**	**676**	**224**	**992**	**10**	**7**	**76.2**	**4.0**	**12.2**	**6.8**	**291**	**5,565**
OPERATION DISTURBANCE																							
Permanent Easement e/	2	0	2	96	7	224	<1	48	90	26	30	305	181	66	299	6	2	14.9	1.8	3.6	<1	<1	1,404
Permanent Access Roads	<1	0	0	<1	0	<1	0	<1	<1	<1	0	0	<1	<1	<1	<1	<1	0	0	<1	0	0	2
Total	**3**	**0**	**2**	**96**	**7**	**224**	<1	**49**	**90**	**26**	**30**	**305**	**181**	**66**	**299**	**6**	**2**	**14.9**	**1.8**	**3.6**	<1	<1	**1,406**
30-Foot Maintenance Corridor	1	0	1	59	4	135	<1	29	54	15	18	183	108	40	179	4	1	8.9	1.1	2.2	<1	<1	843

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown a “<1”).

a/ Acreages for estuaries and wetlands are rounded to the nearest tenth of an acre. Values below 0.1 are shown as <0.1. Acres of wetlands affected during construction according to jurisdictional delineation are much greater (approximately 197 acres) than the land use definition used in this table. See section 4.4 for discussion of impacts to wetlands.

b/ Construction disturbance associated with the aboveground facilities is included in the pipeline construction right-of-way impacts. Operation disturbance for aboveground facilities is presented separately in table 4.1.2.2-3. With aboveground facilities, total operation disturbance is 1,438 acres. This includes the 31-acre Klamath CS and the 1-acre communication tower sites.

c/ These are sites located outside the construction right-of-way. Small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. No soil disturbance would occur. A rubber-tired or track hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

d/ Portions of some of the PARs are located within the construction right-of-way and, therefore, there is some duplication in the acreage calculations. Existing access roads that would be improved (e.g., widening) would affect an additional 14 acres (see table 2.3.2-1). Land use types affected by existing road improvement activity were identified by adjacent land uses, although the majority of the 14 acres is assumed to be road surface or immediate roadside, which would be “Transportation” land use.

e/ The permanent easement is located within the disturbed acreage of the construction right-of-way. It is not an addition to the construction impacts.

state, resulting in a permanent loss of about 528 acres of forest land.[4] Outside of that 30-foot-wide corridor, forest would be restored within the remainder of the construction right-of-way. Pacific Connector would reduce impacts on forest by following its ECRP.[5] However, even with restoration, this would be a long-term impact, as it takes many years for trees to mature.

About 981 acres of agricultural land would be affected by pipeline construction. With the exception of the permanent right-of-way in orchards, these lands can be restored and returned to their original condition and use after the pipeline is installed. Shallow-rooted crops or pasture grasses may be grown across the entire 50-foot-wide permanent easement. The planting of deep-rooted crops, such as orchards and vineyards, would not be permitted directly over the pipeline. Orchards comprise less than 0.1 mile of the pipeline route. Pacific Connector would negotiate with landowners and provide compensation for crop losses or orchards taken out as a result of pipeline construction. Landowners could select seed mixes or crops to be planted over the right-of-way in agricultural crop land or pastures.

To lessen impacts on agricultural lands, Pacific Connector would segregate topsoil and repair any damaged irrigation systems or drain tiles. The segregation of topsoil is discussed in section 4.3. In addition, in agricultural areas the pipeline would have a minimum depth cover of 5 feet over the top of the pipe, where possible, to avoid operational impacts. The largest proportion of agricultural lands crossed by the pipeline, a total of about 30 miles of privately irrigated cropland, would be in Klamath County. Pacific Connector would reduce or mitigate impacts by using a winter construction schedule between MPs 188 and 228, when many of the irrigation canals are dry or unused, and water tables are low. Pacific Connector prepared a *Winter Construction Plan for the Klamath Basin*.[6]

The primary impacts on pasture and rangelands used for grazing livestock would be temporary removal of fences during construction of the pipeline, and temporary removal of livestock from construction areas. To reduce impacts on range, Pacific Connector would erect temporary fences and gates to landowner specifications. Fences cut would be braced and secured to prevent slack wires. If construction activities break or destroy a natural barrier used for livestock control, gaps would be temporarily fenced to prevent passage of livestock. After construction, fences, gates, and cattle guards, including any natural barriers broken, would be restored to their original state as soon as practical. Pacific Connector would consult with landowners and provide them with an opportunity to remove livestock from the construction right-of-way. Hayfields and pastures would not be cleared except in areas directly over the trench or where grading would be required to create a level working surface. Impacts to grazing allotments on federal lands are discussed below in section 4.1.3.2.

We discuss impacts and mitigation for the crossing of residential and commercial lands below in section 4.1.2.3. The crossing of roads by the pipeline is discussed in section 4.10. When crossing

[4] Reported acreage of forest-woodland vegetation impacted in the 30-foot-wide corridor is slightly higher (530 acres) in section 4.5 of this EIS due to differences in habitat calculation versus the land use classifications reported in table 4.1.2.2-2 of this section.

[5] In addition, Pacific Connector would follow the procedures for cutting forest along all lands crossed by its pipeline outlined in the *Right-of-Way Clearing Plan for Federal Lands* included as Attachment 20 of its POD.

[6] Attached as Appendix 1E of Resource Report 1 in the Environmental Report included with Pacific Connector's June 2013 application to the FERC.

other underground utilities, Pacific Connector would follow standard pipeline construction procedures, such as calling the One-Call underground utility number prior to construction in a specific area, and contacting the utility companies to coordinate the crossing (see section 2.4.2.2). The crossing of waterbodies and wetlands is discussed in section 4.4.

Aboveground Facilities

As shown below in table 4.1.2.2-3, the Klamath Compressor Station tract, including the Klamath-Beaver and Klamath-Eagle Meter Stations, would cover about 31 acres of rangeland. The Clarks Branch Meter Station would be located within less than one acre of agricultural land.

TABLE 4.1.2.2-3

Acres Affected by Operation of Pacific Connector Proposed Aboveground Facilities

Facility	Milepost	Land Use	Acres a/
Jordan Cove Meter Station, MLV #1 b/ Receiver c/, d/	1.5R	Industrial	<1
MLV #2 (Boone Creek Road)	15.5	Regenerating Mixed Forest Land	<1
MLV #3 (Myrtle Point Sitkum Road)	29.5	Evergreen Forest	<1
MLV #4 (Deep Creek Spur)	48.4	Regenerating Evergreen Forest	<1
MLV #5 (South of Olalla Creek)	59.6	Cropland/Pasture	<1
Clarks Branch Meter Station, MLV #6, Launcher/Receiver & Communications Tower d/	71.5	Cropland/Pasture	1.0
MLV #7 (Pack Saddle Road)	80.0	Evergreen Forest	<1
MLV #8 (Hwy 227)	94.7	Herbaceous Rangeland	<1
MLV #9 (BLM Road 32-2-12)	113.7	Evergreen Forest	<1
MLV #10 (Shady Cove)	122.2	Transportation, Communications, and Utilities	<1
MLV #11 Launcher/Receiver (Butte Falls)	132. 5	Cropland and Pasture	<1
MLV #12 (Heppsie Mtn Quarry Spur)	150.7	Shrub and Brush Rangeland	<1
MLV #13 (Clover Creek Road)	169.5	Regenerating Evergreen Forest	<1
MLV #14 & Launcher/Receiver Site	187.4	Regenerating Evergreen Forest	<1
MLV #15 (Klamath River)	196.5	Cropland/Pasture	<1
MLV #16 (Hill Road)	214.3	Cropland/Pasture	<1
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Launcher/Receiver & Communications Tower d/	228.1	Shrub and Brush Rangeland	31
		Subtotal	**35**
Communication Sites Not Located at Other Aboveground Facilities			
Blue Ridge e/	~ 20	Transportation, Communications, and Utilities/Commercial	<1
Signal Tree e/	~45.0	Transportation, Communications, and Utilities/Commercial	<1
Flounce Rock e/	~123.0	Transportation, Communications, and Utilities/Commercial	<1
Robinson Butte e/	~159.0	Transportation, Communications, and Utilities/Commercial	<1
Stukel Mountain e/	~209	Transportation, Communications, and Utilities/Commercial	<1
		Subtotal	2
		Total	**36**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).

a/ Permanent impacts are associated with the fenced and graveled sites required for long-term operational use. These facilities would be located within the construction right-of-way for the pipeline; therefore temporary construction disturbance is included in the disturbance associated with the pipeline.

b/ The 17 mainline block valves would be located within areas disturbed by the construction right-of way or within associated aboveground facility footprints (i.e., meter stations and the compressor station); however, the permanent operation acres provided would remain as permanent disturbance associated with these graded, graveled and fenced facilities.

c/ The Jordan Cove Meter Station would be located entirely within the South Dunes Power Plant site.

d/ Communication facilities are included in the disturbed areas associated with the meter stations and compressor station.

e/ Communication facilities would utilize existing towers and equipment buildings, where space is available for lease, with no associated disturbance. If construction of new facilities is required, Pacific Connector would obtain an approximately 100-foot x 100-foot (0.23-acre) area in the immediate area of the existing communication tower facilities.

The Jordan Cove Meter Station would cover less than one acre of industrial land. The other locations for communications towers would be at existing utility areas. The locations of the MLVs would be mostly within the pipeline construction right-of-way, or within the tracts for other aboveground facilities. The installation of aboveground facilities would result in their permanent conversion to industrial lands.

Zoning

The pipeline would cross 49.0 miles within Coos County, 66.1 miles in Douglas County, 55.9 miles within Jackson County, and 60.8 miles within Klamath County. Current zoning designations crossed by the pipeline are as shown in table 4.1.2.2-4.

TABLE 4.1.2.2-4

County Zones Crossed by the Pacific Connector Pipeline Project

County	Zone	Miles Crossed
Coos County	Forest (F)	40.6
	Exclusive Farm Use (EFU)	4.2
	CBEMP (all zones)	3.8
	Rural Residential (RR-5, RR-2)	0.4
	Total	**49.0**
Douglas County	Timberland Resource (TR)	36.1
	Farm Forest (FF)	16.6
	Exclusive Farm Use, Grazing (FG)	10.8
	Agriculture and Woodlot (AW)	1.6
	Rural Residential (5R)	0.5
	Exclusive Farm Use, Cropland (F2)	0.1
	Unknown a/	0.4
	Total	**66.1**
Jackson County	Forest Resource (FR)	37.7
	Woodland Resource (WR)	6.7
	Exclusive Farm Use (EFU)	10.4
	Open Space Reserve (OSR)	1.1
	Rural Residential (RR-5)	<1
	Total	**55.9**
Klamath County	Forest (F)	19.0
	Exclusive Farm Use (EFU-C)	17.2
	Exclusive Farm Use (EFU-CG)	2.5
	Forestry/Range (FR)	9.3
	Natural Resource (NR)	1.9
	Rural Residential (R5)	1.8
	Heavy Industrial (IH)	3.9
	Suburban Residential (RS)	0.1
	Unknown a/	5.1
	Total	**60.8**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").
a/ "Unknown" refers to gaps in the GIS data (usually associated with roads and waterbodies).

Pacific Connector has not requested that any of the land crossed by the pipeline be rezoned by any of the affected counties. Pacific Connector has received a LUCS from each of the counties that would be crossed by the pipeline route. Coos County and Douglas County determined that the Pacific Connector pipeline would be compatible with their comprehensive plan. The Project was not subject to the land development standards of the Jackson County Land Development Ordinance because it would be authorized by the FERC. Likewise, because the pipeline would be authorized by the FERC, it was not subject to the Klamath County Land Development Code and would not require county applications and review. Therefore, no conditional use permits would be necessary in either Jackson or Klamath Counties.

Prior to operation, Pacific Connector may be required by the ODSL to obtain a Special Use and/or Waterway Lease for safety exclusion zones (see section 4.13).

Coastal Zone Management

Coos County and a portion of Douglas County, up to the crest of the Coastal Range, are within Oregon's coastal zone. Therefore, Pacific Connector would need to obtain a finding from the ODLCD that the portion of its pipeline within the coastal zone (MPs 1.5 R to 53) is consistent with the CZMA.

Pacific Connector was issued a conditional use permit from Coos County on September 8, 2010. On December 10, 2009, Douglas County issued a conditional use permit to Pacific Connector. On March 20, 2014, the Douglas County Planning Commission approved an amendment to its 2009 decision, affirmed by the Board of Commissioners of Douglas County on April 30, 2014, allowing the pipeline to cross 7.3 miles of coastal zone in Douglas County. Douglas County issued the corresponding LUCS on June 2, 2014.

Pacific Connector, together with Jordan Cove, submitted an application to the ODLCD to obtain a coastal zone consistency determination on August 1, 2014. On July 8, 2015, the ODLCD signed a stay agreement that delays their review to January 9, 2016. Above, we made a recommendation that the Commission not allow construction of the pipeline to proceed until after the ODLCD makes a finding that the Project is consistent with the CZMA.

4.1.2.3 Existing Residences, Commercial Buildings, and Planned Developments

Existing Residences

Pacific Connector did not identify any commercial buildings within 50 feet of the construction right-of-way for its pipeline and ancillary facilities. There are 10 residences identified within 50 feet of the edge of the construction right-of-way, including TEWAs, listed on table 4.1.2.3-1. For the residences within 50 feet of construction work areas, Pacific Connector developed site-specific drawings depicting the temporary and permanent rights-of-way and has noted special construction techniques and mitigation measures (see table 4.1.2.3-1). Appendix I contains the site-specific drawings for these 10 residences.

TABLE 4.1.2.3-1

Residences within 50 Feet of the Construction Right-of-Way or Temporary Extra Work Areas

MP	Distance from Pipeline (feet)	Distance from Edge of Construction Work Area (feet)	Number of Residences
4.2	288	44	1
14.2	45	15	1
49.6	107	42	1
56.9	81	21	1
57.5	57	17	1
65.6	112	47	1
65.9	54	4	1
122.0	455	96	1
199.7	157	30	1
200.3	310	22	1

We have reviewed the site-specific residential construction plans and find them acceptable for reducing impacts; however, we encourage the owners of each of these residences to notify the Commission with comments on the plans for their individual property.

Within 50 feet of residences, the edge of the construction work area would be fenced for a distance of 100 feet on either side to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Where possible, the width of the construction right-of-way would be reduced near residences, and TEWAs would be located as far away from residences as practical. Pacific Connector would also limit the period of time the trench remains open prior to backfilling in residential areas.

Pacific Connector has proposed the following general measures to reduce impacts on residential properties:

- Landowners would be notified prior to construction, and Pacific Connector has developed and would implement a Landowner Complaint Resolution Procedure. If a landowner is not satisfied with Pacific Connector's response to a complaint, they would be directed to call or email FERC's Dispute Resolution Division for further assistance.
- Pacific Connector would install orange safety fence between the construction right-of-way and the residence.
- Construction would proceed quickly through residential areas, minimizing exposure to nuisance effects, such as noise and dust, and limiting the hours of operations that high decibel noise levels can be conducted.
- Pacific Connector would attempt to schedule activities during normal working hours. Pacific Connector does not currently plan to work on Sundays; however, certain activities may require a 24-hour work schedule.
- Pacific Connector would comply with all local noise ordinances.
- Access and traffic flows would be maintained during construction activities through residential areas, particularly for emergency vehicles.
- Dust minimization techniques such as watering would be used on-site and all litter and debris would be removed daily from the construction site.
- Mature trees, vegetation screens, and landscaping would be preserved to the extent possible. Landowners would be compensated for the removal of any trees.
- Immediately after backfilling the trench, all lawn areas and landscaping within the construction work area would be restored consistent with the requirements of the FERC's *Plan*.
- Pacific Connector would provide alternative sewer facilities if septic system is disturbed during construction. Pacific Connector would repair and restore septic system affected by construction.
- Pacific Connector would compensate landowners for damage to homes should the home be damaged by pipeline construction.
- Depending on the specific circumstances, Pacific Connector may choose to temporarily relocate residents during construction activities. Arrangements would be determined through

negotiations between the landowner and Pacific Connector's Land Representative prior to construction.

- Pacific Connector would implement the measures outlined in their *Groundwater Supply Monitoring and Mitigation Plan*.

During the scoping process, many landowners commented on the Pacific Connector pipeline. Some have requested that the pipeline be moved off their property. In section 3.4, we evaluate route alternatives to lessen impacts on specific tracts where landowners raised routing concerns. Other concerns included impacts on water wells, utility lines, septic systems, slope erosion, farming operations, loss of future development opportunities, and environmental impacts on resources on their land (e.g., vegetation, wildlife, water quality, etc.). Impacts to agricultural land have been addressed above in section 4.1.2.2. Water resources, including wells, are addressed in section 4.4. Erosion is discussed in section 4.3. All socioeconomic-related impacts are discussed in section 4.9. In many cases, Pacific Connector has been able to make minor adjustments to the pipeline route to lessen impacts to individual landowners and address site-specific infrastructure issues (see section 3.4).

Planned Developments

In correspondence with Pacific Connector, planning agency officials at each of the four counties that would be crossed by the pipeline route did not identify any other privately sponsored large-scale projects that are currently being developed, permitted, or constructed. Our own research identified two newly planned developments in Klamath Falls: 1) a 28-unit memory care center on 1 acre on Jade Terrace adjacent to the Sky Lakes Medical Center and Oregon Institute of Technology; and 2) a FedEx distribution center and office on a 4-acre site on Altamont Drive west of the Klamath Regional Airport. At the closest point, the airport is about 1 mile northeast of the pipeline route near MP 202. In section 4.14 (Cumulative Impacts) of this EIS, we discuss other projects that may occur within the watersheds crossed by the pipeline route.

We received comments from affected landowners and other interested parties during scoping that stated the pipeline would impact the ability to do small-scale development, such as adding a home site, barn, or other structure, or dividing a lot into two parcels to sell the other one. In some cases, Pacific Connector modified the route of the pipeline to avoid improvements on private parcels, as discussed in section 3.4 (Pipeline Alternatives). Most recently, Pacific Connector became aware of the planned "Johnson" subdivision (Palomino Pines). Pacific Connector worked with the subdivision landowner and re-routed (MPs 190.15 to 192.28) to minimize the effect to subdivision lots. This re-route was described in Pacific Connector's filing on January 20, 2015 (see Section 4.0, Table 2, Index Map Sheet 29, Detail Map Sheet 81, and Attachment 5). Impacts on private property are further discussed in section 4.9 (Socioeconomics).

Private Forest Lands

Approximately 1,452 acres of private forestlands (including a small fraction of state land) would be affected by the construction right-of-way, TEWAs, and temporary access roads. To mitigate effects to private forest landowners, Pacific Connector would negotiate an easement, which would account for the value of timber to be cleared within the construction right-of-way and TEWAs, lost timber production within the temporary and permanent easement, as well as potential operational easement effects. During public scoping, concerns were raised that the pipeline could interfere with forest operations or timber harvest and potential fire suppression efforts. The following discussion addresses these concerns.

Forest operations, including timber production and harvesting, hauling timber, logging road construction and maintenance, application of chemicals, and disposal of slash on forest lands adjacent to the permanent pipeline easement are not expected to be significantly altered, nor would the costs of forestry operations be expected to increase due to the presence of the pipeline. Surrounding forestry operators would be able to cross the pipeline right-of-way with heavy hauling and logging equipment, provided they coordinate those crossings with Pacific Connector and safety precautions are implemented to protect the integrity of the pipeline. For example, it may be necessary to provide additional cover directly over the pipeline in equipment crossing areas and on logging roads. If a landowner demonstrated a need to cross the pipeline in order to conduct forestry operations, Pacific Connector would work with that property owner to develop a pipeline crossing plan that allows the access points to be constructed and used in a safe manner.

While the requirement to coordinate with the pipeline operator would be an inconvenience for some forest operators, it does not constitute a significant change in forestry operations because the operator would be able to continue to cross the pipeline area in order to access or haul timber. Additionally, timber operators generally develop and carefully consider future harvesting and access plans. The need to consult with the pipeline operator if those plans include future crossings of the pipeline right-of- way would not represent a significant imposition or significant change in normal planning activities. The coordination requirement would also not significantly increase the cost of conducting forestry operations. In some situations, however, the presence of a pipeline along a ridge would require a change in log landing locations, which would affect timber operations. See additional discussion of potential impact on timber operations in section 4.5 of this EIS.

4.1.3 Land Use for Pacific Connector Components on Federal Lands

This section addresses land use on federal lands, including detailed analysis of proposed land management plan amendments on BLM and NFS lands.

4.1.3.1 Land Requirements on Federal Lands

The Pacific Connector pipeline would cross approximately 31 miles of NFS lands and 40 miles of BLM lands (table 4.1.3.1-1). Between MPs 200.5 and 227.2, the pipeline would cross 31 irrigation facilities that fall under the jurisdiction of Reclamation.

Temporary impacts of the pipeline on federal lands would include timber and brush clearing, grading, trenching, impacts to visual quality at some locations, and soil compaction as a result of equipment driving and storage of logs, slash, pipe lengths, and other supplies. Long-term impacts include the time it would take trees to grow back within the temporary construction right-of-way. Permanent impacts would include the conversion of forest to herbaceous vegetation within a 30-foot-wide corridor kept clear of trees, and prohibitions of use of the operating pipeline easement. The pipeline and associated facilities would not cross, and therefore no acreage would be removed from, any federally designated wilderness, wildlife refuge areas, or inventoried roadless areas.

TABLE 4.1.3.1-1

Federal Lands Affected by the Pacific Connector Pipeline Project

Pipeline Facility/Component	Jurisdiction: BLM	Forest Service	Reclamation
Miles Crossed by Pipeline	40.3	30.6	0.7
Temporary Construction Acreage Requirements (acres)			
Construction Right-of-Way	460	350	4
Temporary Extra Work Areas	161	103	<1
Uncleared Storage Areas	173	124	0
Off-site Source/Disposal	7	9	0
Existing Roads Needing Improvements in Limited Locations	2	1	0
Temporary Access Roads (TAR)	<1	0	0
Hydrostatic Discharge Locations Outside the right-of-way	<1	0	0
Total Temporary Impacts (acres)	**803**	**587**	**4**
Permanent Construction Acreage Requirements (acres)			
Permanent Easement	244	185	2
Permanent Access Roads (PAR)	<1	0	0
Existing Roads Needing Improvements in Limited Locations a/	2	1	0
Aboveground Facilities	<1	0	0
Total Permanent Impacts (acres)	**244**	**186**	**2**
Right-of-Way (acres)			
30-Foot Maintained Right-of-way (acres)	147	111	1

Note: Columns may not sum correctly due to rounding. Miles rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1"). Acres rounded to the nearest whole acre (values less than 1 shown as "<1").

a/ Road improvements necessary for construction would not be restored; however, no additional maintenance would occur on access roads improved for construction of the Project. Acres are not included in the Permanent Construction acres total.

Pacific Connector would protect its pipeline from corrosion over time through a cathodic protection (CP) system. The CP system would consist of a number of sites where below ground rectifier/anode beds would be installed that input a low voltage electrical charge into the pipeline. These rectifier/anode beds would typically be spaced about 15 to 20 miles apart, usually installed within the previously disturbed pipeline construction right-of-way. The CP system would be installed about one year after the pipeline would be constructed, to allow the trench to stabilize and for collection of post-construction data on electro-conductivity soil potentials, which is required before the system can be designed and installed. Pacific Connector would consult with appropriate federal, state, and local regulatory agencies after pipeline construction to acquire the permits necessary for the CP system. A Corrosion Control Plan was included as Appendix F to Pacific Connector's POD. Based on a preliminary analysis of CP sites that could create a potential for new electrical service, there is no need for new electrical service on federal lands.

Table 4.1.3.1-2 provides acres affected by the pipeline broken out by land use type and ownership for each federal jurisdiction.

TABLE 4.1.3.1-2

Federal Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres)

Jurisdiction/ Project Element	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Bays and Estuaries	Forested Wetlands	Nonforested Wetlands	Beaches	Strip Mines, Quarries, Gravel Pits	Transitional Areas	Total
Coos Bay BLM																								
Construction a/	0	0	0	19	0	<1	0	0	0	0	0	100	5	5	43	<1	0	0	<1	<1	0	<1	0	**174**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	9	0	<1	0	0	0	0	0	39	2	2	13	<1	0	0	<1	<1	0	0	0	**65**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	6		<1	0	0	0	0	0	24	1	1	8	<1	0	0	<1	0	0	0	0	**39**
Roseburg BLM																								
Construction a/	0	0	0	28	0	0	0	2	0	0	0	73	136	1	94	<1	0	0	0	<1	0	<1	0	**335**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	5	0	0	0	<1	1	1	0	45	0	<1	32	<1	0	0	0	0	0	<0	0	**80**
Permanent Access Roads c/	0	0	0	<1	0	0	0	0	0	0	0	0	<1	0	<1	0	0	0	0	0	0	0	0	**<1**
30-Foot Maintenance Corridor	0	0	0	2	0	0	0	<1	<1	1	0	27	0	<1	19	<1	0	0	0	0	0	0	0	**50**
Medford BLM																								
Construction a/	0	0	0	6	0	0	0	13	56	3	37	65	59	<1	35	<1	<1	0	0	0	0	<1	0	**274**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	2	0	0	0	4	19	1	13	21	19	<1	13	<1	<1	0	0	0	0	0	0	**92**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Foot Maintenance Corridor	0	0	0	1	0	0	0	3	11	<1	8	13	11	<1	8	<1	<1	0	<1	0	0	<1	0	**55**

TABLE 4.1.3.1-2

Federal Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres)

Jurisdiction/ Project Element	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Bays and Estuaries	Forested Wetlands	Nonforested Wetlands	Beaches	Strip Mines, Quarries, Gravel Pits	Transitional Areas	Total
Lakeview BLM																								
Construction a/	0	0	0	1	0	0	0	0	<1	<1	0	16	0	0	0	<1	0	0	0	0	0	0	0	**18**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	<1	0	0	0	0	<1	<1	0	7	0	0	0	<1	0	0	0	0	0	0	0	**8**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	<1	0	0	0	0	<1	<1	0	4	0	0	0	<1	0	0	0	0	0	0	0	**5**
Umpqua National Forest																								
Construction a/	0	0	0	14	0	0	0	0	0	0	0	162	0	0	23	<1	<1	0	<1	<1	0	12	0	**211**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	4	0	0	0	0	0	0	0	52	0	0	9	<1	<1	0	<1	0	0	0	0	**66**
Permanent Access Roads c/	0	0	0	<1	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	<1
30-Foot Maintenance Corridor	0	0	0	3	0	0	0	0	0	0	0	31	0	0	6	<1	<1	0	<1	0	0	0	0	**39**
Rogue River National Forest																								
Construction a/	0	0	0	15	0	0	0	<1	7	3	0	131	0	<1	109	<1	0	0	0	0	2	16	0	**283**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	5	0	0	0	<1	1	1	0	45	0	<1	32	<1	0	0	0	0	0	0	0	**83**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	2	0	0	0	<1	1	1	0	27	0	<1	19	<1	0	0	0	0	0	0	0	**50**

TABLE 4.1.3.1-2

Federal Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres)

Jurisdiction/ Project Element	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Bays and Estuaries	Forested Wetlands	Nonforested Wetlands	Beaches	Strip Mines, Quarries, Gravel Pits	Transitional Areas	Total
Winema National Forest																								
Construction a/	0	0	0	3	0	0	0	1	0	0	0	56	0	<1	31	<1	0	0	<1	0	0	0	0	**92**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	1	0	0	0	<1	0	0	0	23	0	<1	12	<1	0	0	<1	0	0	0	0	**37**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	<1	0	0	0	<1	0	0	0	14	0	<1	7	<1	0	0	<1	0	0	0	0	**22**
Bureau of Reclamation																								
Construction a/	0	0	0	0	0	<1	0	0	4	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	**4**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	0	0	<1	0	0	2	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	**2**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	0	0	<1	0	0	1	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	**1**

Note: Rows may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1".

a/ Construction disturbance associated with pipeline facilities including construction right-of-way, TEWAs, UCSAs, TARs, existing roads needing improvements, pipe yards, off-site source and disposal areas, and hydrostatic discharge locations outside the right-of-way.

b/ The operational right-of-way is located within the disturbed acreage of the construction right-of-way. It is not an addition to the construction impacts.

c/ Portions of some of the PARs are located within the construction right-of-way and, therefore, there is some duplication in the acreage calculations.

BLM Lands

The Pacific Connector pipeline would cross approximately 40 miles of BLM lands within the Coos Bay, Roseburg, Medford, and Lakeview Districts. Of the aboveground facilities, three MLVs would be located on BLM lands. Pacific Connector also proposes to construct one new TAR to support construction and three new PARs on BLM lands to support construction and operation.

Acres of BLM lands, by land use classification, that would be affected by pipeline construction and operation are listed above in table 4.1.3.1-2. For all of the BLM land crossed combined, construction of the Pacific Connector pipeline would affect about 669 acres of forest, 60 acres of rangeland, 54 acres of transportation-utility lands, less than 0.1 acre of agricultural land, 0.8 acre of wetlands, 1 acre of water, and about 2 acres of barren lands/quarries. The BLM expressed concerns regarding impact of the pipeline on current and future forest management activities on federally administered lands that might result from prohibited or restricted land management and use activities within or near the pipeline right-of-way. In response, Pacific Connector provided a list of activities that would be prohibited or restricted on the pipeline right-of-way (table 4.1.3.1-3).

TABLE 4.1.3.1-3

Land Management and Land Use Activities That Would be Prohibited or Restricted on the Proposed Pacific Connector Pipeline Construction and Operational Rights-of-Way

Location	Prohibited/ Restricted Activities	Duration
Directly over the pipeline	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. trees, engineered structures, buildings, roads-parallel, other utilities-parallel, logging, blasting, mining)	During the construction, operations, and maintenance of the pipeline facilities.
Within the pipeline right-of-way clearing limits	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. engineered structures, buildings, roads-parallel, limited logging, blasting, mining)	During the construction of the pipeline facilities.
Within the pipeline right-of-way	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. engineered structures, buildings, roads-parallel, limited logging, blasting, mining)	During the construction, operations, and maintenance of the pipeline facilities.
Within one-quarter mile of the pipeline	Some blasting and mining	During operation and maintenance of the pipeline facilities.
On existing federally managed roads and trails	Only when within the right-of-way, obstructions that may, endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance, and use of the pipeline as described above; otherwise none	During the construction, operations, and maintenance of the pipeline facilities.

The BLM also expressed concerns about how prohibited or restricted activities within the pipeline right-of-way may affect parties who hold valid existing rights of federal lands in the project area. In response, Pacific Connector stated that such situations would be handled on a case-by-case basis. In general, Pacific Connector would identify all landowners and interested parties in each of these situations and would work with them, following the guidelines in the Williams Gas Pipeline Developers' Handbook. The BLM also asked Pacific Connector to identify the requirements and timelines for notification to Pacific Connector when activities are planned on the federal lands, either by the agency or a third party. Pacific Connector responded that for any aboveground alterations Pacific Connector would rely on its Operations & Maintenance Manual Public Awareness and Damage Prevention (Policy 10.17.00.09). This policy requires the company to notify in writing at least once per year any landowner or interested party within 660 feet from either side of the pipeline. The notification would include written information of where the pipeline is and who and how to reach Pacific Connector for any concerns they may have with the pipeline. These notifications would provide the landowner or interested party with the information they need to contact the company to discuss any work around the pipeline or right-of-way.

National Forest System Lands

The pipeline would cross through approximately 30.6 miles of NFS lands within the Umpqua, Rogue River, and Winema National Forests. Acreages of NFS lands, by land use classification, that would be affected by pipeline construction or operation of the Pacific Connector pipeline and associated aboveground facilities are included above in table 4.1.3.1-2. On NFS land, the pipeline would affect about 512 acres of forest, 32 acres of transportation-utility lands, 28 acres of barren lands/quarries, 8 acres of rangelands, 0.5 acre of water, 0.6 acre of wetlands, and 2 acres of beach (i.e., the "beach" category in GIS, in this case banks along the Rogue River).

Reclamation Lands

Between MPs 200.5 and 227.2, Pacific Connector's pipeline route would cross two parcels of withdrawn land totaling 0.7 mile, and 31 irrigation facilities that are managed by Reclamation's Klamath Basin Area Office of the Mid-Pacific Region. Acres of Reclamation land, by land use classification, that would be affected by the Project are included above in table 4.1.3.1-2. Construction of the Pacific Connector pipeline across Reclamation lands and facilities would affect less than half an acre of agricultural land, about 4 acres of rangeland, and less than a tenth of an acre of irrigation ditches.

Construction in the Klamath Basin would occur between October 15 and March 15 to minimize impacts to agricultural activities in the area and to cross the Reclamation irrigation facilities when they are not likely to be used or contain water. Pacific Connector included a *Klamath Facilities Crossing Plan* as Appendix O of its POD, and a *Winter Construction Plan for the* Klamath Basin as Appendix 1E in Resource Report 1 of its June 2013 application to the FERC.

During construction across Reclamation lands and features, their use would be temporarily interrupted. However, after pipeline installation, Pacific Connector would restore those lands and features to their original condition and use.

4.1.3.2 Grazing Allotments on BLM and NFS Lands

The proposed Pacific Connector pipeline route would cross 15 livestock grazing allotments, 5 of which occur on NFS lands managed by the Umpqua, Rogue River, and Winema National Forests, and 10 of which occur on BLM lands managed by the Medford and Lakeview Districts (see table's 4.1.3.2-1 and 4.1.3.2-2). Pacific Connector believes grazing deferments would not be necessary for the Project because grazing is not a dominant land use crossed by the pipeline route. Pacific Connector has consulted with the BLM and the Forest Service regarding grazing resources.

TABLE 4.1.3.2-1

Grazing Allotments on National Forest System Lands Crossed by the Pacific Connector Pipeline Project

Allotment Number	Allotment Name/Pasture	MP	Allotment Acres	Management Category a/	Total AUMs b/	3-Year Average AUMs	Season Used	Livestock Kind	Grazing System	Notes
Umpqua National Forest – Tiller Ranger District										
00R12	Diamond Rock	105.4 - 113.2	21,819	PB: A, F	680	187	5/1-10/31	Cow/Calf	Continuous Season	Managed in conjunction with an adjoining allotment.
Rogue River National Forest – Ashland Ranger District										
00R08	South Butte	153.8 - 167.5	25,570	PB: A, F	230	230	6/1-10-15	Cow/Calf	Continuous	1035 AUs
00R07	Deadwood	167.5 - 167.9	21,174	PB: A, F	382/150 Total of 532	382/150	6/1-10/15 See notes	Cow/Calf	Deferred	Managed with BLM Odd yrs = 6/1–8/15 on FS Even yrs =8/16–10/15 on FS
Winema National Forest – Klamath Ranger District										
OR250	Indian	167.9 - 171.3	10,646	PB: I,A, F	906	665	7/1-10/15	Cow/Calf	Continuous Season	Managed with Buck Allotment as 1 Allotment.
OR220	Buck	171.3 - 172.4	15,932	PB: I,A, F						Same as Indian, managed as 1 Allotment.

a/ 'PB' classification indicates that allotments that have potential to be managed under a quality management strategy. Basic resource damage is not occurring.
P = lack of permittee interest participation;
I = lack of total AMP implementation;
A = lack of reliable range analysis data, and
F = lack of funding to implement quality management.

b/ AUM = animal unit month

TABLE 4.1.3.2-2

Grazing Allotments on BLM Lands Crossed by the Pacific Connector Pipeline Project

Allotment Number	Allotment Name/Pasture	MP	Allotment Acres	Management Category a/	Total AUMs	3-Year Average AUMs	Season Used	Livestock Kind	Grazing System b/	Notes
Medford District										
10004	Longbranch	121.3 - 122.6	11,154	C	93	52	4\16-5\15	Cattle	NX	
10038	Crowfoot	123.5 - 128.4		I			4\15-6\30	"	SS	
10031	Summit Prairie/Carney	131.4 - 131.8	25,693	I	1,158	827	6\1-10\30	"	DF	
10030	Derby Station	133.2 - 133.5	540	C	36	36	N.A.	Closed		Closed to grazing
10024	Big Butte/05-Daisy Mill, 06- Rice Place,04- Lick Creek, 08 Baker Mountain, 07- Baker Flat, 09- Watercress	133.6 - 141.9	21,595	I	1,663	301	4\16-5\31	Cattle	SL	Rice Place pasture now closed to grazing
00126	Heppsie Mountain	148.8 - 153.8	4,076	I	294	277	5/1-10/15	Cattle	SL	
Lakeview District										
0104	Buck Lake	172.4 - 175.7	11,971 e/	C	175 c/	174 c/	6/15 –9/15	Cattle	d/	
0103	Buck Mountain	176.3 - 178.3	7,022 e/	C	204 c/	122 c/	5/15 –9/15	Cattle	d/	
0147	Grubb Spring	178.3 - 189.1	3,524 e/	C	130 c/	130 c/	5/1 – 9/15	Cattle	d/	
0848	Pope	216.5 - 216.8	724 f/	C	48 c/	63 c/	5/1 – 7/31	Cattle	d/	

a/ I = intensive management
C = custodial
M = maintain

b/ NX = Not Allocated: Area is closed to livestock grazing either through a land use plan or by legislation.
SS = Spring/Summer: Use throughout the critical growing season annually.
DF = Deferred: Delay of livestock grazing on an area for an adequate period of time to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants.
SL = Season Long: Season long use annually, including during the growing season (spring, summer, fall).

c/ BLM licensed AUMs only.

d/ Grazing is every year for the listed season; no other specific grazing system.

e/ BLM Klamath Falls Resource Area acres only listed

f/ A portion of the allotment was recently sold reducing the acreage.

Potential impacts to grazing allotments may occur from the temporary loss of forage from Project vegetation clearing and grading activities. In addition, construction activities could disturb improvements such as developed springs and fences or other barriers that restrict livestock to the allotment. From current survey activities, Pacific Connector is not aware of any range improvements such as springs that would be impacted. Pacific Connector does not believe it is necessary to remove livestock from the allotments during construction activities because of the significant size of most of the allotments crossed. Prior to construction, Pacific Connector would coordinate with the BLM and Forest Service regarding lease holder notifications.

Pacific Connector would mitigate impacts on grazing allotments during construction by installing temporary fences as needed to control livestock movement. After construction, permanent repairs to fences and natural barriers or other improvements that were disrupted by construction activities would occur to equivalent or better standards to ensure that livestock do not trail outside the allotment. Additional permanent fences may also be required during operation. After the pipeline is installed, the right-of-way would be restored and revegetated, as discussed in section 4.5. Revegetation is expected to return allotment forage quantity and values to preconstruction conditions within one to two growing seasons.

4.1.3.3 BLM and Forest Service Land Use Plans and Land Allocations

Federal lands are managed under a framework of laws passed by Congress, regulations promulgated through the federal rule-making process by the Secretaries of the Interior and Agriculture to implement these laws passed Executive Orders issued by the President, and policies developed by the agencies to govern day-to-day actions. Each administrative unit of the BLM and Forest Service has a land management plan that provides a framework for on-the-ground implementation of these various laws, regulations and agency policies.

Overview of Statutes Applicable to Federal Land Use Planning

Although a number of federal statutes apply to the Pacific Connector pipeline where it crosses federal lands, there are five primary federal land-use laws that provide the framework for federal land use plans:

- NEPA,
- ESA,
- FLPMA,
- NFMA, and
- The Oregon and California Revested Lands Sustained Yield Management Act of 1937 (O&C Act).

Three of these statutes—NEPA, ESA, and FLPMA—apply to both the BLM and the Forest Service. The relevance of the NEPA and ESA to federal land management along the route of the Pacific Connector pipeline is discussed in chapter 1 of this EIS. For the Pacific Connector pipeline, the O&C Act applies only to BLM lands. BLM's LMPs are based on the requirements of FLPMA. The Forest Service's LRMPs are based on the requirements of the NFMA. FLPMA and NFMA were enacted in a manner to complement each other. Reclamation does not have any land use plans or land allocations administered by the Klamath Basin Area Office that would be amended or modified or which need to be addressed in this EIS.

The O&C Act of 1937 applies to lands granted by the federal government to the Oregon and California Railroad Company. These lands were reconveyed to the federal government when the Oregon and California Railroad (O&C) went bankrupt. A similar, but smaller land grant in 1869 to the Southern Oregon Company was associated with the Coos Bay Wagon Road. These lands were also subsequently reconveyed to the federal government. The O&C Act of 1937 requires the Secretary of the Interior to manage Coos Bay Wagon Road lands and O&C lands for permanent forest production in conformity with the principle of sustained yield. These lands must also be managed in accordance with BLM RMPs in addition to applicable environmental laws such as the ESA. The O&C and Coos Bay Wagon Road land grants resulted in a patchwork of alternating federal and non-federal parcels across western Oregon and northern California.[7] Table 4.1.3.3-1 lists the O&C and Coos Bay Wagon Road lands crossed by the Pacific Connector pipeline.

TABLE 4.1.3.3-1

O&C Lands, Coos Bay Wagon Road Lands, and Reserved Public Domain Lands Crossed by the Pacific Connector Pipeline (miles)

Jurisdiction	O&C Lands	Coos Bay Wagon Road Lands	Reserved Public Domain Lands a/	Total
BLM – Coos Bay District	1.2	9.7	0.0	10.8
BLM – Roseburg District	10.6	1.8	0.6	13.0
BLM – Medford District	12.3	0.0	2.9	15.2
BLM – Lakeview District	1.0	0.0	0.3	1.3
Total BLM	**25.1**	**11.5**	**3.7**	**40.3**
Forest Service– Umpqua NF	3.4	0.0	7.4	10.8
Forest Service– Rogue River NF	0.0	0.0	13.7	13.7
Forest Service – Winema NF	0.0	0.0	6.1	6.1
Total NFS	**3.4**	**0.0**	**27.2**	**30.6**
Total	**28.5**	**11.5**	**30.9**	**70.9**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as “<0.1”).
a/ Reserved Public Domain Lands are the remaining lands not classified as O&C or Coos Bay Wagon Road lands.

Enacted in 1976, the FLPMA established a unified, comprehensive, and systematic approach to managing and conserving public lands to provide for multiple uses and sustained yield of goods and services from public lands. The act includes provisions for withdrawing or otherwise designating or dedicating federal lands for specified purposes. It also establishes procedures for disposing of public lands, acquiring non-federal lands for public purposes, exchanging lands consistent with the prescribed mission of the department or agency involved and for issuing Right-of-Way Grants across lands administered by multiple federal agencies. The BLM is the authorizing agency for the Pacific Connector pipeline right-of-way grant application.

Under Title II of the FLPMA, the BLM and Forest Service are required to establish a planning process for the management of federal lands under a framework of multiple uses sustained yields goods and services. Although there are distinct differences between the BLM and Forest Service planning regulations, the following elements are common to the two agencies:

- use of a systematic, interdisciplinary approach that utilizes information from the physical, biological, economic, and other sciences;
- considering present and potential uses of public lands;
- giving priority to areas of critical environmental concern;

[7] Appendix H of this EIS provides additional discussion of the O&C Act and associated lands related to this Project.

- considering the relative scarcity of the various values of public lands;
- weighing long-term and short-term public benefits;
- complying with applicable pollution control laws; and
- coordinating land-use planning with other relevant federal and state agencies.

The Forest Service is also subject to the requirements of the NFMA, which was enacted as an amendment to the 1974 Forest and Rangeland Renewable Resources Planning Act. In NFMA, Congress established a comprehensive notice and comment process for adopting, amending, and revising LRMPs for units of the NFS (e.g., National Forests). Planning regulations later promulgated by the Secretary of Agriculture explain that National Forest planning and decision making occurs at four levels: nationwide, region wide, LRMPs, and projects. One of the statutory requirements of the NFMA is to "specify…guidelines for LRMPs developed to achieve the goal of providing for diversity of plant and animal communities based on the suitability and capability of the specific lands area in order to meet multiple use objectives." This biodiversity requirement led to the development of the NWFP, which currently guides the management of NFS and BLM lands in southwest Oregon and meets the NFMA's biodiversity goal.

Northwest Forest Plan

In 1994, the Secretaries of Agriculture and Interior jointly signed a *Record of Decision for Amendments to Forest Service and BLM Planning Documents within the Range of the Northern Spotted Owl* (otherwise known as the Northwest Forest Plan or NWFP; Forest Service and BLM 1994a). This decision established the following common land allocations to be used throughout BLM and NFS lands in the area covered by the NWFP.

- **Congressionally Reserved Areas—**Lands reserved by act of Congress including National Parks and Monuments, Wilderness Areas, Wild and Scenic Rivers, National Wildlife Refuges and Department of Defense lands.
- **Late-Successional Reserves—**LSRs in combination with other land allocations and standards and guidelines are intended to maintain functional, interactive LSOG forest ecosystems for species that are dependent on this type of habitat.[8]
- **Adaptive Management Areas—**Areas designed to develop and test new management approaches to integrate and achieve ecological, economic and other social and community objectives.
- **Administratively Withdrawn Areas—**Areas identified in BLM and Forest Service LMPs not scheduled for timber harvest (e.g., recreation sites, administrative facilities).
- **Key Watersheds—**Large watersheds that are a system of refugia that either provide, or are expected to provide, high-quality habitat that is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. Key Watersheds are not a designated area or matrix but overlay all land allocations. Tier 1 Key Watersheds contribute directly to conservation of at-risk stocks of anadromous salmonids, bull trout and resident fish. While Tier 2 Key Watersheds may not contain at-risk fish species, they are important sources of high-quality water.

[8] Appendix H of this EIS provides a comprehensive discussion of LSRs as they relate to the Project.

- **Riparian Reserves—**Areas along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Riparian Reserves are also intended to serve as connectivity corridors between other reserves and the Matrix lands.[9] Riparian Reserves exist within all land allocations of the NWFP.
- **Matrix—**The lands outside the other designated areas listed above. Matrix lands are the area in which most timber harvest and other silvicultural activities would be conducted.

Attachment A to the NWFP ROD, "Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Species within the Range of the Northern Spotted Owl," provides detailed requirements and instructions for how land managers should treat forest lands subject to the NWFP (Forest Service and BLM 1994b).[10] Some standards and guidelines apply to all BLM and NFS lands, while others are only applicable to certain land allocations or activities. More than one set of standards and guidelines may apply in some areas. Where standards and guidelines overlap, both are applied. Where there are conflicts, the standard and guideline that provides the most protection for LSOG-associated species governs.

Federal Land Allocations Affected by the Pacific Connector Pipeline Project

Table 4.1.3.3-2 presents the miles of NWFP land allocations crossed by the Pacific Connector pipeline route.

TABLE 4.1.3.3-2

NWFP Land Allocations Crossed by the Pacific Connector Pipeline Project (miles)

Jurisdiction	LSRs	Unmapped LSRs	Matrix	Riparian Reserves a/
BLM – Coos Bay District	1.0	2.7	7.2	1.8
BLM – Roseburg District	3.9	1.6	7.6	0.5
BLM – Medford District	0.0	0.0	15.2	1.4
BLM – Lakeview District	0.0	0.0	1.3	<0.1
Forest Service – Umpqua	5.5	0.0	5.3	0.8
Forest Service – Rogue River	13.7	0.0	0.0	0.2
Forest Service – Winema	0.0	0.0	6.1	0.5

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").
a/ Riparian Reserves overlay other land use allocations

Effects to different federal land allocations are discussed in relation to each proposed LMP amendment in section 4.1.3.4, and effects to LSRs are discussed in further detail in section 4.1.3.6.

Forest Service Land and Resource Management Plans

Current Forest Service LRMPs for the Rogue River, Umpqua, and Winema National Forests were adopted in the early 1990s (Forest Service 1990a, 1990b, and 1990c). In 1994, the NWFP ROD amended the LRMPs for those portions of National Forests within the range of the NSO to include the NWFP land allocations and standards and guidelines in addition to the existing direction in those plans. Wherever there were conflicts between the NWFP and the underlying land

[9] Appendix J of this EIS provides a comprehensive discussion of Riparian Reserves as they relate to the Project.
[10] Standards and Guidelines: "the rules and limits governing actions, and the principles specifying environmental conditions or level to be achieved or maintained" (Forest Service and BLM 1994b: C-1).

management plan, the direction that provided the most protection for late-successional and old-growth–dependent species was adopted.

BLM Resource Management Plans

The BLM was in the process of revising its RMPs for southwest Oregon when the NWFP was signed in 1994. The BLM was therefore able to incorporate the provisions of the NWFP into its RMPs for areas within the range of the NSO, including the Coos Bay, Medford, and Roseburg Districts and the Klamath Falls Resource Area of the Lakeview District.

Elements Common to BLM and Forest Service Land Management Plans

In addition to the NWFP land allocations described in the previous section, there are three fundamental elements from the NWFP ROD that are common to both the BLM and Forest Service LMPs. These common elements concern standards and guidelines for management of Riparian Reserves, LSRs, and S&M species.[11] In the BLM RMPs, these standards and guidelines are represented as "management direction," but have essentially the same language as that stated in the NWFP ROD.

Common Direction for Implementation of the Aquatic Conservation Strategy

A central objective in the NWFP is the restoration of aquatic habitats. This objective is effected through the ACS of the NWFP (Forest Service and BLM 1994b: B-9). To comply with the ACS objectives, the BLM and Forest Service must manage the riparian-dependent resources needed to maintain existing conditions and implement actions to restore degraded conditions. Improvement relates to restoring biological and physical processes to their ranges of natural variability. This may take from decades to a century or more in some watersheds so it is not expected that any single project would completely accomplish this objective; it is, however, expected that projects be designed so as not to prevent attainment of the ACS objectives and that management actions be should be taken where possible to restore degraded habitats to their historic range of natural variability.

A wide array of standards and guidelines focus on the prohibition or regulation of activities in Riparian Reserves that could prevent attainment of the ACS objectives. Coupled with the goal to "maintain and restore" in each of the ACS objectives, the standards and guidelines provide the context for agency review and implementation of management activities. For both the BLM and the Forest Service, watershed analysis (also called "watershed assessment") provides the baseline from which to assess watershed conditions. Watershed assessments have been developed for all the fifth-field watersheds subject to the NWFP ROD that would be crossed by the pipeline project.

The standards and guidelines for Riparian Reserves restrict activities that would prevent attainment of the ACS objectives and specify stream buffer widths of one site potential tree height on each side of the stream for non-fish-bearing streams and two site potential tree heights on each side of fish-bearing streams. New developments in Riparian Reserves must conform to Standard and Guideline LH 4, which states, "For activities other than surface water developments, issue leases, permits, rights-of-way, and easements to avoid adverse impacts that retard or prevent attainment of ACS objectives."

[11] Appendix K of this EIS provides a detailed discussion of S&M species.

Preliminary assessment of the pipeline project determined that amendment of the standards and guidelines for Riparian Reserves would not be required. Detailed environmental analysis is included in this EIS to support an agency final determination regarding project conformance with Riparian Reserve Standards and Guidelines and ACS. This management direction does not prohibit developments like the Project provided the development can demonstrate compliance with the ACS.

As a whole, the ACS objectives and associated standards and guidelines for Riparian Reserves provide the framework upon which the proposed action, including specific mitigation measures developed by both the BLM and Forest Service (see table 2.1.4-1), has been developed. The ACS is evaluated at multiple scales, from the site or project area to the watershed.

Common Direction for Management of Late-Successional Reserves

The standards and guidelines for LSRs are contained in Attachment A (pages C-9 through C-21) of the NWFP ROD. They are designed to protect and enhance the conditions of LSOG forest ecosystems that serve as habitat for LSOG-dependent species. They are written to apply to specific management actions such as silviculture, range management, mining, and new developments and should be interpreted in that context.

Page C-17 of the NWFP ROD contains specific language applicable to new developments in LSRs:

> *Developments of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects would be reviewed on a case-by-case basis and may be approved when adverse impacts can be minimized and mitigated. These would be planned to have the least possible adverse impacts on Late-Successional Reserves. Developments would be located to avoid degradation of habitat and adverse impacts on identified late-successional species.*

As a whole, the LSR standards and guidelines provide the framework upon which the impacts to LSR, the proposed LSR mitigation actions and the related plan amendments described in section 2 of this EIS are evaluated.

Common Direction for Survey and Manage Species

In 2001, the *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD, or 2001 Survey and Manage ROD; Forest Service and BLM 2001a) was signed. This decision replaced previous direction concerning S&M species, and like the NWFP, amended all of the affected land management plans within the area of the NSO. The amendments in the 2001 Survey and Manage ROD were designed to add clarity, remove duplication, increase or decrease levels of management for specific species based on new information affecting the level of concern for their persistence, and establish a process for making changes to management for individual species in the future originally intended in the 1994 ROD. The 2001 Survey and Manage ROD also retained the direction to manage known sites of protection buffer species but removed their automatic designation as small, species-specific LSRs. For the BLM, the 2001 Survey and Manage ROD amended the RMPs for the Roseburg, Medford, and Coos Bay Districts, and the Klamath Falls Resource Area of the Lakeview District. For the Forest Service, the 2001 ROD amended the LRMPs for the Rogue River and Umpqua National Forests, as well as portions of the Winema National Forest.

4.1.3.4 Proposed Amendments to BLM and Forest Service Land Management Plans

Both BLM and Forest Service LMPs aim to provide goods and services and achieve desired conditions in a specific planning area.[12] Goals and objectives further describe the desired condition for the administrative unit or for certain land allocations. Land allocations are areas that are managed for specific purposes such as wildlife habitat, stream protection or timber production. Similar to a zoning ordinance, standards and guidelines (Forest Service planning documents), or management direction (BLM planning documents) are specific rules that regulate or prohibit activities such as timber sales or road construction to ensure that goals and objectives (desired conditions) of the plan are achieved.

The FLPMA and NFMA both require that proposed projects, including third-party proposals subject to permits or rights-of-way, be consistent with the LMPs of the administrative unit where the project would occur. When a project would not be consistent with the LMP where the project would occur, the BLM or Forest Service have three options: (1) cancel the project, (2) modify it to make it consistent with the LMP, or (3) amend the LMP to make provision for the project.

Pacific Connector has applied for a Right-of-Way Grant for its pipeline to cross BLM and NFS lands. Pacific Connector crafted its proposal to be consistent with BLM and Forest Service LMPs, where feasible. However, because of the linear nature of the pipeline route, it was not possible to be fully consistent with the agency LMPs in all locations across federal lands. Where the proposal cannot be made consistent with existing BLM and Forest Service LMPs, the BLM and Forest Service propose to amend those plans to make provision for the project.

Proposed amendments of BLM and Forest Service LMPs may affect the goods and services provided by the affected plan in addition to having potential environmental consequences. A description of each of the proposed LMP amendments, an assessment of its impact on the delivery of goods and services from BLM and NFS lands, and an evaluation of the effects of each one on land management plan components (goals, objectives, land allocations, standards and guidelines, management direction, etc.) follows. The NFMA and Forest Service planning regulations (36 CFR 219.10(f) [1982 version]) also require the Forest Service to determine whether a proposed amendment constitutes a “significant” change in the affected Forest Service LRMP. Criteria for determining the significance of plan amendments are found in Forest Service Manual (FSM) 1926 (Forest Service 2006a). Where proposed amendments apply to a Forest Service LRMP, these criteria are applied in the form of questions and answers.

[12] The “Planning Area” in the context of a land management plan is the administrative unit described in the applicable plan. It is generally a BLM district or a national forest. “Goods and services” are the outputs that occur from a BLM District or a National Forest under their respective LMP. These outputs may be tangible, commodity goods such as timber or commercial recreation, or intangible non-market values or benefits such as ecosystem services or wildlife habitat. Neither the BLM planning rule (43 CFR 1600) nor the Forest Service planning rule (36 CFR 219) require decision makers to determine non-market values or quantify non-market benefits. For the purposes of this assessment, environmental impacts are identified but market values are not ascribed to non-market goods and services.

Assessment of Effects of Proposed Amendments on BLM and Forest Service Land Management Plans

In the following sections, the numbering of the proposed LMP amendments corresponds to the designations used in the NOI for the Pacific Connector Pipeline Project published by the BLM and Forest Service in the *Federal Register* on September 21, 2012 (Vol. 77, No. 184).

Proposed RMP Amendments Applicable to the BLM Coos Bay District

This section describes two proposed RMP amendments that would apply only to the BLM Coos Bay District. These two amendments relate to impacts and mitigations associated with the LSR network. The analysis of project impacts and mitigations associated with the LSR network is in sections 4.1.3.6 and 4.1.3.7 of this EIS.

Coos Bay District, BLM-1: Site-Specific Exemption of Requirement to Protect MAMU Habitat on the BLM Coos Bay District

The Coos Bay District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMU within the Pacific Connector right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Pacific Connector right-of-way and would not change future management direction at any other location.

In the Coos Bay District, occupied contiguous existing and recruitment MAMU habitat is part of the LSR network. Waiving the requirement to protect contiguous existing and recruitment habitat for MAMU within the Project right-of-way on the Coos Bay District would result in both direct and indirect impacts on mapped and unmapped elements of the LSR network. See section 4.1.3.6 and appendix H of this EIS for an analysis of the Pacific Connector pipeline effects on LSR and mitigation.

Coos Bay District, BLM-4: Reallocation of Matrix Lands to LSR

The Coos Bay District RMP would be amended to change the designation of approximately 387[13] *acres from the Matrix land allocation to the LSR land allocation in Sections 19 and 29 of T. 28 S., R. 10 W., W. M., Oregon. This change in land allocation is proposed to mitigate for the potential adverse impact of the Pacific Connector Pipeline Project on LSRs in the Coos Bay District. The proposed amendment would change future management direction for the lands reallocated from Matrix lands to LSR.*

Reallocation of O&C or Coos Bay Wagon Road Matrix lands to LSR potentially affects the sustained timber yield objective for the O&C and Coos Bay Wagon Road lands. In order to ensure that this objective is met, the BLM is requiring the applicant to acquire 387 acres of comparable lands to be transferred to the BLM to be managed as Matrix lands that contribute to the sustained timber yield objectives of the O&C and Coos Bay Wagon Road lands.

[13] The NOI published in the *Federal Register* listed 454 acres for BLM-4. The change (67 acres) reflects the discovery of an occupied MAMU stand within the proposed Matrix reallocation area. These 67 acres are now unmapped LSR; therefore, the net matrix area has been reduced to 387 acres.

Proposed RMP Amendments Applicable to the BLM Roseburg District

This section describes three proposed RMP amendments that apply only to the Roseburg District BLM. All three of these proposed amendments relate to mapped and unmapped LSRs. Section 4.1.3.6 describes project impacts and mitigations for the LSR network.

Roseburg District BLM-1: Site-Specific Exemption of Requirement to Protect MAMU Habitat on the BLM Roseburg District

The Roseburg District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMU within the Pacific Connector right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Pacific Connector right-of-way and would not change future management direction at any other location or authorize any other project.

Contiguous and existing MAMU habitat is part of the LSR network. By waiving the requirement to protect contiguous existing and recruitment habitat for MAMU on the Roseburg District, there would be both direct and indirect impacts on MAMU habitat that is part of the LSR network (see section 4.1.3.6).

Roseburg District BLM–2: Site-Specific Exemption of Requirement to Retain Habitat in KOAC on the BLM Roseburg District

The RMP for the Roseburg District would be amended to exempt the Pacific Connector Pipeline Project from the requirement to retain habitat in KOAC at three locations. This is a site-specific amendment applicable only to the Pacific Connector right-of-way and would not change future management direction at any other location or authorize any other project.

A KOAC as described in the 1994 NWFP ROD is approximately 100 acres of the best NSO habitat adjacent to a nest site or activity center for all NSO sites known prior to January 1, 1994, on federal Matrix and Adaptive Management Area lands (Forest Service and BLM 1994a). In 2006, BLM provided the applicant with GIS data layers of KOAC within its jurisdictional boundaries. Three KOAC located on Matrix lands (unmapped LSRs) within the Roseburg District occur within the proposed right-of-way for the pipeline project (KOACs P2199, P0361, and P2294) (see figures 4.1-18 and 4.1-19 in section 4.1.3.6).

Roseburg District BLM–3: Reallocation of Matrix Lands to LSR

The Roseburg District RMP would be amended to change the designation of approximately 409 acres from the Matrix land allocations to the LSR land allocation in Sections 32 and 34, T. 29 1/2 S., R. 7 W.; and Section 1, T. 30 S., R. 7 W. W.M, Oregon.

Reallocation of O&C or Coos Bay Wagon Road Matrix lands to LSR potentially affects the sustained timber yield objective for the O&C and Coos Bay Wagon Road lands. In order to ensure that this objective is met, the BLM is requiring the applicant to acquire 409 acres of comparable lands to be transferred to BLM management to be managed as Matrix lands that contribute to the sustained timber yield objectives of the O&C and Coos Bay Wagon Road lands.

Proposed LMP Amendment Applicable to All Administrative Units

BLM/FS-1: Site-Specific Waiver of Management Recommendations for Survey and Manage Species in the BLM Coos Bay District, Roseburg District, Medford District, and Klamath Falls Resource Area of the Lakeview District RMPs, and the Umpqua National Forest, Rogue River National Forest, and Winema National Forest LRMPs

Applicable BLM District RMPs and National Forest LRMPs would be amended to exempt certain known sites within the area of the proposed Pacific Connector Right-of-Way Grant from the management recommendations required by the 2001 "Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines,". For known sites within the proposed right-of-way that cannot be avoided, the management recommendations for protection of known sites of Survey and Manage species would not apply. For known sites located outside the proposed right-of-way but with an overlapping protection buffer, only that part of the buffer within the right-of-way would be exempt from the protection requirements of the management recommendations. Those management recommendations would remain in effect for that part of the protection buffer that is outside of the right-of-way.

Approximately 664 sites of 87 species could be affected by the pipeline project, including approximately 568 sites of 77 species within the clearing limits of the pipeline corridor, 94 of these sites are occupied by *Arborimus longicaudus* (red tree vole)[14]. See section 4.7.4 and appendix K of this EIS for the analysis of species persistence associated with this proposed amendment.

Relationship to LMP Objectives and Significance Assessment for Forest Service Plans

Part 36 CFR 219.10(f) (1982) requires an assessment of the significance of proposed amendments of national forest LRMPs. Criteria for determining the significance of a proposed amendments are found in FSM 1926.51. These criteria are expressed as questions in the following section. If the responsible official elects to implement this proposed amendment, they will use these criteria to determine the significance of the proposed amendment. This section includes the BLM because this proposed amendment applies to the BLM as well as the Forest Service; however, only the Forest Service is required to address whether a proposed amendment is significant in the context of the affected national forest LRMP.

How does this proposed amendment change the BLM and Forest Service LMPs?

S&M species occur along the proposed alignment. The BLM and Forest Service have worked closely with the applicant to refine the alignment to avoid known sites to the extent feasible; in some cases, avoidance of these sites would not be feasible. This proposed amendment waives application of standards and guidelines (described as "management recommendations" in the 2001 Survey and Manage ROD) that generally require protection of known sites of individual survey and manage species. The proposed amendment does not waive the persistence objective for S&M

[14] These values are approximate and based on survey data through Fall 2014 and additional BLM and Forest Service geospatial data as of December 2014. Results from Survey and Manage Species surveys are expected to be updated in 2016 prior to any BLM or Forest Service decision on LMP amendments.

species. This means that for BLM and NFS lands within the project area, individual sites of S&M species may be impacted or lost to construction clearing, but affected species are expected to persist within the range of the NSO despite the loss of these individual sites. See section 4.7.4 and appendix K of this EIS for a detailed analysis of species persistence.

What are the spatial and temporal boundaries of effects?

The spatial boundary of effects is the right-of-way for the Pacific Connector pipeline where it overlaps the protection buffers for affected species (see section 4.7.4 and appendix K of this EIS for detailed analysis). The temporal boundary of the proposed amendment as it relates to land management plans is determined by the duration of the requirements of the 2001 Survey and Manage ROD. This waiver applies to the Pacific Connector pipeline right-of-way as long as the requirements of the Survey and Manage ROD are in force. This proposed amendment does not apply to any other project. The loss of individual sites is presumed to be long-term effect since S&M species are dependent on late-successional forest, which takes 80 years or more to develop.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment would be specific to the Pacific Connector pipeline and would not be related to any other utility corridor or project. It does not prevent attainment of any multiple use goal or objective. The proposed amendment specifically requires that the persistence objective of the Survey and Manage ROD be attained. This is supported by the analysis. Therefore, this proposed amendment would not alter or prevent attainment of long-term goals and objectives in the affected land management plans.

Is this proposed amendment a minor change in standards and guidelines?

This is a minor change in standards and guidelines because:

- The proposed amendment applies only to the Pacific Connector project area and does not affect any other project.
- The geographic area affected by the proposed amendment is a small portion of any single BLM District or National Forest and of the area of the NWFP.
- The amendment is not inconsistent with the species persistence objectives of the Survey and Mange ROD and the NWFP. These objectives must still be met.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

No changes between levels of goods and services associated with the BLM and Forest Service LMPs have been identified as a result of this proposed amendment. Since the proposed amendment does not prevent attainment of goals and objectives in the respective LMPs, it would not alter the long-term relationship between levels of goods and services provided by the LMP.

Does this proposed amendment have an important effect on the LMPs for BLM and/or the Forest Service throughout large portions of the agencies' respective planning areas during the planning period?

As a site-specific waiver of management recommendations for S&M species that is restricted to a single project, this proposed amendment by definition does not have an important effect over a large portion of the respective planning areas. This proposed amendment is not directly related to any other project or location on the BLM Districts or National Forests. Since objectives of the S&M program would still be achieved, and the proposed amendment is site-specific, it does not have an important effect on the entire planning area.

Proposed LRMP Amendments Applicable to the Rogue River National Forest

Six proposed LRMP amendments would apply only to the Rogue River National Forest.[15] As directed by 36 CFR 219.15 and FSM 1926, the decision maker evaluated the proposed Project for consistency with the LRMP (Conroy 2009). That evaluation is the basis for describing the proposed amendments to the Rogue River National Forest LRMP needed to make provision for the Project. This section describes how the proposed amendments would affect the delivery of goods and services and components of the Rogue River National Forest LRMP using the criteria in FSM 1926. These criteria are expressed as questions for each of the proposed LRMP amendments. The Deciding Official for the Forest Service will use this information to determine the significance of these proposed amendments as they relate to the Rogue River National Forest LRMP.

Rogue River National Forest, RRNF-2: Site-Specific Amendment of VOQ on the Big Elk Road

The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the Big Elk Road at about MP 161.4 in Section 16, T.37S., R.4E., W.M., Oregon, from foreground retention (Management Strategy 6, LRMP page 4-72) to foreground partial retention (Management Strategy 7, LRMP page 4-86) and allow 10 to 15 years for amended VQO to be attained. The existing standards and guidelines for VQOs in foreground retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year of completion of the project and that management activities not be visually evident.

How does this proposed amendment change the LRMP?

This proposed amendment would change the VQO for Management Area 6 in the vicinity of where the Pacific Connector pipeline would intersect the Big Elk Road from foreground retention to foreground partial retention and allow 10 to 15 years to achieve the modified VQO.

[15] RRNF-1: Amendment to Provide for Energy Transmission was published in the Federal Register as a potential amendment. Subsequent evaluation by the Forest Supervisor determined that this amendment was not necessary. See Forest Plan Consistency Evaluation.

What are the temporal and spatial boundaries of effects?

This proposed amendment would affect about 5 acres in the year of construction which would decrease to approximately 1.72 acres after 10 years. The 1.72 acres represents the seen area associated with the 30-foot-wide operation corridor of the Pacific Connector pipeline. This proposed amendment would change the VQO on approximately 5 acres (the seen area of the corridor) for approximately 10 years. This change would prevent achievement of the VQO of a natural appearing forest at that location during that period. Drivers passing the corridor would be able to see the corridor for approximately 15 to 20 seconds. This change would affect VQOs in the vicinity of the Big Elk–pipeline intersection. No other LRMP goals and objectives would be affected by this change. This proposed amendment is for the Pacific Connector pipeline only and would not change future management direction for other projects subject to authorization by the Rogue River National Forest.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment would change the VQO on approximately 5 acres (the seen area of the corridor) for approximately 10 to 15 years (Mattson 2009). No other goals and objectives would be affected by this change. This proposed amendment is for the Pacific Connector Pipeline Project only and would not change future management direction for other projects.

Is this proposed amendment a minor change in standards and guidelines?

Standards and guidelines for facilities in Management Area 6 state that "Power lines and other facilities shall be constructed, operated and maintained to achieve the visual quality objective as viewed from the highway" (Forest Service 1990a: 4-84, 4-98). This proposed amendment would not change the standards and guidelines; it would instead change only the VQO for this specific project.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This would be a project-specific amendment that would affect only VQOs in a limited area. It would not change future management of any resource or alter levels of outputs between any other goods and services. The impacts related to scale would be limited to the difference between foreground retention and foreground partial retention at one location after 10 years.
- No other outputs of goods and services that would be affected by the proposed amendment have been identified.
- No other project or plan would be affected by this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LMP area, nor would it affect land and resources on NFS lands other than on the specific portion of the project area near the intersection of the Pacific Connector pipeline route with Big Elk Road because:

- Changes that would result from this proposed amendment would be project-specific and would affect only VQOs and related experiences at the location where the Pacific Connector pipeline route crosses Big Elk Road.
- The project area would affect a very small part of the Rogue River National Forest. The construction right-of-way where most impacts would occur occupies approximately 280 acres of the 632,000-acre Rogue River National Forest. This is less than 0.05 percent of the Rogue River National Forest. This proposed amendment would affect approximately 5 acres.

Rogue River National Forest, RRNF-3: Site-Specific Amendment of VQO on the PCT

The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the PCT at about MP 168 in Section 32, T.37S., R.5E., W.M., Oregon, from Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) to Modification (USDA Forest Service Agricultural Handbook 478) and to allow 5 years for amended VQOs to be attained. The existing standards and guidelines for VQOs in Foreground Partial Retention in the area where the Pacific Connector pipeline route crosses the PCT require that visual mitigation measures meet the stated VQO within three years of the completion of the project and that management activities be visually subordinate to the landscape.

How does this proposed amendment change the LRMP?

The language of this proposed amendment has been revised to address new analysis that was developed in response to comments on the DEIS. This analysis indicates that would change the VQO in Management Area 7 in the vicinity of where the Pacific Connector pipeline route crosses the PCT from partial retention to modification and would extend the timeframe for meeting the objective to 5 years.

What are the temporal and spatial boundaries of effects?

This proposed change would affect approximately 5 acres of seen area in the year of construction. Vegetation growth and mitigation measures would reduce the affected seen area to approximately 2 acres after years. This proposed amendment would reduce the VQO on approximately 5 acres (the seen area of the corridor) for approximately 5 years. This change would not achieve the LRMP visual objective of a natural-appearing forest at that location during that period. Hikers and horseback riders passing the corridor would be able to see it for approximately 1 to 3 minutes (Mattson 2009). This change would only affect VQOs in the vicinity of the PCT-pipeline intersection. It would not be visible from any Level I travel route identified in the RRNF LRMP.

This proposed amendment would be for the Pacific Connector pipeline only and would not change future management direction.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment does not affect multiple use goals and objectives for long-term land and resource management. This proposed amendment would reduce the VQO on approximately 5 acres (the seen area of the corridor) for approximately 5 years. This change would not achieve the Forest visual objective of a natural-appearing forest at that location during that period. Hikers and horseback riders passing the corridor would be able to see it for approximately one to three minutes. This change would only affect VQOs in the vicinity of the PCT Pacific Connector pipeline corridor. This proposed amendment would be for the Pacific Connector pipeline only and would not change future management direction.

Is this proposed amendment a minor change in standards and guidelines?

Standards and guidelines for facilities in Management Area 7 state that “Power lines and other facilities shall be constructed, operated and maintained to achieve the VQO as viewed from the highway” (Forest Service 1990a: 4-84, 4-98) This proposed amendment would not change the standards and guidelines to allow the Pacific Connector pipeline corridor; instead, it would change the VQO that is assigned. Note that this area is not actually seen from the highway, which further moderates the intensity of impacts.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This is a project-specific amendment that would only affect VQO in a limited area. It would not change future management of any resource or alter levels of outputs between any other goods and services so long-term relationships between multiple-use goods and services would not be affected. The impacts related to scale would be limited to the difference between VQOs of partial retention and modification at one location.
- No other outputs of goods and services that would be affected by the proposed amendment have been identified.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would not have an important effect on the entire LMP area nor would it affect land and resources throughout a large part of the planning area because:

- Changes resulting from this proposed amendment would be project-specific and would affect only VQO and related experiences at the location where the Pacific Connector pipeline would cross the PCT. At most, this would affect about 5 acres of seen area that would be visible for 1 to 3 minutes (Mattson 2009).

Rogue River National Forest, RRNF-4: Site-Specific Amendment to VQO Adjacent to Highway 140

> *This proposed amendment does not change VQOs, but instead allows more time to meet the VQO of Middleground Partial Retention as seen from Highway 140. The Rogue River National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO of Middleground Partial Retention between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T.37S., R.3E., W.M., Oregon. Standards and guidelines for Middleground Partial Retention (Management Strategy 9, LRMP Page 4-112) require that VQOs for a given location be achieved within three years of completion of the Project. Approximately 0.8 mile or 9 acres of the Pacific Connector right-of-way in the Middleground Partial Retention VQO visible at distances of 0.75 to 5 miles from State Highway 140 would be affected by This proposed amendment.*

How would this proposed amendment change the LRMP?

This location has a VQO of Middleground Partial Retention. Standards and guidelines for Middleground Partial Retention (Forest Service 1990a: 4–112) require that VQOs for a given location be achieved within three years of completion of a project. The Project would not meet this standard at that location. This proposed amendment would allow 10 to 15 years to meet the Middleground Partial Retention standard at this location. This location would not be visible from other key observation points or travel routes.

What are the temporal and spatial boundaries of effects?

This proposed change would affect approximately 9 acres or about 0.8 mile of the pipeline corridor as seen from Highway 140 in the year of construction. For the next 10 to 15 years, the pipeline corridor would remain visually dominant over the surrounding landscape but would become less evident each year. Vegetation growth and mitigation measures would allow the area to meet the assigned VQO of Middleground Partial Retention after 10 to 15 years. To the degree that travelers look up as they are headed west on Highway 140, this location would be visible from a distance of 0.75 miles to 5 miles for a few minutes. The duration would depend on travel speed but would likely be less than 10 minutes and would likely not be continuous because of the height of roadside trees and line of sight from the highway (Mattson 2009).

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment would not affect multiple use goals and objectives for long-term land and resource management. This proposed amendment would reduce the VQO on approximately 9 acres (the seen area of the corridor) for approximately 10 years. It would therefore not achieve the LRMP visual objective of a natural-appearing forest at that location during that period. This proposed amendment would be for the Pacific Connector pipeline only and would not change future management direction for other projects subject to authorization by the Rogue River National Forest.

Is this proposed amendment a minor change in standards and guidelines?

Standards and guidelines for facilities in Management Area 7 state that "Landscapes seen from selected travel routes are managed so that, to the casual observer, results of activities are evident but are visually subordinate to the natural landscape." This proposed amendment would not change the standards and guidelines to allow the pipeline project corridor. Instead, it would change the amount of time allowed to reach the objective. This would be a minor change to the standards and guidelines.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This would be a project-specific amendment that would only affect VQO in a limited area. It would not change future management of any resource or alter levels of outputs between any other goods and services; long-term relationships between multiple-use goods and services would therefore not be affected. The impacts related to scale are limited to the difference between meeting a VQO immediately or allowing a longer period of time to meet the same objective.
- No other projects that would be affected by this proposed amendment have been identified. The limited scale and lack of impacts on other projects make it improbable that the long-term relationship between levels of goods and services would be affected.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LMP area nor affect land and resources throughout a large part of the planning area because:

- Changes resulting from this proposed amendment would be project-specific and would affect only VQO and related experiences along Highway 140 as seen for a few minutes at a distance of 0.75 mile to 5 miles (Mattson 2009).

Rogue River National Forest, RRNF-5: Site-Specific Amendment to Allow Utility Transmission Corridors in Management Strategy 26, Restricted Riparian Areas

The Rogue River National Forest LRMP would be amended to allow the Pacific Connector pipeline right-of-way to cross the Restricted Riparian land allocation. This would potentially affect approximately 2.5 acres of the Restricted Riparian management strategy at one perennial stream crossing on the South Fork of Little Butte Creek at about MP 162.45 in Section 15, T.37S., R.4E., W.M., Oregon. Standards and guidelines for the Restricted Riparian land allocation prescribe locating transmission corridors outside of this land allocation (Management Strategy 26, LRMP page 4-308).

How would this proposed amendment change the LRMP?

This proposed amendment would allow the Pacific Connector Pipeline Project to cross the Restricted Riparian land allocation at the South Fork of Little Butte Creek.

What are the temporal and spatial boundaries of effects?

The spatial boundary of effects is approximately 3 acres of the 24,000-acre Restricted Riparian land allocation. Temporal boundaries depend on the affected resource. Immediate impacts from construction clearing, such as loss of vegetation cover and soil erosion, can be mitigated in the first year, but reestablishment of mature riparian vegetation may take 50 years or more within the 3-acre construction work area. Low-growing riparian vegetation, such as willows, can be reestablished within 15 feet of the pipeline, but trees with roots that could damage the pipeline cannot be allowed to develop in the maintained 30-foot-wide corridor during the life of the project.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment does not affect multiple use goals and objectives for long-term land and resource management because:

- This proposal would be a project-level amendment that would affect approximately 3 acres of the project area at one stream crossing. No other projects or programs would be affected.
- Only a very small portion (3 acres or 0.01 percent) of the Restricted Riparian land allocation would be affected by this proposed amendment.
- The Forest Service proposed and the applicant adopted an extensive mitigation plan to ensure that LRMP goals and objectives would be achieved. On the Rogue River National Forest, a number of stream crossings associated with roads would be restored as part of the mitigation plan, thus contributing to achieving the LRMP goals and objectives for soils and watersheds as well as the ACS. Riparian planting would also be accomplished as part of the mitigation measures for the Pacific Connector pipeline. See section 4.1.3.5 for a discussion of this proposed amendment as it relates to the ACS.
- An evaluation of stream temperature impacts concluded there would be no discernible water temperature increase at the point of crossing on the South Fork of Little Butte Creek (NSR 2009).

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- It would affect one stream crossing with an estimated 3 acres of 24,000 acres of the Restricted Riparian (about 0.01 percent) land allocation on the Rogue River National Forest.
- An evaluation of the ACS concluded that Pacific Connector Pipeline Project impacts would be within the range of natural variability for the Little Butte Creek watershed. As a result, it is unlikely that the long-term delivery of goods and services would be altered by this proposed amendment.
- The proposed amendment would be project specific.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

Although the Project would have impacts on riparian habitat at the project scale, the proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This proposed amendment does not affect any proposed projects, so it is unlikely that it would affect the delivery of goods from the Forest.
- The proposed amendment is specific to the pipeline project site. It would not authorize other stream crossings in the Restricted Riparian land allocation. The Pacific Connector pipeline affects about 0.01 percent of the Restricted Riparian land allocation. It is highly improbable that effects at that scale would change long-term relationship between levels of goods and services.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire land management plan nor would it affect land and resources throughout a large part of the planning area because:

- The proposed amendment would affect about 3 acres of the Restricted Riparian land allocation. There are 24,000 acres of the Restricted Riparian land allocation on the Rogue River National Forest.
- The project area would be a very small part of the Rogue River National Forest. The construction right-of-way where most impacts would occur occupies approximately 280 acres of the 632,000-acre Rogue River National Forest, approximately 0.05 percent. This proposed amendment changes the LRMP for 3 acres, or 0.0004 percent of the Forest.

Rogue River National Forest, RRNF-6: Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas

> *The Rogue River National Forest LRMP would be amended to waive limitations on areas affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected Management Strategies. Standards and guidelines for detrimental soil impacts in affected Management Strategies require that no more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of a project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices including roads and landings. Permanent recreation facilities or other permanent facilities are exempt (Forest Service 1990a: 4-41, 4-83, 4-97, 4-123, 4-177, 4-307).*

How this does this proposed amendment change the LRMP?

This proposed amendment would waive the restriction on detrimental soil conditions within the right-of-way of all management areas crossed by the Pacific Connector pipeline. This means that more than 20 percent of the project activity area may be in a degraded soil condition as a result of compaction or displacement when pipeline construction is completed.

What are the temporal and spatial boundaries of effects?

For planning purposes, soil impacts are considered long term. Soil displacement would be confined to the project area, but it is not possible to predict how much of the project area would be affected by soil displacement. If it is assumed that 30 to 70 percent of the project area would remain in a detrimental condition after mitigation and rehabilitation, there would be about 62 to 144 acres of detrimental soil conditions depending on soil conditions spread over about 13.5 miles of right-of-way (see also section 4.3.4 for a complete discussion of pipeline impacts on soils and detrimental soil conditions).

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would have only a minimal effect on the attainment of multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. This mitigation plan includes approximately 50 miles of road decommissioning on the Rogue River National Forest; the road decommissioning would be responsive to Forest-wide management goals for soil and water and wildlife habitat. An ancillary benefit of road decommissioning would be amelioration of existing compaction on the roads being decommissioned. If a 14-foot-wide corridor on decommissioned roads is assumed, approximately 84 acres of existing compacted soils would be repaired by the decommissioning, offsetting the acres of detrimental soil conditions from the Pacific Connector pipeline in the Little Butte Creek fifth-field watershed.
- This is a project-level amendment that applies only to the Pacific Connector pipeline and would not change future management for other projects subject to authorization by the Rogue River National Forest.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- This proposal would be a project-level amendment that would affect only the Pacific Connector pipeline. It would not change any future management direction for other projects subject to authorization by the Rogue River National Forest. Impacts would be restricted to the project area.
- Standards and guidelines for future projects remain unchanged.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services in the LRMP because:

- The proposed amendment would affect only the pipeline project area. No other projects would be affected, and no long-term change in management direction would occur for other projects subject to authorization by the Rogue River National Forest.
- No changes in Forest outputs have been identified as a result of the proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would not have an important effect on the entire land management plan nor would it affect land and resources throughout a large part of the planning area because:

- The pipeline project area would affect a very small part of the Rogue River National Forest. If no soil mitigation measures were performed within the right-of-way, the construction impacts would occupy approximately 276 acres (this includes the construction corridor, TEWAs and UCSAs) of the 632,000-acre Rogue River National Forest, approximately 0.04 percent of the Forest. Approximately 30 to 70 percent or 62 to 144 acres of the cleared project area (206 acres) would likely remain in a detrimental soil condition after rehabilitation. Planned mitigation measures that would decompact an additional 84 acres would further reduce potential impacts on the LRMP.

Rogue River National Forest, RRNF-7: Reallocation of Matrix Lands to LSR

The Rogue River National Forest LRMP would be amended to change the designation of approximately 512 acres from the Matrix land allocation to the LSR land allocation in Section 32, T. 36 S., R. 4 E., W. M., Oregon. This change in land allocation is proposed to partially mitigate the potential adverse impact of the Pacific Connector Pipeline Project on LSR 227 on the Rogue River National Forest. This proposed amendment would change future management direction for the lands reallocated from Matrix to LSR.

How does this proposed amendment change the LRMP?

This proposed amendment would reduce the Matrix land allocation on the Rogue River National Forest by 512 acres from 191,839 acres to 191,327 acres, or by approximately 0.27 percent. It would increase the total LSR land allocation on the Rogue River National Forest by 512 acres from 187,745 acres to 188,257 acres, or by approximately 0.27 percent. This proposed amendment would increase LSR 227 by 512 acres from 101,600 acres to 102,112 acres, or by approximately 0.5 percent.

What are the temporal and spatial boundaries of effects?

This proposed amendment would affect 512 acres for the life of the current planning cycle. The spatial boundaries of effects include the area reallocated from Matrix to LSR. Peripheral habitat connectivity with adjacent habitats would be improved on the perimeter of the additional lands reallocated from the Matrix to LSR 227.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This proposed amendment would minimally alter multiple-use goals and objectives for long-term land and resource management because:

- An extensive mitigation plan was developed by the Forest Service and adopted by the applicant to ensure that the goals and objectives of the LRMP related to late-successional forest habitat would be achieved. Mitigation measures include:
  - Closing and decommissioning up to 53 miles of roads. This would help consolidate interior stand habitat and reduce fragmentation to achieve long-term objectives for LSR. There would be an ancillary benefit to the goals and objectives for soils and watersheds through a reduction in soil compaction on existing roads during decommissioning. This reduction would offset unavoidable detrimental soil conditions within the project area.
  - Approximately 600 acres of precommercial thinning of young stands would accelerate the development of late-successional stand conditions.
  - Coarse woody debris (CWD) would be placed back on approximately 300 acres in existing harvest units that are lacking in CWD to provide the constituent elements of late-successional habitat. These areas overlap with precommercial thinning units.
  - Snags would be created on approximately 600 acres that are currently below desired snag levels for LSR. These areas are in addition to the 300 acres of precommercial thinning and CWD placement described above.
- Approximately 55 acres of LSOG would be removed from LSR 227 by the construction of the PCGP Project and 333 acres of LSOG would be added back to the LSR in the land allocation change. Also within the 512 acres being reallocated to LSR 227 there are approximately 179 acres of younger forest (less than 80 yrs old) that would develop into late successional forest over time, further increasing the amount of LSOG in the LSR. Additionally, several elements of the mitigation plan would accelerate the development of late-successional stand characteristics on several hundred acres.

This proposed amendment would not change existing standards and guidelines in the LRMP, but it would change the standards and guidelines under which this parcel of land would be administered. If amended, these 512 acres would be administered as LSR in the future. Modification of standards and guidelines on 512 acres or 0.08 percent of the 623,000-acre national forest would be a minor change.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

- Moving 512 acres from Matrix to the LSR would minimally change the attainment of the long-term balance of goods and services for the Forest because:
- Acres of LSOG habitat replaced in the LSR by the proposed amendment would exceed the acres of LSOG habitat removed by construction of the Pacific Connector pipeline.

Approximately 55 acres of LSOG would be removed from the LSR by the construction of the Pacific Connector Pipeline Project, and approximately 333 acres of LSOG would be added back to the LSR in the land allocation change. Additionally, several elements of the mitigation plan would accelerate the development of late-successional stand characteristics on several hundred acres within the LSR where the potential loss of habitat would occur.

- The Pacific Connector Pipeline Project would not affect outputs from the LRMP because it would not stop any existing or planned project. If it would not stop or otherwise affect any management activity designed to benefit the LSR or meet other management direction, then it is not likely that the Pacific Connector Pipeline Project would affect the multiple-use balance of the LRMP.
- Probable sale quantity would not be affected before the Rogue River LRMP is revised because the Forest has the capacity to maintain probable sale quantity without the acres of Matrix lands that are being reallocated to LSR. If a linear relationship between acres and outputs is assumed, the potential effect would be less than one-half of one percent of the Forest's probable sale quantity since this proposed amendment would affect less than one-half of one percent of the Forest's Matrix land base. This proposed amendment would not prevent future vegetation management activities such as thinning that would benefit LSR and also contribute to the local forest products industry.

Does this proposed amendment have an important effect on the entire land management plan or would it affect land and resources throughout a large portion of the Rogue River National Forest during the planning period?

The proposed amendment would not have an important effect on the entire LMP area, nor would it affect land and resources throughout a large part of the planning area because:

- Reducing the Matrix land allocation of 191,839 acres by 512 acres or approximately 0.27 percent would not be an important change. This would not alter the outputs of goods and services from the Matrix lands during this planning period.
- The project area would affect only a very small part of the Rogue River National Forest. The construction right-of-way where most impacts would occur occupies approximately 280 acres of the 632,000-acre Rogue River National Forest, or approximately 0.05 percent of the Forest.
- Proposed amendments associated with the Pacific Connector Pipeline Project would be coordinated with the Regional Ecosystem Office (REO) and Regional Interagency Executive Committee as required by the NWFP.

Proposed LRMP Amendments Applicable to the Umpqua National Forest

Four proposed amendments would apply only to the Umpqua National Forest LRMP. As directed by 36 CFR 219.15 and FSM 1926, the decision maker evaluated the proposed Pacific Connector pipeline for consistency with the LRMP (Dills 2009). That evaluation is the basis for describing the proposed amendments to the Umpqua National Forest LRMP needed to make provision for the project. This section describes how the proposed amendments would affect the delivery of goods and services and components of the Umpqua National Forest LRMP using the criteria in FSM 1926. These criteria are expressed as questions for each of the proposed LRMP amendments. The deciding official for the Forest Service will use this information to determine the significance of these proposed amendments as they relate to the Umpqua National Forest LRMP.

Umpqua National Forest, UNF-1: Site-Specific Amendment to Allow Removal of Effective Shade on Perennial Streams

The Umpqua National Forest LRMP would be amended to change the standards and guidelines for Fisheries (Umpqua National Forest LRMP, page IV-33, Forest-Wide) and for Water Quality (Umpqua National Forest LRMP, page IV-60, Forest Wide) to allow the removal of effective shading vegetation where perennial streams are crossed by the Pacific Connector right-of-way. This change would potentially affect an estimated total of three acres of effective shading vegetation at approximately four perennial stream crossings in the East Fork of Cow Creek subwatershed from MPs 109 to 110 in Sections 16 and 21, T.32S., R.2W., W.M., Oregon.

How does this proposed amendment change the LRMP?

This proposed amendment would allow removal of effective shade in the Forest-wide standards and guidelines for fisheries, S&G #1 on page IV-33 (Forest Service 1990b). This would occur on approximately four crossings of perennial streams and would affect approximately 3 acres of effective shade where the Pacific Connector Pipeline Project crosses perennial streams.

What are the temporal and spatial boundaries of effects?

The temporal boundary of effects for the proposed plan amendment is the duration of the present planning cycle or until effective shade is reestablished at the crossings. The spatial boundary of effects is the stream crossings plus the distance downstream that any temperature effect occurs. This proposed amendment would affect approximately 3 acres of effective shade in the first year of construction. Stream temperatures with mitigations to reestablish shade may increase at the crossing site by 0.1 to 0.2°C but are expected to return to background levels within short distances because of groundwater recharge and inflows from other channels. With mitigation measures, temperatures are expected to remain near or at background levels (NSR 2009, 2014) and below the 60.8°F threshold established by the State of Oregon (ORS 340-041-0028).

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would not alter multiple-use goals and objectives for long-term land and resource management because:

- This proposal would be a project-level amendment that would apply only to the Pacific Connector Pipeline Project. No other projects or programs would be affected.
- The Forest Service proposed and the applicant has adopted an extensive mitigation plan to ensure that the LRMP goals and objectives would be achieved. On the Umpqua National Forest, five off-site road crossings of perennial streams would be improved in addition to mitigation measures where the Pacific Connector Pipeline Project crosses perennial streams.
- An evaluation of the ACS concluded that Pacific Connector Pipeline Project impacts would likely be within the range of natural variability for the affected resources.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- It would allow removal of effective shade on an estimated 3 acres of 9,237 acres, or 0.03 percent, of Riparian Reserves in the Upper Cow Creek fifth-field watershed.
- There would be no impacts on stream temperature from this action outside of the project area (NSR 2009, 2014; see also section 4.1.3.5, and appendix J of this EIS).
- Mitigation measures associated with the Pacific Connector Pipeline Project would likely provide effective shade within the first year after construction (NSR 2009, 2014).
- This proposed amendment would be project-specific and would apply only to the Pacific Connector Pipeline Project. It would not change any future management direction for other projects subject to authorization by the Umpqua National Forest.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- Mitigation measures associated with the Pacific Connector Pipeline Project would likely provide effective shade within the first year after construction (NSR 2009, NSR 2014).
- The area affected by the proposed amendment would be very small; less than 3 acres of the watershed would be affected.
- There would be no temperature impacts beyond those anticipated at the site-scale.
- An ACS evaluation did not identify any impacts that are outside the range of natural variability for the Upper Cow Creek watershed.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Umpqua National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire land management plan nor would it affect land and resources throughout a large part of the planning area because:

- It would affect approximately 3 acres of effective shade in the 47,416-acre Upper Cow Creek fifth-field watershed.
- The construction right-of-way where most impacts would occur would occupy approximately 220 acres of the 983,129-acre Umpqua National Forest, or approximately 0.02 percent of the Forest. This proposed amendment would affect approximately 3 acres.

Umpqua National Forest, UNF-2: Site-Specific Amendment to Allow Utility Corridors in Riparian Areas

The Umpqua National Forest LRMP would be amended to change prescriptions C2-II (LRMP IV-173) and C2-IV (LRMP IV-177) to allow the Pacific Connector pipeline route to run parallel to the East Fork of Cow Creek for approximately 0.1 mile between about MPs 109.7 and 109.8 in Section 21,

> *T.32S., R.2W., W. M., Oregon. This change would potentially affect approximately 1 acre of riparian vegetation along the East Fork of Cow Creek.*

How does this proposed amendment change the LRMP?

This proposed amendment would allow the Pacific Connector pipeline to be constructed parallel to approximately 0.1 mile of the East Fork of Cow Creek south of Forest Road 3200-500 from MP 109.7 to MP 109.8.

What are the temporal and spatial boundaries of effects?

The temporal boundary of effects is the duration of the current planning cycle while this requirement remains in effect or until vegetation in the riparian area has recovered. Spatially, this proposed amendment would affect 0.1 mile of Riparian Reserve or less than 1 acre of Riparian Reserve adjacent to a perennial, fish-bearing stream. Approximately 20 to 60 feet of riparian vegetation dominated by LSOG forest would remain between the Pacific Connector Pipeline Project corridor and the East Fork of Cow Creek along this reach. Within the portion of the Project corridor that lies within the Riparian Reserve for the East Fork of Cow Creek (and its tributaries), erosion control and revegetation can be accomplished within the first year following construction consistent with the site-specific restoration plan prepared for the Forest Service; however, the loss of riparian habitat structure and function on less than 1 acre is a longer-term effect. Restoring riparian vegetation that includes larger trees would take at least 50 to 70 years on the less than 1 acre where these trees are removed.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would not affect the attainment of multiple-use goals and objectives for long-term land and resource management because:

- This proposal is a project-level amendment that would apply only to the Pacific Connector Pipeline Project. Although less than 1 acre would be affected within the Pacific Connector Pipeline Project corridor, no other projects or programs would be affected.
- An ACS assessment concluded that any project impacts were within the range of natural variation for the Upper Cow Creek Watershed (see section 4.1.3.5 and appendix J of this document).
- The Forest Service proposed and the applicant has adopted an extensive mitigation plan to ensure that LRMP goals and objectives would be achieved. On the Umpqua National Forest, five off-site road crossings of perennial streams would be improved in addition to on-site mitigation measures that would be implemented where the Pacific Connector Pipeline Project would affect aquatic habitat.
- BMPs adopted by the applicant would limit possible sedimentation in adjacent streams and water bodies.
- Where the pipeline parallels the East Fork of Cow Creek (and its tributaries) effective shade may be lost for the first 20 to 40 feet after the Pacific Connector Pipeline Project crosses Forest Road 3200-500 at MP 109.7. From that point until the corridor turns and crosses the East Fork of Cow Creek at MP 109.8, there would be a 20- to 60-foot distance between the pipeline right-of-way and the creek that would provide buffering vegetation. This

buffer would maintain the existing channel profile and reduce the impacts on aquatic food chains because the overhanging vegetation would not be impaired.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- Less than 1 acre of Riparian Reserve would be affected in the 47,416-acre Upper Cow Creek fifth-field watershed.
- There are no effects of this proposed amendment beyond the project area.
- This proposed amendment would be project-specific and would apply only to the Pacific Connector Pipeline Project. No future management direction would be changed.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- No other projects or programs would be affected by this proposed amendment. It is therefore unlikely that the long-term relationship between goods and services provided by the plan would be altered.
- The area affected by the proposed amendment is less than 1 acre of the 983,129-acre Umpqua National Forest.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Umpqua National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LRMP area nor would it affect land and resources throughout a large part of the planning area because:

- The Pacific Connector Pipeline Project would affect only a very small part of the Umpqua National Forest. The construction right-of-way where most impacts would occur would occupy approximately 220 acres of the 983,129-acre Umpqua National Forest. This proposed amendment affects less than 1 acre or 0.00009 percent of NFS lands managed by the Umpqua National Forest.
- Any stream temperature increase at the project scale would be negligible at the scale of the larger stream network and at the fifth-field watershed scale (NSR 2009, 2013).

Umpqua National Forest, UNF-3: Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas

The Umpqua National Forest LRMP would be amended to waive limitations on the area affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way. The standards and guidelines for soils (LRMP page IV-67) require that not more than 20 percent of the project area have detrimental compaction, displacement, or puddling *after completion of a project. This amendment applies only to the right-of-way and associated work areas of the Pacific Connector Gas Pipeline. It does not affect other projects, or change any future management direction.*

How would this proposed amendment change the LRMP?

This proposed amendment would allow the Pacific Connector Pipeline Project to exceed the restriction on the proportion of an activity area that may have detrimental soil conditions. This means that more than 20 percent of the activity area may be in detrimental soil condition, primarily from compaction and displacement associated with right-of-way clearing.

What are the spatial and temporal boundaries of the impacts?

For planning purposes, soil impacts are considered long term. Detrimental conditions would be confined to the project area, but predicting how much would be affected would be speculative. Assuming that 30 to 70 percent of the project area would remain in a detrimental condition after mitigation and rehabilitation about 54 to 127 acres would be affected.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would minimally affect multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. This mitigation plan includes approximately 8 miles of road decommissioning on the Umpqua National Forest that is responsive to Forest-wide management goals for soil and water. Decommissioning includes rehabilitation of compacted soils. Assuming a 14-foot-wide compacted soil area on decommissioned roads, approximately 14 additional acres of compacted soils would be rehabilitated, contributing to goals and objectives for soils and watersheds and partially offsetting the detrimental soil conditions associated with the Pacific Connector Pipeline Project.
- This is a project-level amendment that applies only to the Pacific Connector Pipeline Project and would not change future management direction.
- Even without mitigation measures, the Pacific Connector Pipeline Project would affect no more than 223 acres (0.02 percent) of the 983,129-acre Umpqua National Forest. With on-site mitigation measures, the number of acres that would be affected would be reduced to 54 to 127 acres within the pipeline right-of-way. Off-site mitigation measures would further reduce detrimental soil conditions by an estimated additional 14 acres.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- This proposal would be a project-level amendment that would affect only the Pacific Connector Pipeline Project. It would not change any future management direction, and impacts would be restricted to the project area.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This proposed amendment would affect only the project area. No other projects would be affected and no long-term change in management would occur.
- No changes in Forest outputs occur as a result of this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or would it affect land and resources throughout a large part of the Umpqua National Forest during the planning period?

The Pacific Connector Pipeline Project would affect only a very small part of the Umpqua National Forest. The construction right-of-way where most impacts would occur (this includes the construction corridor, TEWAs, and UCSAs) occupies approximately 223 acres of the 983,129-acre Umpqua National Forest. Areas where detrimental soil conditions may exist would affect 54 to 127 acres or 0.006 to 0.013 percent of the forest. This proposed amendment, by its own evidence, would not affect large parts of the planning area or the area of the entire plan.

Umpqua National Forest, UNF-4: Reallocation of Matrix Lands to LSR

The Umpqua National Forest LRMP would be amended to change the designation of approximately 588 acres from the Matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W., W.M., Oregon; and Sections 13 and 24, T.32S., R.3W., W.M., Oregon. This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Pacific Connector Pipeline Project on LSR 223 in the Umpqua National Forest. This proposed amendment would change future management direction for the lands reallocated from Matrix to LSR.

How would this proposed amendment change the LRMP?

This proposed amendment would reduce the Matrix land allocation on the Umpqua National Forest by 588 acres from 412,300 acres to 411,712 acres, or by approximately 0.14 percent. It would increase the total LSR land allocation on the Forest by 588 acres from 375,160 acres to 375,748 acres, or by approximately 0.16 percent. This proposed amendment would increase LSR 223 by 588 acres from 66,900 acres to 67,488 acres, or by approximately 0.9 percent.

What are the spatial and temporal boundaries of effects?

This proposed amendment would affect 588 acres, or 0.06 percent, of the Umpqua National Forest for the life of the current planning cycle.

Does this proposed amendment affect multiple-use goals and objectives for long-term land and resource management?

This change would have only a minimal effect on the attainment of multiple-use goals and objectives for long-term land and resource management because:

- An extensive mitigation plan has been developed by the Forest Service and adopted by the applicant to ensure that the goals and objectives of the LRMP related to late-successional forest habitat would be achieved. Mitigation measures include:
  - Creation of snags on 175 acres of LSRs that are below desired snag densities for LSRs.
  - Placing LWD on 165 upland acres in units that are currently below desired levels for LWD.
  - Closing and decommissioning 7.6 miles of roads in LSRs to reduce fragmentation and develop interior stand habitat over time.
  - Thinning approximately 2,080 acres of overstocked stands and underburning approximately 1,128 acres in LSR to reduce fire risk and accelerate development of LSR characteristics.
- Approximately 23 acres of LSOG would be removed from the LSR 223 allocation by the construction of the Pacific Connector pipeline; approximately 431 acres of LSOG would be added back to the LSR 223 in the land allocation change, increasing the amount of LSOG in the LSR. Also within the 588 acres being reallocated to LSR 223, there are approximately 157 acres of younger forest (less than 80 years old) that would develop into late successional forest over time, further increasing the amount of LSOG in the LSR. Additionally, several elements of the mitigation plan would accelerate the development of late-successional stand characteristics on several hundred acres within the LSR where the potential loss of habitat would occur.

Is this proposed amendment a minor change in standards and guidelines?

This proposed amendment is a change in land allocation. Lands that are transferred from the Matrix land allocation to LSR would be managed under the LSR standards and guidelines in the future. This means that they would be managed for late successional and old-growth habitat conditions instead of multiple-use objectives associated with Matrix lands. This is a minor change in standards and guidelines because it affects 588 acres or 0.06 percent of the 983,129 Umpqua National Forest. This proposed amendment would reduce the Matrix land allocation on the Umpqua National Forest by 588 acres from 412,300 acres to 411,712 acres, or by approximately 0.14 percent. It would increase the total LSR land allocation on the Forest by 588 acres from 375,160 acres to 375,748 acres, or by approximately 0.16 percent.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

Moving 588 acres from the Matrix to the LSR would only minimally affect attainment of the long-term balance of goods and services for the Forest because:

- The Pacific Connector Pipeline Project would not affect outputs from the LRMP because it would not affect any existing or planned project. If it would not stop or affect any management activity designed to benefit the LSR or meet other management objectives, it is not likely that it would affect the multiple-use balance of the LRMP.

- Probable sale quantity would not be affected before the Umpqua LRMP is revised because the Forest has the capacity to maintain probable sale quantity without the acres of Matrix lands that would be reallocated to LSR. If a linear relationship between acres and outputs is assumed, the potential effect would be less than two-tenths of one percent of the Forest's probable sale quantity since this proposed amendment would affect less than two-tenths of one percent of the Forest's Matrix land base. This proposed amendment would not prevent future vegetation management activities such as thinning that would benefit LSR and that would also contribute to the local forest products industry. As a practical matter, it is highly unlikely that the LSOG forest that is in Matrix lands reallocated to LSR would be harvested even if it remained in the Matrix land base because Recovery Action 32 for NSOs strives to maintain existing LSOG forests.
- Other larger changes in land allocation have been found to be non-significant amendments of the Umpqua LRMP.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large part of the Umpqua National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LMP area nor would it affect land and resources throughout a large part of the planning area because:

- Reducing the Matrix land allocation of 412,300 acres by 588 acres would affect only about 0.14 percent of the Matrix land base.
- The Pacific Connector Pipeline Project would affect a very small part of the Umpqua National Forest. The proposed reallocation of land would affect 588 acres or 0.06 percent of the 983,129-acre Umpqua National Forest. By its own evidence, this proposed amendment affects a very small area compared to the overall area of the Umpqua National Forest.

Proposed LRMP Amendments Applicable to the Winema National Forest

Five proposed site-specific amendments would apply only to the Winema National Forest LRMP. As directed by 36 CFR 219.15 and FSM 1926, the decision maker evaluated the proposed Pacific Connector pipeline for consistency with the LRMP (Shimamoto 2009). That evaluation is the basis for describing the proposed amendments to the Winema National Forest LRMP needed to make provision for the Pacific Connector Pipeline Project. This section describes how the proposed amendments would affect the delivery of goods and services and components of the Winema National Forest LRMP using the criteria in FSM 1926. These criteria are expressed as questions for each of the proposed LRMP amendments. The deciding official for the Forest Service will use this information to determine the significance of these proposed amendments as they relate to the Winema National Forest LRMP.

Winema National Forest, WNF-1: Site-Specific Amendment to Allow Utility Corridors in Management Area 3

The Winema National Forest LRMP would be amended to change the standards and guidelines for Management Area 3 (LRMP page 4-103 and 4-104, Lands)

> *to allow the Pacific Connector pipeline corridor in Management Area 3 from the Forest Boundary in Section 32, T.37S., R.5E., W.M., Oregon, to the Clover Creek Road corridor in Section 4, T.38S, R.5E., W.M., Oregon. Standards and guidelines for Management Area 3 state that the area is currently an avoidance area for new utility corridors. This proposed new utility corridor is approximately 1.5 miles long and occupies approximately 17 acres.*

How would this proposed amendment change the LRMP?

This proposed amendment would allow creation of a pipeline corridor from the Forest boundary to the point where the Pacific Connector pipeline would join the Clover Creek Road.

What are the spatial and temporal boundaries of effects?

This proposed amendment would allow an approximately 1.5-mile-long pipeline corridor in Management Area 3; the pipeline corridor would affect approximately 17 acres of the Management Area. As the corridor becomes revegetated over time, the affected area would decrease to approximately 4 acres. The pipeline corridor would be seen only at the crossing with the Dead Indian Memorial Highway and where the corridor joins the Clover Creek Road. The visual impact at the Dead Indian Memorial Highway crossing is discussed in a separate section below. This would be a long-term effect because the 4 acres would be maintained in a low vegetation state for the life of the project.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would have only a minimal effect on the attainment of multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan that includes mitigation measures to minimize the visual impacts of the Pacific Connector Pipeline Project and meet long-term goals and objectives for visual quality.
- Over time, the visual standards for the area would be achieved.

Is this proposed amendment a minor change in standards and guidelines?

This change in management area direction and standards and guidelines would be relatively minor in the context of the LRMP because:

- The proposed amendment is site-specific and only applies to the Pacific Connector Pipeline Project.
- There are 119,000 acres of Management Area 3 on the Forest. The Pacific Connector Pipeline Project corridor would affect 17 acres, or about 0.01 percent of the management area.
- The proposed amendment would allow an impact that extends the seen pipeline corridor adjacent to the Clover Creek road to north-bound travelers for approximately 10 to 15 seconds.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

The proposed amendment would not alter the long-term relationship between levels of multiple-use goods and services because:

- This proposal is a project-specific amendment that would affect a limited area of MA-3. It would not change future management of any other resource or alter levels of outputs between any other goods and services; long-term relationships between multiple-use goods and services would therefore not be affected.
- No other LRMP outputs of goods and services have been identified that would be affected by this proposed amendment.
- Over time, a visual standard of partial retention would be achieved.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Winema National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LRMP area nor would it affect land and resources throughout a large part of the planning area because:

- Changes resulting from this proposed amendment are project-specific and would affect only visual standards and related experiences at the location where the Pacific Connector Pipeline Project corridor is visible along the Clover Creek Road.
- This proposed amendment would affect 17 acres or about 0.002 percent of the 1.04 million–acre Winema National Forest.

Winema National Forest, WNF-2: Site-Specific Amendment of VQO on the Dead Indian Memorial Highway

The Winema National Forest LRMP would be amended to allow 10 to 15 years to achieve the VQO of Foreground Retention where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately MP 168.8 in Section 33, T.37S., R.5E., W. M., Oregon. Standards and guidelines for Scenic Management, Foreground Retention (LRMP 4-104, Management Area 3A, Foreground Retention) requires that visual standards for a given location be achieved within 1 year of completion of a project. The Forest Service proposes to allow 10 to 15 years to meet the specified visual standards at this location.

How would this proposed amendment change the LRMP?

This proposed amendment would change the timeframe for which Foreground Retention would be achieved after construction of the Pacific Connector Pipeline Project is completed from one year to 10 to 15 years.

What are the spatial and temporal boundaries of effects?

This proposed amendment would initially affect about 3 acres of Management Area 3A. Over a period of 10 to 15 years, the affected area would decrease to about 0.25 acre.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would have only a minimal effect on the attainment of multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. This mitigation plan includes mitigation measures to minimize the visual impact of the Pacific Connector Pipeline Project and meet long-term goals and objectives.
- Over time, the visual standard for the area would be achieved.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- There are 27,315 acres of Management Area 3A on the Forest. Allowing the Pacific Connector Pipeline Project crossing at the Dead Indian Memorial Highway would create an impact that is visible for about 13 seconds. Less than 3 acres would be affected, which is much less than 1 percent of Management Area 3A. This is also a very small portion of the Forest.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

The proposed amendment would not alter the long-term relationship between levels of multiple-use goods and services because:

- This proposal is a project-specific amendment that would affect only visual standards in a limited area. It would not change future management of any other resource or alter levels of outputs between any other goods and services. Long-term relationships between multiple-use goods and services would therefore not be affected.
- No other Forest outputs of goods and services have been identified that would be affected by this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Winema National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire land management plan nor would it affect land and resources throughout a large part of the planning area because:

- Changes resulting from this proposed amendment would be project-specific and would affect only visual standards and related experiences at the location where the Pacific Connector Pipeline Project is visible where it crosses the Dead Indian Memorial Highway.
- The Pacific Connector Pipeline Project would affect a very small part of the Winema National Forest. The construction right-of-way where most impacts would occur would occupy approximately 90 acres of the 1.04 million–acre Winema National Forest, which is a tiny fraction of the Forest.

Winema National Forest, WNF-3: Site-Specific Amendment of VQO Adjacent to the Clover Creek Road for Management Area 3B

The Winema National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO for Scenic Management, Foreground Partial Retention, where the Pacific Connector right-of-way would be adjacent to Clover Creek Road from approximately MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T.38S., R.5E., W.M., Oregon, and Sections 7 and 18, T.38S., R.6E., W.M., Oregon. This change would potentially affect approximately 50 acres. Standards and guidelines for Foreground Partial Retention (LRMP, page 4-107, Management Area 3B) require that VQOs be met within 3 years of completion of a project.

How does this proposed amendment change the LRMP?

This proposed amendment would change the timeframe for which Foreground Partial Retention would be achieved after construction of the Pacific Connector Pipeline Project is completed from one year to 10 to 15 years.

What are the spatial and temporal boundaries of effects?

This proposed amendment would initially affect about 50 acres of Management Area 3B. Over a period of 10 to 15 years, the affected area would decrease to about 29 acres.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would only minimally alter multiple-use goals and objectives for long for term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. This mitigation plan includes measures to minimize the visual impact of the Pacific Connector Pipeline Project along Clover Creek Road and meet long-term goals and objectives.
- Over time, the visual quality standards for the area would be achieved.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- They would be project-specific for the Pacific Connector Pipeline Project. There are 15,703 acres of Management Area 3B on the Forest. Allowing the Pacific Connector Pipeline Project to parallel Clover Creek Road would affect visual integrity for approximately 6 miles and would affect about 50 acres of this management area. The effect would be relatively short term (10 to 15 years) and would affect less than 1 percent of Management Area 3.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

The proposed amendment would not alter the long-term relationship between levels of multiple-use goods and services because:

- This proposal would be a project-specific amendment that would affect only visual standards in a limited area. It would not change future management of any other resource or alter levels of outputs between any other goods and services. Long-term relationships between multiple-use goods and services would there not be affected.
- No other Forest outputs of goods and services have been identified that would be affected by this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Winema National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LMP area, nor would it affect land and resources throughout a large part of the planning area because:

- Changes resulting from this proposed amendment are project-specific and would affect only visual standards and related experiences at the location where the Pacific Connector Pipeline Project is visible adjacent to the Clover Creek Road.
- The Pacific Connector Pipeline Project would affect only a very small part of the Winema National Forest. The construction right-of-way where most impacts would occur occupies approximately 50 acres of the 1.04 million–acre Winema National Forest, which is a tiny fraction of the Forest.

Winema National Forest, WNF-4: Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas

The Winema National Forest LRMP would be amended to waive restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected management areas. Standards and guidelines for detrimental soil impacts in all affected management areas require that no more than 20 percent of the activity area be detrimentally compacted, puddled, or displaced upon completion of a project (LRMP page 4-73, 12-5).

How does this proposed amendment change the LRMP?

This proposed amendment would exempt the Pacific Connector Pipeline Project from the restriction on the proportion of an activity area that may have detrimental soil conditions. Under this proposed amendment, more than 20 percent of the activity area for the Pacific Connector Pipeline Project could have a detrimental soil condition when the project is completed. The detrimental soil condition would primarily result from displacement associated with trenching.

What are the spatial and temporal boundaries of effects?

For planning purposes, soil impacts are considered long term. Soil displacement would be confined to the project area, but it would be speculative to predict how much soil would be affected. If it is assumed that 30 to 70 percent of the project area would remain in a detrimental condition after mitigation and rehabilitation, about 24 to 56 acres spread over about 6 miles of right-of-way, or about 4 to 9 acres per mile, would be affected.

Does this proposed amendment affect multiple-use goals and objectives for long-term land and resource management?

This change would not significantly alter multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. Pacific Connector's ECRP includes substantial mitigation measures to reduce soil impacts and restore productivity.
- This proposal is a project-level amendment that applies only to the Pacific Connector Pipeline Project and would not change future management.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- This proposal would be a project-level amendment that would affect only the Pacific Connector Pipeline Project. It would not change any future management direction, and impacts would be restricted to the project area.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

It would not change the long-term relationship between levels of multiple-use goods and services because:

- It would affect only the project area. No other projects would be affected, and no long-term change in management would occur.
- No changes in Forest outputs would occur as a result of this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Winema National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LMP area nor would it affect land and resources throughout a large part of the planning area because:

- The project area would affect only a very small part of the Winema National Forest. The construction right-of-way where most impacts would occur occupies approximately 92 acres (this includes the construction corridor, TEWAs, and UCSAs) of the 1.04 million–acre Winema National Forest, which is a tiny fraction of the Forest. If detrimental soil conditions were to affect 30 to 70 percent of the project area, only about 24 to 56 acres, or about 6 to 9 acres per mile of right-of-way, would be in a detrimental condition.

Winema National Forest, WNF-5: Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within Riparian Areas (Management Area 8)

The Winema National Forest LRMP would be amended to waive restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in Management Area 8, Riparian Area (Management Area 8). This change would potentially affect approximately 0.5 mile or an estimated 9.6 acres of Management Area 8. Standards and guidelines for Soil and Water, Management Area 8 require that not more than 10 percent of the total riparian zone in an activity area be in a detrimental soil condition upon the completion of a project (LRMP page 4-137, 2).

How would this proposed amendment change the LRMP?

This proposed amendment would allow the Pacific Connector Pipeline Project to exceed restrictions on detrimental soil impacts in Management Area 8.

What are the spatial and temporal boundaries of effects?

The Pacific Connector Pipeline Project potentially would affect approximately 0.5 mile of the Management Area 8 Riparian Area, totaling an estimated 9.6 acres. For planning purposes, soil impacts are considered long term. Assuming that 30 to 70 percent of the area would remain in a detrimental condition after mitigation and rehabilitation, approximately 3 to 6 acres would potentially be affected.

Does this proposed amendment affect multiple use goals and objectives for long-term land and resource management?

This change would not significantly alter multiple-use goals and objectives for long-term land and resource management because:

- The Forest Service has proposed and the applicant has adopted an extensive mitigation plan to ensure that long-term goals and objectives would be attained. The ECRP has substantial mitigation measures to reduce soil impacts and restore productivity.
- This is a project-level amendment that applies only to the Project and would not change future management.

Is this proposed amendment a minor change in standards and guidelines?

Changes in standards and guidelines associated with this proposed amendment would be minor because:

- This would be a project-level amendment that would affect only the Pacific Connector Pipeline Project. It would not change any future management direction, and impacts would be restricted to the project area.

Does this proposed amendment affect the long-term relationship between levels of goods and services provided by the LRMP?

This proposed amendment would not change the long-term relationship between levels of multiple-use goods and services because:

- This proposed amendment would affect only the project area. No other projects would be affected and no long-term change in management would occur.
- No changes in Forest outputs occur as a result of this proposed amendment.

Does this proposed amendment have an important effect on the entire land management plan or affect land and resources throughout a large portion of the Winema National Forest during the planning period?

The proposed amendment would neither have an important effect on the entire LRMP area nor affect land and resources throughout a large part of the planning area because:

- The project area would affect only a very small part of the Winema National Forest. The construction right-of-way where most impacts would occur occupies approximately 92 acres (this includes the construction corridor, TEWAs, and UCSAs) of the 1.04 million–acre Winema National Forest, which is a tiny fraction of the forest. The proposed amendment would affect less than 10 acres of the Forest.

4.1.3.5 Resource Values and Conditions on Federal Lands: ACS

This section provides information for BLM and Forest Service decision makers to evaluate whether the proposed Pacific Connector Pipeline Project retards or prevents attainment of the objectives of the ACS of the NWFP. This section summarizes EIS appendix J, Aquatic Conservation Strategy Technical Report, which contains the full text of the analysis. Section numbers that refer to sections in appendix J are so noted. Content of this section reflects interagency direction for demonstrating compliance with the ACS (Goodman et al. 2007).

The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems on BLM and NFS lands in the area of the NWFP (Forest Service and BLM 1994a, 1994b). The ACS established watershed assessment requirements, management objectives, and Riparian Reserves and Key Watersheds as land allocations on BLM and NFS lands. Standards and guidelines for management and protection of aquatic resources on BLM and NFS lands were also developed as part of the NWFP to ensure that the objectives of the ACS are achieved. BLM and Forest Service line officers must determine whether activities that occur on BLM or NFS lands retard or prevent attainment of the ACS objectives established under the NWFP.

Private lands dominate the landscape in many of the watersheds that would be crossed by the project. The ACS applies only to lands managed by the BLM and the Forest Service within the area covered by the NWFP. On private lands, compliance with the CWA is the best evidence of protection of aquatic values. Issuance of permits for the Pacific Connector Pipeline Project under Section 401 of the CWA from the ODEQ and Section 404 of the CWA from the COE demonstrate compliance with the CWA. Pacific Connector's application to FERC will include the necessary information for the ODEQ and COE permits. The BLM and Forest Service require that the applicant secure those permits prior to making any findings related to the ACS. Section 4.4 of this EIS describes watershed impacts of the Pacific Connector Pipeline Project on private lands.

Summary of Environmental Consequences Related to the ACS

The Pacific Connector pipeline would traverse approximately 40 miles of BLM lands and 31 miles of NFS lands on its 232-mile route from Malin to Coos Bay, Oregon. The pipeline project would cross portions of 19 fifth-field watersheds, 16 of which include BLM or NFS lands where the ACS applies. Tables 4.1.3.5-1a and 4.1.3.5-1b summarize (1) the number and acreage of Riparian Reserves of perennial and intermittent streams and forested wetlands that would be crossed by the pipeline on BLM or NFS lands, and (2) the number and acreage of Riparian Reserves that would be "clipped" where a portion of the Riparian Reserve is impacted without the pipeline trench crossing a waterbody or wetland. In 12 of the 16 watersheds traversed by the pipeline on federal lands, the pipeline project would cross perennial or intermittent streams or clip areas designated as Riparian Reserves; in 4 of the watersheds crossed, the pipeline project would not intersect with Riparian Reserves or stream crossings.

The Pacific Connector pipeline route would follow ridgelines and existing rights-of-way, such as powerlines and roads, wherever possible. This analysis shows that impacts on BLM and NFS Riparian Reserves and aquatic habitats would be temporary or minor in scale in any given fifth-field watershed or sixth-field subwatershed. Possible impacts would be sediment transport to waterbodies where construction at stream crossings causes surface erosion, disturbance of banks and stream bottoms, possible increases in water temperature from removal of effective shade and removal of vegetation at stream crossings. Use of roads, including standards for reconstruction, would be subject to applicable ACS standards and guidelines. In order to minimize potential adverse impacts on fish, timing of instream work would be tied to work windows established by the ODFW. These time periods were established to avoid the vulnerable life stages of potentially affected fish species, including migration, spawning, and rearing.

TABLE 4.1.3.5-1a

Summary of Riparian Reserves, Stream Channels, and Wetlands Crossed by the Pacific Connector Pipeline Project on BLM and NFS Lands by Administrative Unit

	Perennial Streams Crossed a/		Intermittent Streams Crossed		Wetlands Crossed b/		Total Stream Channels or Wetlands Crossed		Riparian Reserves Clipped without Stream or Wetland Crossings c/		Total d/	
Agency	**Stream Channels Crossed e/**	**Riparian Reserves Cleared (Acres)**	**Stream Channels Crossed**	**Riparian Reserves Cleared (Acres)**	**Wetlands Crossed**	**Riparian Reserves Cleared (Acres)**	**Total Crossed**	**Total Riparian Reserves Cleared (Acres)**	**Riparian Reserves Clipped**	**Total Riparian Reserves (Acres)**	**Affected Riparian Reserves**	**Cleared (Acres)**
BLM Coos Bay District	3	8.4	10	9.2	3	0.5	16	18.1	4	22.0	20	40.1
BLM Roseburg District	1	4.1	2	3.9	2	0.3	5	8.31	2	11.4	7	19.7
BLM Medford District	3	7.7	13	17.3	1	1.2	17	29.2	4	7.2	21	36.4
BLM Lakeview District	0	0.0	1	1.32	0	0.0	1	1.3	0	0.0	1	1.3
Total BLM	**7**	**20.2**	**26**	**31.**	**6**	**2.0**	**39**	**53.9**	**10**	**40.1**	**49**	**94.0**
Umpqua National Forest	4	7.3	3	6.3	1	2.0	8	15.6	3	1.4	11	17.0
Rogue River National Forest	1	2.5	1	1.6	0	0.0	2	4.1	2	0.6	4	4.7
Winema National Forest	0	0.0	2	3.3	2	2.5	4	5.8	4	2.6	8	8.3
Total Forest Service	**5**	**9.7**	**6**	**11.2**	**3**	**4.5**	**19**	**25.4**	**9**	**4.6**	**28**	**30.0**
Total BLM and Forest Service	**12**	**29.9**	**32**	**42.9**	**9**	**6.5**	**53**	**79.3**	**19**	**45.3**	**72**	**124.7**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest tenth of an acre (values below 0.1 are shown as "<0.1").

Data Source: Resource Report 3, table 2A-3A and BLM and Forest Service Riparian Reserve Assessment, database.

a/ "Crossed" means that the pipeline trench crosses the stream channel or delineated wetland area.

b/ "Wetlands" refers to delineated wetland areas that are not already counted as streams. Where the Riparian Reserve of a wetland is fully encompassed in the adjacent Riparian Reserve of a stream channel, the acres are counted as part of the stream channel to avoid double counting and are shown as 0 in this table.

c/ "Clipped" means that the Riparian Reserve associated with a stream channel or wetland was cleared as part of the construction corridor or TEWA, but the pipeline trench did not cross the stream channel or delineated wetland area.

d/ This table includes only areas where vegetation is cleared in the construction corridor and temporary extra work areas (TEWAs). An additional 11.05 acres of Riparian Reserves are used as Uncleared Storage Areas (UCSAs) where habitat may be modified but vegetation is not removed.

e/ Irrigation ditches or other man-made water conveyances are crossed by the project, but they do not create Riparian Reserves and are not subject to the requirements of the NWFP.

TABLE 4.1.3.5-1b

Vegetation Age Class Structure of Riparian Reserves Cleared in Construction Corridor and TEWAs by Administrative Unit, BLM and Forest Service

		LSOG (>80 Years) Forest Cleared (Acres)				Mid-Seral (40-80 Years) Cleared (Acres)				Early Seral (0-40 Years) Cleared (Acres)						
Administrative Unit	**Waterbody Type**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hardwood Forest**	**Total LSOG Cleared**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hard-wood Forest**	**Total Mid-Seral Cleared**	**Conifer Forest**	**Shrub or Brush-field**	**Grasslands and non-forest**	**Total Early Seral Cleared**	**Total All Vegetation Classes (Acres)**	**Stream Channel or Wetland Area within Corridor (Acres)**	**Total within Cleared Area (Acres)**
BLM Coos Bay	Perennial Stream	2		<1	2			2	2	5	<1			6	10	<1
	Intermittent Stream	2		<1	3	9		<1	9	4	3			7	19	<1
	Wetland			<1	<1	3	<1	<1	4	<1	<1			<1	5	<1
	Total	**5**		**1**	**6**	**12**	**<1**	**2**	**15**	**10**	**4**			**14**	**35**	**<1**
BLM Roseburg	Perennial Stream					4			4	2				2	7	<1
	Intermittent Stream	2		1	3			<1	<1	<1			<1	<1	5	<1
	Wetland	<1			<1	4			4				<1	<1	4	<1
	Total	**3**		**1**	**4**	**9**		**<1**	**9**	**2**			**<1**	**3**	**16**	**<1**
BLM Medford	Perennial Stream	2	<1	2	5		<1	1	1			<1	<1	<1	7	<1
	Intermittent Stream	2	5	3	9			1	1			6	2	8	18	<1
	Wetland					1	<1		1		<1			<1	1	
	Total	**3**	**6**	**5**	**14**	**1**	**<1**	**2**	**4**		**<1**	**6**	**2**	**8**	**26**	**<1**
BLM Lakeview	Intermittent Stream			1	1								<1	<1	1	<1
Total BLM	Perennial Stream	4	<1	2	7	4	<1	3	7	7	<1	<1	<1	9	23	<1
	Intermittent Stream	6	5	6	17	9		2	11	5	3	6	2	15	43	<1
	Wetland	<1		<1	<1	9	<1	<1	9	<1	<1		<1	1	11	<1
	Total	**10**	**6**	**9**	**25**	**22**	**<1**	**5**	**27**	**13**	**4**	**6**	**3**	**26**	**78**	**1**
Umpqua NF	Perennial Stream	3			3	<1			<1	3				3	7	<1
	Intermittent Stream					3			3	<1				<1	4	<1
	Wetland					2			2						2	
	Total	**3**			**3**	**5**			**5**	**3**				**3**	**12**	**<1**

TABLE 4.1.3.5-1b

Vegetation Age Class Structure of Riparian Reserves Cleared in Construction Corridor and TEWAs by Administrative Unit, BLM and Forest Service

		LSOG (>80 Years) Forest Cleared (Acres)				Mid-Seral (40-80 Years) Cleared (Acres)				Early Seral (0-40 Years) Cleared (Acres)						
Administrative Unit	**Waterbody Type**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hardwood Forest**	**Total LSOG Cleared**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hard-wood Forest**	**Total Mid-Seral Cleared**	**Conifer Forest**	**Shrub or Brush-field**	**Grasslands and non-forest**	**Total Early Seral Cleared**	**Total All Vegetation Classes (Acres)**	**Stream Channel or Wetland Area within Corridor (Acres)**	**Total within Cleared Area (Acres)**
Rogue River NF	Perennial Stream	1			1					1				1	2	<1
	Intermittent Stream					<1			<1	<1			<1	<1	1	<1
	Wetland	<1			<1					<1				<1	<1	
	Total	**1**			**1**	**<1**			**<1**	**2**			**<1**	**2**	**4**	**<1**
Winema NF	Perennial Stream															
	Intermittent Stream	2			2					2				2	4	<1
	Wetland	<1			<1	<1	<1		<1	1			<1	1	3	<1
	Total	**3**			**3**	**<1**	**<1**		**<1**	**3**			**<1**	**3**	**7**	**<1**
Total Forest Service	Perennial Stream	4			4	<1			<1	4				4	9	<1
	Intermittent Stream	2			2	3			3	3			<1	3	9	<1
	Wetland	1			1	2	<1		2.4	1			<1	2	5	<1
	Total	**7**			**7**	**6**	**<1**		**6**	**9**			**<1**	**9**	**23**	**<1**
Total BLM and Forest Service	Perennial Stream	8	<1	2	11	5	<1	3	8	11	<1	<1	<1	13	32	<1
	Intermittent Stream	9	5	6	19	12		2	14	8	3	6	3	19	52	<1
	Wetland	1		<1	2	11	<1	<1	11	2	<1		<1	3	16	<1
	Total	**18**	**6**	**9**	**32**	**28**	**<1**	**5**	**34**	**21**	**4**	**6**	**3**	**34**	**100**	**2**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).

Sediment

Corridor construction and stream crossings may create conditions where accelerated soil erosion and sediment transport to streams could occur in the absence of active and aggressive erosion control measures and rapid successful revegetation.

There are three project phases when sediment could be created:

1. **Corridor clearing and construction.** The ECRP for the project describes the erosion control measures that would be implemented during corridor clearing to minimize transport of sediment to adjacent and nearby aquatic habitats. The FERC EI, in cooperation with agency representatives of the BLM and Forest Service, would determine appropriate temporary measures to be used to minimize potential erosion and sediment impacts during and after timber clearing operations. These are proven erosion control techniques. As a result of application of the measures in the ECRP, soil erosion and sediment transport during corridor clearing and construction is expected to be minor and within the range of natural variability of the watersheds where the action occurs. These measures include:
    - Leaving slash generated during timber clearing operations on the corridor to reduce erosion over the following winter. This minimizes raindrop impacts and overland flow.
    - Scarifying compacted surfaces, where appropriate, to promote infiltration and reduce runoff;
    - Use of additional slash/brush piles and coarse woody debris (limbs to large logs) at appropriate locations to minimize offsite runoff and sedimentation. Coarse woody debris placed on contour has been shown to be an effective hillslope measure to reduce erosion (Robichaud et al. 2000).
    - Installation of slope breakers (water bars) at appropriate locations and spacings to shorten slope lengths, prevent concentrated flow, and divert runoff to stabilized areas. Waterbars are a proven and effective method of reducing the erosive energy of overland flow, diverting overland flow and minimizing sediment transport;
    - Installation of silt fences and straw bale sediment barriers to prevent transport of sediment to aquatic habitats. Pacific Connector has committed to install and maintain erosion control structures including silt fences at stream crossings until effective ground cover is reestablished. Silt fences are 90 to 95 percent efficient at trapping sediment (Robichaud et al. 2000).
    - Temporary seeding (using appropriate quick-germinating cover crops such as annual ryegrass or other appropriate cover species), where not precluded by federal restrictions on introduced species; and/or
    - Mulching of corridor areas that do not have sufficient cover. Geotextile fabric erosion control blankets may also be used to provide temporary ground cover. Mulching reduces raindrop impacts, and when in contact with the ground, limits overland flow and sediment transport.
2. **Stream channel crossing.** During stream crossings, Pacific Connector will primarily use dam-and-pump construction methods on flowing streams to isolate the crossing construction site from the flowing stream on both the upstream and downstream sides of the crossing. In some cases, the flume method may also be used. The BLM and Forest

Service have used the dam-and-pump method to install culverts in flowing streams. A literature review of pipeline stream crossing studies showed the dam-and-pump method to be effective at controlling sediment. During construction, the crossing site is isolated from the stream by dams, and water is pumped around the site to maintain downstream flows. When dams and pumps are removed and the stream is allowed to flow across the crossing site, there may be a short-term (typically a few hours) pulse of sediment that will vary by substrate type. When compared to sediment mobilized by natural disturbance events such as fires and high-intensity precipitation, the sediment created is expected minor, short-term and well within the range of natural variation and comparable in scale to a minor bank slough. The flume method is also effective at controlling sediments as discusses in section 4.6.2.3 of this EIS.

Pacific Connector conducted an extensive engineering analysis of stream crossings that included substrate type, channel morphology and other variables (GeoEngineers 2013c; 2013d). The findings of this analysis were consistent with the findings noted above and in appendix J. In this EIS, see also section 4.6.2.3, Sedimentation and Turbidity Resulting from Pipeline Installation Across Inland Freshwater Streams and Impacts on Aquatic Resources.

3. **Post-construction.** The analysis discloses that in the first year or two following construction, a minor pulse of sediment could be observed following the first seasonal rain, but this sediment-laden water is likely to dissipate within a few hundred feet and would be indistinguishable from background levels. With the exceptions noted below at MP 119.7, 125.59 and 131.7, this is expected to be a very minor amount of sediment because of the requirements in the ECRP to establish and maintain erosion control structures, sediment barriers, effective ground cover and accomplish rapid revegetation. Pacific Connector has committed to maintain silt barriers until effective ground cover is reestablished. Silt fences are 90 to 95 percent efficient at trapping sediment (Robichaud et al. 2000). As a result of these measures, the Project corridor is not expected to become a chronic source of fine sediments. For areas with reclamation sensitivity (see section 4.3.4 of this EIS) the Forest Service and BLM will also require soil remediation with biosolids or other appropriate organic materials to ensure successful revegetation. Except as noted at MP 119.7, 126.59 and 131.7, the analysis discloses that with the application of measures in the ECRP and effective soil remediation, projected impacts from sediment would be short term, minor, and within the range of natural variability for the watersheds crossed by the Project (appendix J, section 1.3.1.2; see also section 4.3.4 and section 4.6.2.3, Sedimentation and Turbidity Resulting from Pipeline Installation Across Inland Freshwater Streams and Impacts on Aquatic Resources.)

   At MPs 119.7 (Trail Creek Watershed), 126.59 (Shady Cove - Rogue River Watershed), and 131.7 (Big Butte Creek Watershed), the Project, if constructed, would likely become a chronic source of sediment that may retard attainment of ACS objectives at those locations. At MPs 119.7 and 131.7, the filed alignment lies entirely within the Riparian Reserve, and is closely adjacent and parallel to intermittent stream channels. Clearing limits at these locations would remove most riparian vegetation adjacent to the affected stream channel leaving little or no undisturbed area adjacent to the channel. At MP 126.59, the filed alignment crosses three intermittent stream channels in close proximity in an area that is sparsely vegetated and highly erosive once disturbed. In all three of these locations, soils inventories and agency experience indicate that revegetation would be difficult once these areas are disturbed. As a result, these three locations would likely become chronic sources of sediment that may retard attainment of ACS objectives.

The BLM Medford District has requested the applicant reroute the alignment at these locations. Preliminary changes in alignment have been developed with the concurrence of the Medford District BLM that would address these issues. At MPs 119.7 and 131.7, a realignment proposal has been developed that would move the corridor out of the adjacent Riparian Reserve. At MP 126.59, an alignment modification has been developed that would eliminate a stream crossing and move the alignment into an area that can be revegetated. Once final engineering of modified alignments on these locations has been completed, the filed alignment will be modified to reflect these changes. This assessment would then be modified to reflect the new alignment.

If implementation or post-project monitoring show evidence as defined by the BLM or Forest Service of unacceptable surface erosion on an area of at least 100 square feet and at least 5 feet wide, or unacceptable sediment transport to aquatic systems, Pacific Connector would be required by the terms of the right-of-way grant to take additional erosion control measures as needed, as directed by the BLM or Forest Service, to reduce sediment transport to background levels. Evidence of "unacceptable" levels of sediment transport would include silt fences or other sediment barriers that are not maintained, lack of effective ground cover, visible turbidity at channel crossings, visible evidence of sheet or gulley erosion where sediment is transported to aquatic systems, or deposition downstream of crossings.

<u>Streambed and Stream Bank Impacts</u>

All stream crossings on BLM and NFS lands (whether intermittent or perennial, wet or dry) would have either: (1) a bridge; (2) a temporary culvert with temporary road fill to be removed after work is completed; or (3) a low water ford with a rock mat. If water is present in streambeds at the time of construction, Pacific Connector will utilize temporary construction bridges during all phases of construction to cross the waterbodies. Where feasible, Pacific Connector's contractors would attempt to lift, span, and set the bridges from the streambanks. Where it is not feasible to install or safely set the temporary bridges from the streambanks, only the equipment necessary to install the bridge or temporary support pier would cross the waterbody. Any equipment required to enter a waterbody to set a bridge would be inspected to ensure it is clean and free of dirt or hydrocarbons (Resource Report 2: 31). Agency representatives would also participate in pre-construction evaluation of crossing methods as necessary.

At stream crossings, the corridor width would be reduced from 95 feet to 75 feet where it is feasible to do so, and TEWAs would be set back at least 50 feet from the stream channel. The area of potential disturbance to stream banks and bottoms from equipment is generally less than 15 feet wide. Measures described above would minimize disturbance of streambanks and channel bottoms. The stream crossing for the pipeline would be accomplished by constructing a trench 4 to 6 feet wide and deep enough to avoid possible channel scouring. Typically, this would be at least 3 to 5 feet below the stream bottom. In some locations, steep streambanks would be "laid back" (excavated) to a 2:1 to 3:1 backslope ratio to stabilize the banks and minimize bank erosion from the stream. These crossings are identified in the individual watershed descriptions. After installation of the pipeline, the trench would be backfilled with material excavated from the trench and capped with gravel as needed. Boulders and

LWD removed from the corridor would be placed as needed within the stream crossing area and Riparian Reserve to reestablish or improve pre-crossing conditions. Streambanks would be revegetated with native species and "armored" as needed and specified by Agency representatives with LWD and boulders to ensure stability. Channel breakers or plugs would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench. A site-specific crossing evaluation has been completed by Pacific Connector that specifies likely BMPs to be applied at each crossing (GeoEngineers 2013c). Prior to construction, a final evaluation, which would include Agency representatives, would be completed to determine crossing methods based on conditions at the time of construction. Site-specific restoration plans have been developed by the agencies for each of the eight perennial stream crossings that occur on BLM or NFS lands to ensure that the sites are restored to pre-crossing conditions.

Temperature

Vegetation clearing in the pipeline project corridor potentially affects stream temperature where removal of vegetation increases stream exposure to solar radiation. There are five perennial stream crossings on NFS lands and two on BLM lands where corridor construction potentially could remove shading vegetation. To evaluate whether corridor construction would increase water temperatures, a site-specific field evaluation of stream temperature impacts on the five perennial stream crossings on NFS lands was conducted (NSR 2015b). The evaluation showed that with mitigation measures, any temperature increases would be less than 0.2°C and limited to the point of maximum impact. No impacts were predicted at the stream network scale because of the small volume of affected streams, likely groundwater inputs, and the assimilative capacity of the stream network. On-the-ground conditions and water temperature model results suggest that it is unlikely the stream temperature downstream of any of the perennial crossings would be increased above the ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) (NSR 2009:41-42, Table 6.1.1). BLM personnel conducted a field review of perennial stream crossings on BLM lands and determined that increases in stream temperature were unlikely to occur as a result of construction (appendix J, section 1.3.1.3; see also individual watershed discussions in this section).

Pacific Connector used predictive modeling on a representative cross-section of crossings along the Pacific Connector route, spanning the ecoregions, Hydrologic Unit Codes (HUCs), width classes, and aspect classes present from Coos Bay to Malin, Oregon, including stream crossings on BLM and NFS lands. Model results show a maximum predicted increase of 0.16°C over one 75-foot clearing. Thermal recovery analysis shows that temperatures return to ambient within a maximum distance of 25 feet downstream of the pipeline corridor, based on removal of existing riparian vegetation over a cleared right-of-way width of 75 feet. These findings are consistent with NSR (2009). Pacific Connector also assessed the cumulative impact of right-of-way clearing on stream temperatures. Given that mitigation for loss of effective shade would occur, and that predictive modeling using the Stream Segment Temperature Model (SSTEMP) shows that the local impacts would be small in magnitude and spatially limited, the cumulative effects of the pipeline project on the thermal regime in the Coos, Coquille, South Umpqua, Rogue, Klamath, and Lost River Basins are expected to be exceptionally minor and well below detection in the field (GeoEngineers 2013d: 26).

Temporary Construction Corridor

The construction corridor would be 75 to 95 feet wide, excluding TEWAs and UCSAs. Clearing of the construction corridor would remove vegetation; with both short-term and long-term effects. In the short term, disturbed areas within the right-of-way would be revegetated after pipeline installation. Where mid or late-seral vegetation is removed this would result in a long-term change in vegetative condition. The analysis discloses that the scale of this impact would be minor in each single watershed and, given the fire and flood disturbance history of southwest Oregon, well within the range of natural variability for the watersheds crossed. Approximately 125 acres[16] (table 4.1.3.5-1a) or approximately 0.06 percent of an estimated 189,000 acres of Riparian Reserves on BLM and NFS lands in watersheds crossed by the Project (table 4.1.3.5-2a, later in this section) would cleared in the construction corridor, hydrostatic test sites or TEWAs. Approximately 11 acres of UCSAs would be located within Riparian Reserves (table 4.1.3.5-1a). Riparian habitat in these uncleared storage areas may be modified, but existing canopy would not be removed. On all BLM and NFS lands, approximately 32 acres of Riparian Reserves within the construction clearing are LSOG forest. Of these, approximately 18 acres are coniferous forests, 6 acres are deciduous hardwood forests, and 9 acres are mixed hardwood and coniferous forests. The remaining affected Riparian Reserves consist of early seral (34 acres), mid-seral (34 acres), or non-forest vegetation (2 acres) (table 4.3.1.5-1b). There would be seven crossings of perennial fish-bearing streams where a total of 8 acres of LSOG would be within the clearing limits of the pipeline project (appendix J of this EIS).

Permanent Pipeline Easement

Pacific Connector would retain a 50-foot-wide operational permanent easement for the entire length of its pipeline. Within this 50-foot easement, a 30-foot-wide corridor centered on the pipeline would be maintained in an herbaceous state, and trees would be removed within 15 feet from the pipeline centerline. However, the remainder of the permanent easement would be fully restored with native vegetation, according to Pacific Connector's ECRP, including trees in forested areas. No service road would be established or maintained within this inspection corridor. LWD and boulders would be placed as needed within the permanent easement to minimize surface erosion, provide wildlife habitat, and discourage OHV use.

Hydrostatic Testing

Hydrostatic testing is the process used to pressure test the pipeline with water to identify potential leaks. Pacific Connector has prepared a *Draft Hydrostatic Testing Plan* that incorporates requirements from the BLM and Forest Service for discharge of water used in testing, erosion control measures at discharge sites, and prevention of aquatic pathogen transmission (*Draft Hydrostatic Testing Plan,* Appendix M of Pacific Connector's POD). Key points of this plan relative to the ACS include:

- None of the water sources are federally controlled. All water sources are controlled by municipalities, local water districts, Reclamation, or the State of Oregon. Pacific

[16] Acres of affected Riparian Reserves are based on the 2013 filed alignment in the application. Minor realignments noted above and changes in final engineering are expected to reduce to reduce affected Riparian Reserve acres by about 8 to 10 percent.

Connector would secure permits for water sources from the jurisdiction that controls the source site.

- All of the discharge sites have been reviewed in the field and approved by the BLM and Forest Service.
- Erosion control measures at discharge sites have been designed to allow the discharged water to soak into the ground without causing sediment transport to stream channels.
- No water would be discharged to streams or other waterbodies on BLM or NFS lands. Water that has soaked into the round may, however, indirectly reach stream channels as subsurface flows.
- Waters known to include aquatic pathogens would not be used for hydrostatic testing.
- All water from non-domestic sources would be treated with chlorine to prevent the transmission of aquatic pathogens. Chlorinated water would be discharged according to the ODEQ's May 19, 1997, Memorandum for Chlorinated Water Discharges (ODEQ 1997).

Use and Maintenance of Roads

Approximately 330 miles of existing BLM or NFS roads would be used during construction of the pipeline. Post-project monitoring and maintenance would use a much smaller subset of these roads and is expected to be no more than light truck traffic. Pacific Connector prepared a TMP for federal lands as Appendix Y of its POD. Road use standards and guidelines (Forest Service) and management direction (BLM) applicable to the ACS have been incorporated into the TMP (appendix J, section 1.2.2). Any necessary reconstruction such as surfacing, culvert upgrades, running surface widening, or curve widening are also identified, with specifications, in the TMP. The pipeline project is consistent with requirements in BLM and Forest Service LMPs for use of roads.

Compliance with Standards and Guidelines

Standards and guidelines regulate or prohibit activities to ensure that objectives of land management plans would be achieved. Compliance with standards and guidelines for activities in Riparian Reserves is an important part of ensuring that the objectives of the ACS would be achieved. The preliminary analysis discloses that the Pacific Connector pipeline would be consistent with the requirements of the NWFP for activities in Riparian Reserves. As required by the Standard and Guideline for Lands, LH-4, requirements necessary to accomplish the objectives of the ACS would be incorporated into the Right-of-Way Grant if issued by the BLM.

These requirements include:

- seasonal restrictions on operations to the ODFW in-stream work window on all perennial streams;
- use of temporary bridges at stream crossings to prevent bank and bottom disturbance;
- use of dry dam-and-pump methods that isolate the stream from the crossing site to minimize sediment produced at perennial streams;
- installation of water bars as needed to divert water off of slopes;
- maintenance of effective ground cover according to agency standards until revegetation is completed;
- installation and maintenance of sediment barriers until permanent effective ground and revegetation is completed;

- monitoring after storm events to ensure that erosion control measures and sediment barriers are functioning;
- revegetation of Riparian Reserves and upland areas with native vegetation specified by the BLM and Forest Service;
- soil remediation that includes decompacting compacted soils and the use of biosolids or other organic supplements as needed to accelerate revegetation; and
- scattering LWD and slash in amounts specified by the BLM and Forest Service across the right of way to provide ground cover and maintain long-term site productivity.

Standard and Guideline WR-3 in the NWFP (Forest Service and BLM 1994b) stipulates that mitigation measures not be used as substitutes for preventing habitat degradation. Standard and Guideline WR-3 does not mean that mitigation measures cannot be used to offset otherwise unavoidable impacts of a project.[17] The BLM and Forest Service interpret WR-3 to mean that mitigation measures are not to be used as a substitute for appropriate design standards, to allow an inappropriate standard of environmental compliance, or to justify a project. Appropriate design measures and application of BMPs for water quality have been incorporated throughout the ECRP and other PODs. Mitigation measures are not being used as substitutes for preventing habitat degradation, to allow inappropriate environmental standards to be used, or to justify the project.

The Pacific Connector proposal would not be compliant with underlying and more restrictive standards and guidelines in the Umpqua, Rogue River, and Winema National Forests' LRMPs that apply to riparian areas. Although BMPs and appropriate design standards have been applied, these are otherwise unavoidable effects due to the limitations of routing and the linear nature of the pipeline project. These standards and guidelines are not specific to the ACS; however, the analysis must show that implementation of these amendments would not prevent attainment of ACS objectives. Site-specific amendments of these aquatic-related standards and guidelines are proposed to make provision for the Project:

- Rogue River National Forest, RRNF-5: Proposed site-specific amendment to allow utility transmission corridors in Management Strategy 26, Restricted Riparian Areas.
- Umpqua National Forest, UNF-1: Proposed site-specific amendment to allow removal of effective shade on perennial streams.
- Umpqua National Forest, UNF-2: Proposed site-specific amendment to allow utility corridors to parallel riparian areas.
- Winema National Forest, WNF-5: Proposed site-specific amendment to waive limitations on detrimental soil conditions within Riparian Areas (Management Area 8).

These amendments are discussed in the sections of this chapter that are applicable to the watershed where they occur.

Table 4.1.3.5-2a summarizes ownership and land allocations by agency for each of the watersheds where the Pacific Connector pipeline crosses federal lands. This provides the environmental baseline from which to measure how the pipeline project would affect lands within each of the listed land allocations by watershed.

---

[17] See CEQ Regulation 40 CFR 1508.14(f) which directs agencies to include appropriate mitigation measures, and 1502.16(h) which directs agencies to identify means to mitigate adverse environmental impacts.

TABLE 4.1.3.5-2a

BLM and Forest Service Land Allocations in Watersheds Crossed by the Pacific Connector Pipeline Project

		Land Ownership (acres)				Federal Land Allocation (acres)						
						LSR		Matrix		Riparian Reserves		
Watershed	**Watershed Total (acres)**	**BLM**	**NFS**	**Total BLM and NFS**	**Other**	**BLM**	**NFS**	**BLM**	**NFS**	**BLM**	**NFS**	**Total**
South Coast Basin												
Coos Bay Frontal	151,611	5,408	4,914	10,322	141,289	0	0	5,408	4,914	2,056	2,555	4,611
Coquille	111,644	2,737	0	2,737	108,907	0	0	2,737	0	1,094	0	1,094
NF Coquille River	98,407	36,854	0	36,854	61,553	16,268	0	20,585	0	19,275	0	19,275
EF Coquille River	85,963	45,540	0	45,540	40,424	24,066	0	21,474	0	25,097	0	25,097
MF Coquille River	197,314	59,286	1,545	60,831	136,483	16,386	0	42,901	0	23,715	618	24,333
South Coast Basin Total	**644,940**	**149,825**	**6,459**	**156,284**	**488,656**	**56,720**	**0**	**93,105**	**4,914**	**71,236**	**3,173**	**74,410**
South Umpqua River Sub-Basin												
Olalla - Lookingglass	103,212	27,373	0	27,373	75,839	12,642	0	14,731	0	8,755	0	8,755
Clark Branch S. Ump.	59,577	7,483	0	7,483	52,094	0	0	7,483	0	2,698	0	2,698
Myrtle Creek	76,250	31,111	133	31,244	45,006	0	0	31,111	133	12,748	54	12,803
Days Creek S. Ump.	141,569	57,997	2,807	60,804	80,765	24,193	2,417	33,804	390	21,852	142	21,994
Elk Creek S. Ump.	54,356	370	34,187	34,558	19,798	68	14,271	303	19,916	137	12,641	12,778
Upper Cow Creek	47,499	9,866	24,151	34,017	13,482	8,672	2,350	1,194	21,801	4,831	11,827	16,658
South Umpqua River Sub-Basin Total	**482,464**	**134,201**	**61,279**	**195,479**	**286,984**	**45,575**	**19,039**	**88,626**	**42,240**	**51,021**	**24,665**	**75,686**
Upper Rogue River Sub-Basin												
Trail Creek	35,338	14,701	4,353	19,055	16,283	3	0	14,699	4,353	3,232	957	4,189
Shady Cove Rogue River	74,268	22,439	0	22,439	51,828	5	0	22,434	0	6,941	0	6,941
Big Butte Creek	158,243	29,520	58,181	87,701	70,541	0	1,636	29,520	56,545	4,959	8,334	13,293
Little Butte Creek	238,879	54,843	59,900	114,743	124,135	0	52,813	54,843	7,088	5,155	5,631	10,786
Upper Rogue River Sub-Basin Total	**506,727**	**121,504**	**122,435**	**243,938**	**262,788**	**8**	**54,449**	**121,496**	**67,986**	**20,287**	**14,922**	**35,209**
Upper Klamath Sub-Basin												
Spencer Creek	**54,247**	**8,751**	**22,323**	**31,074**	**23,172**	**0**	**5,319**	**8,751**	**17,004**	**210**	**535**	**745**
Total All Watersheds												
Total All Watersheds	**1,688,377**	**414,281**	**212,495**	**626,775**	**1,061,600**	**102,303**	**78,807**	**311,978**	**132,144**	**142,754**	**43,295**	**186,050**

Note: Acres rounded to nearest whole acre. Rows/columns may not sum correctly.

Mitigation Measures

Off-site mitigation measures that are a part of the proposed action (see table 2.1.4.3-1) would help ensure that watershed function would be maintained or restored during construction and operation of the pipeline project as required by the ACS. These measures are considered in the section of this chapter that describes individual watershed conditions, and in detail in appendix J of this EIS.

Off-site mitigation actions that contribute to the objectives of the ACS include:

- Approximately 85.2 miles of road decommissioning, of which approximately 14 miles are in Riparian Reserves. Decommissioning roads can substantially reduce sediment delivery to streams (Madej 2000; Keppeler et al. 2007). Proposed road decommissioning would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the pipeline project occur. This mitigation is responsive to ACS objectives 2, 3, 4, and 5 and Standards and Guidelines for Key Watersheds (Forest Service and BLM 1994b).
- Approximately 60.9 miles of road resurfacing and drainage improvement. Road surfacing reduces sediment by capping existing fine textured sediments in the running surface of a gravel road with coarser rock or by paving. Paving all but eliminates traffic-generated sediments. Drainage repair reestablishes out-sloping, cross-drains and in some cases ditchlines to ditch-relief culverts. These actions have the effect of getting water off the road before it can enter streamcourses. This mitigation is responsive to ACS objectives 2, 3, 4, and 5 and Standards and Guidelines for Key Watersheds (Forest Service and BLM 1994b).
- Approximately 12.8 miles of road stormproofing to reduce the risk of road failures during storms. Drainage repair reestablishes out-sloping, cross-drains and in some cases ditchlines to ditch-relief culverts. These actions have the effect of getting water off the road before it can enter streamcourses and reducing the risk of road failure. This mitigation is responsive to ACS objectives 2, 3, 4, and 5 and Standards and Guidelines for Key Watersheds (BLM and Forest Service 1994b).
- Approximately 30 miles of instream LWD projects. Placement of LWD in streams adds structural complexity to aquatic systems by creating pools and riffles and trapping fine sediments, and can contribute to reductions in stream temperatures over time (Tippery et al. 2010). This is responsive to ACS objectives 2, 3, 4, and 5 (Forest Service and BLM 1994b).
- Fourteen fish passage culverts. Old culverts may block fish passage either by poor design or by failure over time. Removing these blockages and replacing them with fish-friendly designs can allow fish and other aquatic organisms to access previously unavailable habitat. This is responsive to ACS objectives 1, 2, 3, and 9 (Forest Service and BLM 1994b).
- Approximately 0.5 mile of riparian planting. Riparian planting reestablishes willows and other riparian vegetation in areas where prior land use has removed existing vegetation. Riparian plantings reestablish shade, increase bank stability and, over time, contribute to restored riparian plan plant communities.

- Approximately 6.4 miles of fencing. Fencing restricts cattle grazing in sensitive riparian ecosystems. This allows riparian vegetation to be reestablished and eliminates hoof damage to stream banks.
- Approximately 6,560 acres of fuels reduction and stand density management and 2,000 acres of underburning to reduce fuels. This action may be revised depending on the final scale and follow-up assessment of the 2015 Stouts Fires that began in August 2015. High intensity stand replacement fires may adversely affect riparian values. Reducing fuel loading and stand density can reduce the risk of high intensity fires in areas where the treatments occur, and slow the spread of fires. Stand density reductions in riparian zones have the dual benefit of reducing the risk of stand-replacing fire, while also accelerating the development of late-successional stand conditions by accelerating growth of remaining trees. This is responsive to ACS objectives 8 and 9.
- Reallocation of approximately 1,800 aces from the Matrix land allocation to the LSR land allocation. Managing lands for LSR objectives generally benefits aquatic resources. This measure is responsive to all nine ACS objectives.

Determining Consistency with the ACS at Multiple Scales

The ACS does not prohibit project-level impacts so long as the effects of the action do not retard or prevent attainment of ACS objectives (Forest Service and BLM 1994b: B-9). Project impacts that result in minor and short-term degradation of the aquatic habitat do not necessarily constitute noncompliance with the ACS. Where impacts do occur, the analysis must show they are within the range of natural variability for the watershed where they occur or that the action would move the key processes that influence Riparian Reserves toward the range of natural variability (Reeves 1996). Under the ACS, a project cannot have a long-term negative effect on riparian-dependent resources (Forest Service and BLM 1994c: 3&4 68-69). For example, short-term "pulse" disturbances that result in the deposition of sediment in amounts and texture that mimic natural events may fall within the range of natural variability for a watershed, and would likely not prevent attainment of ACS objectives. Conversely, actions that result in the long-term chronic deposition of fine sediments that do not fall within the range of natural variability in a given watershed probably would not be consistent with the ACS. In all cases, agency decision makers must use the scale, duration, and intensity of impacts and professional judgment to determine whether an action prevents attainment of ACS objectives.

As described in appendix J of this EIS, the ACS assessment prepared for this pipeline project by the BLM and Forest Service defined spatial scales as follows:

- The "site" in the context of this ACS assessment varies in size depending on impacts. It encompasses the Project footprint and areas of potential direct or indirect impacts adjacent to the Project location. The "site" is variable and is intended to reflect the ecological function and variable nature of riparian areas. The "site" may encompass areas outside of Riparian Reserves.
- The "subwatershed" is the sixth-field HUC scale as defined by the U.S. Geological Survey (USGS).
- The "watershed" is the fifth-field HUC scale as defined by the USGS.

- The "basin" is an aggregation of fifth-field watersheds into one logical drainage (i.e., the Umpqua basin), typically at the fourth-field HUC scale. In the Coast Range Province, it may include small drainages that are not part of a larger river system but have common beneficial use and resource concerns.
- The "province" refers to the physiographic (also called aquatic) provinces established in the Report of the Forest Ecosystem Management Assessment Team (FEMAT; Forest Service et al. 1993). These are areas of similar geologic and general climatic conditions.
- "Riparian Reserves" are land allocations in BLM and Forest Service land management plans where special standards and guidelines apply. Riparian Reserves adjacent to fish-bearing streams are two site-potential tree heights wide (on each side of the stream). Riparian Reserves on wetlands and other waterbodies, including intermittent streams, extend one site potential tree height from the edge of the waterbody.
- In this ACS assessment, temporal and spatial scales and the intensity of impacts are defined as follows:
  - Short-term impacts are generally limited to the season(s) of construction.
  - Long-term impacts are those that would persist beyond the season(s) of construction.
  - Minor impacts are defined as impacts that are confined to the general construction site. They either are "short-term" impacts or longer term impacts that are within the range of natural variability at the scale where the impact occurs and that would not prevent attainment of ACS objectives.
- Impacts that are not "minor" are those that that are outside the range of natural variability and would prevent attainment of ACS objectives.

The consistency of the Pacific Connector pipeline with the ACS as defined by the NWPF (Forest Service and BLM 1994b) and subsequent policy interpretations (Goodman et al. 2007) is demonstrated by:

- Using watershed assessments to describe watershed conditions and ranges of natural variability for key physical and biological processes for each fifth-field watershed that would be crossed by the pipeline project.
- Evaluating direct, indirect, and cumulative impacts at the site and watershed scale against the nine ACS objectives for each fifth-field watershed.
- Compliance with applicable agency management direction (i.e., NWFP Standards and Guidelines [appendix J, table 2.2-1]).
- Showing that the environmental consequences of agency decisions regarding proposed land management plan amendments do not prevent attainment of ACS objectives (see appendix J, table 1.2.3-1).
- REO review of any proposed amendments of NWFP standards and guidelines that have been incorporated into land management plans that would reduce protections for aquatic resources. The purpose of this review is to determine if the objectives of standards and guidelines for the ACS would be significantly adversely affected by the proposed amendment(s) (appendix J, table 1.2.3-1).

- A finding by the agency decision makers in the ROD, based on evidence and facts presented in the project EIS and its appendices, that the action taken by the BLM and Forest Service (see appendix J, section 1.2.3.) would not prevent attainment of the ACS objectives at the appropriate scales.

Regional Context of the ACS

The ACS is applied at multiple scales. In order to provide a logical framework for assessment, the report of the FEMAT that underlies the NWFP established physiographic provinces (Forest Service et al. 1993). Physiographic provinces (also referred to as "provinces" or "aquatic provinces") incorporate physical, biological, and environmental factors that shape broad-scale landscapes. Physiographic provinces reflect differences in geology (e.g., uplift rates, recent volcanism, and tectonic disruption) and climate (e.g., precipitation, temperature, and glaciation). These factors result in broad-scale differences in soil development and natural plant communities. Within each province, variable characteristics of rock stability affect the steepness of local slopes, soil texture, soil thickness, drainage patterns, and erosional processes. Thus, physiographic provinces have utility in the description of both terrestrial and aquatic ecosystems (Forest Service et al. 1993).

Within provinces, vegetation types, land-use practices, and responses to disturbance are typically similar. The pipeline project would cross the Coast Range, Klamath-Siskiyou, Western Cascades, and High Cascades provinces (see appendix J, figure 1-1). In the following sections, each of these four provinces is described in terms of climate, geology, soils, vegetation, and the fifth-field watersheds within each of them (appendix J, figure 2.1-1).

Key Watersheds

The NWFP identifies "key" watersheds that have regional significance for the protection of water quality and aquatic habitat. Tier 1 Key Watersheds are intended to benefit at-risk fish species and stocks by providing refugia for maintaining and recovering habitat. Tier 2 Key Watersheds provide high-quality water. Key Watersheds include areas of both high quality and degraded habitat. Key watersheds with high-quality habitat serve as anchors for the potential recovery of depressed stocks. Those of lower quality habitat have a high potential for restoration and would become areas of high-quality habitat if appropriate restoration measures are implemented. The NWFP designates Key Watersheds as the highest priority for restoration. Table 4.1.3.5-2b identifies Key Watersheds that would be crossed by the pipeline project right-of-way.

Specific effects of the Pacific Connector Pipeline Project in Key Watersheds are addressed in the watershed descriptions in this section.

TABLE 4.1.3.5-2b

Miles of Pacific Connector Pipeline Project Right-of-Way in Key Watersheds by Administrative Unit

Watershed	Coos Bay BLM Miles	Roseburg BLM Miles	Medford BLM Miles	Lakeview BLM Miles	Total BLM Miles	Umpqua NF Miles	Rogue River NF Miles	Winema NF Miles	Total NF Miles	Total BLM and NF Miles
Elk Cr.-South Umpqua	—	0.1	—	—	0.1	2.7	—	—	2.7	2.8
Days Cr. South Umpqua (Tier 1) (These fifth-field watersheds are both part of the South Umpqua Key Watershed)		6.7			6.7	1.6			1.6	8.2
North and South Forks Subwatersheds, Little Butte Cr. (Tier 1)	—	—	3.9	—	3.9	—	8.4	—	8.4	12.3
Spencer Cr. (Tier 1)	—	—	—	1.0	1.0	—	—	6.1	6.1	7.1
Clover Cr. Subwatershed, Spencer Cr.(Tier 2)	—	—	—	0.2	0.2	—	—	—	—	0.2
Total	**0.0**	**6.8**	**3.9**	**2**	**9**	**4.2**	**8.4**	**6.1**	**18.7**	**30.6**

Note: Miles rounded to nearest tenth of a mile. Rows/columns may not sum correctly.
Source: Resource Report 2, Table 2.2-4

Historical Disturbance Processes and Patterns in the Pacific Northwest

A critical aspect of the Pacific Northwest riverine and riparian environment is the widespread occurrence of steep, unstable hillslopes that result in active erosional environments. Recent geologic uplift, weathered rocks and soil, and heavy rainfall all contribute to high landslide frequency and to high sediment loads in many of the region's rivers. Hillslope steepness is one of the simplest indicators of areas prone to mass wasting (e.g., rapid mass movements of soil and organic material down hillslopes and stream channels). The response of these steep hillslopes to disturbance processes shaped the evolution of the aquatic environments in the region.

In the Pacific Northwest, fire historically was the dominant watershed disturbance process (Everest and Reeves 2007). Synergy between fire and subsequent intense rainstorms and flood events may be the sequence of disturbances with the greatest effect on riparian ecosystems in the Pacific Northwest (Benda et al. 1998 cited in Everest and Reeves 2007). Wildfires temporarily increase the supply of water and sediment to fluvial systems (Malmon et al. 2007). Runoff-initiated surface erosion events tend to peak during the first year after a forest fire. These effects are highly variable but are typically short-lived (two to four years) due to vegetative recovery (Legleiter et al. 2003). During that period, affected drainages may produce visibly turbid water during each heavy storm or snowmelt event. Landslides, however may occur several years after a severe fire (Wondzell and King 2003). The lag is largely due to the relatively slow decay of roots of fire-killed trees and shrubs. Once these anchors are lost, the soil is more likely to slough from steep slopes when saturated with rainfall or snowmelt.

Mass wasting (i.e., debris torrents, landslides and movement of unstable earthflow terrains) following a fire can transport tremendous amounts of sediment and wood debris to stream channels. Reeves (cited in the Catching-Beaver Watershed Assessment [BLM 2010]) observed that mass wasting following fire can deposit so much material that 2 or 3 meters of accumulated sediment and coarse debris can still remain in the channel 100 years after the deposition event. The accelerated erosion associated with intense fire combined with normal background levels may cause a fivefold increase in sediment yield, and the recovery to pre-fire sediment yields may take

20 to 30 years (Swanson 1981, cited in the Catching Beaver WA [BLM 2010]). Many terrace-like features next to mountain streams in the Pacific Northwest are relic depositions of material transported by debris avalanches that were subsequently cut through by streams. Small, third- to fifth-order forested streams are in close proximity to sediment sources (adjacent hillslopes and channel banks). LWD and boulders form persistent structures that trap significant volumes of sediment in these channels, reducing sediment transport in the short term and substantially increasing channel stability. External sediment inputs such as mass wasting and bank collapse, along with wood accumulation, tend to dominate the channel morphology of smaller streams (e.g., Big Creek on BLM lands or the East Fork Cow Creek on NFS lands), while larger streams are primarily influenced by downstream fluvial sediment transport and bank erosion (e.g., Middle Creek on BLM lands). Bed material transport occurs under relatively high flow conditions for a very short period of time. Since major erosional events are almost always associated with excessive amounts of precipitation, their occurrence depends on these storms occurring during periods of increased susceptibility to surface erosion and mass wasting following intense wildfire (Wondzell and King 2003). Average bankfull discharge recurrence in western Oregon has an interval of 1.1 to 1.2 years, while eastern Oregon has intervals of 1.4 to 1.5 years; thus in any given year, there is a reasonable assurance that a bankfull event could occur (Castro 1997).

The impacts of these disturbance pulses can range from increases in sediment transport in streams to mass wasting events that affect riparian stands at the site to subwatershed scale and deposit large amounts of sediment and LWD in and adjacent to stream channels. Historically, these "pulse" disturbances of sediment occurred infrequently at any given site or subwatershed and affected a relatively small part of the watershed at any one time, though at the watershed or regional scale, disturbance processes were (and are) a constant factor in Pacific Northwest landscapes. Pulse disturbances generally allow aquatic ecosystems to remain within their normal historical range of states and conditions since there is sufficient time between disturbances to enable ecosystems to recover to pre-disturbance conditions (Everest and Reeves 2007).

The large-scale ecological structures, functions, and processes that shaped Pacific Northwest watersheds have been substantially altered by anthropogenic factors. Fire suppression has altered the historical frequency and intensity of fire events in the Pacific Northwest. As result of fire suppression and timber harvest, there has been a general shift in vegetation patterns, structures, and ecological processes from relatively larger patches of late-successional and old-growth forest with frequent low-intensity fires to more fragmented landscapes that are dominated by early and mid-seral plant communities. Large, high-intensity fires do occur (e.g., the Biscuit Fire in 2002), possibly with increasing frequency and intensity. In the past, forest practices (timber harvest) in the Pacific Northwest increased the occurrence of mass wasting events and the magnitude of sediment yield to the aquatic environment. Road-related mass wasting is a major source of sediment (Hassan et al. 2005). Land use patterns and, in particular, forest roads have altered the sediment regimes in many stream networks, replacing episodic pulses of coarse sediments with chronic transport and deposition of fine sediments.

<u>Oregon Coast Range Province, MP 1-47</u>

After leaving Coos Bay, the Pacific Connector pipeline corridor would traverse the southernmost part of the Coast Range Province for approximately 47 miles (appendix J, figure 1-1). This province includes all lands in Oregon from the Coquille River basin north and the Pacific Ocean eastward to the crest of the Coast Range. The province is 30 to 60 miles wide and averages about

1,500 feet above MSL in elevation. The Coos Bay Frontal, Lower Coquille North, and the East and Middle Fork Coquille fifth-field watersheds are included in in the Coast Range Province.

Landform and Erosional Processes

The southern part of the Coast Range Province generally consists of steep slopes with narrow ridges developed on resistant sedimentary rocks. Westward-flowing streams erode headward to mountain passes on the east side of the Coast Range. Many of the higher peaks are composed of resistant igneous rocks. Steep, highly dissected slopes are subject to mass wasting (i.e., debris flows). Tributary channels join at relatively low angles, which allow debris flows to travel for long distances. Unstable landscapes (i.e., earthflows) may constrict or deflect stream channels, creating local low-gradient depositional stream reaches upstream.

The Coast Range is composed primarily of soft marine sedimentary rocks overlying basalt at depth. Combined with the wet climate of the western slopes of the Coast Range and the typically steep terrain, these non-resistant rocks produce an active erosional environment with frequent landslides. Natural disturbance regimes in this province tend to be highly episodic, with large pulses of sediment delivery associated with high-intensity fire, flooding, and wind events, followed by a recovery period with low-level chronic sediment delivery extending over decades (BLM 2010:26). Debris torrents generally begin in first- and second-order streams and come to rest in lower third-order and upper fourth-order draws.

Erosional processes the Coast Range province are dominated by mass wasting associated high-intensity rainfall events. Erosional processes are accelerated where these rainfall events overlap with large, stand-replacing fires. Precipitation gradients decrease from west to east, so landslide frequency decreases with decreased precipitation. Historic land uses such as splash dams for log drives and hydraulic mining during the 19th century dramatically altered landscapes and downstream channels where this activity occurred.

Climate

The mountainous areas on the western slope of the Coast Range receive some of the highest precipitation totals in the continental U.S., with some areas receiving up to 200 inches per year. The Oregon Coast near Coos Bay is typically cool and foggy, with annual precipitation (rainfall equivalent) of about 65 inches. Almost all of the low elevation precipitation falls as rain. As elevation increases, the amount of precipitation that falls as snow increases. Rain typically falls from October to June, though trace amounts as well as coastal fog help keep the vegetation green throughout the summer. Periodic high-intensity storms may drop several inches of rainfall in a few hours causing “peak flow” events that are primary drivers of natural disturbance and watershed conditions, particularly in Riparian Reserves. Summer thunderstorms, though rare, can also result in localized high-intensity rainfall events.

Vegetation

The Coast Range Province is dominated by forests of Douglas-fir, western hemlock, and western red cedar. Vegetative recovery after disturbance is very rapid. Salmonberry and other brush species rapidly occupy disturbed sites. The southern half of the province includes a mixture of private, BLM, and NFS lands. The northern half is largely in private and state ownership. Logging and several extensive wildfires during the last century have changed most of the LSOG forest in the northern end of the province to early and mid-seral forest. Older forests in the southern half of the province are highly fragmented, especially on BLM lands, which are typically intermixed with private lands in a checkerboard pattern of alternating square-mile sections.

Klamath-Siskiyou Province MP 47–105, 118–153

The Klamath-Siskiyou Province encompasses the Klamath and Siskiyou Mountains and lies between the Coast Range and the Cascades, south of the Willamette Valley. The Project would traverse the northeast corner of the Klamath-Siskiyou Province for approximately 93 miles (appendix J, figure 1-1). It includes parts of the Umpqua and Rogue River National Forests, and the Roseburg and Medford Districts of the BLM. This landscape is typified by deeply dissected valleys and jutting ridges and foothills. Much of this province lies within a rain shadow sheltered from the Pacific maritime influences by the mountains of the Coast Range. The region has a rugged landscape, with high peaks and deep canyons. Elevations range from about 1,000 to 7,000 feet above MSL. Portions of the Middle Fork Coquille River, Olalla-Lookingglass, Myrtle Creek, Clark's Branch-South Umpqua, Elk Creek–South Umpqua, Upper Cow Creek, Trail Creek, Shady Cove Rogue River, Big Butte, and Little Butte Creek fifth-field watersheds are in the Klamath-Siskiyou Province.

Landform and Erosional Processes

The Klamath-Siskiyou Province is rugged and deeply dissected. Tributary streams generally follow the northeast-southwest orientation of rock structure created by accretion of rocks onto the continent. Variable materials juxtapose steep slopes subject to debris flows and gentle slopes subject to earthflows. Scattered granitic rocks are subject to debris flows and severe surface erosion. High rates of uplift have created steep streamside hillslopes known as inner gorges, especially near the coast. The Klamath-Siskiyou Province is known for its highly complex geology. Most of the area is composed of highly deformed volcanic and marine sedimentary rocks with some metamorphic terranes. Also included are deformed pieces of oceanic crust and granitic intrusive bodies. Bedrock is often intensely metamorphosed and fractured. Well-developed floodplains and terraces near major rivers give way to highly dissected mountains with high-gradient streams. Many streams in this province flow only intermittently because of high gradients and low summer precipitation.

Erosional processes in the Klamath-Siskiyou Province are dominated by mass wasting associated high-intensity rainfall events. Erosional processes are accelerated where these rainfall events overlap with large, stand-replacing fires. Precipitation gradients decrease from west to east, so landslide frequency decreases with decreased precipitation. Hydraulic mining during the 19th century dramatically altered landscapes and downstream channels where this activity occurred.

Climate

The valleys and foothills of the Klamath-Siskiyou Province experience a Mediterranean-type climate, while higher elevations demonstrate more montane impacts. Precipitation in the lowlands ranges from 25 to 50 inches a year, while higher elevations may receive up to 130 inches per year. Areas outside the Coast Range rain shadow receive considerably more precipitation. Most precipitation falls as rain and snow during the winter, though summer thunderstorms may produce measureable amounts.

Vegetation

This area is dominated by mixed-conifer and mixed-conifer/hardwood forests. Land ownerships include a mixture of BLM, NFS, private, and state lands. Forests are highly fragmented by natural factors (e.g., poor soils, dry climate, and wildfires) and human-induced factors (e.g., harvest and roads). Much of the historical harvest in this area has been selective cutting rather than clearcutting. As a result, many stands that were logged in the early 1900s include a mixture of old trees left after harvest and younger trees that regenerated after harvest. Much of the area within the Province is characterized by high fire frequencies. Any plan to protect LSOG forests in these areas must include careful consideration of fire management.

Western Cascades Province MP 105-113

Approximately 13 miles of the pipeline corridor cross the north-south trending Western Cascades Province (appendix J, figure 1-1). This province, which drains westward to the Pacific Ocean, reaches elevations of 4,400 feet above MSL in watersheds crossed by the Pacific Connector Pipeline Project. Portions of the Upper Cow Creek and Trail Creek fifth-field watersheds are in the Western Cascades Province.

Landform and Erosional Processes

The landforms in the Western Cascades Province are distinguished from the High Cascades by older volcanic activity and longer glacial history. Ridge crests at generally similar elevations are separated by steep, deeply dissected valleys. Complex volcanoclastic formations juxtapose relatively stable volcanic deposits that weather to thick soils and are subject to earthflows. Unconsolidated alluvial and glacial deposits are subject to streambank erosion and landslides. Tributary channels flow at large angles into wide, glaciated valleys. Stream gradients are typically moderate to high (2 to 30 percent).

Climate

Lowland areas may receive as little as 60 inches of precipitation per year, while higher elevations may receive up to 120 inches annually. Much of the precipitation that falls above 4,000 feet above msl is snow. Average January temperatures range from 26 to 41°F while average July temperatures range from 44 to 78°F.

Vegetation

Forests of this province consist primarily of Douglas-fir and western hemlock at lower to middle elevations. Land ownerships include a mixture of private and state lands, federal lands, and tribal lands. The BLM and Forest Service administer extensive areas of federal lands in this Province. Private and state lands within this area are managed intensively for timber production under the forest practice and water quality laws of the State of Oregon and are primarily early and mid-seral forests whereas federally administered lands still include significant areas (albeit highly fragmented) of LSOG forest. Forests at the southern section of the province are largely replaced by mixed-conifer forests of Douglas-fir, grand fir, and incense-cedar. A large proportion of the known NSO population in Washington and Oregon occurs in the Western Cascades.

High Cascades Province MP 153-180

Approximately 23 miles of the Project corridor would be located in the High Cascades Province (appendix J, figure 1-1). This Province consists of one north-south trending mountain chain that drains both westward to the Pacific Ocean and eastward into Klamath and Columbia Basins (see appendix J, figure 1-1). The High Cascades Province reaches a peak elevation of 9,493 feet MSL at the summit of Mt. McLoughlin. Portions of the Little Butte Creek, Spencer Creek, and Mills Creek–Lost River fifth-field watersheds are in this province.

Landform and Erosional Processes

The province consists of volcanic landforms with varying degrees of historic glaciation. Lava flows form relatively stable plateaus, capped with pumice and ash deposits by the recent Cascade volcanoes. Drainages are generally not yet well developed or otherwise disperse into highly permeable volcanic deposits. Geologically recent volcanic pumice and ash deposits are subject to large debris flows when saturated by snowmelt. This province is composed primarily of approximately 3 million year old volcanic material, primarily andesite and basalt that were subsequently glaciated. Mountains in this province are moderately dissected. Headwater streams have medium to high gradients and are often associated with large meadow-spring complexes. Expansive pumice plateaus associated with the eruption of Mt. Mazama about 5,000 years ago (Dead Indian Plateau, Clover Creek) with droughty soils characterized by high snowmelt infiltration and low summer water retention fill valley floors adjacent to volcanic peaks.

Climate

The High Cascades Province is climatically diverse, with mild valleys, snowy mountains, and alpine conditions at the highest elevations. Precipitation ranges from 45 to 100 inches per year and is largely associated with orographic influences of the mountains in this province. In the lowlands, average January temperatures range from 30 to 45°F while average July temperatures range from 49 to 85°F. At higher elevations, average January temperatures range from 23 to 37°F while average July temperatures range from 44 to 74°F.

Vegetation

This province is dominated by mixed-conifer and ponderosa pine forests at mid- to lower elevations and by true fir forests at higher elevations. The higher elevations of the High Cascades Province support forests of silver fir and mountain hemlock. Some National Parks and wilderness areas within this province include significant areas of mid-elevation LSOG forest. Land ownership patterns include a mixture of NFS, private, state, Indian, and National Park Service lands; Wildlife Refuges managed by the FWS; and BLM land. Forests in this region are highly fragmented due to a variety of natural factors (e.g., poor soils, high fire frequencies, and high elevations) and human-induced factors (i.e., clearcutting and selective harvest). Before the advent of fire suppression in the early 1900s, wildfires played a major role in shaping the forests of this region. Intensive fire suppression efforts in the last 60 years have resulted in significant fuel accumulations in some areas and shifts in tree species composition and may have made forests more susceptible to large high-severity fires and to epidemic attacks of insects and diseases. Any plan to protect LSOG forests in this area must include considerable attention to fire management and to the resilience of forest stands.

Watersheds Crossed by the Pacific Connector Pipeline Project on BLM or NFS Lands Where the ACS Applies

Coos Bay Frontal Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-3 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Coos Bay Frontal watershed. The pipeline project would clip one Riparian Reserve and cross one intermittent stream in the Coos Bay Frontal watershed. Watershed conditions and recommendations are described in the Catching-Beaver Watershed Assessment (BLM 2010) and discussed in detail in appendix J of this EIS.

TABLE 4.1.3.5-3

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Coos Bay Frontal Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features. The pipeline project corridor would clear approximately 2.9 acres or about 0.14 percent of the Riparian Reserves in the Coos Bay Frontal watershed. The pipeline would be located on or near a ridgetop and would affect about 3 acres or about 0.06 percent of the BLM lands in the watershed (appendix J, tables 2.3.3.1-2, 2.3.3.1-3). The pipeline project would be adjacent to an existing powerline corridor or in second-growth timber. Impacts to aquatic systems are expected to be short term, minor, and well within the range of natural variability for the Coast Range because of application of Best Management Practices (BMPs), erosion control measures, and rapid revegetation. Approximately 18 percent of the watershed is currently late successional and old growth (LSOG) (BLM 2010:48). No LSOG would be removed by the Project corridor in the Coos Bay Frontal watershed (appendix J, table 2.3.3.1-4). BLM cannot restore diversity, complexity and landscape-scale features at the fifth-field scale because BLM manages less than 5 percent of the lands within the watershed.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project has one intermittent stream crossing in the Coos Bay Frontal watershed. The crossing would not affect spatial or temporal connectivity because the pipeline would be buried and the actual area of bank and stream bottom disturbance would be small (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and banks and stream bottoms restored to conditions similar to the pre-construction condition. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project has one intermittent stream crossing in the Coos Bay Frontal watershed. During construction, the actual area of bank and stream bottom disturbance would be small at each crossing (<15 feet wide). Long-term impacts on the bed and banks of these features would be minor and limited to the site of construction because the pipeline would be buried. After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the *Wetland and Waterbody Crossing Plan*. See appendix J, table 2.3.1.1-5 for specific measures. This level of disturbance is well within the historical and current range of natural variability for bank and channel stability in watersheds of the Coast Range Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	It is possible that there may be minor amounts of sediment mobilized during construction (see appendix J, section 1.3.2). No longer term impacts on water quality are expected from the pipeline project in the Catching Slough subwatershed or Coos Bay Frontal watershed because of application of BMPs during construction, implementation of the ECRP, and the ridgetop location of the pipeline.

TABLE 4.1.3.5-3

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Coos Bay Frontal Watershed

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Any sediment impacts from the pipeline project are expected to be minor and short-term and well within the range of natural variability for the Coast Range Province. The pipeline location, application of BMPs for water quality, restoration of bed and banks, LWD placement, aggressive erosion control, and the rapid natural revegetation capacity of the Coast-Range Province are expected to limit any potential sediment impacts.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project is not expected to have any effect on instream flows. The single stream crossing in this watershed is a first-order intermittent stream. It is unlikely that flow regimes could be altered because vegetation in the Catching Slough subwatershed is hydrologically recovered, the Project is located on or near a ridgetop, and the scale of the pipeline project in the Coos Bay Frontal subwatershed is limited (0.1 percent of BLM lands in the subwatershed).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project is not expected to have any impact on floodplain inundation or water table elevation because of its location and lack of connectivity to floodplains and wet meadows.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	The pipeline project impacts on riparian vegetation would be minor and limited to the site of construction. Most of the Riparian Reserve vegetation at this site is second-growth upland forest. Existing herbaceous and brush cover would be maintained to the extent practicable within the clearing limits. Large woody debris (LWD) and boulders would be restored to the disturbed areas after construction. Revegetation would be accomplished using native riparian species.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The pipeline project impacts on riparian vegetation would be minor and limited to the site of construction. Most of the Riparian Reserve vegetation is upland second-growth forest. Existing herbaceous and brush cover within the clearing limits would be maintained to the extent practicable. LWD and boulders would be restored to the disturbed areas after construction. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, Coos Bay Frontal Watershed

Given the location of the pipeline right-of-way on or near ridgetops on BLM lands and the relatively small area of the BLM lands in the Coos Bay Frontal watershed that would be affected by the pipeline project (3 acres or 0.06 percent of BLM lands watershed), it is highly improbable that actions related to the pipeline on BLM lands would affect watershed condition in the Coos Bay Frontal watershed or the Catching Slough subwatershed. Although there are possible project-related impacts in the form of sediment at one intermittent stream crossing, those would be minor and short term (see appendix J, table 2.3.1.3-1). Vegetative condition would change in the Riparian Reserve, but this is a minor impact at the project scale. No LSOG vegetation would be removed in Riparian Reserves. No pipeline project impacts relevant to the ACS have been identified that are outside of the range of natural variability for watersheds on BLM lands in the Coast Range Province.

Coquille River Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-4 compares the pipeline project impacts to the objectives of the ACS for the Coquille River watershed. The pipeline corridor would clip one Riparian Reserve near a ridgetop near the watershed boundary in Cunningham Creek, but would not intersect any stream

TABLE 4.1.3.5-4

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Coquille River Watershed

ACS Objective	**Project Impacts**
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are a landscape-scale feature. The pipeline corridor would affect approximately 1 acre or 0.11 percent of Riparian Reserves in the Coquille River watershed (appendix J table 2.3.4.1-3). This is well within the range of natural variability for changes in vegetative condition in the Coast Range Province. No stream channels are crossed in the watershed. The Coquille River watershed on BLM lands is approximately 39% late successional and old growth (LSOG).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project would not intersect any streams and would affect 0.11 percent of Riparian Reserves in the Coquille River watershed; therefore, discernible impacts on aquatic- and riparian-dependent species are unlikely.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would not affect streambanks or stream bottoms in the Coquille River watershed because the Project would not intersect stream channels.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	The pipeline project would not intersect any streams in the Coquille River watershed; therefore, it would have no impact on aquatic- and riparian-dependent species.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The pipeline project would not affect the sediment regime for aquatic species because of the limited scale of the pipeline project, application of best management practices and the requirements of the ECRP, and the lack of intersections with stream channels.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project would not affect instream flows because there are no stream intersections.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not affect floodplains and water table elevations in meadows because there would be no intersections with these features.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	The impacts of the pipeline project on riparian vegetation would be minor and limited to the site of construction. Most of the Riparian Reserve vegetation at this site is second-growth upland forest. Existing herbaceous and brush cover would be maintained to the extent practicable within the clearing limits. Large woody debris (LWD) would be placed back within the cleared area. No stream channels would be intersected.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The impacts of the pipeline project on riparian vegetation would be minor and limited to the site of construction. Most of the Riparian Reserve vegetation is upland second-growth forest. Existing herbaceous and brush cover within the clearing limits would be maintained to the extent practicable. LWD and boulders would be restored to the disturbed areas after construction. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by Project construction and operation in the watershed (see appendix K of this EIS).

channels in the Coquille River watershed. Approximately 1 acre or 0.11 percent of the Riparian Reserves in the watershed would be cleared. Watershed conditions and recommendations are described in the Middle Main Coquille, North Coquille Mouth, and Catching Creek Watershed Analysis (BLM 1997) and described in detail in appendix J of this EIS.

Summary, Coquille River Watershed

The Pacific Connector Pipeline Project does not cross any stream channels in the Coquille River Watershed on BLM-managed lands. One Riparian Reserve is minimally affected. Given the location of the pipeline corridor on BLM lands and the very small proportion of BLM Riparian Reserves affected by the Project (about 1 acre or 0.11 percent of Riparian Reserves in the watershed) and the relatively small area of BLM lands in the Coquille River watershed that would be affected by the pipeline project (about 1 acre or 0.05 percent BLM lands in the watershed), it is highly improbable that actions related to the pipeline on BLM lands would affect the watershed condition in the Coquille River watershed or the Cunningham Creek subwatershed. No pipeline project impacts relevant to the ACS have been identified that are outside of the range of natural variability for watersheds on BLM lands in the Coast Range Province.

North Fork Coquille River Watershed

Project Impacts by ACS Objectives

Table 4.1.3.5-5 compares the pipeline project impacts to the objectives of the ACS for the North Fork Coquille River watershed. The pipeline corridor crosses three intermittent channels and one perennial stream channel and three forested wetlands. Two corridor-channel intersects of intermittent streams occur in the Hudson Creek subwatershed. The other two corridor-channel intersects are approximately 7 miles away in the Middle Creek subwatershed so the potential for synergistic downstream sediment accumulation from crossings on BLM lands and related impacts to aquatic and riparian resources is very low. The majority of Riparian Reserves clipped are in the Hudson Creek subwatershed and the Middle Creek subwatershed. Approximately 17 acres of Riparian Reserves (0.09 percent of the Riparian Reserves in the watershed) would be cleared in the pipeline project right-of-way. About 9 acres of Riparian Reserve effects are associated with channel crossings; the remaining 7 acres of Riparian Reserve effects are associated with Riparian Reserves that would be clipped, but do not involve a stream crossing (appendix J, tables 2.3.5.1-1 through -4). Watershed conditions and recommendations are described in the North Fork Coquille Watershed Analysis (BLM 2002a) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-5

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, North Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that would be affected by the pipeline project corridor. The corridor is located primarily in early or mid-seral forests (appendix J, table 2.3.5.1-4) adjacent to an existing utility corridor and road and largely on or near ridgetops to minimize impacts on aquatic habitats. The Project corridor would affect 41 acres of BLM lands or about 0.11 percent of the North Fork Coquille River watershed and about 17 acres or 0.09 percent of the Riparian Reserves within the watershed (appendix J, table 2.3.5.1-3). Most of the habitats crossed by the corridor are already disturbed from past management practices. Impacts to aquatic systems are expected to be short-term and minor because of application of best management practices (BMPs) and erosion control measures and anticipated rapid revegetation of disturbed areas. Impacts of the Project are expected to be within the range of natural variability for natural disturbance processes in the Coast Range Province. BLM lands in the North Fork Coquille watershed are approximately 45 percent late successional and old growth (LSOG).

TABLE 4.1.3.5-5

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, North Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the North Fork Coquille River watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the POD (i.e., *Wetland and Waterbody Crossing Plan*). At each crossing, bed and bank disturbances would be small (<15 feet wide). After construction, key habitat components such as large woody debris (LWD) and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project corridor would cross three intermittent streams and one perennial fish-bearing stream in the North Fork Coquille River watershed. During construction, the actual area of bank and stream bottom disturbance at each crossing would be is small (<15 feet wide). Impacts on the bed and banks of these features would be minor and limited to the site of construction because the pipeline would be buried. During construction of the Middle Creek crossing, steep streambanks will be laid back to a stable configuration. After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions where appropriate, consistent with the POD requirements. A site-specific crossing plan is in preparation to ensure accomplishment of these objectives. See appendix J, section 2.3.5 for specific measures. This level of disturbance is well within the historical and current range of natural variability for bank and channel stability in watersheds of the Coast Range Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction, particularly during the crossing of Middle Creek, a perennial stream with silty sand banks and stream bottom. These impacts are expected to be short term and limited to the general area of construction. No long-term impacts on water quality are expected because of application of the ECRP, including maintenance of effective ground cover (see appendix J, section 1.3.1.2) and BMPs during construction. A small amount of shading vegetation would be removed where the corridor crosses Middle Creek, which is already listed under Section 303(d) of the Clean Water Act for temperature due to sparse riparian cover along much of its length (see appendix J, figure 2.3-5). No change in water temperature is expected because shading appears to have much less effect on water temperature on the downstream reaches of perennial streams (Brown 1970, cited in North Fork Coquille River watershed assessment, page. 7-12), possibly due to the higher volume of flow in these lower reaches.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing. Dry open-cut methods would be used to cross stream channels (see appendix J, section 1.3.2.1). Any sediment impacts are expected to be minor and short-term (e.g., first wet season) and well within the range of natural variability for the Coast Range Province due to implementation of the ECRP, including BMPs for water quality, restoration of bank and bottom configurations, LWD placement, and erosion control along with the anticipated rapid revegetation characteristic of the Coast Range Province. Road repairs would also help reduce sediment levels in the watershed and move the sediment regime toward the desired condition.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	On streams with flowing water at the time of crossing, the dam-and-pump method (described in section 1.3.1) would be used to maintain flows in the channel downstream of the crossing. No alterations of flows resulting from construction beyond the short-term, site-scale level are anticipated. The pipeline corridor would occupy about 0.10 percent of the North Fork Coquille River watershed. It is highly unlikely that any impacts in this small part of the watershed could affect the timing, magnitude, and duration of peak flows in the watershed, especially in light of other past and ongoing human activities.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project corridor crosses two forested wetlands in the Hudson Creek subwatershed and one forested wetland in the Middle Creek subwatershed, together affecting a total of 4 acre of Riparian Reserve. Trench plugs would be installed on each side of these wetlands to block subsurface flows and maintain water table elevations, as required by FERC's *Wetland and Waterbody Construction and Mitigation Procedures*. Regardless, pipeline project construction may have short-term impacts on water tables in these isolated forest wetlands. These site-specific impacts would be minor (i.e., limited to the general area of construction) and would not be hydrologically connected to larger wetland areas, and may also regulated under Section 404 of the Clean Water Act. By restricting crossings to the dry season (July 1 to September 15), possible impacts on the water tables in these wetland areas are expected to be minor and short term.

TABLE 4.1.3.5-5

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, North Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	Pipeline project impacts on riparian vegetation in the North Fork Coquille River watershed would be minor. In the short term, all vegetation would be removed from the Project corridor. About 1 acre of vegetation within the Riparian Reserve to be cleared along the Project corridor is LSOG forest; 12 acres is mid-seral conifers and hardwoods and 3 acres is early seral forest (see appendix J, table.2.3.5.1-1-4). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Overall, Project construction would affect approximately 0.09 percent of the Riparian Reserves in the watershed. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Project impacts on vegetation are expected to be well within the range of natural variability given the disturbance history of the Coast Range.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Pipeline project impacts on riparian vegetation in the North Fork Coquille River watershed would be minor (17 acres or 0.09 percent of the Riparian Reserves in the watershed (appendix J, table 2.3.5.1-1-3). Most of the cleared Riparian Reserve vegetation is upland second-growth conifers and hardwoods. Existing herbaceous and brush cover within the Project clearing limits would be maintained to the extent practicable. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, North Fork Coquille River Watershed

The routing of the pipeline project through BLM lands, coupled with the relatively small area of BLM land that would be affected by pipeline construction (41 acres or 0.11 percent of the fifth-field watershed; appendix J, table 2.3.5.1-2), make it highly improbable that pipeline project impacts would affect conditions at the subwatershed or watershed scale. Although there are site-level impacts (e.g., short-term sediment and a change in vegetative condition at stream crossings), these would be minor or limited to the boundaries of the project area (appendix J, section 2.3.5.4).

Clearing of vegetation within Riparian Reserves (17 acres or 0.09 percent of Riparian Reserves in the watershed [appendix J, table 2.3.5.1-1-3]) would have long-term but minor impacts on vegetation condition because the areas are widely dispersed and most of the vegetation that would be cleared is early or mid-seral; about 1 acre of LSOG vegetation in Riparian Reserves would be removed by construction of the pipeline project corridor in the North Fork Coquille River watershed (appendix J, table 2.3.5.1-1-4). These impacts are limited to the pipeline corridor and are well within the range of natural variability given the disturbance history within the Coast Range (appendix J, section 2.3.5.4). The watershed would remain well above the 15 percent LSOG minimum threshold established in the NWFP (appendix J, section 2.3.4.5).

Riparian vegetation along Middle Creek, the only perennial stream crossed by the pipeline project within the watershed, is confined to narrow bands due to previous timber harvesting, agriculture, and road construction. Middle Creek is currently on the CWA Section 303(d) list of impaired water bodies for elevated temperatures, which appear to be related to low canopy cover over the stream. The crossing of Middle Creek (MP 27.04) would be unlikely to affect stream temperature (appendix J, section 2.3.5.4, section 2.3.5.8) because it minimally affects the existing solar loading. A site-specific stream temperature assessment of the Middle Creek crossing by the BLM confirmed that stream temperatures are not likely to be affected by this crossing.

Off-site mitigation would further reduce pipeline project impacts. Logs generated in the corridor clearing process or otherwise provided by Pacific Connector would be used as LWD placed at 80 pieces/mile in 3.7 miles of in-stream projects to restore aquatic habitats on the watershed. Road surfacing at the bridge approach on Woodward and Alder Creek Roads would greatly reduce transport of sediments to nearby aquatic habitats. These off-site mitigation measures proposed for BLM lands would supplement on-site minimization, mitigation, and restoration actions. Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.3.5.6). Table 4.1.3.5-6 describes proposed off-site mitigations in the North Fork Coquille River watershed.

TABLE 4.1.3.5-6

Proposed Off-site Mitigation Projects for North Fork Coquille River Watershed

Project Type	Mitigation Group	Project Name	Qty.	Project Rationale
LWD Instream Placement	Aquatic Habitat	Steinnon Creek Instream Large Wood Placement	1.5 miles	Lack of recruitment of LWD into channels is a consistent factor limiting aquatic habitat quality in watersheds crossed by the PCGP. Implementation of the project would result in the removal of a small amount of LWD from the Riparian Reserves associated with intermittent and perennial channels. The removal of trees within and adjacent to the channel will reduce future recruitment of LWD into the channel and associated Riparian Reserves. Placing LWD at key locations within the channel and Riparian Reserves would offset both the short-term and long-term effects of loss of LWD recruitment to these areas, thereby contributing to attainment of ACS objectives. Collectively, these mitigation measures would result in placement of almost 300 pieces of LWD in 3.7 miles of channels.
LWD Instream Placement	Aquatic Habitat	Upper North Fork Coquille River Instream Large Wood Placement	2.2 miles	
Road Surfacing	Road Sediment Reduction	Bridge Approach Paving – Woodward & Alder Creek Roads	2 sites	Road-related sediment has negatively affected the North Fork Coquille River watershed. While Best Management Practices will be implemented, construction of the PCPG will likely cause some sediment to reach channels and potentially impact the aquatic habitat. Surfacing the approaches to the Woodward Creek and Alder Creek bridges would reduce, if not eliminate, sediment input to aquatic habitat for anadromous and resident salmonids underneath and adjacent to these bridges.

Proposed amendments of the Coos Bay RMP to waive protection measures for S&M species and to cross MAMU habitat in this watershed would not prevent attainment of ACS objectives (section 2.3.4.5) because the project does not threaten the persistence of any riparian-dependent species. All relevant Project impacts are within the range of natural variability for watersheds in the Coast Range Province (Appendix J, section 2.3.5.4). No project impacts have been identified that would prevent attainment of ACS objectives (Appendix J, section 2.3.4.8).

East Fork Coquille River Watershed

Project Impacts by ACS Objectives

Table 4.1.3.5-7 compares the Pacific Connector pipeline impacts to the objectives of the ACS for the East Fork Coquille River watershed. There are two intermittent stream channels in the East Fork Coquille River watershed that would be crossed by the pipeline (appendix J, table 2.3.6.1-4). These crossings are approximately 5 miles apart in separate subwatersheds, so the potential for accumulation of impacts or synergistic effects from these crossings on BLM lands is very low. Six Riparian Reserves not associated with stream channel crossings would be clipped by the proposed right-of-way. Approximately 6 acres of Riparian Reserves, or 0.03 percent of Riparian

Reserves in the watershed, would be cleared; approximately 1 acre of Riparian Reserves would be modified in uncleared storage areas (appendix J, table 2.3.6.1-1-3). Less than 1 acre of LSOG vegetation would be cleared in Riparian Reserves; 3 acres of early seral forest would be cleared (appendix J, table 2.3.6.1-4). Watershed conditions and recommendations are described in the East Fork Coquille Watershed Analysis (BLM 2002b) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-7

Compliance of Pacific Connector Pipeline Project with ACS Objectives, East Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves and aquatic systems are landscape-scale features that would be crossed by pipeline project. The pipeline corridor would intersect two intermittent streams, one of which is at an existing road crossing and is located primarily in early or mid-seral forests where it crosses Riparian Reserves (appendix J, table 2.3.6.1-4). The Project corridor would clear 39 acres (0.09 percent) of the East Fork Coquille River watershed of which about 6 acres are in Riparian Reserves. Impacts of the pipeline project are expected to be within the range of natural variability for natural disturbance processes in the Coast Range Province (see appendix J, Table 2.3.6.4-2). BLM lands in the East Fork Coquille River are approximately 39 percent LSOG.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the East Fork Coquille River watershed because the pipeline would be buried in the two intermittent stream channels that would be crossed. At each crossing, bed and bank disturbances would be small (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. The residual levels of disturbance are anticipated to be well within the range of natural variability the Coast Range Province.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project corridor would cross two intermittent stream channels in the East Fork Coquille River watershed, one of which is at an existing road crossing. During construction, the actual area of bank and stream bottom disturbance would be small at each crossing (<15 feet wide). Long-term impacts on the bed and banks of these features would be minor and limited to the site of construction because the pipeline would be buried. After construction, key habitat components such as large woody debris (LWD) and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the POD requirements. See appendix J, table 2.3.5.4-1 for specific measures. This level of disturbance is well within the historical and current range of natural variability for bank and channel stability in the watersheds of the Coast Range Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment could be mobilized during the crossing of two intermittent streams. These impacts are expected to be short term and limited to the general area of construction (see appendix J, section 1.3.1.2). No long-term impacts on water quality are expected because of application of the ECRP and best management practices (BMPs) during construction. The two channel intersections in this watershed are in separate subwatersheds approximately 5 miles apart, so the potential for accumulation impacts is very low.

TABLE 4.1.3.5-7

Compliance of Pacific Connector Pipeline Project with ACS Objectives, East Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing. Dry open-cut stream crossings would be used to cross stream channels. Any sediment impacts are expected to be minor and short-term and well within the range of natural variability for the Coast Range Province due to application of the POD, including BMPs for water quality, restoration of bank and bottom configurations, LWD placement, and erosion control along with the anticipated rapid revegetation characteristic of the Coast Range Province. See appendix J, table 2.3.5.7-1 for specific measures. As a result, potential sediment impacts are expected to be well within the range of natural variability for historical and current conditions in the Coast Range Province. Road repairs would also help reduce sediment levels in the watershed and move the sediment regime toward the desired condition.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	If either of the intermittent streams is flowing at the time of construction, the dam-and-pump method (described in appendix J, section 1.3.1) would be used to maintain flows in the channel downstream of the crossing. No alterations of flows resulting from construction beyond the short-term, site-scale level are anticipated. The pipeline project corridor would occupy about 0.10 percent of the East Fork Coquille River watershed on BLM lands. It is highly unlikely that any impacts in this small part of the watershed would affect the timing, magnitude, and duration of peak flows in the watershed, especially in light of other past and ongoing human activities (appendix J, section 1.3.1.6).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	No wetland or meadows would be affected by the pipeline project on BLM lands in the East Fork Coquille River watershed; therefore, the water tables in these features would not be affected.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Pipeline project impacts on riparian vegetation in the East Fork Coquille River watershed would be minor. Vegetation that would be cleared in the Riparian Reserve along the pipeline corridor consists of early and mid-seral conifers and hardwoods (see appendix J, table 2.3.5.1-4). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Overall, pipeline project construction would affect 0.03 percent of the Riparian Reserves in the watershed. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the East Fork Coquille River watershed would be minor (about 6 acres or 0.03 percent of the Riparian Reserves in the watershed). Most of the Riparian Reserve vegetation that would be cleared is upland second-growth forest. Existing herbaceous and brush cover within the Project clearing limits would be maintained to the extent practicable. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by Project construction and operation in the watershed (see appendix K of this EIS).

Summary, East Fork Coquille River Watershed

The routing of the pipeline project through BLM lands, coupled with the relatively small area of BLM land that would be affected by pipeline construction (about 44 acres or 0.10 percent of the fifth-field watershed), makes it highly improbable that project impacts would affect conditions at the subwatershed or watershed scale. Although there are site-level impacts (e.g., small amounts of sediment and a change in vegetative condition at stream crossings), these would be minor and largely limited to the boundaries of the project area (appendix J, section 2.3.6.3).

Clearing of vegetation within Riparian Reserves (about 6 acres or 0.03 percent of the Riparian Reserves in the watershed) would cause long-term but minor changes in vegetation condition. Less than 1 acre of the Riparian Reserve vegetation that would be cleared in the East Fork of the Coquille is LSOG. The remaining 3 acres that would be cleared is all early seral vegetation.

Off-site mitigation would further offset pipeline project impacts in the watershed. Logs generated in the corridor clearing process or otherwise provided by Pacific Connector would be used as LWD placed at 80 pieces/mile in 2.8 miles of instream projects to restore aquatic habitats. Approximately 5.5 miles of road surfacing projects in the South Fork of Elk Creek and Yankee Run Creek would greatly reduce transport of sediments to nearby aquatic habitats. Reallocation of approximately 180 acres of Matrix lands to LSR would provide additional aquatic protections to streams that are within the reallocation area. These off-site mitigation measures identified by BLM would supplement on-site minimization, mitigation, and restoration actions. Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.3.6.7). Table 4.1.3.5-8 describes proposed off-site mitigation measures in the East Fork Coquille River Watershed.

TABLE 4.1.3.5-8

Proposed Off-site Mitigation Measures in the East Fork Coquille River Watershed

Project Type	Mitigation Group	Project Name	Qty.	Project Rationale
Road Surfacing	Road Sediment Reduction	Road Surfacing – South Fork Elk Creek	2.6 miles	Road-related sediment has negatively affected the East Fork Coquille. Improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed.
Road Surfacing	Road Sediment Reduction	Road Surfacing – Yankee Run Mainline	2.0 miles	Surfacing the BLM road that is parallel to the South Fork Elk Creek would reduce if not eliminate sediment input to adjacent Chinook, coho, steelhead, and cutthroat habitat.
Road Surfacing	Road Sediment Reduction	Road Surfacing – Yankee Run Spurs	0.9 miles	Surfacing the BLM road that is parallel to Yankee Run Creek would reduce if not eliminate road-related sediment input to coho, steelhead, and cutthroat habitat.
LWD instream	Aquatic Habitat	Yankee Run In-stream Large Wood Placement	2.75 miles	Lack of large woody debris (LWD) and recruitment of LWD into streams is a consistent factor limiting aquatic habitat quality in all watersheds crossed by the pipeline project. Implementation of the pipeline project would result in the removal of large woody debris from the Riparian Reserves associated with intermittent and perennial streams. The removal of vegetation within and adjacent to the channel will preclude future recruitment of large woody debris into the channel and associated Riparian Reserves. Placing LWD at key locations within the channel and associated Riparian Reserves would offset both the short-term and long-term effects from loss of LWD recruitment to Riparian Reserves and associated aquatic and riparian habitat and contributes to the accomplishment of Aquatic Conservation Strategy (ACS) objectives.
Fire Suppression	Fire Suppression	Heli-Pond Construction	2 sites	High intensity fire has been identified as the single factor most impacting late-successional and old-growth (LSOG) forest habitats on federal lands in the area of the Northwest Forest Plan (NWFP). Construction of the pipeline and associated activities removes both mature and developing stands and will increase fire suppression complexity, however the corridor also provides a fuel break. Within the East/Middle Fork subwatersheds, there is an 18+ mile gap between helicopter accessible waterholes. Quick response time is imperative for successful control in wildfire situations during initial attack. Most water sources in this area are low in the drainage and accessible only by truck. Heli-ponds at these locations would enable a 2-3 mile radius for aerial application. Fire control is necessary to protect LSRs and endangered species habitat should a wildfire occur.

TABLE 4.1.3.5-8

Proposed Off-site Mitigation Measures in the East Fork Coquille River Watershed

Project Type	Mitigation Group	Project Name	Qty.	Project Rationale
Land Re-Allocation from Matrix to LSR Non-Federal Land Acquisition	Acquisition	LSR Reallocation & Land Acquisition	180 acres	This action contributes to the “neutral to beneficial” standard for new developments in mapped and unmapped Late Successional Reserves (LSRs) by adding acres to the LSR land allocation to offset the long-term loss of habitat due to the construction and operation of the pipeline project. The action also compensates for the removal of occupied marbled murrelet habitat and suitable spotted owl habitat. In addition, the selected parcel reduces the potential edge effects caused by management of Matrix lands adjacent to occupied murrelet sites by reallocating the entire parcel to LSR.

The proposed amendment of the Coos Bay RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the Pacific Connector pipeline does not threaten the persistence of any riparian-dependent species. (appendix J, section 2.3.6.6). All relevant pipeline project impacts are within the range of natural variability for watersheds in the Coast Range Province (appendix J, section 2.3.6.3). No project impacts have been identified that would prevent attainment of ACS objectives (appendix J, section 2.3.6.8).

Middle Fork Coquille River Watershed

Project Impacts by ACS Objectives

Table 4.1.3.5-9 compares the Pacific Connector pipeline impacts to the objectives of the ACS for the Middle Fork Coquille River watershed. There are eight stream channel crossings, and seven locations where Riparian Reserves would be clipped by the construction clearing, but the stream channel would not be crossed by the pipeline trench. Approximately 25 acres of Riparian Reserves, or 0.10 percent of the Riparian Reserves in the watershed, would be cleared and 1 acre would be modified in UCSAs (appendix J, table 2.3.7.1-3). Stream channel intersections with the Pacific Connector pipeline corridor would occur in two separate subwatersheds approximately 10 miles apart (appendix J, figure 2.3.7.1-1). In the Big Creek subwatershed, six intermittent streams and one perennial stream would be crossed between MP 35.9 and MP 37.35; three of the intermittent stream crossings are associated with an existing road. Approximately 10 miles away in the Headwaters Middle Fork Coquille subwatershed, one perennial and one intermittent stream would be crossed. Watershed conditions and recommendations are described in the Middle Fork Coquille Watershed Analysis (BLM 1999a) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-9

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Middle Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that would be affected by the pipeline project. Within the Middle Fork Coquille River watershed, the pipeline would cross two perennial streams (tributary of Big Creek MP 37.35 and Deep Creek MP 48.27). These perennial crossings are in different subwatersheds and are miles apart. Seven intermittent streams would be crossed. Six of these are in the Big Creek subwatershed, of which three are co-located with existing crossings in roads. One intermittent stream crossing is in the Deep Creek subwatershed. The pipeline corridor, hydrostatic test and temporary extra work areas (TEWAs) would clear 96 acres or about 0.18percent (appendix J, table 2.3.7.1-2) of the BLM lands in the watershed, of which 25 acres are Riparian Reserves (appendix J, table 2.3.7.1-4). This amount is about 0.10 percent of the Riparian Reserves in the watershed (appendix J, table 2.3.7.1-3). Applying the estimate from the Upper Middle Fork subwatershed that 29 percent of the Riparian Reserves are late successional and old growth (LSOG), there are approximately 6,800 acres of LSOG in Riparian Reserves (appendix J, table 2.3.7.1-1: 23,703.15*.29=6,873) in the Middle Fork Coquille River watershed on BLM lands. Approximately 3 acres of LSOG vegetation or 0.05 percent of estimated LSOG in Riparian Reserves would be cleared. Over 3 miles of the corridor on BLM lands in the watershed are located on or adjacent to existing roads. Impacts to aquatic systems are expected to be short term and minor because of application of best management practices, erosion control measures, and anticipated rapid revegetation of disturbed areas. Impacts of the pipeline project are expected to be within the range of natural variability for natural disturbance processes in the Coast Range Province (appendix J, table 2.3.7.4-2). Approximately 35 percent of the BLM lands in the Middle Fork Coquille watershed are LSOG (appendix J, Data Summaries, table 3.7-1).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	Wherever possible, the pipeline project is proposed to be on roads and ridgetops to minimize crossings of stream channels and Riparian Reserves. No forested wetlands outside of stream crossings would be affected by the project in the Middle Fork Coquille River watershed. The pipeline project is not expected to affect spatial or temporal connectivity in the watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the *Wetland and Waterbody Crossing Plan*. At each crossing, bed and bank disturbances would be small (<15 feet wide). After construction, key habitat components such as large woody debris (LWD) and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Proposed mitigation projects would improve aquatic connectivity by repairing culverts that currently preclude passage of aquatic organisms. The residual levels of disturbance are anticipated to be well within the range of natural variability in the Coast Range Province.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project corridor would cross seven intermittent streams and two perennial fish-bearing streams in the Middle Fork Coquille River watershed. Impacts to the bed and banks of these features would be minor and limited to the site of construction because the pipeline would be buried and the actual area of bank and stream bottom disturbance is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the *Wetland and Waterbody Crossing Plan*. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained, although during construction, streambanks and bottoms would be disturbed. Given the fire and landslide history of the Coast Range Province, this level of disturbance is well within the range of natural variability for the Middle Fork Coquille River watershed.

TABLE 4.1.3.5-9

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Middle Fork Coquille River Watershed

ACS Objective	Project Impacts
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction, particularly during the dry open-cut crossing (i.e., dam and pump) of tributaries to Big Creek and Deep Creek that are perennial streams. These impacts are expected to be short term and limited to the general area of construction (see appendix J, section 1.3.1). No long-term impacts on water quality are expected because of the rapid regrowth of vegetation typical of the Coast Range Province and application of the ECRP and best management practices during construction. A small amount of shading vegetation would be removed where the corridor would cross perennial tributaries of Deep Creek and Big Creek.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing (GeoEngineers 2009a). Dry open-cut stream crossings would be used to cross stream channels (see appendix J, section 1.3.1). Any sediment impacts are expected to be minor and short term and well within the range of natural variability for the Coast Range Province due to application of the POD, including best management practices for water quality, restoration of bank and bottom configurations, LWD placement, and erosion control along with the anticipated rapid revegetation characteristic of the Coast Range Province. Potential for cumulative sediment impacts exists in Big Creek because of the close proximity of channel crossings. If project monitoring detects cumulative sediment impacts, Pacific Connector would be required to take corrective actions to reduce sediment to background levels. Road repairs would also help reduce road-related sediment in the watershed, thereby moving the sediment regime closer to the desired condition.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	On streams with flowing water at the time of crossing, the dam-and-pump method (described in appendix J, section 1.3.1) would be used to maintain flows in the channel downstream of the crossing. No alterations of flows resulting from construction beyond the short-term, site-scale level are anticipated. The pipeline corridor would occupy about 0.14 percent of the Middle Fork Coquille River watershed (appendix J, table 2.3.7.1-2). It is highly unlikely that any impacts in of this scale would affect the timing, magnitude, and duration of peak flows in the watershed, especially in light of other past and ongoing human activities (appendix J, section 1.3.1.6). The pipeline project would not create the kinds of conditions (e.g., large openings with many stream connections) that historically altered peak flows.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	No wet meadows would be crossed in the Middle Fork Coquille River watershed. Floodplain crossings associated with perennial streams are narrow and likely consist of unconsolidated landslide deposits where the water table fluctuates seasonally. Channel breakers (internal plugs) would be installed so that the trench would not lower the water table if wet areas are encountered during floodplain crossings. The pipeline project would not affect water tables in wet meadows and floodplains in the Middle Fork Coquille River watershed. Instream LWD mitigation projects would improve stream channel conditions and help restore floodplain connectivity where these mitigation projects occur.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Middle Fork Coquille River watershed would be minor. In the short term, all vegetation would be removed from the Project corridor, including about 25 acres of Riparian Reserves (appendix J, table 2.3.7.1-3). This is about 0.10 percent of the Riparian Reserves in the watershed (appendix J, table 2.3.7.1-3). Approximately 3 acres of LSOG vegetation or 0.05 percent of estimated LSOG vegetation in Riparian Reserves in the Middle Fork Coquille River watershed would be cleared for the Project corridor and temporary extra work areas (appendix J, table 2.3.7.1-4). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Stream temperatures and sediment regimes are not expected to change as a result of the Project (see previous discussions). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. These restoration efforts would help maintain and restore the biological and physical functions of the Riparian Reserves in the watershed.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the Middle Fork Coquille River watershed would be minor 25 acres or 0.10 percent of the Riparian Reserves in the watershed). Early-seral (6 acres and mid-seral (5 acres) comprise most of the Riparian Reserve vegetation that would be cleared. Existing herbaceous and brush cover within the Project clearing limits would be maintained to the extent practicable. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline project construction and operation in the watershed (see appendix K of this EIS).

Summary, Middle Fork Coquille River Watershed

The routing of the Pacific Connector pipeline through BLM lands, coupled with the relatively small area of BLM lands that would be affected by pipeline construction (approximately 107 acres or 0.18 percent of the BLM lands in the fifth-field watershed [appendix J, table 2.3.7.1-2]), make it highly improbable that pipeline project impacts would affect conditions at the subwatershed or watershed scale. Although there are site-level impacts (e.g., small amounts of sediment and a change in vegetative condition at stream crossings), these would be minor and largely limited to the project area and well within the range of natural variability for disturbance processes in the Coast Range Province (appendix J, section 2.3.7.4).

Widely separated small changes in vegetative condition in Riparian Reserves (approximately 26 acres or 0.10 percent of Riparian Reserves in the Middle Fork Coquille River watershed) would have long-term but minor impacts. This level of vegetation change is well within the range of natural variability given the fire and landslide history of the Coast Range Province (see appendix J, sections 2.1.1 and 2.3.7.4.). Reforestation and revegetation with appropriate riparian vegetation would restore the terrestrial riparian environment over time. The probability of accumulation of impacts on BLM lands between stream crossings in the Big Creek subwatershed and stream crossings in the Headwaters Middle Fork Coquille River subwatershed is very low because of the wide separation of pipeline project impacts.

Off-site mitigation would further reduce pipeline project impacts. Instream LWD projects would contribute to the restoration of 2.7 miles of perennial fish-bearing streams. Approximately 4.4 miles of road surfacing and repair projects would substantially reduce transport of sediments to nearby aquatic habitats. Paving of selected stretches of road would further reduce potential sediments. These off-site mitigation measures identified by BLM would supplement on-site minimization, mitigation, and restoration actions. Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.3.7.6). Table 4.1.3.5-10 describes

TABLE 4.1.3.5-10

Proposed Off-site Mitigation Measures in the Middle Fork Coquille River Watershed

Project Type	Mitigation Group	Project Name	Project Rationale	Quantity	Unit
Fire suppression	Fire suppression	Heli-Pond construction	High intensity fire has been identified as the single factor most impacting late-successional and old-growth forest habitats on federal lands in the area of the Northwest Forest Plan (NWFP). Construction of the pipeline and associated activities would remove both mature and developing stands and would increase fire suppression complexity; however, the corridor would also provide a fuel break. Within the East/Middle Fork watersheds, there is an 18+ -mile gap between helicopter accessible waterholes. Quick response time is imperative for successful control in wildfire situations during initial attack. Most water sources in this area are low in the drainage and accessible only by truck. Heli-ponds at these locations would enable a 2-3 mile radius for aerial application. Fire control is necessary to protect Late Successional Reserves (LSRs) and endangered species habitat should a wildfire occur.	1	ea.

TABLE 4.1.3.5-10

Proposed Off-site Mitigation Measures in the Middle Fork Coquille River Watershed

Project Type	Mitigation Group	Project Name	Project Rationale	Quantity	Unit
Land Re-Allocation from Matrix to LSR Non-Federal Land Acquisition	Acquisition	LSR Reallocation& Land Acquisition	This action contributes to the “neutral to beneficial” standard for new developments in mapped and unmapped LSRs by adding acres to the LSR land allocation to offset the long-term loss of LSR habitat due to the construction and operation of the Pacific Connector pipeline. The action also compensates for the removal of occupied marbled murrelet habitat and suitable roosting, nesting, and foraging habitat for northern spotted owls. In addition, the selected parcel reduces the potential edge effects caused by management of Matrix lands adjacent to occupied murrelet sites by reallocating the entire parcel to LSR.	207	acres
LWD instream	Aquatic Habitat	Upper Rock Creek In-stream Large Wood Placement	Lack of large wood and recruitment of large woody debris (LWD) into streams is a consistent factor limiting aquatic habitat quality in all watersheds crossed by the Pacific Connector pipeline. There are approximately 7.3 miles of corridor, 9 stream crossings. Implementation of the pipeline project would result in the removal of LWD from the Riparian Reserves associated with intermittent and perennial streams. The removal of vegetation within and adjacent to the channel will preclude future recruitment of large woody debris into the channel and associated Riparian Reserves. Placing LWD at key locations within the channel and associated Riparian Reserves would offset both the short-term and long-term effects from loss of LWD recruitment to Riparian Reserves and associated aquatic and riparian habitat and contributes to the accomplishment of Aquatic Conservation Strategy (ACS) objectives.	2.1	miles
LWD instream	Aquatic Habitat	Middle Fork Coquille LWD Placement		0.6	miles
Road Drainage and Surface Enhancement	Road Sediment Reduction	Camas Mountain Road Drainage and Surface Enhancement	Road-related sediment and stream network extension from ditchlines have negatively affected the Middle Fork Coquille. There are approximately 7.3 miles of corridor and 9 stream crossings in the Middle Fork Coquille. Roads do not meet current best management practices and are a source of chronic sediment delivery to fish bearing streams. The 9.1 and 9.2 roads currently show signs of water rutting and stream network extension. Stormproofing and blocking the road will reduce the potential for sediment-laden water to be carried off the road surface and into the ditch where it could be transmitted to the stream network. Surfacing the BLM road that is parallel to Fall Creek would reduce if not eliminate sediment input to coho, steelhead, and cutthroat habitat. Surfacing the bridge approach would reduce if not eliminate sediment input to coho, steelhead, and cutthroat habitat from this location.	3.5	miles
		Dice, Boulder, and Twelvemile Creek road systems		11	miles
Road Surfacing	Road Sediment Reduction	Road Surfacing -Fall Creek System		0.9	miles
Road Surfacing	Road Sediment Reduction	Bridge Approach paving -Sandy & Jones Creek Roads		2	ea.

proposed off-site mitigation measures in the Middle Fork Coquille River watershed. Proposed amendments of the Coos Bay RMP and the Roseburg District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the Pacific Connector pipeline does not threaten the persistence of any riparian-dependent species (appendix J, section 2.3.7.5). All relevant pipeline project impacts are within the range of natural variability for watersheds in the Coast Range Province (appendix J, section 2.3.7.4). No project-related impacts that would prevent attainment of ACS objectives have been identified (appendix J, section 2.3.7.8).

Olalla Creek–Lookingglass Creek Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-11compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Olalla Creek–Lookingglass Creek watershed. The pipeline project corridor would not intersect any waterbodies or Riparian Reserves on federal land in this watershed. No direct or indirect impacts on riparian resources in this watershed have been identified. Watershed conditions and recommendations are described in the Olalla-Lookingglass Watershed Analysis (BLM 1998a) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-11

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Olalla Creek–Lookingglass Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	The pipeline project watershed would have minimal impact on landscape-level features in the Olalla-Lookingglass Creek because it would affect 0.09 percent (about 9 acres out of 10,000 acres) of the federal land on the watershed. No Riparian Reserves in the watershed would be affected.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project would have no stream intersections in the Olalla-Lookingglass Creek watershed; therefore, it would have no impact on connectivity in aquatic and riparian species habitats.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would not affect streambanks or stream bottoms in the Olalla-Lookingglass Creek watershed because the Project would not intersect stream channels.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	The pipeline project has no stream intersections in the Olalla-Lookingglass Creek watershed; therefore, it would have low impact on aquatic- and riparian-dependent species.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The pipeline project would not affect the sediment regime in aquatic habitats on the Olalla-Lookingglass Creek watershed because of the limited scale of the Project, application of Best Management Practices and other requirements of the *Erosion Control and Revegetation Plan*, lack of intersections with stream channels, and absence of riparian impacts.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project would not affect instream flows on the Olalla-Lookingglass Creek watershed because there would be no stream intersections.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not affect floodplains and water table elevations in meadows and wetlands in the Olalla-Lookingglass Creek watershed because there would be no intersections with these features.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	The pipeline project would not affect species composition and structural diversity of Riparian Reserves in the Olalla-Lookingglass Creek watershed because no Riparian Reserves would be affected by the project.

TABLE 4.1.3.5-11

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Olalla Creek–Lookingglass Creek Watershed

ACS Objective	Project Impacts
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The pipeline project would not affect any riparian-dependent species on the Olalla-Lookingglass Creek watershed because no Riparian Reserves would be affected by the project.

Summary, Olalla-Lookingglass Creek Watershed

Given the location of the Pacific Connector pipeline corridor on BLM lands, the lack of intersections with waterbodies, and the absence of Riparian Reserve impacts, it is highly unlikely that pipeline construction and operation would negatively affect watershed conditions on BLM land in the Olalla-Lookingglass Creek watershed. No pipeline project impacts relevant to ACS objectives have been identified that are outside the current range of natural variability for the watershed (appendix J, section 2.4.3.4). Proposed amendments of the Roseburg District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.3.5). Mitigations associated with the Project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.3.6). Table 4.1.3.5-12 shows proposed off-site mitigations in the Olalla-Lookingglass watershed.

TABLE 4.1.3.5-12

Proposed Off-site Mitigation Projects for the Olalla-Lookingglass Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Land Re-Allocation from Matrix to LSR Non-Federal Land Acquisition	Acquisition	LSR Reallocation and Land Acquisition	This mitigation contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the Late Successional Reserve (LSR) land allocation to offset the long-term loss of acres and related habitat from the construction and operation of the Pacific Connector pipeline. It also contributes to objectives of the Aquatic Conservation Strategy (ACS) by managing forests for late-successional stand conditions (Forest Service and BLM 1994b: B-12).
Road Stabilization	Road Sediment Reduction	Olalla Tie Road Renovation	Transport of road sediment to stream channels is a primary concern in the Olalla-Lookingglass watershed. Many existing roads do not meet current best management practices and serve as sources of chronic sediment delivery to fish bearing streams. General renovation of the Olalla Tie Road (e.g., resurfacing and drainage channel repair, along with stabilization of several landslides that cross the road) will reduce the delivery of road-related sediments to stream channels.

Clark Branch–South Umpqua River Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-13 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Clark Branch–South Umpqua River watershed. The pipeline project corridor would not intersect any waterbodies or Riparian Reserves on federal land in the Clark Branch–South Umpqua River watershed. Watershed conditions and recommendations are described in the Middle South Umpqua Watershed Analysis (BLM 1999b) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-13

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Clark Branch-South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	The pipeline project would have a low impact on landscape-level features in the Clark Branch–South Umpqua River watershed because it would clear only 0.01 acre of Riparian Reserves (less than 0.01 percent of the watershed) and would affect 0.16 percent of the federal land on the watershed.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project has no stream intersections in the Clark Branch-South Umpqua River watershed; therefore, it would have no impact on connectivity in aquatic and riparian species habitats.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would not affect streambanks or stream bottoms in the Clark Branch-South Umpqua River watershed because the project would not intersect stream channels.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	The pipeline project would have no stream intersections in the Clark Branch-South Umpqua River watershed; therefore, it would have no impact on aquatic- and riparian-dependent species.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The pipeline project would not affect the sediment regime in aquatic habitats on the Clark Branch-South Umpqua River watershed because of the limited scale of the Project, application of best management practices and other requirements of the *Erosion Control and Revegetation Plan*, lack of intersections with stream channels, and absence of riparian impacts.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project would not affect instream flows on the Clark Branch-South Umpqua River watershed because there would be no stream intersections and clearing in the Transient Snow Zone would be minimal.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not affect floodplains and water table elevations in meadows and wetlands in the Clark Branch–South Umpqua River watershed because there would be no intersections with these features.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The pipeline project would not affect species composition and the structural diversity of Riparian Reserves in the Clark Branch-South Umpqua River watershed because no Riparian Reserves would be affected by the Project.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The pipeline project would not affect any riparian-dependent species in the Clark Branch–South Umpqua River watershed because no Riparian Reserves would be affected by the project.

Summary, Clark Branch–South Umpqua River Watershed

Given the location of the pipeline project corridor on BLM lands, the lack of intersections with waterbodies, and the absence of impacts on Riparian Reserve, it is highly unlikely that project construction and operation would prevent attainment of the ACS objectives in this watershed (appendix J, section 2.4.4.8). Proposed amendments of the Roseburg District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.3.5). No pipeline project impacts relevant to ACS objectives have been identified that are outside the current range of natural variability for the watershed (appendix J, section

2.4.4.4). Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.4.6). Table 4.1.3.5-14 shows proposed off-site mitigations in the Clark Branch–South Umpqua River watershed.

TABLE 4.1.3.5-14

Proposed Off-site Mitigation Projects for Clark Branch-South Umpqua Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Fish Passage	Fish Passage	Rice Creek Culvert Replacements	Man-made barriers to fish passage, such as culverts not designed for fish passage, malfunctioning and plugged culverts, have restricted access of fish populations to quality upland habitat in the Clark Branch-S. Umpqua watershed. If one of these small, old culverts were to plug up with debris, road fill might enter the stream network. Replacing these faulty culverts with well-designed crossing structures that allow passage of adult and juvenile salmonids through the stream crossing at a range of flows will extend the availability of upstream habitat. This contributes to reestablishing historic connectivity with habitat in the watershed.
Road Drainage	Road Sediment Reduction	East Fork Willis Creek Tributary Culvert Replacement	Sediment is one of the primary water quality problems identified in the Middle South Umpqua watershed assessment on the Clark Branch-S. Umpqua watershed. Analyses clearly indicated that the sediment-turbidity habitat indicator is at risk or more likely not functioning properly. This particular culvert on the East Fork of Willis Creek is old, undersized, shot-gunned, plugged with debris, and eroding the road fill. The culvert also has poor alignment with the stream at the outlet. Replacing the culvert with a properly sized one will reduce the risk of road fill failure.
Road Drainage	Road Sediment Reduction	Judd Creek Culvert Removal	This culvert is undersized and there is a large amount of road fill associated with it. Were the culvert to become plugged, fluxes of sediment to the channel and deposition downstream in fish bearing reaches could occur. Pulling the culvert and fill material and storm proofing the road would prevent such sediment dynamics. In addition, the road is blocked by a landslide just beyond. Access to the stream crossing is gradually being lost due to soil slumping and vegetation growth. Implementing this project also means that access to the crossing will not be lost.

Myrtle Creek Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-15 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Myrtle Creek watershed. The pipeline project corridor would not intersect any waterbodies on federal land in the Myrtle Creek watershed. One Riparian Reserve is clipped by the construction corridor, which would result in approximately one acre of clearing. Approximately three acres would be modified by UCSAs. Watershed conditions and recommendations are described in the Myrtle Creek Watershed Analysis and Water Quality Restoration Plan (BLM 2002c) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-15

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Myrtle Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	The pipeline project is not expected to affect landscape-scale features on BLM lands in the Myrtle Creek watershed because of Project routing and the limited nature of Project impacts. The pipeline corridor would clear approximately 44 acres or 0.14 percent of the federal land on the Myrtle Creek watershed and approximately one acre of Riparian Reserves (appendix J, table 2.4.5.1-1-3). Any impacts on aquatic systems are expected to be localized, short term, and minor because of the lack of intersects with aquatic systems, application of best management practices and erosion control measures, and the anticipated rapid revegetation of disturbed areas. Impacts of the pipeline project are expected to be within the range of natural variability for natural disturbance processes in the Klamath-Siskiyou Province (appendix J, section 2.4.5.4).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Myrtle Creek watershed because there would be no stream crossings and Riparian Reserve impacts would be minimal. Aquatic system connectivity would be enhanced by repairs to culverts on Slide Creek that currently preclude passage of anadromous fish species and other aquatic organisms. Any residual levels of disturbance are anticipated to be minor, short-term and well within the range of natural variability in the Klamath-Siskiyou Province (appendix J, section 2.4.5.4).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would not affect streambanks or stream bottoms in the Myrtle Creek watershed because the project would not intersect stream channels or riparian habitat directly bordering the channels.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment could be mobilized during construction, but the impacts of the sediment are expected to be short term and limited to the immediate area. Since no streams would be crossed, riparian impacts would be minimal. With application of the *Erosion Control and Revegetation Plan* and best management practices during construction, there should be no long-term impacts associated with sediment transport or elevated temperatures due to reduced shading. Minor amounts of riparian vegetation adjacent to the two intermittent tributaries would be affected; however, the tributaries would likely be dry at the time of construction and would not contribute to the temperature balance of downstream reaches during the critical summer season. Road stabilization, drainage enhancement, and surface upgrade mitigation projects are expected to contribute to improvements in overall watershed condition.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing. The landslide on South Myrtle Hill would be cleaned up and the hill stabilized as part of off-site mitigation. No streams would be crossed and only a very minor amount of riparian vegetation would be affected. Any sediment impacts are expected to be minor and short term (e.g., first wet season) and well within the range of natural variability for the Klamath-Siskiyou Province due to application of POD best management practices and the anticipated rapid revegetation that is characteristic of the province. As a result, potential sediment impacts would be kept to negligible levels. Road repairs and drainage enhancements would help reduce sediment impacts on the watershed, thereby moving the sediment regime closer to the desired condition.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project would not affect instream flows because there would be no stream intersections and very minor riparian zone impacts. All of the drainages in the watershed are more than 75 percent hydrologically recovered (BLM 2002c:114). The pipeline project would affect less than 1 percent of the watershed; therefore, clearing associated with the project is unlikely to affect peak flows. The pipeline project is unlikely to affect flow regimes because of the extent of hydrologic recovery in the watershed, corridor routing along ridgetops, the limited acreage of the project, and lack of stream connectivity.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not affect floodplains and water table elevations in meadows because there would be no intersections with these features and no change to stream morphology or functioning that would cause abandonment of floodplains (e.g., by down cutting).

TABLE 4.1.3.5-15

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Myrtle Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Pipeline project impacts on riparian vegetation in the Myrtle Creek watershed would be minor. Overall, pipeline construction would affect less than half an acre of the Riparian Reserves in the watershed. Following construction, replanting with native species would facilitate reestablishment of riparian communities.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Pipeline project impacts on riparian vegetation in the Myrtle Creek watershed would be minor (less than half an acre) and would occur in early to mid-seral stages of forest growth in upland areas adjacent to intermittent creeks. Large woody debris from corridor clearing would be placed in riparian zones to increase habitat diversity. Revegetation of conifer forest communities would be encouraged by planting of native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline project construction and operation in the watershed (see appendix K of this EIS).

Summary, Myrtle Creek Watershed

Given the location of the Pacific Connector pipeline corridor on BLM lands, the lack of intersections with waterbodies, and the small area of Riparian Reserves affected, it is highly unlikely that pipeline project construction and operation would adversely affect watershed conditions on BLM land in the Myrtle Creek watershed. No pipeline project impacts relevant to the ACS objectives have been identified that are outside the current range of natural variability for the watershed (appendix J, section 2.4.5.4). Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.5.6). Table 4.1.3.5-16 shows proposed off-site mitigations in the Myrtle Creek watershed.

TABLE 4.1.3.5-16

Proposed Off-site Mitigation Projects for Myrtle Creek Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Fish Passage	Fish Passage	Slide Creek Culvert Replacement	Man-made barriers to fish passage have negatively affected access to habitat in the Myrtle Creek watershed. The existing culvert on Slide Creek is perched, undersized, and a barrier to anadromous and resident fish passage. Replacing this culvert with one that will pass adult and juvenile salmonids at a range of flows will extend the availability of upstream habitat, mitigating unavoidable effects to habitat quality on stream reaches crossed by the pipeline corridor. In addition, old, undersized culverts like this one are at risk of failure. Culvert plugging could cause bank topping and the transport of road fill to the stream network.
Road Stabilization	Road Sediment Reduction	South Myrtle Hill Slide Repair	Sediment in streams resulting from road-related landslides is a limiting factor in the Myrtle Creek watershed. The South Myrtle Hill Road has been affected by upslope failure and landslides. Stabilizing these upslope areas will help reduce the potential for catastrophic slope failure and related sediment delivery to downslope and nearby aquatic habitats.
Road Drainage and Surface Enhancement	Road Sediment Reduction	Slide Creek Road Drainage and Surface Enhancement	Sediment in streams is a major concern in the Myrtle Creek watershed. Many roads on the watershed do not meet current best management practices and, as such, are sources of chronic sediment delivery to fish bearing streams. Surfacing and drainage repair to about 1.0 miles of Ben Branch Road would help reduce sediment delivery to a fish bearing stream.

Proposed amendment of the Roseburg District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian dependent species (appendix J, section 2.4.5.8). All relevant pipeline project impacts are within the range of natural variability for watersheds in the Coast Range Province (appendix J, section 2.4.5.4). No project effects have been identified that would prevent attainment of ACS objectives (appendix J, section 2.5.4.8).

Days Creek–South Umpqua River Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-17 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Days Creek–South Umpqua River watershed. The pipeline project would cross two ridgetop wetland swales affecting approximately one-quarter of an acre of forested wetlands and clear approximately 8.4 acres of Riparian Reserves, but would not cross any stream channels. The Riparian Reserves of five intermittent streams would be clipped, clearing approximately 0.5 acres in the Days Creek-South Umpqua River watershed. All affected Riparian Reserves are near ridgetops. The intermittent streams associated with them would likely be dry during construction. The two wetlands are ridgetop swales that have no apparent surface connection to stream channels. Watershed conditions and recommendations are described in the South Umpqua Watershed Analysis and Water Quality Restoration Plan (BLM 2001) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-17

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Days Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that would be affected by the pipeline project. The pipeline corridor would impact 0.31 percent of the BLM land and 1.89 percent of the NFS land on the Days Creek–South Umpqua River watershed. Approximately 8.4 acres of Riparian Reserves would be cleared (0.04 percent of Riparian Reserves on federal lands). Nearly all of the vegetation cleared is mid-seral. While the cutting of trees where the corridor intersects Riparian Reserves would result in a long-term change in vegetation condition, it would be minor in scale and well within the range of natural variability for vegetative change given the fire history of the Days Creek–South Umpqua River watershed. The application of Best Management Practices (BMPs) and erosion control measures, use of native vegetation, and the anticipated rapid revegetation of disturbed areas would likely further reduce Project impacts. The level of impacts is well within the range of natural variability for disturbance processes described by Everest and Reeves (2007) and Agee (1993) and as documented in the South Umpqua River watershed assessment (BLM 2001). The Days Creek South Umpqua watershed is approximately 32 percent late successional and old growth (LSOG) forest (appendix J, Data Summary, table 3.7-1).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Days Creek–South Umpqua River watershed. No streams would be crossed, and impacts on Riparian Reserve impacts would be minimal. Aquatic system connectivity would be enhanced by replacement of culverts on Beal Creek that currently preclude passage of anadromous fish species and other aquatic organisms. Any residual levels of disturbance are anticipated to be well within the range of natural variability.

TABLE 4.1.3.5-17

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Days Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would have no discernible impact on streambanks or bottoms in the Days Creek–South Umpqua River watershed because no stream channels would be crossed. The few impacts on Riparian Reserve are associated with near ridge top intermittent streams or ridgetop (wetland) swales that have no apparent surface connectivity to the drainage system and, therefore, little influence on the physical integrity of the aquatic system. Off-site mitigation measures involving large woody debris (LWD) and boulder placement in several miles of stream channel would help restore physical integrity and complexity.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Sediment impacts are expected to be as described in appendix J, section 1.3.1. Minor amounts of sediment would be mobilized during construction, but these impacts are expected to be short term and limited to the immediate project area. Connectivity to aquatic systems is limited since no stream channels would be crossed. With application of the *Erosion Control and Revegetation Plan* (ECRP)and BMPs, no long-term impacts associated with sediment transport are anticipated. No impacts on water temperature are expected because no channels would be crossed and no effective shade would be removed. Any sediment transport to aquatic systems that may occur would be offset by mitigation projects involving off-site road drainage enhancement, surface upgrade, and storm proofing. The intermittent tributaries located adjacent to the Riparian Reserve vegetation that would be affected would likely be dry at the time of construction and would not contribute to the temperature balance of downstream reaches during the critical summer season.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing. There would be no stream channels crossed in the watershed; because the route lies on a ridgetop, connections to aquatic systems that would transport sediment are limited. All waterbodies adjacent to affected Riparian Reserves are expected to be dry during construction. Sediment fluxes are expected to be minor, short term, and well within the range of natural variability for the Klamath-Siskiyou Province with implementation of the erosion control measures in ECRP and BMPs as well as the anticipated rapid revegetation that is characteristic of the Province. Erosional impacts are therefore expected to be consistent with those described in appendix J, section 1.3.1. Road repairs and storm proofing would help reduce sediment impacts in the watershed and move the sediment regime closer to the desired condition.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	It is highly unlikely that the pipeline project would affect flows because of limited connectivity to aquatic systems. The pipeline routing is on a ridgetop in the watershed and would not cross any stream channels. The watershed is hydrologically recovered (BLM 2001:143) and the corridor would affect 0.46 percent of the watershed (appendix J, table 2.4.6.1-2) so changes in peak flows as a result of construction are highly unlikely.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	Two small forested wetlands would be crossed in or near a ridgetop swale in the Stouts Creek subwatershed at MP 102.1 and 102.2. Trench plugs would be installed on each side of these wetlands to block subsurface flows and maintain water table elevations, as required by the FERC's *Wetland and Waterbody Construction and Mitigation Procedures*. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on water tables of these wetland areas are expected to be minor and short-term. These features appear to have no surface connectivity with the Stouts Creek drainage network.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Approximately 8.43 acres or approximately 0.04 percent of Riparian Reserves in the watershed would be cleared by the pipeline project. All affected Riparian Reserves are located at or near ridgetops and contribute little to the thermal regulation, nutrient filtering, bank erosion and channel stability of the drainage networks on the watershed. Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Replanting with native species would facilitate recovery of vegetation communities. LWD and boulder placement in and adjacent to 1.2 miles of stream channel as part of off-site mitigation would help to enhance physical complexity of the aquatic habitats. These restoration efforts, along with the limited impacts on which they are directed, would maintain and restore biological and physical functions of the Riparian Reserves on the watershed.

TABLE 4.1.3.5-17

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Days Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Pipeline project impacts on riparian vegetation on BLM land in the Days Creek–South Umpqua River watershed would be minor (approximately 8.4 acres cleared) and occur largely in early to mid-seral stages forests along ridgetops. Impacts to ridgetop swale wetlands total less than one acre. Existing herbaceous and brush cover would be maintained to the extent practicable. To maintain riparian habitat, construction Best Management Practices would be implemented. LWD and boulders would be placed in channels and adjacent riparian areas and along 1.2 miles of watershed streams to restore and stabilize channel crossings. Revegetation would be encouraged by planting of native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, Days Creek–South Umpqua River Watershed

Given the location of the Pacific Connector Pipeline Project corridor on BLM lands, the relative lack of intersections with waterbodies and the small acreage of Riparian Reserve affected, it is highly unlikely that pipeline construction and operation would prevent attainment of ACS objectives on BLM land in the Days Creek–South Umpqua River watershed. No pipeline project impacts relevant to the ACS have been identified that are outside of the range of natural variability for disturbance processes in the watershed (appendix J, section 2.4.6.4). Proposed amendments of the Roseburg District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.6.5). Mitigations associated with the pipeline project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.6.6). Table 4.1.3.5-18 shows proposed off-site mitigation measures for the Days Creek–South Umpqua Watershed.

TABLE 4.1.3.5-18

Proposed Off-site Mitigation Projects for Days Creek–South Umpqua Watershed

Administrative Unit	Mitigation Group	Project Type	Project Name	Project Rationale	Quantity	Unit
Roseburg BLM	Stand Density Fuel Break	Fuels Reduction	Days Creek South Umpqua Hazardous Fuel Reduction	High intensity wildfire has been identified as the single natural factor most impacting late successional and old-growth forest habitats on the Days Creek-South Umpqua watershed. Like a road, the corridor serves a fuel break. Fuels reduction on 1,000 acres adjacent to the corridor will increase the effectiveness of the corridor as a fuel break. The mitigated area is part of the Days Creek to Shady Cove fuel break and ties in with similar projects on the Umpqua National Forest.	1,000	acres
Roseburg BLM	Road Sediment Reduction	Road Drainage and Surface Enhancement	South Umpqua Road Drainage and Surface Enhancement	The Days Creek-South Umpqua watershed is a Tier 1 Key watershed. Sediment is likely the most limiting factor to aquatic functioning in streams of the watershed. Roads do not meet current best management practices and are a source of chronic sediment delivery to fish bearing streams. Surfacing and drainage repair along 10 miles of roads on the watershed would reduce sediment delivery to fish bearing streams, thereby contributing to the attainment of Aquatic Conservation Strategy (ACS) objectives.	10	miles
Roseburg BLM	Road Sediment Reduction	Road stormproofing	31-4-3.2 Road Stormproofing	The Days Creek-South Umpqua watershed is a Tier 1 Key watershed. Sediment is likely the most limiting factor to aquatic function in the South Umpqua basin. There is concern that the Shively Creek culverts may fail, resulting in substantial sediment transport to Shively Creek. Removing these faulty culverts will prevent possible deposition of fine road sediments in stream channels. This mitigation project should occur before road becomes too narrow for heavy equipment access.	1	project
Roseburg BLM	Fire suppression	Suppression Capacity	Dry Hydrants	By installing six dry hydrants, fire vehicles will have an easier time filling up with water, and additional water sources will be available. In this way, areas that have had restoration work for fish populations could still be safely accessed for fire suppression. Over all, better water sources will improve fire suppression success and therefore help protect natural resources..	6	sites
Roseburg BLM	Aquatic and Riparian Habitat	Large Woody Debris (LWD) instream	West Fork Canyon Creek Instream LWD	Lack of LWD and sources of recruitment of this LWD in many streams are major factors limiting aquatic habitat quality in the watershed. There are approximately 8.16 miles of corridor in the watershed. Implementation of the Pacific Connector Pipeline Project would result in the removal of LWD and clearing of woody vegetation from about 6 acres.	0.8	miles

TABLE 4.1.3.5-18

Proposed Off-site Mitigation Projects for Days Creek–South Umpqua Watershed

Administrative Unit	Mitigation Group	Project Type	Project Name	Project Rationale	Quantity	Unit
Roseburg BLM	Aquatic and Riparian Habitat	Fish Passage	Beal Creek Culvert Replacement	Man-made barriers to fish passage have restricted access to quality habitat in the watershed. Both culverts targeted for replacement are undersized and obstructing anadromous and resident fish passage. Replacing these two culverts with ones properly sized for the stream (can handle peak flows) will allow fish passage and reduce the risk of them plugging up and causing road fill failures.	2	sites
Umpqua National Forest (UNF)	Terrestrial Habitat Improvement	Snag Creation	Days Cr.–South Umpqua Snag Creation	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Data rely on the Cow Creek Watershed Analysis which suggests the watershed is far below historic levels of snag habitat due of past management actions. This project will add to those cumulative impacts. As snags are a critical component of LSR spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forest's Land and Resource Management Plan and the Northwest Forest Pan (NWFP). Forests require analysis and mitigation under most management activities. Replacement would be immediate though there would be a 10-year delay as snag decay develops. Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	16	Acres
UNF	Terrestrial Habitat Improvement	Snag Creation	Days Cr.–South Umpqua Late Successional Reserve (LSR) Snag Creation		32	Acres
UNF	Stand Density Fuel Break	Underburn	Days Cr.–South Umpqua Matrix Underburn	Both mature stands and developing stands will be removed during pipeline construction. Impacts to mature and developing stands will exceed the life of this project by many decades. Density management will increase longevity of existing mature stands by reducing losses from disease, insects and fire. Density management in younger stands will accelerate development of late-successional and old-growth (LSOG) forest. Associated fuel reductions reduce risk of loss to fire and reduce potential fire size and intensity	102	Acres
UNF	Stand Density Fuel Break	Underburn	Days Cr.–South Umpqua LSR Underburn		125	Acres
UNF	Stand Density Fuel Break	Precommercial Thinning	Days Cr.–South Umpqua. LSR Precommercial Thinning	The Pacific Connector pipeline would cause direct impacts to existing interior, developing interior habitat. The project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Thinning of young stands is a recognized treatment within LRSs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12; ROD Pages B-11; ACS Objectives, C-11 and C-17).	53	Acres

TABLE 4.1.3.5-18

Proposed Off-site Mitigation Projects for Days Creek–South Umpqua Watershed

Administrative Unit	Mitigation Group	Project Type	Project Name	Project Rationale	Quantity	Unit
UNF	Stand Density Fuel Break	Fuels Reduction	Days Cr. South Umpqua LSR Integrated Fuels Reduction	High intensity fire has been identified as the single factor most impacting LSOG forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and will increase fire suppression complexity, however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor will increase the effectiveness of the corridor as a fuel break. Fuels reduction will lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire. This segment is part of the Milo to Shady Cove fuel break and ties in with similar projects on the BLM.	232	Acres
UNF	Stand Density Fuel Break	Fuels Reduction	Days Cr. South Umpqua Matrix Integrated Fuels Reduction		150	Acres
UNF	Road sediment reduction	Road Closure	Days Cr. South Umpqua Road Closure	Mowing and maintenance of pipeline corridor, temporary road construction, and road use are direct disturbance impacts to wildlife. Road closure would mitigate some of those impacts, improve interior stand connectivity, and benefit aquatic habitats over time.	0.5	Miles

Note: Acres and mile rounded to nearest whole acre and tenth of a mile, respectively.

Elk Creek–South Umpqua River Watershed

Project Impacts by ACS Objective

Table 4.1.3.5-19 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Elk Creek–South Umpqua River watershed. The Pacific Connector Pipeline Project is on or near ridgetops along the Elk Creek hydrologic divide. The pipeline project crosses one small forested wetland located along the ridge that is too small to register. No stream channel intersects occur in the Elk Creek Watershed. Watershed conditions and recommendations are described in the Elk Creek Watershed Analysis (Forest Service 1996) and described in detail in appendix J of this EIS.

TABLE 4.1.3.5-19

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Elk Creek–South Umpqua Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that are affected by the Pacific Connector Pipeline Project. The pipeline corridor would affect (cleared and modified) 0.61 percent of the BLM land and 0.09 percent of the NFS land on the Elk Creek–South Umpqua watershed (appendix J, table 2.4.7.1-2), and 3 acres or 0.02 percent Riparian Reserves would be cleared on BLM and NFS lands in the Elk Creek–South Umpqua watershed. The application of best management practices (BMPs) and erosion control measures, use of native vegetation, and the anticipated rapid revegetation of disturbed areas would likely further reduce Project effects. The level of impact is well within the natural range of variability for disturbance processes described by Everest and Reeves (2007), Agee (1993), and as documented in the South Umpqua watershed assessment (Forest Service 1996).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to impact spatial or temporal connectivity in the Elk Creek–South Umpqua watershed. No streams are crossed, and no Riparian Reserve are impacted. Aquatic system connectivity would be enhanced by replacement of three culverts within the watershed. Any residual levels of disturbance are anticipated to be well within the range of natural variability (appendix J, section 2.4.7.4).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The pipeline project would have no discernible impact on stream banks or bottoms in the Elk Creek–South Umpqua watershed because no stream channels are crossed. Off-site mitigations involving large woody debris (LWD) within riparian reserves would help restore this physical integrity and complexity (appendix J, section 2.4.7.6).
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction, but these effects are expected to be short-term and limited to the immediate project area. Connectivity to aquatic systems is limited since no stream channels are crossed. With application of the *Erosion Control and Revegetation Plan* (ECRP) and BMPs, there should be no long-term effects associated with sediment transport. No impacts to water temperature are expected because no channels are crossed and no effective shade is removed. Any sediment transport to aquatic systems that may occur would be offset by off-site road drainage enhancement, surface upgrade, and storm-proofing mitigation projects.

TABLE 4.1.3.5-19

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Elk Creek–South Umpqua Watershed

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in corridor routing. There are no stream channels crossed in the watershed and the route lies on a ridge top so connections to aquatic systems that would transport sediment are limited. All waterbodies adjacent to affected Riparian Reserves are expected to be dry during construction. As a result, sediment fluxes are expected to be minor and short-term and well within the range of variability for the Klamath–Siskiyou Province due to implementation of the erosion control measures in ECRP, BMPs, and the anticipated rapid revegetation that is characteristic of the Province. As a result, erosional effects are expected to consistent with those described in appendix J, section 1.3.1. Road repairs and storm proofing would help reduce sediment effects in the watershed and move the sediment regime closer to the desired condition (appendix J, section 2.4.7.6).
Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	It is highly unlikely that the pipeline project would impact flows because of limited connectivity to aquatic systems. The pipeline routing is on a ridge top in the watershed and does not cross any stream channels. The watershed is hydrologically recovered, and the corridor affects 0.09 percent of the watershed on NFS and BLM lands (appendix J, table 2.4.7.1-2) so changes in peak flows as a result of construction are highly unlikely.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not affect floodplains and water table elevations in meadows because these features are not crossed by the project in the Elk Creek Watershed.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Pipeline project effects to Riparian Reserves in the Elk Creek–S. Umpqua Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Replanting with native species would facilitate recovery of vegetation communities. LWD placement within 17 acres of riparian reserves and would help to enhance physical complexity of the aquatic habitats (appendix J, section 2.4.7.6). These restoration efforts, along with the limited effects to which they are directed, would maintain and restore biological and physical functions of the Riparian Reserves in the watershed.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Existing herbaceous and brush cover would be maintained to the extent practicable. To maintain riparian habitat, construction BMPs would be implemented. LWD placement within 17 acres of riparian reserves would help to enhance physical complexity of the aquatic habitats (appendix J, section 2.4.7. Revegetation would be encouraged by planting of native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, Elk Creek–South Umpqua Watershed

Given the ridgetop location of the pipeline corridor on BLM and NFS lands and the lack of intersects with waterbodies and Riparian Reserves, it is highly unlikely that Pacific Connector Pipeline Project construction and operation would prevent attainment of ACS objectives on BLM and NFS land in the Elk Creek–South Umpqua watershed. Amendments of the Roseburg District BLM and Umpqua National Forest LMPs to waive protection measures for S&M species would not prevent attainment of ACS objectives (appendix J, section 2.4.7.5). No pipeline project effects relevant to the ACS have been identified that are outside of the range of variability for disturbance processes in the watershed (appendix J, section 2.4.7.4).

Mitigations associated with the Pacific Connector Pipeline Project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.7.6). The project mitigation plan includes the following activities in the Elk Creek Watershed that are consistent with recommendations in the Elk Creek Watershed

Analysis. Table 4.1.3.5-20 shows proposed off-site mitigations in the Elk-Creek–South Umpqua watershed.

TABLE 4.1.3.5-20

Proposed Off-site Mitigation Projects for Elk Creek–South Umpqua Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Fuels Reduction	Stand Density Fuel Break	Hazardous Fuel Reduction	This project is 1,183 acres of shaded fuel breaks primarily along the ridgetop between Elk Creek and Cow Creek. High intensity wildfire has been identified as the single natural factor most impacting late successional and old growth forest habitats on the Elk Creek–South Umpqua watershed. Fuel breaks help reduce the potential for large-scale stand-replacement fire. At the landscape scale, this contributes to the maintenance of canopy and reduces the risk of loss of riparian vegetation. The mitigated area is part of the Days Creek to Shady Cove fuel break and ties in with similar projects on the Umpqua National Forest.
			This project is 95 acres of commercial thinning. This has the effect of regulating stand density, accelerating the development of larger trees, and reducing the risk of stand-replacing fire by regulating stand density and ladder fuels.
Habitat Improvement	Upland Terrestrial	Terrestrial LWD Placement	This project is 290 acres of log placement in upland units. To the degree large logs are placed in Riparian Reserves, they would benefit riparian habitats This restores coarse woody debris (CWD) in old harvest units that are currently devoid of this habitat element. CWD also contributes to long-term soil productivity.
Habitat Improvement	Upland Terrestrial	Meadow Restoration	This project is 101 acres of meadow restoration at Callahan Meadows. This has the effect of restoring native plant communities and controlling invasive weeds.
Habitat Improvement	Stand Density	Precommercial Thinning	This project is 363 acres of pre-commercial thinning of young stands in LSR. This has the effect of regulating stand density and accelerating the development of interior stand conditions by accelerating growth
Habitat Improvement	Upland Terrestrial	Off-site Pine Removal	This project is 338 acres of off-site pine removal. This removes trees that are not genetically adapted to the site where they are located and provides a mechanism to restore ponderosa pine and sugar pines that are adapted to the site.

Upper Cow Creek Watershed

Project Impacts by ACS Objectives

Table 4.1.3.5-21 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Upper Cow Creek watershed. BLM and NFS lands where the ACS applies comprise about 49 percent of the Upper Cow Creek watershed (appendix J, table 2.4.8.1-1; Forest Service 1995a). Watershed conditions and recommendations are described in the Cow Creek Watershed Analysis (Forest Service 1995a) and in detail in appendix J of this EIS. In the Cow Creek Watershed:

- timber harvest and removal of LWD from creek channels has reduced structural complexity of the aquatic habitat and its ability to retain sediments;
- chronic, fine-grained sediment, primarily related to roads have negatively affected aquatic habitats; and
- the presence of roads has segregated some stream reaches from upslope habitats that are needed for replenishment of LWD (Forest Service 1995a).

In the Upper Cow Creek Watershed, the Pacific Connector Pipeline Project crosses four perennial streams, two intermittent streams, and one small forested wetland. The pipeline project also clips one perennial stream Riparian Reserve and six wetland Riparian Reserves. Approximately 20 acres of Riparian Reserves would be cleared. This area is about 0.41 percent of the Riparian Reserves in the South Fork of Cow Creek and 0.12 percent of all Riparian Reserves in the Upper Cow Creek watershed (appendix J, table 2.4.8.1-3).

TABLE 4.1.3.5-21

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features that would be affected by the Pacific Connector Pipeline Project. There would be four perennial and two intermittent stream crossings in the South Fork Cow Creek subwatershed. (Note that Hydrofeature N at MP 111.01 is a perennial stream but because of an upstream diversion, it is dry in the summer. It is counted here has an intermittent stream.) One small shrub dominated wetland is also crossed. Riparian Reserves associated with1 perennial stream and 6 forested wetlands are clipped. The Project corridor is located primarily in early or mid-seral forests (appendix J, table 2.4.8.1-4) and largely on or near ridgetops to minimize impacts on aquatic habitats. The Project corridor would affect 78 acres or about 0.32 percent of BLM and NFS lands in the Upper Cow Creek watershed and about 20 acres or 0.12 percent of the Riparian Reserves within the watershed. Impacts to aquatic systems are expected to be short-term and minor and limited to the project scale because of application of Best Management Practices and erosion control measures. Large woody debris (LWD) cleared in construction of the corridor would be used to stabilize and restore stream crossings. Off-site mitigation measures including road stormproofing and decommissioning and installation of fish-friendly culverts are expected to improve watershed conditions in the Upper Cow Creek watershed (appendix J, section 2.4.8.6). While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variation given the fire history of Upper Cow Creek (appendix J, section 2.4.8.4).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Upper Cow Creek watershed other than during the construction period because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the *Wetland and Waterbody Crossing Plan*. In the short-term during construction connectivity would be disrupted. At each crossing, the corridor would be necked down to 75 feet wide. Bed and bank disturbances associated with equipment and trenching are small (<15 feet wide). After construction all disturbed areas would be returned to their approximate original contours to restore preconstruction contours and drainage patterns. The temporary construction right-of-way would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the *Erosion Control and Revegetation Plan* (ECRP). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Connectivity would be improved by installation of fish-friendly culverts at four sites currently preclude passage of aquatic organisms (appendix J, section 2.4.8.6). The residual levels of disturbance are anticipated to be well within the range of natural variability in the Klamath–Siskiyou Province.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance associated with equipment crossing and trenching is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the POD requirements. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained, although in the short-term

TABLE 4.1.3.5-21

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
	(during construction) elements of the aquatic system could be disturbed. This level of disturbance is well within the range of natural variability that for watersheds of the Klamath-Siskiyou Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Mercury from abandoned mercury mines in the East Fork of Cow Creek is a known issue. Broeker (2010a) and GeoEngineers (2013b) assessed potential risk of release of mercury from disturbance of affected sediments. Mercury concentration of 0.29 part per million (PPM), which is in exceedance of ODEQ threshold of 0.1 PPM, was detected in soil and stream sediment samples at one site. Special measures including maintenance of 100% effective ground cover have been adopted as recommended by ODEQ. As a result, the presence of inorganic mercury is not anticipated to cause any health risk. Minor amounts of sediment would be mobilized during construction, particularly during the dry open-cut crossing dam and pump crossing of the East Fork of Cow Creek and its perennial tributaries (GeoEngineers 2013b). Water quality impacts from sediment are expected to be short-term and limited to the general area of construction (appendix J, section 1.3.1). No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (appendix J, section 1.3.1 and previous discussion) and Best Management Practices during construction. Approximately 3 total acres of effective shading vegetation would be removed at 4 perennial stream crossings. A site-specific shade analysis conducted by Pacific Connector (NSR 2009) showed minor temperature increases were possible at the project scale but no impacts would occur beyond the immediate area of construction, and there were no temperature impacts at the stream network scale. Water quality is expected to remain within the range that supports aquatic biota.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Upper Cow Creek watershed sediment regime was historically characterized by pulse-type disturbances (Forest Service 1995; Everest and Reeves 2007). The East Fork of Cow Creek, a drainage in the South Fork Cow Creek Subwatershed is characterized by the Cow Creek watershed Assessment as being “in balance” for sediment transport and deposition. The Pacific Connector Pipeline Project is not likely to alter these conditions. Eighty percent (3.73 of 4.73 miles) of the pipeline project in the Upper Cow Creek watershed is on ridgetops with little or no aquatic connectivity. Site-specific field reviews by geologists show the project is unlikely to cause landslides or activate currently stable earth-flow terrains because unstable areas have been avoided (GeoEngineers 2009a; Hanek 2011; Koler 2013). Surface erosion and sediment transport to streams would be minimized because Project would maintain 100 percent effective ground cover, effective sediment barriers and other erosion control measures as needed (See the sediment discussion at the beginning of this section). Sediment generated during construction is expected be minor, and limited to the general area of construction by the use of dry, dam-and-pump measures that isolate the crossing from flowing water during construction (appendix J, section 1.3.1). The pipeline project is not expected to alter the balance of sediment transport and storage in the East Fork of Cow Creek. The pipeline project is not expected to alter either the pulse-type disturbance or surface erosion sediment regimes of the Cow Creek drainage (appendix J, section 2.4.8.4). A pulse of sediment could be observed following the first seasonal rain, but this sediment-laden water is likely to dissipate within a few hundred feet and would be indistinguishable from background levels.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	Instream flows would be interrupted for a short period of time during installation of dams during dam and pump crossings. The area of construction that is between upstream and downstream dams would be dewatered for during the actual crossing construction. During construction, water would be pumped around the construction site to maintain downstream flows. It is possible that there may be local increases in runoff from canopy removal but at the watershed scale flow regimes would not be altered by the Pacific Connector pipeline because of the small scale of the project relative to the watershed, the relatively high proportion (85 percent) of the watershed that is hydrologically recovered and the lack of connectivity of most of the route to any stream network. See the discussion of peak flow processes in appendix J, section 2.4.8.4 for additional information.

TABLE 4.1.3.5-21

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project corridor clips the Riparian Reserve of six forested wetlands and crosses one delineated wetland. Trench plugs would be installed on each side of these wetlands as needed to block subsurface flows and maintain water table elevations, as required by FERC's *Wetland and Waterbody Construction and Mitigation Procedures*. Regardless, pipeline project construction may have short-term impacts on water tables in these isolated forest wetlands. These site-specific impacts would be minor (i.e., limited to the general area of construction) and are not connected to larger wetland areas, and may also regulated under Section 404 of the Clean Water Act. By restricting crossings to the dry season (July 1 to September 15), possible impacts on water tables of these wetland areas are expected to be minor and short term.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Upper Cow Creek watershed would be minor. In the short term, all vegetation would be removed from the pipeline corridor. About 8 acres of vegetation within the Riparian Reserve to be cleared in the pipeline corridor is early or mid-seral vegetation (appendix J, table 2.4.8.1-4). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Overall, pipeline project construction would affect approximately 0.12 percent of the Riparian Reserves in the watershed (appendix J, table 2.4.8.1-3). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. These restoration efforts, along with the limited impacts on which they are directed, would maintain and restore biological and physical functions of the Riparian Reserves in the watershed.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the Upper Cow Creek watershed would be minor (20 acres or 0.12 percent of the Riparian Reserves in the watershed) (appendix J, table 2.4.8.1-3). Most of the cleared Riparian Reserve vegetation is upland second-growth forest (appendix J, table 2.4.8.1-4). Existing herbaceous and brush cover within the Project clearing limits would be maintained to the extent practicable. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, Upper Cow Creek Watershed

The South Fork Cow Creek subwatershed has four perennial stream crossings within 1 mile. This is the highest number of perennial stream crossings in one subwatershed on BLM and NFS lands. Construction of the Pacific Connector Pipeline Project in the Upper Cow Creek watershed has high potential for impacts that could prevent attainment of ACS objectives particularly as related to sediment and water temperature (appendix J, sections 2.4.8.4 and 2.4.8.5). The pipeline project has addressed these issues as follows:

- **Project Routing—**Approximately 80 percent of the route in the Upper Cow Creek watershed is on a ridgetop with little or no connectivity to aquatic habitats or Riparian Reserves. Between MPs 109 and 110 in the South Fork Cow Creek subwatershed, the route has been modified to avoid potentially unstable areas. The Forest Service has participated extensively in routing of the Pacific Connector pipeline and concurs that the location is unlikely to trigger mass wasting or excessive surface erosion (appendix J, sections 2.4.8.4 and 2.4.8.5).
- **Implementation of Water Quality Best Management Practices—**A site-specific BMP implementation plan based on construction impact and site-response risk has been prepared that is expected to maintain water quality (GeoEngineers 2013c). Within Riparian

Reserves for all hydrologic features crossed by the pipeline between MPs 109 and 110, the pipeline project would provide 100 percent post-construction ground cover on all disturbed areas. Wood fiber is the preferred material supplemented as needed by biosolids. In addition, the Pacific Connector pipeline would construct water bars at 50-foot intervals. Other erosion control measures would be used as needed to prevent surface erosion associated with stream crossings or to prevent sediment transport that may affect riparian systems (appendix J, section 2.4.8.4).

- **Mitigation of Potential Impacts on Stream Temperature—**A temperature analysis on perennial stream crossings showed the Project may have minor temperature impacts (approximately 0.1°C) at the project scale (NSR 2009). Although the analysis showed there would be no impact at the next downstream reach below the crossings because of groundwater infiltration, flow volumes and existing shade, the pipeline project would transplant larger conifers to riparian areas at perennial crossings in the East Fork Cow Creek to mitigate for temperature impacts at the project scale. Temperatures are expected to remain below those specified by the State of Oregon for streams in the Umpqua basin (appendix J, section 2.4.6.4).
- **Mercury—**The Forest Service contracted with a geologist consultant to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally-occurring minerals along a 2,000-foot section of the pipeline route between MP 109 and the East Fork Cow Creek (Broeker 2010b; GeoEngineers 2013b). Geochemical analysis of the soil and stream sediment samples have determined very low to nominal concentrations of naturally occurring mercury mineralization. The mercury level at one of the stream sediment sites was 0.29 part per million, which was above the Level II screening level value of 0.1 part per million for invertebrates (ODEQ 1998a, cited in GeoEngineers 2013b). In order to prevent this naturally occurring mercury from mobilizing during and after construction, additional erosion control measures and monitoring would be conducted at these sites. The proposed pipeline construction activities by Pacific Connector within the upper East Fork Cow Creek watershed are not anticipated to disturb and expose soils and bedrock strata that contain more than low amounts of naturally occurring mercury mineralization; and any sediment that is generated is not likely to reach the aquatic environment due to implementation of short-term and permanent mitigation measures outlined in Pacific Connector’s ECRP and as listed in GeoEngineers (2013b).

There are approximately 4,559 acres of Riparian Reserves (NFS lands only) in the Upper Cow Creek Watershed of which approximately 1,595 acres are LSOG (Forest Service 1995a: 94, 95). Approximately 20 acres of Riparian Reserves or 0.12 percent of the Riparian Reserves on NFS lands in the watershed would be cleared (appendix J, table 2.4.8.1-3). Of this, approximately 3 acres are LSOG (appendix J, table 2.4.8.1-4). This is about 0.17 percent of the LSOG in Riparian Reserves on NFS lands in the Upper Cow Creek watershed. Early and mid-seral forest vegetation constitutes the remaining 8 acres of the affected Riparian Reserve vegetation. LSOG and mid-seral vegetation (approximately 5 acres) cleared in the right-of-way would be a long-term, but minor in scale, change in vegetation that is within the range of natural variability for the Upper Cow Creek watershed considering its history of disturbance from stand replacement fire and subsequent landslides (appendix J, section 2.4.8.4.). NFS and BLM lands are currently 36 percent LSOG and exceed minimum watershed thresholds for LSOG forest after consideration of Pacific Connector Pipeline Project impacts (appendix J, section 2.4.8.5).

Off-site mitigation measures, identified by the Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Cow Creek watershed assessment. Mitigations associated with the Project are responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.4.8.6). Table 4.1.3.5-22 shows proposed off-site mitigation projects in the Upper Cow Creek watershed.

TABLE 4.1.3.5-22

Off-site Mitigations in the Upper Cow Creek Watershed

Project Type	Mitigation Group	Project Name	Qty.	Unit	Project Rationale	Land Allocation
Fish Passage Culverts	Aquatic	Fish Friendly Culvert Replacement at Applegate Creek, Beaver Creek, Beaver Creek Trib., and East Fork Cow Creek	4	Ea.	Poor culvert design, erosion at outlets and lack of maintenance of resulted in several road-stream crossings that block access to upstream aquatic habitats. Culvert replacements with fish-friendly designs will benefit fish and other aquatic biota by reconnecting habitats and reducing sediment contributions from these locations. This is responsive to Aquatic Conservation Strategy (ACS) objectives 1, 2, 3, and 5.	Riparian Reserve
Road Closure	Road Sediment Reduction	Road Barricades and Stormproofing	2.6	Miles	Road density and lack of road maintenance were identified as major sources of sediment in the Cow Creek watershed assessment. Decommissioning, barricading, and stormproofing roads reduce road related sediment contributions. This is responsive to ACS objectives 4 and 5.	LSR and Matrix
Road Decommissioning	Road Sediment Reduction	Road Decommissioning	4.3	Miles		
Integrated Stand Density and Fuels Reduction	Stand Density and Fuels Reductions	Upper Cow Creek Matrix Integrated Fuels Reduction	606	Acres	Forest stands in Upper Cow Creek are often overstocked with unnaturally high fuel loads that make them susceptible to high intensity fire. Stand density and underburn fuel reduction projects are designed to reduce fuel loading and stand density in overstocked, fire-prone stands to historic ranges to reduce the risk of high intensity stand replacement fire. Since these types of fires can be a major cause of surface erosion and mass wasting in granite and schist soils, this contributes to reestablishing a natural sediment regime over time by reducing the probability of a large, high intensity fire in this area. This is responsive to ACS objectives 1, 2, and 5.	Matrix
Integrated Stand Density and Fuels Reduction	Stand Density and Fuels Reductions	Upper Cow Creek LSR Integrated Fuels Reduction	972	Acres		LSR
Integrated Stand Density and Fuels Reduction	Underburning	Upper Cow Creek Matrix Underburn	410	Acres		Matrix
Integrated Stand Density and Fuels Reduction	Underburning	Upper Cow Creek LSR Underburn	531	Acres		LSR
Habitat Enhancement	Terrestrial Habitats	Terrestrial LWD Placement	62	Acres	Logging, fire suppression, and fuels treatments have reduced the number of snags and pieces of LWD in Upper Cow Creek. Portions of snag creation and terrestrial LWD projects in Matrix and LSR would occur within Riparian Reserves. This would contribute to ACS objectives for restoring snag levels and down wood to historic ranges in treated areas and is responsive to ACS objectives 1 and 8.	LSR, Matrix, and Riparian Reserves
Habitat Enhancement	Terrestrial Habitats	LSR Snag Creation	91	Acres		
Habitat Enhancement	Terrestrial Habitats	Matrix Snag Creation	14	Acres		
Forest Plan Amendment		Cow Creek Matrix to LSR Land Reallocation	588	Acres	The Pacific Connector project crosses LSR acres in Upper Cow Creek and adjacent watersheds. Matrix to LSR Reallocation provides aquatic protections by managing upland areas for LSOG conditions. This is responsive to all nine ACS objectives.	Matrix / LSR

Several site-specific proposed amendments of the Umpqua National Forest LRMP are required to make provision for the Pacific Connector Pipeline Project. These proposed amendments are not expected to prevent attainment of the ACS in the Upper Cow Creek watershed (appendix J, section 2.4.8.5).

- Proposed amendment UNF-1 would allow removal of effective shade on perennial streams. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009) showed that any temperature increase resulting from removal of effective shade would be minor, and limited to the point of maximum impact at the site of construction.
- Proposed amendment UNF-2 would allow the Pacific Connector corridor to run parallel to an existing stream within the riparian zone. The amendment would not prevent attainment of ACS objectives because an uncut buffer 30 to 60 feet wide would remain between the corridor and the East Fork of Cow Creek. An estimated 94 percent of the effective shade would be maintained adjacent to the East Fork of Cow Creek, erosion control measures specified in the ECRP are expected to be effective at controlling surface erosion, and LWD would not be removed from the stream. Sources of LWD would remain on both sides of the channel.
- Proposed amendment UNF-3 would allow the Pacific Connector Pipeline Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4).
- Proposed amendment UNF-4 would reallocate approximately 588 acres from the Matrix land allocation to the LSR allocation. This would benefit aquatic habitats because this area would be managed for late-successional stand conditions that provide additional aquatic protections.
- Proposed amendment of the Umpqua National Forest LRMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the Pacific Connector Pipeline Project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.8.5).

The routing of the pipeline project through NFS lands, coupled with the relatively small area of BLM and NFS land affected by pipeline construction (79 acres or 0.32 percent of the BLM and NFS lands in the fifth-field watershed; appendix J, table 2.4.8.1-2), makes it highly improbable that Project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and a long-term change in vegetative condition at stream crossings), these would be minor in scale and largely limited to the boundaries of the project area (appendix J, section 2.4.8.4).

No project-related impacts that would prevent attainment of ACS objectives have been identified (appendix J, section 2.4.8.8). All relevant Pacific Connector Pipeline Project impacts are within the range of natural variability for watersheds in the Oregon Cascades and Klamath Provinces, although some of these processes have been altered from their natural condition (appendix J, section 2.4.8.4).

Trail Creek

Project Impacts by ACS Objective

Table 4.1.3.5-23 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Trail Creek watershed. BLM and NFS lands where the ACS applies comprise about 50 percent of the Trail Creek watershed (appendix J, table 2.5.3.1-1). Watershed conditions and recommendations are found in the Trail Creek Watershed Analysis (BLM 1999c) and described in detail in appendix J of this EIS. In the Trail Creek watershed, timber harvest and removal of LWD from creek channels have reduced structural complexity of the aquatic habitat and its ability to retain sediments. Chronic, fine-grained sediment, primarily related to roads, has negatively affected aquatic habitats. The presence of roads has segregated some stream reaches from upslope habitats that are needed for replenishment of LWD. The pipeline project crosses one intermittent stream and clips five Riparian Reserves on BLM lands (appendix J, table 2.5.3.1-1-4)..

TABLE 4.1.3.5-23

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed landscape-scale features that would be affected by the Pacific Connector Pipeline Project. There is one Riparian Reserves that is clipped by the project corridor on NFS lands in the Trail Creek watershed (appendix J, table 2.5.3.1-4). Three Riparian Reserves are clipped and two Riparian Reserves are crossed on BLM lands. One intermittent stream channel is crossed on BLM lands at MP 119.7. There are also stream crossings on adjacent private lands. On BLM and NFS lands subject to the ACS, the pipeline corridor is primarily in early or mid-seral forests (appendix J, table 2.5.3.1-4) and largely on or near ridgetops to minimize impacts on aquatic habitats. Approximately 5.32 acres or 0.13 percent of the Riparian Reserves in the Trail Creek watershed are cleared by the pipeline project (appendix J, table 2.5.3.1-3). Approximately 3 acre of late successional and old-growth (LSOG) forest would be removed by the Project from a clipped Riparian Reserve in Lower Trail Creek (appendix J, table 2.5.3.1-4). Impacts to aquatic systems are consistent with those described in appendix J, section 1.3.1. LWD cleared in construction of the corridor would be used to stabilize and restore stream crossings. Off-site mitigation measures including road stormproofing and decommissioning and instream large woody debris (LWD) projects are expected to improve watershed conditions in the Trail Creek watershed (appendix J, section 2.5.3.6). At MP 119.7, the pipeline project has been rerouted to lessen the impact of a small intermittent stream that would have run parallel to the pipeline trench. While there would be long-term effects on vegetation in Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variability for the watershed.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Trail Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the POD (i.e., *Wetland and Waterbody Crossing Plan*). Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance associated with equipment crossing and trenching is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site, and the bed and banks would be returned to pre-construction conditions, consistent with the POD requirements. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. The residual levels of disturbance are anticipated to be well within the range of natural variability in the Western Oregon Cascade Province.

TABLE 4.1.3.5-23

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	No stream channels are crossed on BLM or NFS lands where the ACS applies so physical integrity of banks and stream bottoms would not be affected. There are crossings on private lands immediately adjacent to BLM property boundaries. The impacts of crossing construction would be the same as if those crossings were on BLM lands and are disclosed here because of the close proximity. Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the POD requirements (i.e., *Wetland and Waterbody Crossing Plan*). By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained, although in the short term (during construction) elements of the aquatic system could be disturbed. This level of disturbance is well within the range of natural variability that for watersheds of the Western Oregon Cascade Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	No long-term impacts on water quality are expected because of application of the *Erosion Control and Revegetation Plan* (ECRP) including maintenance of effective ground cover and best management practices during construction (see appendix J, section 1.3.1 and previous discussion).
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Trail Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM 1999c; Everest and Reeves 2007). More chronic erosion and deposition of fine sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. In their 2013 filing, Pacific Connector proposed a route that would have paralleled, and largely encompassed the Riparian Reserve of a small intermittent channel at MP 119.7. Field review by the BLM indicated that this area was moderately to severely erosive and may be difficult to revegetate if disturbed. This area was also flashy (runoff comes up rapidly with storms) because of relatively shallow soils. A route variation was filed in 2015 that removed this crossing from BLM lands. the pipeline project construction and operation are not likely to alter sediment patterns in the watershed, nor are they likely to exacerbate these conditions. Proposed mitigation projects would contribute significantly to reduction of sediments and restoration of aquatic functions (appendix J, section 2.5.3.6).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project is not likely to affect peak flows in the Trail Creek watershed because of its predominately ridgetop location, the relatively small area of the watershed affected (less than 1 percent) and relative lack of connectivity to aquatic systems. The Trail Creek Watershed Assessment noted that increases in peak flows were a low risk in all of the subwatersheds and in the watershed as a whole (BLM 1999c).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project would not cross any meadows or wetlands in the Trail Creek watershed on BLM or NFS lands, so there would be no impact from the project on water tables or seasonal inundation of these areas
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Trail Creek watershed would be minor. The pipeline project would clear approximately 5.32 acres of vegetation in Riparian Reserves or 0.13 percent of the Riparian Reserves on BLM and NFS lands in the Trail Creek watershed (appendix J, table 2.5.3.1-3). Approximately one acre affected are mid-seral plant communities; roughly 3 acre is LSOG (appendix J, table 2.5.3.1-4). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Planned mitigation measures include 2.6 miles of instream LWD that would contribute to restoration of aquatic function (appendix J, section 2.5.3.6).

TABLE 4.1.3.5-23

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed

ACS Objective	Project Impacts
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the Trail Creek watershed would be minor. The pipeline project would clear approximately 5.32 acres of vegetation in Riparian Reserves or 0.13 percent of the Riparian Reserves on BLM and NFS lands in the Trail Creek watershed. Less than 1 acre affected are early seral plant communities and approximately 3 acres are LSGO. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

In their 2013 filing, Pacific Connector proposed a route that would have paralleled, and largely encompassed, the Riparian Reserve of a small intermittent channel at MP 119.7. Field review by the BLM indicated that this area was moderately to severely erosive and may be difficult to revegetate if disturbed. This area was also flashy (runoff comes up rapidly with storms) because of relatively shallow soils. At the request of the BLM, Pacific Connector filed a route variation to avoid this channel that was reviewed and approved by the BLM. This route variation reduced the acres of affected Riparian Reserve and provided a location that avoided soils with revegetation sensitivity.

Pacific Connector has modified their route in the Trail Creek watershed to better address the ACS objectives and has incorporated measures consistent with the Riparian Reserve standards and guidelines. While this assessment demonstrates that short-term impacts associated with the project would occur at the site scale related to the removal of riparian vegetation, and impacts on streambanks, and substrates, when considering the design measures and BMPs that have been incorporated into the pipeline project, the impacts on Riparian Reserves would be minor and short term at the watershed or landscape scale.

Summary, Trail Creek Watershed

There would be no intersections with Riparian Reserves or stream crossings on NFS lands in the Trail Creek watershed. The pipeline route clips five Riparian Reserves on BLM lands. Two of these are associated with stream crossings that occur on adjacent private lands. At MP 119.7, at the request of the BLM, Pacific Connector filed a route variation to avoid this crossing; this was subsequently reviewed and approved by the BLM. This route variation reduced the acres of affected Riparian Reserve and provided a location that avoided soils with revegetation sensitivity. As a result of this proposed realignment, one intermittent channel would be crossed on BLM lands.

Clearing associated with the pipeline project corridor would remove approximately 3 acres of LSOG vegetation in Riparian Reserves (appendix J, table 2.5.3.1-4). While this is a long-term change in vegetative condition, it is minor in scale and well within the range of natural variability for changes in vegetative condition given the fire history of the watershed (appendix J, section 2.5.3.4).

The high clay-content soils in the watershed (BLM 1999c:1-4) present a potential issues with possible compaction, sediment produced at stream crossings, and sediment that could be mobilized by overland flow. Subsoil ripping (including the use of hydraulic excavators) is a proven method to reduce soil compaction. Measures in the ECRP including soil remediation with biosolids or other organic materials, rapid revegetation, and maintenance of effective ground cover are likely to control surface erosion. Erosion control measures described in appendix J, section 1.3 for stream crossings are likely to be successful at minimizing sediment associated with clearing in Riparian Reserves in the Trail Creek watershed. The BLM and Forest Service may require additional erosion control measures if needed.

Stream crossings adjacent to the BLM property boundary on private lands are addressed in section 4.4 of this EIS.

Off-site mitigation measures, identified by the BLM and Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Trail Creek watershed assessment and would contribute to improving terrestrial and aquatic conditions within the watershed (appendix J, section 2.5.3.6). Table 4.1.3.5-24 describes proposed off-site mitigation measures in the Trail Creek watershed.

TABLE 4.1.3.5-24

Off-site Mitigations on BLM and NFS Lands in the Trail Creek Watershed

Agency	**Project Type**	**Mitigation Group**	**Project Name**	**Project Rationale**
Forest Service	Fuels Reduction	Stand Density Fuel Break	Upper Trail Creek Shaded Fuel Break (414 Acres)	High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the Northwest Forest Plan (NWFP). Construction of the pipeline and associated activities removes both mature and developing stands and will increase fire suppression complexity; however, the corridor also provides a fuel break. Fuels reduction adjacent to the corridor will increase the effectiveness of the corridor as a fuel break. Fuels reduction will lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire. These segments tie together as part of the Milo to Shady Cove fuel break on both BLM and NFS lands.
BLM	Fuels Reduction	Stand Density Fuel Break	Trail Creek Fuel Hazard Reduction (687 Acres)	
BLM	Fire Suppression	Fire suppression	Trail Creek Pump Chance (3 Sites)	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats by providing readily available water sources.
Forest Service	Road Decommissioning	Road Sediment Reduction	Upper Trail Creek Road Decommissioning (1.1 Miles)	Sediment has been identified by the Upper Rogue Watershed Council as a limiting factor for aquatic habitat in Trail Creek. Road decommissioning reduces habitat fragmentation, reduces road-related sediment and improves hydrologic connectivity and by reducing road density.
Forest Service	Road storm-proofing	Road Sediment Reduction	Trail Creek Road Stormproofing (0.5 Mile)	Sediment has been identified by the Upper Rogue Watershed Council as a limiting factor for aquatic habitat in Trail Creek. Stormproofing improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed.
BLM	Road Storm Proofing	Road Sediment Reduction	Trail Creek Road Stormproofing (4.3 Miles)	
BLM	Road Surfacing	Road Sediment Reduction	Trail Creek Road Resurface (16.3 Miles)	Sediment has been identified by the Upper Rogue Watershed Council as a limiting factor for aquatic habitat in Trail Creek. Road surfacing helps reduce road related sediment by providing a wear-resistant running surface and capping erodible fine sediments.
Forest Service	Snag Creation in Matrix Lands	Upland Terrestrial	Snag Creation (109 Acres)	The Pacific Connector Pipeline Project would remove current and future sources of snags, which provide a key wildlife habitat element. Snag creation replaces the existing and potential snags lost in the corridor.

TABLE 4.1.3.5-24

Off-site Mitigations on BLM and NFS Lands in the Trail Creek Watershed

Agency	Project Type	Mitigation Group	Project Name	Project Rationale
BLM	LWD instream	Aquatic Habitat	Trail Creek LWD (2.6 Miles)	Lack of large wood and recruitment of large woody debris (LWD) into streams is a consistent factor limiting aquatic habitat quality in all watersheds crossed by the Pacific Connector pipeline. Implementation of the pipeline project would result in the removal of LWD from the Riparian Reserves associated with intermittent and perennial streams. The removal of vegetation within and adjacent to the channel will preclude future recruitment of large woody debris into the channel and associated Riparian Reserves. Placing LWD at key locations within the channel and associated Riparian Reserves would offset both the short-term and long-term effects from loss of LWD recruitment to Riparian Reserves and associated aquatic and riparian habitat and contributes to the accomplishment of ACS objectives.

A site-specific amendment of the Umpqua National Forest LRMP to waive limitation on detrimental soil compaction is proposed to make provision for the Pacific Connector Pipeline Project. This proposed amendment is minor in scope and is not expected to prevent attainment of ACS objectives because of implementation of the ECRP and the fact that there are no stream intersects on NFS lands in the Trail Creek watershed (appendix J, section 2.5.3.5). Proposed amendment of the Umpqua National Forest LRMP and the Medford District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian dependent species (appendix J, section 2.5.3.5).

The routing of the pipeline through BLM and NFS lands, coupled with the relatively small area of BLM and NFS land cleared by pipeline project construction (112 acres, impacting 0.73 percent of federal lands), make it highly improbable that Project impacts could affect watershed conditions beyond the site scale. Although there are project-level impacts such as short-term sediment and a change in vegetative condition one stream crossing these would be minor and largely limited to the boundaries of the project area (appendix J, section 2.5.3.4).

No project-related impacts that would retard or prevent attainment of ACS objectives have been identified (appendix J, section 2.5.3.8). Impacts, as they relate to relevant ecological processes, are within the range of natural variability for watersheds in the Cascades and Klamath-Siskiyou Provinces, although some of these processes have been altered from their natural condition (appendix J, section 2.5.3.4).

<u>Shady Cove–Rogue River</u>

Project Impact by ACS Objective

Table 4.1.3.5-25 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Shady Cove–Rogue River watershed. The pipeline project would include 4.4 miles of corridor, three intermittent stream channel crossings, and one small forested wetland on BLM lands within the Shady Cove-Rogue River Watershed (appendix J, table 2.5.4.1-1-4). BLM lands where the ACS applies comprise approximately 22,448 acres, or approximately 30 percent of the

74,284-acre watershed. Watershed conditions and recommendations are found in the Shady-Cove Rogue River Watershed Analysis (BLM 2012) and described in detail in appendix J.

In their 2013 filing, Pacific Connector proposed a route that crossed three intermittent streams at MPs 126.5, 126.52, and 126.59 on BLM lands. Field review by the BLM indicated that these areas are moderately to severely erosive and may be difficult to revegetate if disturbed. These areas are flashy (runoff comes up rapidly with storms) because of relatively shallow soils. Based on these concerns, Pacific Connector worked closely with BLM to provide a route variation that avoided these three crossing and shifted downslope where two crossings were in a better location. This route variation was filed in January 2015. This proposed realignment reduced the acres of affected Riparian Reserves, eliminated one stream crossing, and place the corridor in an area not subject to erosion and revegetation sensitivity.

Although Pacific Connector has modified the pipeline project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve standards and guidelines, the assessment demonstrates that short-term impacts associated with the Project would occur at the site scale related to the removal of riparian vegetation, and impacts on streambanks, and substrates. With the elimination of one crossing and relocating the other two at less sensitive locations, when considering the design measures and BMPs that have been incorporated into the project, the impacts on aquatic habitat would be minor and short term at the watershed or landscape scale. This is apparent when considering the total amount of Riparian Reserves that are located within the Shady Cove–Rogue River watershed (10,930 acres) and the amount of clearing (9 acres) in Riparian Reserves within the watershed (0.13 percent) (appendix J, table 2.5.4.1-3). Further, because of the linear characteristic of the pipeline, the Riparian Reserve crossings would be spread out across the landscape and would be discontinuous. In addition, the pipeline project's Riparian Reserve crossings are associated with small intermittent streams that are not fish bearing (BLM 2012).

TABLE 4.1.3.5-25

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Shady Cove–Rogue River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed landscape scale features that would be affected by the Project. There are 8 Riparian Reserves that are affected by the Project corridor on BLM-managed lands in the Shady Cove–Rogue River watershed. No riparian reserves are affected on NFS lands. Three intermittent stream channels and one small forested wetland are crossed on BLM-managed lands. On BLM-managed lands subject to the ACS, the Project corridor is located primarily on or near ridgetops to minimize impacts on aquatic habitats. Approximately 8.5 acres or 0.12 percent of the Riparian Reserves in the Shady Cove–Rogue River watershed are potentially affected by the Project (table 2.5.4.1-3). Approximately 2.43 acres of LSOG would be removed by the Project (table 2.5.4.1-4). Impacts to aquatic systems are consistent with those described in section 1.3.1. LWD cleared in construction of the corridor or otherwise provided by Pacific Connector would be used to stabilize and restore stream crossings. Off-site mitigation measures including road improvements and resurfacing and instream LWD projects are expected to improve watershed conditions in the watershed (section 2.5.4.6). While there are long-term impacts on Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (section 2.5).

TABLE 4.1.3.5-25

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Shady Cove–Rogue River Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Pacific Connector Pipeline Project would remove approximately 6.9 acres of riparian vegetation within the Big Butte Creek Watershed, all within the McNeil Creek subwatershed where the project parallels an intermittent stream between MP 131.4 and 131.79. Although the stream is intermittent, it is likely this amount of canopy loss would affect stream channel complexity and connectivity by removing sources of large wood adjacent to the stream channel and creating chronic sources of fine sediments immediately adjacent to the stream channel. This impacts would likely retard attainment of ACS objectives. The BLM has requested a realignment at this location to move the corridor completely out of the Riparian Reserve. This would completely eliminate any possible impact on aquatic habitat connectivity. When Pacific Connector files final engineering on this realignment this evaluation will be modified to reflect that change.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	There are three intermittent stream channel crossings on BLM lands in the Shady Cove – Rogue River watershed. Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the Wetland and Waterbody Crossing Plan. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained, although in the short term (during construction) elements of the aquatic system could be disturbed. This level of disturbance is well within the range of natural variability that for watersheds of the Western Oregon Cascade Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Three intermittent stream channels are crossed on BLM-managed lands. Approximately 8.5 acres or 0.12 percent of the riparian reserves on BLM-managed lands in the Shady Cove–Rogue River watershed are potentially affected by the Project (table 2.5.4.1-3) No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (section 1.3.1) and Best Management Practices during construction.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Shady Cove–Rogue River Watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM 2012). More chronic erosion and deposition of fine sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. Riparian Reserve intersects occur at right angles to the Reserve, or minimally clip the boundary. With the elimination of one stream crossing and relocation of two others to less sensitive areas, the Project construction and operation is not likely to alter this sediment pattern nor is it likely to exacerbate these conditions. Proposed mitigation projects would contribute to reduction of sediments and restoration of aquatic functions (section 2.5.4.6.).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is unlikely to affect peak flows in the Big Butte Creek watershed because of its predominately ridgetop location, the relatively small area of the watershed affected (less than 0.05 percent of the total acres in Riparian Reserves on BLM and NFS lands), and relative lack of connectivity to aquatic systems.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project would not affect wetlands in the Big Butte Creek watershed on BLM lands, so there would be no measurable impact from the Project on water tables or seasonal inundation of these areas.

TABLE 4.1.3.5-25

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Shady Cove–Rogue River Watershed

ACS Objective	Project Impacts
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Shady Cove–Rogue River Watershed would be minor. The Project would potentially affect approximately 8.5 acres of vegetation in Riparian Reserves or 0.12 percent of the riparian reserves on BLM-managed lands in the Shady Cove–Rogue River watershed (table 2.5.4.1-3. Approximately 2.4 acres of LSOG forest would be removed (table 2.5.4.1-4) Riparian Reserve intersects occur at right angles to the Reserve, or minimally clip the boundary. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Planned mitigation measures include 2.5 miles of instream LWD which would contribute to restoration of aquatic function (section 2.5.4.6).
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the Shady Cove–Rogue River watershed would be minor. The Project would potentially affect approximately 8.5 acres of vegetation in Riparian Reserves or 0.12 percent of the riparian reserves on BLM-managed lands in the Shady Cove–Rogue River Watershed (table 2.5.4.1-3). Approximately 2.4 acres of LSOG forest would be removed (table 2.5.4.1-4. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by Project construction and operation in the watershed (see appendix M).

Summary, Shady Cove–Rogue River Watershed

The pipeline route would cross three intermittent streams and one small wetland on BLM lands. The project would also clip Riparian Reserves associated with five intermittent streams and one perennial stream but would not cross the streams. The pipeline project would remove approximately 8.5 acres of vegetation within Riparian Reserves, or approximately 0.12 percent of vegetation within Riparian Reserves on BLM lands within the watershed (appendix J, table 2.5.4.1-3). Approximately 2 acres of the riparian vegetation removed would be LSOG forest habitat (appendix J, table 2.5.4.1-4).

Stream crossings proposed in the 2013 application at MP 126.5, 126.52 and 126.59 were subject to a route variation filed with FERC in 2015 to better able to of ACS objectives. Measures in the ECRP including revegetation and maintenance of effective ground cover are likely to control surface erosion. Erosion control measures described in appendix J, section 1.3.1 for stream crossings would likely be successful at minimizing sediment associated with relocated stream crossings in the watershed. The BLM may require additional erosion control measures if needed. Since all of the streams crossed are intermittent, they are likely to be dry by late summer when water temperatures are an issue, and it is unlikely there would be any impact on water temperature.

Off-site mitigation measures, identified by the BLM, would supplement on-site minimization, mitigation, and restoration actions (appendix J, section 2.5.4.6). These proposed off-site mitigation actions are responsive to recommendations in the Shady Cove–Rogue River Watershed Analysis (BLM 2012) and would contribute to improving terrestrial and aquatic conditions within the watershed. Table 4.1.3.5-26 describes proposed off-site mitigations in the Shady Cove–Rogue River watershed.

TABLE 4.1.3.5-26

Proposed Off-site Mitigations on BLM Lands in the Shady Cove–Rogue River Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Fuels Reduction	Stand Density Fuel Break	Shady Cove Fuel Hazard Reduction 866 acres	High intensity fire has been identified as the single factor most impacting late successional and old-growth (LSOG) forest habitats on federal lands in the area of the Northwest Forest Plan (NWFP). Construction of the Pacific Connector pipeline and associated activities would remove both mature and developing stands and would increase fire suppression complexity; however, the corridor would also provide a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire. This segment is part of the Milo to Shady Cove fuel break and would tie in with similar projects on the Umpqua National Forest.
Fuels Reduction	Stand Density Fuel Break	Shady Cove Fuel Hazard Maintenance 866 acres	This would provide a mechanism for maintenance of fuel breaks over time for the life of the pipeline project.
Large Woody Debris (LWD) Instream	Aquatic Habitat	Shady Cove LWD 2.5 miles (Estimated 15 acres of aquatic habitat)	Lack of large wood and recruitment of LWD into streams is a consistent factor limiting aquatic habitat quality in all watersheds crossed by the Pacific Connector pipeline. Implementation of the pipeline project would result in the removal of LWD from the Riparian Reserves associated with intermittent and perennial streams. The removal of vegetation within and adjacent to the channel would preclude future recruitment of LWD into the channel and associated Riparian Reserves. Placing LWD at key locations within the channel and associated Riparian Reserves would offset both the short-term and long-term impacts from loss of LWD recruitment to Riparian Reserves and associated aquatic and riparian habitat and would contribute to the accomplishment of Aquatic Conservation Strategy (ACS) objectives.
Road Drainage and Surface Enhancement	Road Sediment Reduction	Shady Cove Road Improvement 1.0 mile	Sediment has been identified by the Upper Rogue Watershed Council as a limiting factor for aquatic habitat in Upper Rogue. The effects of the pipeline project would be similar to those of a road, including habitat fragmentation and potential impacts to flow and sediment regimes. Improvement of existing roads would restore hydrologic connectivity and reduce sediment by managing drainage and restoring surfacing where needed.
Road Surfacing	Road Sediment Reduction	Shady Cove Road Resurface 1.5 miles	Sediment has been identified by the Upper Rogue Watershed Council as a limiting factor for aquatic habitat in the Upper Rogue. The effects of the pipeline project would be similar to those of a road, including the potential for sediment mobilization and transport. Road surfacing helps reduce road related sediment by providing a wear-resistant running surface and capping erodible fine sediments.

The routing of the pipeline through the relatively small area of BLM land that would be affected by pipeline project construction (74 acres or 0.33 percent of BLM lands and 0.19 percent of the all ownerships in the watershed) makes it highly improbable that project impacts would affect watershed conditions beyond the site scale considering the route variation. Although there are project-level impacts (e.g., short-term sediment and a change in vegetative condition at stream crossings), these would be minor and largely limited to the boundaries of the project area (appendix J, section 2.5.4.4).

Considering the route variations that eliminated one crossing and relocated two others, no project-related impacts that would retard or prevent attainment of ACS objectives have been identified (appendix J, section 2.5.4.8). Impacts, except as noted, would be within the range of natural variability for watersheds in the Western Cascades and Klamath Mountain Provinces although some of these processes have been altered from their natural condition (appendix J, section 2.5.4.4). Proposed amendment of the Medford District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.5.4.5).

Big Butte Creek

Project Impacts by ACS Objective

Table 4.1.3.5-27 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Big Butte Creek watershed. The pipeline project would include 0.82 miles of corridor and two intermittent stream crossings on BLM lands within the Big Butte Creek watershed where the ACS applies. Approximately 7 acres, or 0.05 percent of the Riparian Reserves on BLM and NFS lands in the watershed, are affected. BLM lands in the McNeil Creek subwatershed, where all of the pipeline would occur, comprise approximately 3,426 acres (21 percent) of the 16,292-acre subwatershed. From MP 131.4 to 131.78, the filed Project alignment lies parallel to an adjacent intermittent stream and largely overlays the associated Riparian Reserve. Because of the close proximity to the adjacent stream, construction of the project in this location would cause substantial impacts on riparian vegetation on the east side of the channel, and likely cause this reach to become a chronic source of sediment. These impacts would likely retard attainment of ACS objectives at this location. The BLM has requested Pacific Connector realign this section to reduce potential sediment and impacts on Riparian Reserves. The applicant has developed a proposed realignment that would move the corridor to an adjacent ridgetop that is entirely outside of the Riparian Reserve. This proposed realignment would eliminate Riparian Reserve and sediment impacts at this location. When engineering has been completed and the applicant has filed this realignment with FERC, this assessment will be modified to reflect that change. Watershed conditions and recommendations are found in the Upper Big Butte Watershed Analysis (BLM 1995a), Central Big Butte Creek, Big Butte Watershed Analysis (BLM 1995b) and the Big Butte Creek Water Quality Restoration Plan (BLM 2008a) and described in detail in appendix J.

TABLE 4.1.3.5-27

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Big Butte Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed landscape scale features that would be affected by the Project. There are three riparian reserves that are affected by the Project corridor on BLM lands in the watershed. No riparian reserves are affected on NFS lands. Two intermittent stream channels are crossed on BLM lands. On BLM lands subject to the ACS, the Project corridor is located primarily on or near ridgetops to minimize impacts on aquatic habitats. From MP 131.4 to 131.78, the Project would closely parallel an intermittent stream and would clear most of the riparian vegetation on the east side of the stream. This is a disproportionate impact when compared to crossings at right angles to streams that are typical of the project. At the request of the BLM, the applicant has developed an alternative alignment that would move the corridor to an adjacent ridge and completely avoid impacts to the Riparian Reserve. When engineering is completed on this realignment and it has been filed with FERC, this assessment will be modified to reflect that change. Approximately 7 acres or 0.05 percent of the riparian reserves in the watershed would be affected by the Project. Most of those acres are affected by the reach described above. The proposed realignment would eliminate most impacts on Riparian Reserves in the Big Butte Creek watershed. Off-site mitigation measures including resurfacing would improve conditions in the watershed (see appendix J, section 2.5.5.5). Except as noted above, while there are long-term impacts on Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed.

TABLE 4.1.3.5-27

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Big Butte Creek Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Pacific Connector Pipeline Project would remove approximately 7 acres of riparian vegetation within the Big Butte Creek Watershed, all within the McNeil Creek subwatershed where the project parallels an intermittent stream between MP 131.4 and 131.79. Although the stream is intermittent, it is likely this amount of canopy loss would affect stream channel complexity and connectivity by removing sources of large wood adjacent to the stream channel and creating chronic sources of fine sediments immediately adjacent to the stream channel. This impacts would likely retard attainment of ACS objectives. The BLM has requested a realignment at this location to move the corridor completely out of the Riparian Reserve. This would completely eliminate any possible impact on aquatic habitat connectivity. When Pacific Connector files final engineering on this realignment this evaluation will be modified to reflect that change.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	From MP 131.4 to 131.78, the project would closely parallel an intermittent stream and would clear most of the riparian vegetation on the east side of the stream. This is a disproportionate impact when compared to crossings at right angles to streams that are typical of the project. Construction at this location would likely not maintain the integrity of the aquatic system. At the request of the BLM, the applicant has developed an alternative alignment that would move the corridor to an adjacent ridge and completely avoid impacts to the Riparian Reserve. When engineering is completed on this realignment and it has been filed with FERC, this assessment will be modified to reflect that change. Although the stream is intermittent, it is likely this amount of canopy loss would affect stream channel complexity by removing sources of large wood adjacent to the stream channel and creating chronic sources of fine sediments immediately adjacent to the stream channel. This impacts would likely retard attainment of ACS objectives. The BLM has requested a realignment at this location to move the corridor completely out of the Riparian Reserve. This would completely eliminate any possible impact on aquatic habitat and channel complexity. When Pacific Connector files final engineering on this realignment this evaluation will be modified to reflect that change
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Two intermittent stream channels are crossed on BLM-managed lands. Approximately 7 acres or 0.05 percent of the riparian reserves in the Big Butte Creek Watershed are potentially affected by the Project all within the McNeil Creek subwatershed where the project parallels an intermittent stream between MP 131.4 and 131.79. Although the stream is intermittent, it is likely this amount of canopy loss would affect water temperature early in the summer. This impacts would likely retard attainment of ACS objectives. The BLM has requested a realignment at this location to move the corridor completely out of the Riparian Reserve. This would completely eliminate any possible impact on aquatic habitat and channel complexity. When Pacific Connector files final engineering on this realignment this evaluation will be modified to reflect that change.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	From MP 131.4 to 131.78, the project would closely parallel an intermittent stream and would clear most of the riparian vegetation on the east side of the stream channel. If constructed as proposed, this site would likely become a chronic source of sediment because of the adjacency of the stream channel to the project corridor. It is likely these impacts would retard attainment of ACS objectives. At the request of the BLM, the applicant has developed an alternative alignment that would move the corridor to an adjacent ridge completely out of the Riparian Reserve. When engineering is complete and the realignment has been filed with FERC, this assessment will be modified to address the change. The Big Butte Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM 1999d). More chronic erosion and deposition of fine sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. With the exception noted above, the Project construction and operation is not likely to alter this sediment pattern nor is it likely to exacerbate these conditions. Proposed mitigation projects including road resurfacing would contribute to reduction of sediments and restoration of aquatic functions (Appendix J, section 2.5.5.6).

Summary, Big Butte Creek Watershed

Forests on BLM lands within the Medford District in the Big Butte Creek watershed would be affected over the long term by construction and operation of the Pacific Connector Pipeline Project.

The pipeline project would not affect any NFS lands in the watershed. Approximately 7 acres of vegetation would be cleared on BLM lands within the watershed. This represents approximately 0.05 percent of BLM lands within the watershed (appendix J, table 2.5.5.1-3). While this is a long-term change in vegetative condition, it is limited to the site scale and is within the range of natural variability for changes in vegetative condition given the fire history of the watershed.

From MPs 131.4 to 131.78, the pipeline project would closely parallel an intermittent stream and would clear most of the riparian vegetation on the east side of the stream. This is a disproportionate impact when compared to crossings at right angles to streams that are typical of the project. Construction at this location would likely become a chronic source of sediment and would not maintain the integrity of the aquatic system. These impacts would likely retard attainment of ACS objectives at this location. At the request of the BLM, the applicant has developed an alternative alignment that would move the corridor to an adjacent ridge and completely avoid impacts to the Riparian Reserve. When engineering is completed on this realignment and it has been filed with FERC, this assessment will be modified to reflect that change.

The pipeline would cross two intermittent streams within the Big Butte Creek Watershed on BLM land on the filed alignment. The proposed realignment discussed above would eliminate these crossings. Except as noted above, measures in the ECRP including re-vegetation and maintenance of effective ground cover are likely to control surface erosion. Erosion control measures described in appendix J, section 1.3.1 for stream crossings would likely be successful at minimizing sediment associated with stream channel crossings in the watershed. The BLM may require additional erosion control measures if needed Impacts on stream temperature are unlikely because the affected channels are intermittent streams.

Off-site mitigation measures, identified by the BLM, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation actions are responsive to recommendations in the Big Butte Creek Water Quality Restoration Plan (BLM 2008a) and would contribute to improving terrestrial and aquatic conditions within the watershed (appendix J, section 2.5.5.6). Table 4.1.3.5-28 describes proposed off-site mitigations in the Big Butte Creek watershed.

TABLE 4.1.3.5-28

Proposed Off-site Mitigations on BLM Lands in the Big Butte Creek Watershed

Project Type	Mitigation Group	Project Name	Project Rationale
Fire Suppression	Fire suppression	Big Butte Creek Pump Chance 1 site	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats by providing readily available water sources.
Road Surfacing	Road Sediment Reduction	Big Butte Creek Road storm-proofing 6.4 miles	Sediment was identified by the Upper Rogue Watershed Council as a factor that limited aquatic habitat in Big Butte Creek. The effects of the Pacific Connector Pipeline Project are similar to those of a road, including possible impacts to flow and sediment regimes. Improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed.

Except as noted above, the routing of the pipeline through the relatively small area of BLM land that would be affected by pipeline project construction (approximately 14 acres) makes it highly improbable that project impacts would affect watershed conditions beyond minor, short-term impacts at the site scale on two isolated intermittent streams. Impacts on Riparian Reserves could be further reduced by realignment to get the corridor out of the Riparian Reserves at MP 131.4 to 131.78. Although there are project-level impacts (e.g., short-term sediment and a change in vegetative condition at stream crossings), these would be minor and would be largely limited to the boundaries of the project area except as noted above. Proposed amendment of the Medford District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the pipeline project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.5.5.5).

Except as noted above, no project-related impacts that would prevent attainment of ACS objectives have been identified (appendix J, section 2.5.5.8). Impacts, as they relate to relevant ecological processes, would be within the range of natural variability for watersheds in the Western Oregon and High Cascade Provinces although some of these processes have been altered from their natural condition (appendix J, section 2.5.5.4).

Little Butte Creek

Project Impacts by ACS Objective

Table 4.1.3.5-29 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Little Butte Creek watershed. BLM and NFS lands where the ACS applies comprise approximately 114,658 acres or 48 percent of the Little Butte Creek watershed (appendix J, table 2.5.6.1-1). Riparian Reserves comprise approximately 10,785 acres (about 9.4 percent of the watershed) on BLM and NFS lands. Watershed conditions and recommendations are found in the Little Butte Creek Watershed Analysis (BLM and Forest Service 1997) and described in detail in appendix J of this EIS. The pipeline project would include 6 miles on BLM lands and 14 miles on NFS lands. A total of about 18 acres or 0.17 percent of the Riparian Reserves would be cleared in the watershed on federal lands:

- One perennial stream channel crossing,
- Seven intermittent stream channel crossings, and
- Two intermittent stream and one wetland where Riparian Reserves are clipped, but the associated waterbodies are not crossed by the pipeline project.

TABLE 4.1.3.5-29

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The Pacific Connector Pipeline Project would clear about 18 acres or about 0.17 percent of Riparian Reserves on BLM and NFS lands in Little Butte Creek (appendix J, table 2.5.4.1-2, 4). There are seven intermittent and one perennial stream channels crossed in the Little Butte Creek watershed. Impacts to aquatic systems are expected to be short-term and minor and limited to the project scale because of application of best management practices and erosion control measures (appendix J, sections 2.5.6.4 and 1.3.1). Large woody debris (LWD) cleared in construction of the corridor would be used to stabilize and restore stream crossings. Off-site mitigation measures including road stormproofing and over 65 miles of road decommissioning, over 9 miles of instream projects, snag creation, and coarse woody debris placement are expected to improve watershed conditions in the Little Butte Creek watershed (appendix J, section 2.5.6.6). While there would be long-term changes in vegetation in Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (appendix J, section 2.5.6.4).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15 feet wide). This level of disturbance is comparable to a bank slough (appendix J, section 1.3.1.) and well within the range of natural variability that for watersheds of the Klamath–Siskiyou Province and High Cascades Province (appendix J, section 2.5.6.4). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the POD requirements. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Little Butte Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the *Wetland and Waterbody Crossing Plan*. At each crossing, bed and bank disturbances from equipment crossing and trenching are small (<15 feet wide). After construction all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary construction right-of-way would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the *Erosion Control and Revegetation Plan* (ECRP). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossings, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the Oregon Department of Fish and Wildlife in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 18 acres) would contribute to restoration of aquatic connectivity. The residual levels of disturbance are anticipated to be well within the range of natural variability in the Klamath–Siskiyou Province and High Cascades Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction. These impacts are expected to be short-term and limited to the general area of construction (see appendix J, section 1.3.1). No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (see appendix J, section 1.3.1) and Best Management Practices during construction (appendix J, section 1.3.1.1). Effective shade would be removed at the crossing of the South Fork Little Butte Creek at MP 162.45. A site-specific shade analysis (NSR 2009) found no temperature impacts at the site or at the stream network scale at this crossing.

TABLE 4.1.3.5-29

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Little Butte Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM and Forest Service 1997). The current sediment regime in the watershed has replaced these pulse-type disturbances with more chronic erosion and deposition of fine sediments primarily from urban and agricultural land use, timber harvest and roads. The pipeline project construction and operation are not likely to alter this sediment pattern nor are they likely to exacerbate these conditions because of implementation of measures in the ECRP (appendix J, section 1.3.1) including maintenance of effective ground cover, water bars to dissipate overland flows and maintenance of sediment barriers until revegetation is successful. Sediment impacts from construction are expected to be similar to those described in appendix J, section 1.3.1.2. Proposed mitigation projects including road resurfacing and decommissioning would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale (appendix J, section 2.5.6.6). Any sediment impacts are expected to be well within the range of natural variability given the disturbance history of the Little Butte Creek Watershed (appendix J, section 2.6.5.4). A pulse of sediment could be observed following the first seasonal rain, but that this sediment-laden water is likely to dissipate within a few hundred feet and would be indistinguishable from background levels.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project is unlikely to affect peak flows in the Little Butte Creek watershed because of the dispersed nature of impacts, the current hydrologically recovered conditions in the watershed, the relatively small proportion of the watershed affected and the relative lack of connectivity to aquatic systems (appendix J, section 2.5.6.4). Decommissioning roads (66.2 miles) as part of the off-site mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (appendix J, section 2.5.6.6).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Pacific Connector Pipeline Project crosses one small (<0.1 acre) wetland in the Little Butte Creek Watershed. Trench plugs would be used at the edge of the wetland area if any are encountered to minimize drainage by the pipeline trench. Decommissioning 66.3 miles of roads, 18 acres of which are in Riparian Reserves (appendix J, section 2.5.6.6) would contribute substantially to restoring floodplain functions where these projects occur.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 20 acres or 0.18 percent of the Riparian Reserves in the watershed on federal lands are potentially affected by the pipeline project (appendix J, table 2.5.6.1-4). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Coarse wood placement and snag creation on 126 acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (appendix J, section 2.5.6.6).
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Pipeline project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 20 acres or 0.18 percent of the Riparian Reserves in the watershed on federal lands are potentially affected by the project. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Coarse wood placement and snag creation on 126 acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (appendix J, Section 2.5.6.4). No riparian-dependent Survey and Manage species have been identified whose persistence would be threatened by the pipeline project (appendix J, section 2.5.6.5)

Summary, Little Butte Creek Watershed

Little Butte Creek is the largest, and in some ways, the most complex, watershed crossed by the Pacific Connector Pipeline Project. With 19.7 miles of corridor and 327 acres of clearing on BLM and NFS lands, this watershed has the most federal land area affected of the 19 watersheds crossed by the pipeline project. Little Butte Creek is geologically complex with both Klamath-Siskiyou Province and High Cascade Province landscapes. It is ecologically diverse and important, providing some of the most productive coho salmon streams in the Upper Rogue Basin. Little Butte Creek is a Tier One Key Watershed above the confluence of the North and South Forks, and all of the NFS lands in the watershed are managed as LSR (appendix J, section 2.5.6.1). Against this backdrop, compliance with the ACS is an important measure of pipeline project impacts.

Pacific Connector has modified their pipeline project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve standards and guidelines. The assessment demonstrates that short-term impacts associated with the pipeline project would occur to streambanks, and substrates at the site scale. Change in vegetative condition from clearing of forest within the pipeline construction corridor is a long-term impact. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (appendix J, section 2.5.4.4; table 2.5.4.2-1). This is especially apparent when considering the total amount of Riparian Reserves that are located within the Little Butte Creek watershed (10,791 acres) and the amount of clearing (18 acres) in Riparian Reserves (0.17 percent of the Riparian Reserves in the watershed) (appendix J, table 2.5.6.1-3). Also, because of the linear characteristic of the pipeline, the Riparian Reserve crossings would be spread out across the landscape and would be discontinuous.

Off-site mitigation measures including over 66 miles of road decommissioning (53 miles are within the Key Watershed), 9.6 miles of LWD instream projects, 21.8 miles of road resurfacing, identified by the BLM and Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Little Butte Creek Watershed Assessment (BLM and Forest Service 1997) and the South Cascades Late-Successional Reserve Assessment (Forest Service et al. 1998). Mitigation associated with the pipeline project is responsive to watershed analysis recommendations and would improve watershed conditions where they are applied (appendix J, section 2.5.6.4). Table 4.1.3.5-30 describes proposed mitigation measures in the Little Butte Creek watershed.

Three site-specific amendments of the Rogue River National Forest LRMP and one amendment of the Medford District RMP related to the ACS are proposed to make provision for the pipeline project (appendix J, section 2.5.6.5):

- Proposed amendment RRNF-5 would allow the Pacific Connector Pipeline Project to cross the MA-26 Restricted Riparian land allocation at one location on the South Fork of Little Butte Creek. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009) showed there would be no temperature increase from shade removal at this location, effective ground cover and sediment barriers would be maintained and implementation of the ECRP is expected to control surface erosion and reestablish native vegetation.
- Proposed amendment RRNF-6 would allow the Pacific Connector Pipeline Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4).

- Proposed amendment of the Rogue River National Forest LRMP and the Medford District RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the Pacific Connector Pipeline Project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.8.5).

The Pacific Connector Pipeline Project is otherwise consistent with standards and guidelines for activities in Riparian Reserves for the Rogue River National Forest and the Medford District, BLM.

The routing of the pipeline through BLM and NFS lands, coupled with the relatively small area of BLM and NFS land affected by pipeline project construction (0.20 percent of BLM lands and 0.49 percent of NFS lands of the fifth-field watershed), makes it highly improbable that project impacts could affect watershed conditions. The relative lack of intersections with aquatic systems serves to further minimize possible impacts (appendix J, section 2.5.6.1). Although there are project-level impacts from short-term sediment and long-term change in vegetative condition at stream crossings), these would be minor in scale (appendix J, section 2.5.6.4).

No project-related impacts that would prevent attainment of ACS objectives have been identified (appendix J, section 2.5.6.8). All relevant pipeline project impacts are within the range of natural variability for watersheds in the Klamath-Siskiyou and High Cascades Provinces, although some of these processes have been altered from their natural condition (appendix J, section 2.5.6.4).

TABLE 4.1.3.5-30

Proposed Mitigation Measures on BLM and NFS Lands in the Little Butte Creek Watershed

Admin Unit	Mitigation Group	Project Name	Quantity	Unit	Project Rationale	Land Allocation
Medford BLM	Aquatic and Riparian Habitat	Little Butte Cr. Fish Screen	1	site	Irrigation diversions have negatively impacted fisheries in Little Butte Creek by causing entrapment. There is a private irrigation ditch with an unscreened diversion and associated push up dam on BLM land in the lower 1.5 miles of Lost Creek. The unscreened ditch is currently accessible to juvenile and adult fish, creating a stranding hazard with limited return access to the main channel. The pus- up dam is constructed at the beginning of the irrigation season and removed at the end of the season. This stream is considered coho critical habitat and building a push up dam in the creek each season disturbs gravels, generates sediment and creates an unnecessary disturbance during steelhead spawning season. Creating a permanent diversion structure, possibly in the form of a boulder weir, would divert water without yearly maintenance and would provide for both upstream and downstream fish passage.	Riparian Reserve
Medford BLM	Aquatic and Riparian Habitat	Lost Cr. Instream LWD	8.6	miles	Lost Cr. provides habitat for Coho Salmon. Lack of large wood and recruitment of LWD into streams is a consistent factor limiting aquatic habitat quality in all watersheds crossed by the Pacific Connector pipeline. Implementation of the Pacific Connector Pipeline Project would result in the removal of large woody debris from the Riparian Reserves associated with intermittent and perennial streams. The removal of vegetation within and adjacent to the channel would preclude future recruitment of large woody debris into the channel and associated Riparian Reserves. Placing large woody debris at key locations within the channel and associated Riparian Reserves would offset both the short-term and long-term impacts from loss of LWD recruitment to Riparian Reserves and associated aquatic and riparian habitat and contributes to the accomplishment of ACS objectives.	Riparian Reserve
Medford BLM	Fire suppression	Little Butte Cr. Pump Chance	8	sites	Construction of the pipeline and associated activities would increase fire suppression complexity. Pump chances increase capacity for agency response and help reduce potential fire losses to valuable habitats by providing readily available water sources.	All
Medford BLM	Road Sediment Reduction	Little Butte Cr. Road Improvement	3.5	miles	Sediment has been identified by the LBC Watershed Council as a limiting factor for aquatic habitat in Little Butte Creek. The Pacific Connector pipeline has approximately 6 miles of corridor and 7 stream crossings on BLM lands in the LBC fifth-field watershed. The effects of the Pacific Connector pipeline are similar to a road, including possible impacts to flow and sediment regimes. Improvement of existing roads restores hydrologic connectivity and reduces sediment by managing drainage and restoring surfacing where needed.	Riparian Reserve, Matrix
Medford BLM	Road Sediment Reduction	Little Butte Cr. Road Decommissioning Butte Falls RA	2.4	miles	Sediment has been identified by the LBC Watershed Council as a limiting factor for aquatic habitat in Little Butte Creek. There are approximately 6 miles of the Pacific Connector pipeline corridor and 7 stream crossings on BLM lands in LBC. The effects of the Pacific Connector pipeline include habitat fragmentation and potential impacts to flow and sediment regimes. Road decommissioning reduces habitat fragmentation, reduces road-related sediment and improves hydrologic connectivity by reducing road density.	

TABLE 4.1.3.5-30

Proposed Mitigation Measures on BLM and NFS Lands in the Little Butte Creek Watershed

Admin Unit	Mitigation Group	Project Name	Quantity	Unit	Project Rationale	Land Allocation
Medford BLM	Road Sediment Reduction	Little Butte Cr. Road Resurfacing Ashland Resource Area	9.0	miles	Sediment has been identified by the LBC Watershed Council as a limiting factor for aquatic habitat in Little Butte Creek. The Pacific Connector pipeline has approximately 6 miles of corridor and 7 stream crossings on BLM lands in the LBC fifth-field watershed. The effects of the pipeline include the potential for sediment mobilization and transport. Road improvement efforts (resurfacing) help restore hydrologic and reduce road-related sediment that could be delivered to stream channels.	Riparian Reserve, Matrix
RRNF	Aquatic and Riparian Habitat	SF Little Butte Cr. LWD	1.5	Mile	Over the last century, many streams with high aquatic habitat potential have become simplified, and therefore, have a reduced capacity to provide quality habitat. Riparian stands have decreased health and vigor, resulting in increased time to develop large tree structure for wildlife, stream shade, and future instream wood. Placement of LWD in streams adds structural complexity to aquatic systems, traps fine sediments and can contribute to reductions in stream temperatures over time. The BLM completed placement last year on 3 miles of Spencer Creek below this reach. Addition of this segment would complete the stream rehabilitation on the reach of Spencer Creek where the project occurs. Logs from the Project right-of-way would be used for the project. An estimated 75 pieces are needed. A helicopter would be used to place the logs.	Riparian Reserve, LSR
RRNF	Aquatic and Riparian Habitat	Little Butte Cr. Stream Crossing Decommissioning	32	Sites	Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline right-of-way crossings.	Riparian Reserve
RRNF	Road sediment reduction	Little Butte Cr. Road Decommissioning	53.2	Miles	A construction corridor 75 to 95 feet wide with additional work areas would be cleared. Of this, a 30-foot-wide route along the pipeline route would be maintained in early successional habitat. This strip of land, in a forested ecosystem, provides a barrier for movement of small animals between the remaining forest blocks and degrades neighboring habitat through edge effects and fragmentation. This is of special concern in riparian ecosystems where movement of wildlife species is concentrated. Decommissioning and planting selected roads in conjunction with precommercial thinning treatments (see other mitigations) would block up forested habitat and reduce edge effects and fragmentation in a period of about 40 years. Removal of culverts and roadbeds in riparian reduces sedimentation to the waters. This mitigation meets ACS objectives 2, 4, 5, 8 & 9. Little Butte Creek is a key watershed and road reduction is a major objective (NWFP ROD C-7). Note that this would be most effective if done in conjunction with the thinning proposed. This mitigation also offsets the impacts of soil compaction and displacement within the construction right-of-way.	Riparian Reserve, LSR

TABLE 4.1.3.5-30

Proposed Mitigation Measures on BLM and NFS Lands in the Little Butte Creek Watershed

Admin Unit	Mitigation Group	Project Name	Quantity	Unit	Project Rationale	Land Allocation
RRNF	Stand Density Fuel Break	Little Butte Cr LSR Precommercial Thin	617	Acres	There would be direct impacts to existing interior, developing interior habitat. The Pacific Connector project would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Maintenance of pipeline corridor would provide a continued vector for predators, early-seral species and non-native species. Also the Project would result in a direct loss in biological services provided by mature forest characteristics for many decades past the life of this Project. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction. Thinning of young stands is a recognized treatment within LRSs if designed to accelerate development of late-successional habitat characteristics (NWFP ROD C-12; ROD Pages B-11 ACS Objectives, C-11 and C-17).	LSR
RRNF	Terrestrial Habitat Improvement	Little Butte Cr. Mardon Skipper Butterfly	20	Acres	The Dead Indian Plateau region is one of three known sites for Mardon skipper butterflies in the world. It is also adjacent to a known site for short-horned grasshoppers. Both species are on the Forest's Sensitive Species list. The pipeline requirement of a permanent open corridor provides a unique opportunity to develop habitat for these skippers and grasshoppers. Planting the corridor with plants preferred by these Sensitive Species has the potential to increase the habitat and local range for these two species. Rehabilitation of disturbed sites is required under various BMP guidelines. Use of specific plant species has no additional problems. Results would be immediate in stabilizing the local habitat and location would be in the pipeline.	LSR
RRNF	Terrestrial Habitat Improvement	Little Butte Cr. LSR LWD Placement	306	Acres	Mitigate for the loss of recruitment of large down wood to adjacent stands and within the construction clearing zone. The project would forgo the development of large down wood for the life of the Project and for decades after. Downed wood is a critical component of Mature Forest ecosystems. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Managing for the proposed levels provide for a greater assurance of species abundance (DecAID; ROD C-11). Acres that can be treated are necessarily limited by material available from the corridor.	LSR

TABLE 4.1.3.5-30

Proposed Mitigation Measures on BLM and NFS Lands in the Little Butte Creek Watershed

Admin Unit	Mitigation Group	Project Name	Quantity	Unit	Project Rationale	Land Allocation
RRNF	Terrestrial Habitat Improvement	Little Butte Cr. LSR Snag Creation	622	Acres	Mitigate immediate and future impacts to snag habitat from the clearing of the pipeline right-of-way. The project prevents development of large snags during the life of the project and for decades after. Corridor construction would result in loss of snag habitat on approximately 775 acres of corridor construction (includes safety zone buffer). This project would add to those cumulative impacts. As snags are a critical component of LSR spotted owl habitat, replacement is needed. Snag requirements are specifically outlined in the Forests' LMPs and NWFP. Forests require analysis and mitigation under most management activities. There would be a 10-year delay as snag decay develops. Snag management is required in the Rogue River National Forest LMP (4-20), with levels set under the various management directions. Snag Management is discussed in the NWFP for LSRs on C-14 and 15 of the ROD (items 4 and 7). Snag management levels are based on the Forest's Plant Association Guidelines. Snags are also discussed in the South Cascades LSR Assessment (Chap. 3).	LSR
RRNF	Reallocation of Matrix Lands to LSR	LSR 227 Addition	12	Acres	This is the Little Butte Creek portion of amendment RRNF 7 which would reallocate 512 acres from the Matrix land allocation to the LSR land allocation. This action contributes to the "neutral to beneficial" standard for new developments in LSRs by adding acres to the LSR land allocation to offset the long-term loss of acres of acres and habitat from the construction and operation of the Pacific Connector Pipeline Project.	LSR

Spencer Creek

Project Impacts by ACS Objective

Table 4.1.3.5-31 compares the Pacific Connector Pipeline Project impacts to the objectives of the ACS for the Spencer Creek watershed. BLM and NFS lands where the ACS applies comprise approximately 57 percent of the Spencer Creek watershed (appendix J, table 2.6.3.1-1). Watershed conditions and recommendations are found in the Spencer Creek Watershed Analysis (BLM et al. 1995) and described in detail in appendix J. The pipeline project would include 1.0 miles of right-of-way on BLM lands and 6 miles on NFS lands. A total of 9 acres of Riparian Reserves or 1.19 percent of the Riparian Reserves in the watershed (appendix J, table 2.6.3.1-4) would be affected on:

- Five intermittent stream channels and two wetlands crossed by the Pacific Connector Pipeline Project.
- Four intermittent streams and two wetlands where Riparian Reserves are clipped but the associated stream channel or wetland is not crossed.

TABLE 4.1.3.5-31

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The Pacific Connector Pipeline Project would affect about 9 acres or about 1.19 percent of Riparian Reserves on BLM and NFS lands in the Spencer Creek watershed (appendix J, table 2.6.3.1-3). There are five intermittent stream channels crossed in the Spencer Creek watershed. No perennial streams are crossed. Riparian Reserves associated with two forested wetlands and four intermittent streams are clipped. Impacts to aquatic systems are expected to be short-term or minor and limited to the project scale because of application of best management practices and erosion control measures (appendix J, sections 2.6.3.4 and 1.3.1.). Clearing of 5.41 acres of late successional and old-growth (LSOG) vegetation in Riparian Reserves is a long-term change in condition, but is minor in scale, and within the range of natural variability given the disturbance processes in Spencer Creek (appendix J, section 2.6.3.4). Spencer Creek watershed remains above the 15 percent threshold for LSOG vegetation established in the Northwest Forest Plan (NWFP) (appendix J, section 2.6.3.5). Large woody debris (LWD) cleared in construction of the corridor would be used to stabilize and restore stream crossings. Off-site mitigation measures including road stormproofing and over 21 miles of road decommissioning, 1.5 miles of instream projects, fencing and riparian planting projects are expected to improve watershed conditions in the Spencer Creek watershed. While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (appendix J, section 2.6.2.6).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15 feet wide). This level of disturbance is comparable to a bank slough (appendix J, section 1.3.1.2) and well within the range of natural variability for watersheds of the High Cascades Province (appendix J, section 2.6.3.4). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions, consistent with the *Wetland and Waterbody Crossing Plan*. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained. Off-site mitigation measures (appendix J, section 2.6.3.6) would substantively improve watershed conditions by decommissioning 21.5 miles of roads (36 acres total of which 13 acres are in riparian reserves), replanting willows along 0.5 mile of perennial streams and restoring LWD in 1.5 miles of Spencer Creek.

TABLE 4.1.3.5-31

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The pipeline project is not expected to affect spatial or temporal connectivity in the Spencer Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the POD (i.e., *Wetland and Waterbody Crossing Plan*). Additionally, all of the channel crossed in Spencer Creek are intermittent and are likely to be dry at the time of crossing. In the short-term during construction connectivity could be disrupted for 1 to 5 days. At each crossing, bed and bank disturbances are small (<15 feet wide). After construction all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary construction right-of-way would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the *Erosion Control and Revegetation Plan* (ECRP). After construction, key habitat components such as LWD and boulders would be restored on-site and the bed and banks would be returned to pre-construction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. With the exception of a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 13 acres) would contribute to restoration of aquatic connectivity (appendix J, section 2.6.3.6). The residual levels of disturbance are anticipated to be well within the range of natural variability in the High Cascades Province (appendix J, section 2.6.3.4).
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Pipeline stream crossings in Spencer Creek are expected to occur when intermittent stream channels are dry. Minor amounts of sediment would be generated during construction that may be mobilized during the onset of seasonal precipitation in the fall. These impacts are expected to be short term and limited to the general area of construction (see appendix J, section 1.3.1). No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (see appendix J, section 1.3.1) and best management practices during construction (appendix J, sections 1.3.1.1 and 2.6..3.4) Off-site mitigation measures (appendix J, section 2.6.3.6) address key issues identified in the watershed assessment and are expected to substantially improve watershed conditions.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Spencer Creek Watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from streambank erosion following major disturbances such as fires and high-intensity winter storms. More chronic erosion and deposition of fine sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. The Pacific Connector Pipeline Project construction and operation are not likely to alter this sediment pattern nor are they likely to exacerbate these conditions. Sediment impacts from construction are expected to be similar to those described in appendix J, section 1.3.1.2. Proposed mitigation projects including 21.5 miles of road decommissioning would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale. Any sediment impacts are expected to be well within the range of natural variability given the disturbance history of the Spencer Creek watershed (appendix J, section 2.6.3.4).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The pipeline project is unlikely to affect flow patterns in the Spencer Creek watershed because of the dispersed nature of impacts, high infiltration rates and the relatively small proportion of the watershed affected (appendix J, section 2.6.3.4). Decommissioning roads (21.5 miles) as part of the off-site mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (appendix J, section 2.6.3.6).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The pipeline project corridor crosses two small wetland areas and clips the Riparian Reserve of another two forested wetlands. Trench plugs would be installed on each side of these wetlands as needed to block subsurface flows and maintain water table elevations, as required by FERC's *Wetland and Waterbody Construction and Mitigation Procedures*. Regardless, pipeline project construction may have short-term impacts on water tables in these isolated forest wetlands. These crossings may also regulated under Section 404 of the Clean Water Act. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on water tables of these wetland areas are expected to be minor and short term.

TABLE 4.1.3.5-31

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Pipeline project impacts on riparian vegetation in the Spencer Creek Watershed would be minor. Approximately 9 acres or 1.19 percent of the Riparian Reserves in the watershed are potentially affected by the project (appendix J, table 2.6.3.1-3). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Revegetation of 13 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (appendix J, section 2.6.3.6).
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Pipeline project impacts on riparian vegetation in the Spencer Creek Watershed would be minor. Approximately 9 acres or 1.19 percent of the Riparian Reserves in the watershed are potentially affected by the project. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. Revegetation on 13 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves. The persistence of riparian-dependent Survey and Manage species would not be threatened by pipeline construction and operation in the watershed (see appendix K of this EIS).

Summary, Spencer Creek Watershed

Spencer Creek is the easternmost and driest watershed that is crossed by the Pacific Connector Pipeline Project in the High Cascades Province where the ACS applies.[18] It is also a Tier One Key Watershed in the NWFP. Stream densities are much lower than watersheds west of the Cascade crest. Spencer Creek would have 9 acres of Riparian Reserves cleared or 1.16 percent of Riparian Reserves in the watershed . Precipitation patterns show a strong declining gradient from 40 inches a year on the crest of the Cascades to less than 12 inches where Spencer Creek flows into the Klamath River. The pumice soils in the watershed have high infiltration rates and rarely exhibit overland flows and mass wasting seen in other watersheds crossed by the pipeline project. By locating the pipeline project adjacent to the Clover Creek Road for much of its length, project impacts on wetlands and stream channels have been minimized when compared to the impacts of creating a new corridor with the Project.

Pacific Connector has modified their pipeline project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve standards and guidelines. The assessment demonstrates that short-term impacts associated with the Pacific Connector pipeline would occur to streambanks and substrates at the site scale. Change in vegetative condition from clearing the corridor is a long-term impact that would occur on 9 acres of Riparian Reserves. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (appendix J, section 2.6.3.4). Also, because of the linear characteristic of the pipeline project, the Riparian Reserve crossings would be spread out across the landscape and would be discontinuous.

[18] Mill Creek, Lake Ewauna, and JC Boyle watersheds are also crossed by the pipeline project, but they are outside the area of the NWFP. Of these, only Lake Ewauna watershed has a small piece of BLM lands that are crossed. The ACS does not apply in that location.

TABLE 4.1.3.5-32

Proposed Off-Site Mitigation Projects on BLM and NFS Lands in the Spencer Creek Watershed

Agency	Project Type	Project Name	Quantity	Unit	Project Rationale	Land Allocation
BLM	Riparian Vegetation Riparian Stand Density	Upper Spencer Creek LSR/ Riparian Treatment	3.0	miles	Spencer Creek is a Tier One, Key Watershed. Implementation of the Pacific Connector Pipeline Project would require removal of riparian vegetation, thereby influencing the form and function of Riparian Reserves. This project would thin, pile and burn dense white fir understory vegetation and fall occasional trees into the stream channel for large woody debris (LWD). This would enhance forest health and diversity with the LSR/Riparian Reserve by restoring stand density to more natural and sustainable levels. This contributes to forest health and sustainability of riparian reserves by increasing resistance to insect and disease losses and reducing the risk of stand replacing fire. LWD in stream channels contributes to meeting water quality and total maximum daily load (TMDL) targets and provides habitat for sensitive fish and invertebrate species.	Riparian Reserves and LSR
BLM	Riparian Vegetation Riparian Stand Density	Miners Creek LSR, Riparian Treatment	3.0	miles		Riparian Reserves
BLM	Road Closure Road Sediment Reduction	Spencer Creek Repair Existing Road Closure	12	sites	Roads negatively impact wildlife. Implementation of the Pacific Connector Pipeline Project would require use of a large number of permanent and temporary roads and other access routes. Road closures (barricades) were established in the watershed to reduce road density to meet Resource Management Plan objectives for both the aquatic conservation strategy and reduce impacts to wildlife. This project repairs the existing closure structures to ensure that road closures remain effective. Spencer Creek is a Tier One, Key Watershed. Maintaining road closures also reduces sediment by keeping closed roads revegetated.	Riparian Reserves
BLM	Road Sediment Reduction	Spencer Creek Drainage Improvements and Sediment Trap Removal	15	sites	Spencer Creek is a Tier One, Key Watershed. The pipeline project uses a number of roads for access and construction. Drainage improvements and removing non-functioning cross drains and sediment traps at selected locations would benefit aquatic habitat/connectivity by restoring drainage and reducing sediment transport.	Riparian Reserves
BLM	Road Sediment Reduction	Keno Access Road Repair and Culvert Replacement	1	site	Spencer Creek is a Tier One, Key Watershed. The existing stream crossing (culvert) is undersized in both length and diameter, therefore it ability to meet ACS objectives is minimized. The culvert underlying the existing road bed periodically causes erosion of the road prism and adjacent upland and riparian areas. Replacement of the culvert would allow stabilization of the road shoulder and reduce sediment input to Miner's creek and its contribution of sediment to Spencer creek. If this work is not completed, the condition would eventually lead to increased sedimentation. Replacement of this drainage structure would decrease road-related erosion, increase the hydrologic capacity of the crossing and enhance aquatic connectivity for fish and other aquatic organisms.	Riparian Reserves
FS	Aquatic	Riparian Planting	0.5	miles	This is a meadow site along a 0.5-mile reach of Spencer Creek just upstream of Buck Lake (T38S R5E sec 11) that has lost streamside vegetation and has compacted soils. There is an overall need to restore health and vigor to riparian stands by maintaining and improving riparian reserve habitat. Shade provided by the plantings would contribute to moderating water temperatures in Spencer Creek. Root strength provided by new vegetation will increase bank stability, decrease erosion and sediment depositions to Spencer Creek and provide habitat for species that use riparian habitats. This is responsive to Aquatic Conservation Strategy (ACS) objectives 3, 4, 5, 8, and 9.	Riparian Reserves

TABLE 4.1.3.5-32

Proposed Off-Site Mitigation Projects on BLM and NFS Lands in the Spencer Creek Watershed

Agency	Project Type	Project Name	Quantity	Unit	Project Rationale	Land Allocation
FS	Aquatic	Spencer Creek LWD	1.0	miles	Over the last century, a 1-mile reach of Spencer Creek (T38S R6E sec 18) with high aquatic habitat potential has become simplified, and therefore, has a reduced capacity to provide quality habitat. Riparian stands have decreased health and vigor, resulting in increased time to develop large tree structure for wildlife, stream shade, and future instream wood. Placement of LWD in streams adds structural complexity to aquatic systems, traps fine sediments and can contribute to reductions in stream temperatures over time (Tippery et al. 2010). The BLM completed placement last year on 3 miles of Spencer Creek below this reach. Addition of this segment would complete the stream rehabilitation on the reach of Spencer Creek where the project occurs. Logs from the pipeline project right-of-way would be used for the project. An estimated 75 pieces are needed. A helicopter would be used to place the logs. This is responsive to Aquatic Conservation Strategy objectives 2, 3, 4 and 5.	Riparian Reserves
FS	Aquatic	Interpretive Sign	1	project	Continued recreational dam building occurs at this location resulting in negative impacts to stream morphology and riparian habitat impacting fish and the only known Upper Klamath Basin population of Giant Pacific Salamander. There is a need to educate the public as to the detrimental effects of this dam building action and this would best be served by installation of an informational sign to reach those parties utilizing the site.	Riparian Reserves
FS	Aquatic / Terrestrial	Road Decommissioning	21.4	miles	Reduction in road density is a central recommendation of the Spencer Creek Watershed Analysis. The objective of road decommissioning for this project is to reduce road density and accelerate the revegetation of the decommissioned roads with trees to reduce negative impacts of roads on wildlife habitat and aquatic environments. Some natural-surface roads have poor drainage that can lead to erosion and increased sediment in nearby streams (Trombulak and Frissell 2000). Road obliteration can improve drainage and to reduce chronic sediment input to the stream systems (Madej 2000; Switalski et al. 2004; Tippery et al. 2010). This mitigation also offsets the impacts of soil compaction and displacement within the construction right-of-way by reducing compaction in the decommissioned roadbeds. Table 2.6.2.6-2 and figure 2.6-4 in appendix J compare miles of roads decommissioned with impacts of the Pacific Connector project corridor on riparian reserves, acres in degraded soil condition and number of stream crossings. Likely benefits of road decommissioning include increased infiltration of precipitation, reduced surface runoff, and reduced sediment production from surface erosion (Switalski et al. 2004). Where roads are decommissioned within riparian areas, riparian vegetation may be reestablished. Approximately 5.2 miles or 13 acres of proposed decommissioning occur within Riparian Reserves. Approximately 21.4 miles of roads are currently open that can be decommissioned. Road densities decrease at all scales with this mitigation. The greatest reductions in road density occur within 0.3 mile of the pipeline project corridor, showing that mitigations are associated with the impact of the project where the impacts from the pipeline project would occur. Overall, this accomplishes a reduction in road density of 24 percent (appendix J, table 2.6.2.6-3). Assuming a 14-foot average road width, 21.4 miles of proposed road decommissioning would revegetate approximately 36 acres (21.4*5280*14/43560=36 acres) that are currently native road surfaces in the Spencer Creek watershed. This mitigation is responsive to ACS objectives 2, 3, 4, and 5 and Standards and Guidelines for Key Watersheds (Forest Service and BLM 1994b: B-11, C-7).	Riparian Reserves

TABLE 4.1.3.5-32

Proposed Off-Site Mitigation Projects on BLM and NFS Lands in the Spencer Creek Watershed

Agency	Project Type	Project Name	Quantity	Unit	Project Rationale	Land Allocation
FS	Aquatic / Terrestrial	Allotment Fencing	6.4	miles	Construct allotment fencing along the south side of the ROW through National Forest System lands (approximately 6.4 miles). This fence would serve to divide the Buck Indian Allotment into pastures north and south at Clover Creek Road. This fence would keep cattle from grazing newly revegetated areas in the right-of-way corridor, including areas where the corridor crosses Spencer Creek, thus helping to ensure that erosion control and revegetation objectives are met.	Riparian Reserves
FS	Aquatic / Terrestrial	Harden Ford	1	project	Stream crossing improvements would improve aquatic habitat/connectivity and reduce sedimentation. The road accessing this location has been closed on the BLM and Forest Service. The private landowner and cattle cross the ford to access pasture from private land. The raw, unstable banks at this crossing allow fine sediments to enter the stream. This ford needs to be hardened and the banks re-vegetated and protected from grazing. The Forest Service side from the upper Spencer Creek dispersed campground needs more boulders or a method of blocking four-wheel-drive vehicles.	Riparian Reserves

Off-site mitigation measures, identified by the BLM and Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Spencer Creek Watershed Analysis (BLM et al. 1995) and would improve watershed conditions where they are applied (appendix J, section 2.6.3.6). Table 4.1.3.5-32 describes proposed off-site mitigation measures in the Spencer Creek watershed.

Three site-specific amendments of the Winema National Forest LRMP and one amendment of the Lakeview Resource Area RMP that have a nexus with the ACS are proposed to make provision for the Pacific Connector Pipeline Project (appendix J, section 2.6.3.5):

- Proposed amendments WNF-4 and WNF-5 would allow the Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 of this EIS).
- Proposed amendment of the Winema National Forest LRMP and the Lakeview Resource Area RMP to waive protection measures for S&M species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (appendix J, section 2.4.8.5).

The Pacific Connector Pipeline Project is otherwise consistent with standards and guidelines for activities in Riparian Reserves for the Winema National Forest and the Klamath Falls Resource Area of the Lakeview District, BLM.

The routing of the pipeline through BLM and NFS lands, coupled with the relatively small area of BLM and NFS land affected by pipeline project construction (0.17 percent of BLM lands and 0.41 percent of NFS in the fifth-field watershed), makes it highly improbable that pipeline project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and long-term a change in vegetative condition at stream crossings), these would be minor in scale (appendix J, section 2.6.3.4).

No project-related impacts that would prevent attainment of ACS objectives have been identified. All relevant pipeline project impacts are within the range of natural variability given the disturbance patterns and fire history of watersheds in the High Cascades Province (appendix J, section 2.6.3.4).

4.1.3.6 Resource Values and Conditions on Federal Lands: LSRs

This section of the EIS summarizes appendix H, LSR Technical Report, which contains the full text of the analysis.

The LSR Network

The NWFP allocated a network of LSRs to conserve species of concern within the existing configuration of land ownership and the location of remaining LSOG forests within the range of the NSO (see section 4.1.3.3 above). The reserve network is embedded in a matrix of “working” forests and was designed to maintain LSOG forests in a well-distributed pattern across these federal lands (Moeur et al. 2011).

The LSR network is composed primarily of areas of large (mapped) reserves, but also includes smaller areas of "unmapped" reserves that are composed of sites occupied by MAMUs or are KOACs. The LSR standards and guidelines are designed to guide management activities occurring within these LSRs to protect and enhance the conditions of the LSOG forest ecosystems contained therein (Forest Service and BLM 1994b). The proposed Pacific Connector pipeline route would cross three mapped LSRs (223, 227, and 261). The proposed mitigation associated with reallocation of Matrix lands to LSR would also affect LSR 259.

LSR Elements

In 1994, the standards and guidelines for the NWFP described five elements that were used to designate LSRs: (1) areas mapped as part of an interacting reserve system; (2) LS/OG 1 and 2 areas within MAMU Zone 1, and certain owl additions, mapped by the Scientific Panel on Late-Successional Forest Ecosystems (1991); (3) sites occupied by MAMUs; (4) KOACs; and (5) Protection Buffers for specific endemic species identified by the Scientific Analysis Team (1993) (Forest Service and BLM 1994b).

Today, elements (1) and (2) are commonly referred to as "mapped" LSRs, and elements (3) and (4) are commonly referred to as "unmapped" LSRs. Although element (5), protection buffers, was originally part of the LSR network, it was later removed by the 2001 Survey and Manage ROD (Forest Service and BLM 2001a). The 2001 Survey and Manage ROD retained the direction to manage known sites of protection buffer species but removed their designation as small, species-specific LSRs.

Mapped LSRs

Most LSR areas are mapped.[19] The LSR network includes approximately 7.4 million acres or about 30 percent of the area covered by the NWFP. Several factors were considered in designating these reserves, including key watersheds and significant areas of old-growth forest that had previously been identified (Forest Service and BLM 1994b). These included LS/OG 1 and 2 areas (most ecologically significant, and ecologically significant LSOG forests, respectively) identified by the Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991).

Unmapped LSRs

Unmapped LSRs include sites occupied by MAMUs and KOACs. For MAMUs, surveys are required for projects that occur within MAMU habitat to determine if there is occupation within the project area. If occupation is documented, all contiguous existing and recruitment habitat within a 0.5-mile radius is to be protected and managed by the standards and guidelines for LSRs. The standards and guidelines for LSRs also apply to known NSO activity centers (as of January 1, 1994) located in Matrix or Adaptive Management Areas of the NWFP. Activity centers are defined as an area of concentrated activity of either a pair of NSOs or a territorial single owl. Each KOAC has a 100-acre area identified around or near the activity center, where the standards and guidelines for LSRs apply (Forest Service and BLM 1994b).

[19] Maps of the LSR network are available at the following website: http://www.reo.gov/gis/data/gisdata/index.htm.

LSR Standards and Guidelines

The standards and guidelines for LSRs are contained in Attachment A (pages C-9 through C-21) of the NWFP ROD. They are designed to protect and enhance conditions of LSOG forest ecosystems that serve as habitat for LSOG species. They are written to apply to specific management actions such as silviculture, range management, mining, new developments, etc., and should be interpreted in that context.

The standards and guidelines that apply to new developments such as pipelines are addressed on page C-17 of the NWFP standards and guidelines.

> *Developments of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects would be reviewed on a case-by-case basis and may be approved when adverse impacts can be minimized and mitigated. These would be planned to have the least possible adverse impacts on Late-Successional Reserves. Developments would be located to avoid degradation of habitat and adverse impacts on identified late-successional species.*

The LSR standards and guidelines provide the framework upon which the proposed LSR mitigation actions and related plan amendments for the Pacific Connector pipeline are evaluated.

Project Impacts on LSRs on BLM and NFS Lands

The Pacific Connector pipeline would cross about 71 miles of land managed by the BLM or Forest Service. The pipeline would cross four BLM districts (Coos Bay, Roseburg, Medford, and the Klamath Falls Resource Area of the Lakeview District) for a total of approximately 40 miles. The pipeline would also cross three national forests (Rogue River, Umpqua, and Winema) for a total of approximately 31 miles.

The mapped LSRs that would be crossed are depicted on figure 4.1-5. The proposed Pacific Connector pipeline would affect mapped LSRs on four of the seven BLM and Forest Service units: the Coos Bay and Roseburg Districts for the BLM, and the Rogue River and Umpqua National Forests for the Forest Service. Several unmapped LSR areas would also be affected in the Coos Bay and Roseburg Districts of the BLM. These unmapped LSRs are depicted in figures 4.1-6 and 4.1-7. Direct impacts would occur in the areas that would be cleared (i.e., forest vegetation would be removed) for the pipeline right-of-way and the TEWAs. Direct impacts would also occur in acres that would be “modified” by the Pacific Connector pipeline. These acres include UCSAs that would not be cleared of trees during construction. These areas would be used to store forest slash, stumps, and dead and downed log materials that would be scattered across the right-of-way after construction, which would be considered temporary habitat modifications.

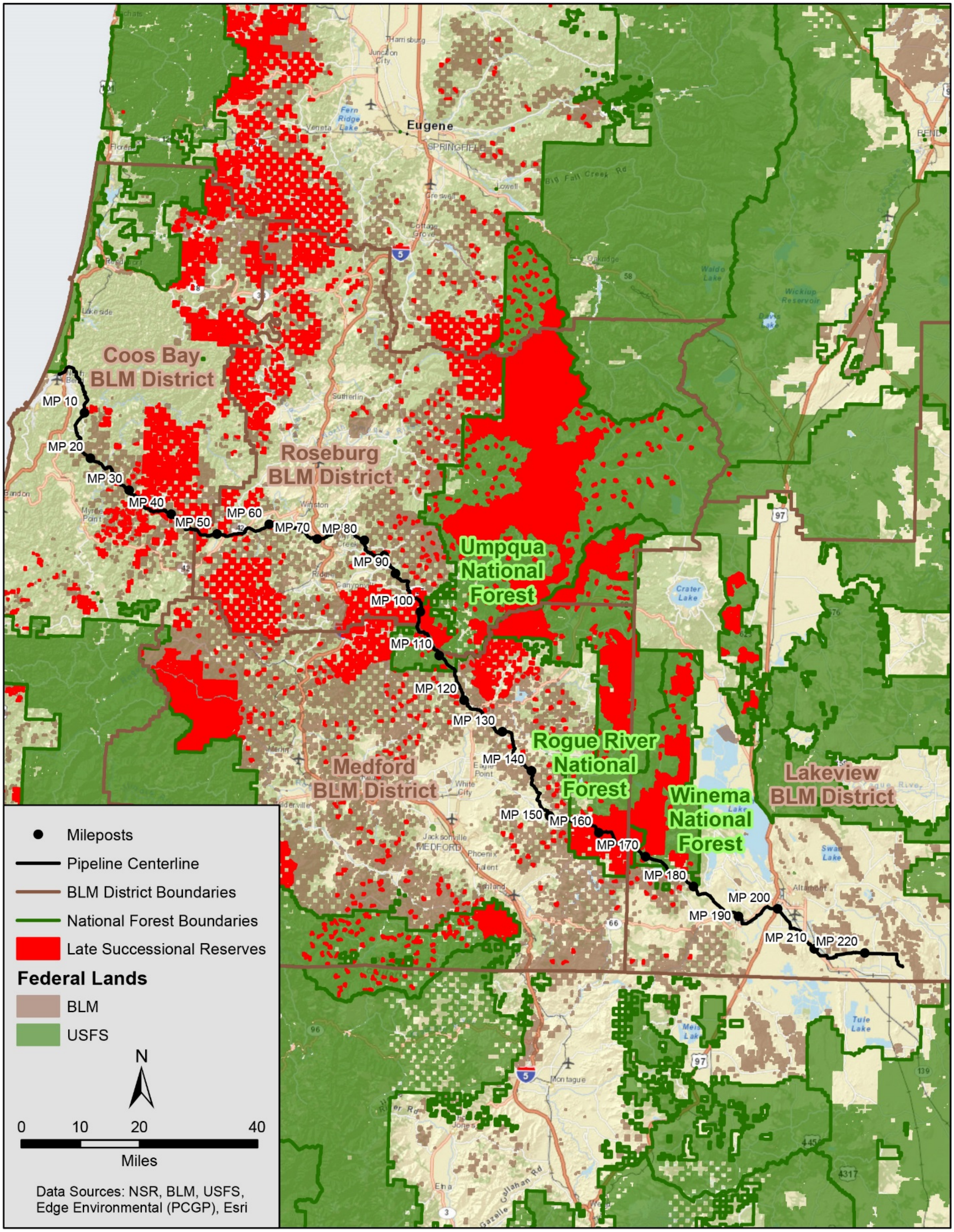


Figure 4.1-5. Overview Map of the Pacific Connector Pipeline Project and LSRs on BLM and NFS Lands

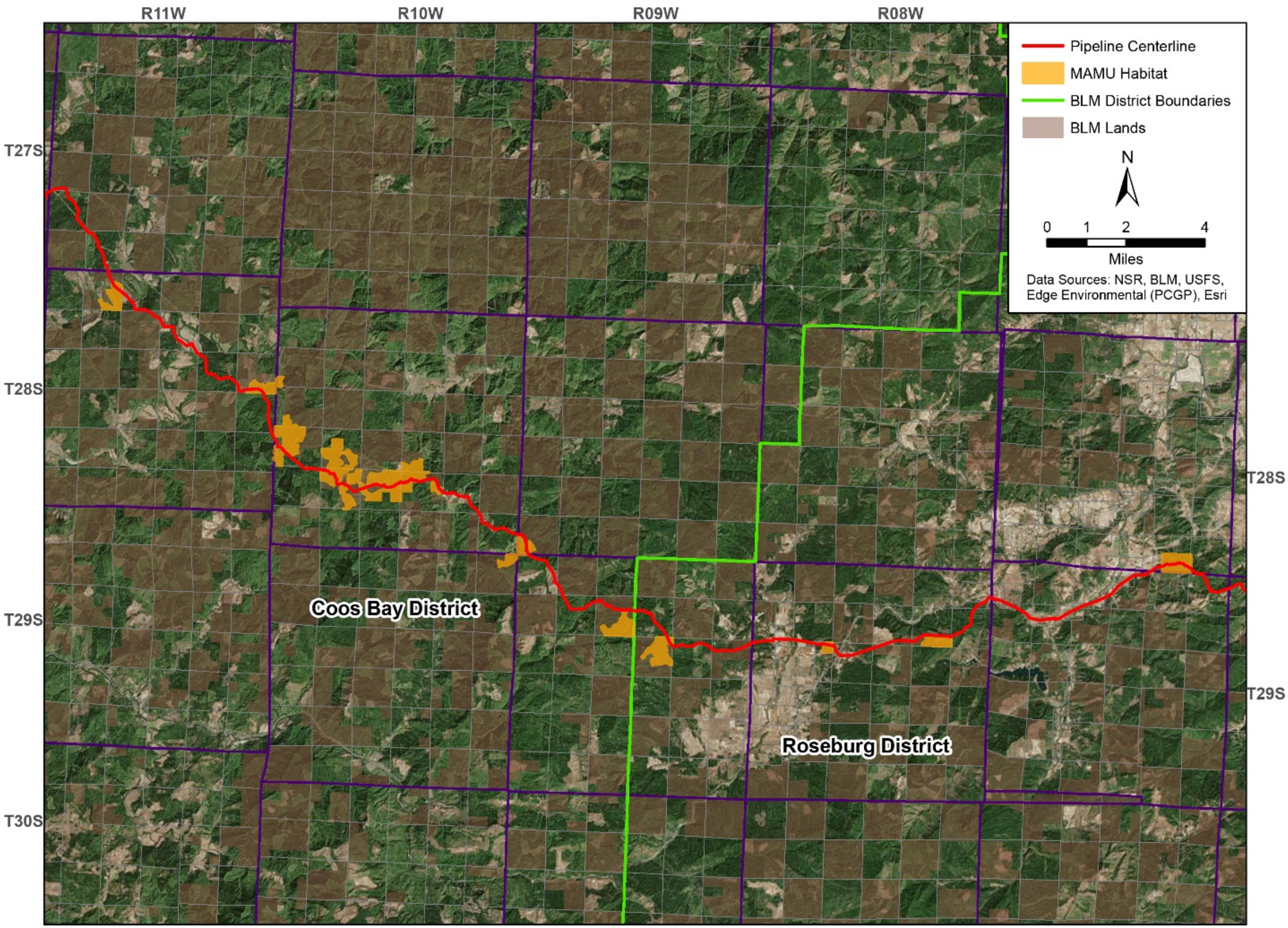


Figure 4.1-6. Occupied MAMU Stands Within the BLM Coos Bay and Roseburg Districts Crossed by the Pacific Connector Pipeline Route

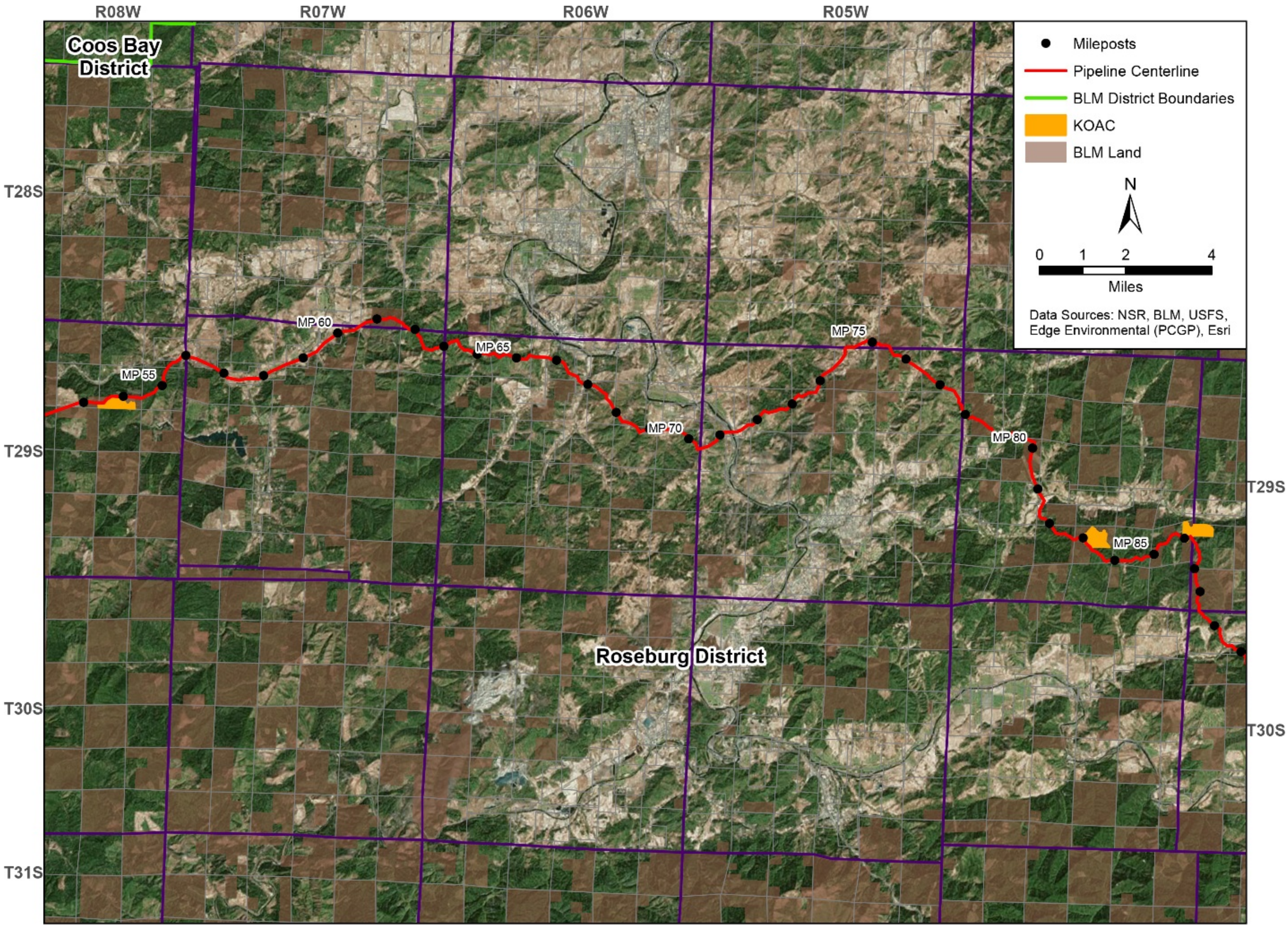


Figure 4.1-7. KOACs Within the BLM Roseburg District Crossed by the Pacific Connector Pipeline Route

Indirect impacts from construction of the pipeline are also expected within LSRs that have interior forest that the MAMU and NSO rely on for nesting habitat. The conversion of large tracts of LSOG forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. Such edge impacts—magnitude of changes over distance from the edge to forest interior—would depend on the general orientation to the sun. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995; Chen et al. 1995; Harper et al. 2005). Together, sun and wind: (1) desiccate leaves by increasing evapotranspiration; (2) influence which plant species survive and thrive along the edge, usually favoring shade intolerant species; and (3) affect the soil, insects, and other animals along the edge. Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. However, effects are dependent on local conditions, such as orientation of an edge. The magnitudes of change in humidity with distance from an edge are most extreme with south-facing edges, compared to east- and west-facing edges (Chen et al. 1995). These effects would vary along the pipeline route as a function of route orientation and the facing direction of each edge. Because the Pacific Connector pipeline generally trends from northwest to southeast, edge effects would be most pronounced on the southwest-facing edges and weakest along the northeast-facing edges. Fundamental changes in the microclimate (moisture, temperature, solar radiation) of a stand have been recorded greater than 700 feet from the forest edge (Chen et al. 1995).

Using recommendations from the ESA Sub-Task Group and Habitat Quality Subtask Group,[20] indirect effects are considered to extend for 100 meters from the created edge in LSOG forest. In making their recommendation, the sub-task groups considered the study done by Karen A. Harper et al. (2005), which looked at edge influence on forest structure in fragmented landscapes. The study reviewed the effects caused by forest edges on multiple response variables including: (1) forest processes of tree mortality/damage, recruitment, growth rate, canopy foliage, understory foliage, and seedling mortality, (2) forest structure by canopy trees, canopy cover, snags and logs, understory tree density, herbaceous cover, and shrub cover, and (3) stand composition by species, exotics, individual species and species diversity. The study found that the mean distance of edge influence on any single response variable did not exceed 100 meters. Therefore, indirect impacts for the Project are estimated to extend for 100 meters beyond the cleared area on each side of the corridor in LSOG forest habitat. There is no corresponding research for edge impacts in younger forest stands (less than 80 years old). There is, however, research that indicates the effect extends out approximately two times the average tree height (Morrison et al. 2002). Based on this, an estimate of 30 meters is used in non-LSOG forest habitat. In non-forested areas, no indirect impacts are estimated since no new edge would be created. Table 4.1.3.6-1 and figure 4.1-8 provide a summary of the total number of LSR acres that would be directly and indirectly affected on BLM and NFS lands by the Pacific Connector pipeline.

[20] These sub-task groups were part of an Interagency Task Force, which included representatives of the FWS and NMFS, as well as the Forest Service, BLM, ODLCD, ODE, ODSL, COE, ODFW, EPA, and ODEQ, to obtain specific input, guidance, and technical approach reviews. Agencies participating in the Interagency Task Force reviewed information provided by Jordan Cove and Pacific Connector.

TABLE 4.1.3.6-1

Summary of Total LSR Acres Directly and Indirectly (a/) Affected by the Pacific Connector Pipeline

District/National Forest	Mapped LSR			Unmapped LSR			Total LSR		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
BLM District									
Coos Bay	35 b/	56	91	40	181	220	75 b/	237	312
Roseburg	80	177	257	37	87	124	116	265	381
Total BLM	***115***	***234***	***348***	***76***	***268***	***344***	***191***	***502***	***692***
Forest Service National Forest									
Umpqua	85	241	325	0	0	0	85	241	325
Rogue River	276	534	810	0	0	0	276	534	810
Total Forest Service	***361***	***775***	***1,135***	***0***	***0***	***0***	***361***	***775***	***1,135***
Total Overall	**475**	**1,008**	**1,483**	**76**	**268**	**344**	**552**	**1,276**	**1,828**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
Data source: BLM, Forest Service GIS data layers
a/ Total impacts include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
b/ The acres include the direct and indirect impacts in the Matrix acres that would be reallocated to LSR on the Coos Bay District.

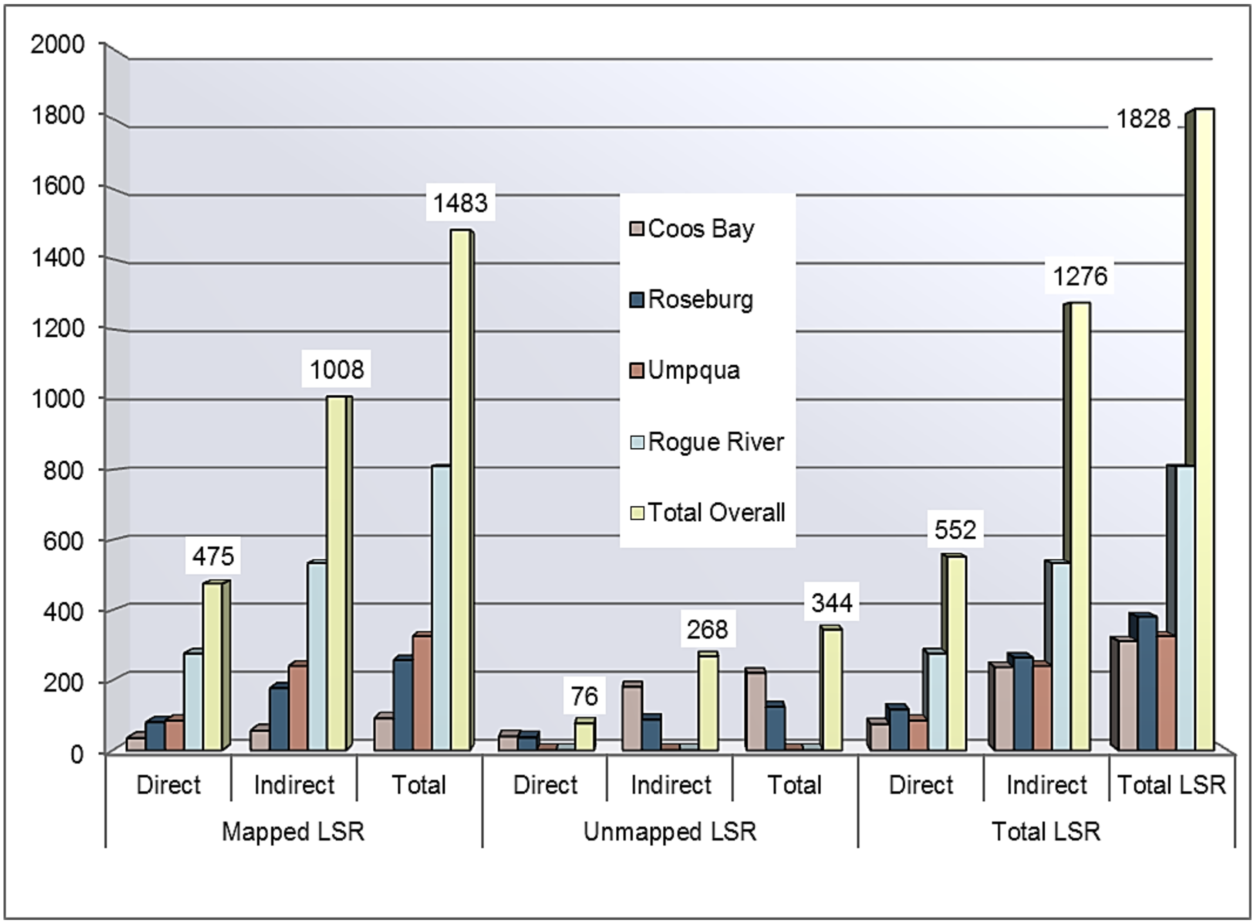


Figure 4.1-8. Summary of Total LSR Acres Directly and Indirectly Affected by the Pacific Connector Pipeline Project

The construction, operation, and maintenance of the Pacific Connector Pipeline Project would affect LSRs on federal lands in several ways. It would remove and fragment LSOG forest habitat that some vertebrate and invertebrate species are dependent on. It would directly affect individuals of species listed as threatened under the ESA (NSO and MAMU) through removal of suitable nesting, roosting, and foraging habitat for NSO, and through the removal of suitable or potential nesting habitat for MAMU. The indirect impacts discussed above would result in the loss of interior LSOG forest habitat and increased predation. These impacts and others from the proposed construction, operation, and maintenance of the Pacific Connector pipeline on LSOG forests are discussed in sections 4.3.2, 4.4.2, 4.5.2, 4.6.2, and 4.7.3 of this EIS. In addition to the direct and indirect impacts of the Project, cumulative impacts are addressed in section 4.14. This analysis would include other actions proposed on federal lands as well as the off-site mitigation actions. The analysis in this section focuses on how the proposed LMP amendments and mitigation actions would affect the LSR land allocation in terms of the distribution, quantity, and quality of LSOG habitat.

Land Management Plan Amendments Related to LSRs on BLM and Forest Service Lands.

The Need for Plan Amendments and Off-Site Mitigation in LSRs

Under the FLPMA and the NFMA, the Pacific Connector pipeline would have to conform to BLM and Forest Service land use plans. Those plans incorporate the NWFP standards and guidelines. The standard and guideline in the NWFP for new developments in LSRs states:

> *Developments of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects be reviewed on a case-by-case basis and may be approved when adverse impacts can be minimized and mitigated. These will be planned to have the least possible adverse impacts on Late-Successional Reserves. Developments will be located to avoid degradation of habitat and adverse impacts on identified late-successional species.* (Forest Service and BLM 1994b: C-17).

In order to be consistent with the standard above, the proposed development (with mitigation) should result in impacts that are either neutral or beneficial to the creation and maintenance of late-successional habitat in LSRs (Forsgren et al. 2001).

Avoidance

Alternative routes that would avoid all LSRs were investigated by the applicant, BLM, Forest Service, and the FERC. Some required lengthy rerouting both in terms of the overall length of the pipeline and in the amount of private land affected. These alternatives and the reasons why they were not selected are discussed in section 3.4 of the EIS. The steps taken to avoid LSRs and how they were incorporated into the proposed route where feasible are also discussed in section 3.4, and in Resource Report 10 attached to Pacific Connector's application to the FERC.

In summary, because the Pacific Connector pipeline is a linear, large-diameter, high-pressure natural gas pipeline that must be routed to ensure safety, stability, and integrity, it is unreasonable, impractical, and infeasible to entirely avoid all designated LSRs within the project area for the following reasons:

- The overall extent of the designated LSR land allocation in the project area makes it impractical to completely avoid LSRs;
- The length of the pipeline, extending approximately 232 miles from Malin to Coos Bay across portions of Klamath, Jackson, Douglas, and Coos Counties, and traversing federal lands managed by four BLM districts as well as three national forests, makes it impractical to avoid all designated LSRs;
- The checkerboard landownership pattern of BLM lands within the project area makes it unreasonable to avoid LSRs;
- Large contiguous areas of federal lands (see figure 4.1-5) in the project area make it impractical and infeasible to entirely route around these lands to avoid LSRs; and
- Where LSRs are encountered along the alignment, the routing requirements of the pipeline to ensure a safe, stable, and constructible alignment to ensure long-term integrity make it infeasible/unreasonable to avoid LSRs by aligning the pipeline on steep side slopes or other potentially unstable areas.

Address Public Need

The Commission will consider the need and public benefit of this Project when making its decision on whether or not to authorize it, as documented in the Project Order. The cooperating agencies will consider public benefit within the context of each agency's respective authorities. Each cooperating agency will document its decision in the applicable permit, approval, concurrence, or determination.

Minimize Impacts

During the Pacific Connector pipeline route selection process, interdisciplinary teams from the BLM and Forest Service worked with the FERC and the applicant to develop steps that would minimize impacts on LSRs where avoidance was not feasible. In some cases, Forest Service–suggested realignments were incorporated into the proposed route, as in the situation between MPs 104.8 and 111.5 (see discussion in section 3.4.2.8 of this EIS).

To minimize impacts on LSRs, Pacific Connector took the following elements into consideration in route selection and construction design:

- Performed routing and geotechnical evaluations to ensure the most stable pipeline alignment for long-term stability. These efforts would minimize the potential need to conduct future maintenance activities, which could require additional impacts on LSRs.
- Where feasible, the proposed alignment was co-located with existing roads and early seral, conifer plantations to reduce impacts on LSOG habitat and to minimize disturbance impacts.
- Areas of side slopes were avoided to minimize the need for additional TEWAs to accommodate the necessary cuts and fill to safely construct the pipeline.
- The number and size of the planned TEWAs in LSRs were minimized to those critical for safe pipeline construction.

- Additional TEWAs were located in previously disturbed areas (i.e., areas that were recently logged) or in young regenerating forest stands.
- Existing roads would be used to access the construction right-of-way during construction and the right-of-way would be used as the primary travel-way to move equipment and materials up and down the right-of-way to remove the need for additional roads within LSRs. The existing roads would also be used during operations and maintenance to avoid the need for new access routes.
- Pacific Connector would replant or allow trees to naturally regenerate to within 15 feet of the pipeline centerline within the permanent pipeline easement to minimize potential long-term impacts of the pipeline easement.

Detailed descriptions of all the conservation measures proposed by the Pacific Connector are included in Table 1 of Resource Report 3 in its application to the FERC.

Mitigate for Impacts that Cannot Be Avoided

In addition to avoidance and minimization, off-site mitigation would also be necessary to ensure that unavoidable adverse impacts are mitigated to meet the direction that overall the impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat in LSRs. Pacific Connector drafted a *Compensatory Mitigation Plan* (CMP) to avoid, reduce, or mitigate impacts on ESA listed threatened and endangered species and their habitats. [21] A portion of the CMP was developed specifically to compensate for the unavoidable adverse impacts of the Pacific Connector Pipeline Project on LSRs with a goal to achieve a neutral or beneficial condition within affected LSRs, and to maintain the long-term integrity of the BLM and Forest Service land use plans for LSRs. Under the CMP, unavoidable impacts on LSOG forest habitats within LSRs on BLM and NFS lands would be compensated for by a combination of reallocation of Matrix lands to LSR and implementing off-site mitigation projects. The off-site mitigation actions of stand treatments and fuel breaks are consistent with the management recommendations for LSR 223, 227, and 261. Stand treatments would enhance or accelerate the development of LSOG habitat elements to further offset the impacts of the Project on LSRs in the long term (greater than 50 years). Fuel breaks would help reduce the risk of loss of LSOG forest to catastrophic wildfires. The off-site mitigation actions of road decommissioning, snag creation, and large wood placement would improve the quality of the LSOG forest habitat in LSRs. On BLM lands, the proposed mitigation actions also include having the applicant acquire approximately 796 acres of non-federal forest lands to replace the Matrix lands that are being reallocated to LSR.

The primary mitigation action for the impacts of the pipeline on LSRs would add acres to the LSRs. The BLM and Forest Service are proposing to accomplish this through reallocation of Matrix lands to LSR. Reallocating these acres would require amendments to the BLM Coos Bay and Roseburg District, and the Forest Service Umpqua and Rogue River National Forest, LMPs. The analysis in the following sections looks at the acres of habitat (by habitat type of LSOG, non-LSOG and non-forest) that would be removed (cleared) by the Pacific Connector pipeline with the amount of habitat that would be reallocated since this would be the most direct comparison of acres affected in the LSR system. Table 4.1.3.6-2 and figure 4.1-9 display a summary comparison between the LSR acres that would be cleared by the construction of the Pacific Connector pipeline

[21] The mitigation actions are described in section 2.1.4 and appendix F of this DEIS. The CMP is attached to our BA as Appendix O.

and the proposed reallocation of Matrix lands to LSR. Amendments concerning LSRs associated with the Pacific Connector pipeline would be coordinated with the REO as required by the NWFP. Analysis of the aggregated amendments for LSR across all administrative units for the Pacific Connector pipeline and the total proposed off-site mitigations is included in section 4.1.3.7 below.

TABLE 4.1.3.6-2

Comparison of Total LSR Acres Cleared by the Pacific Connector Pipeline and the Acres of Matrix Reallocated to LSR a/

District/National Forest	LSR Components (b/) Affected by the Pacific Connector Pipeline Project Right-of-Way Clearing: Mapped LSRs	Marbled Murrelet Stands	Known Owl Activity Centers	Total LSR Clearing	LSR Mitigation: Matrix to LSR Reallocations
BLM District					
Coos Bay	32 c/	33	0	64	387
Roseburg	57	16	7	81	409
National Forest					
Umpqua	67	0	0	67	588
Rogue River	206	0	0	206	512
BLM and Forest Service Combined					
Total	363	49	7	418	1,896

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
Data source: BLM, Forest Service GIS data layers
a/ Clearing includes acres in the pipeline corridor and the TEWAs.
b/ Marbled murrelet stands and known owl activity centers outside of mapped LSRs.
c/ Includes the acres cleared in the Matrix that would be reallocated to LSR on the Coos Bay District.

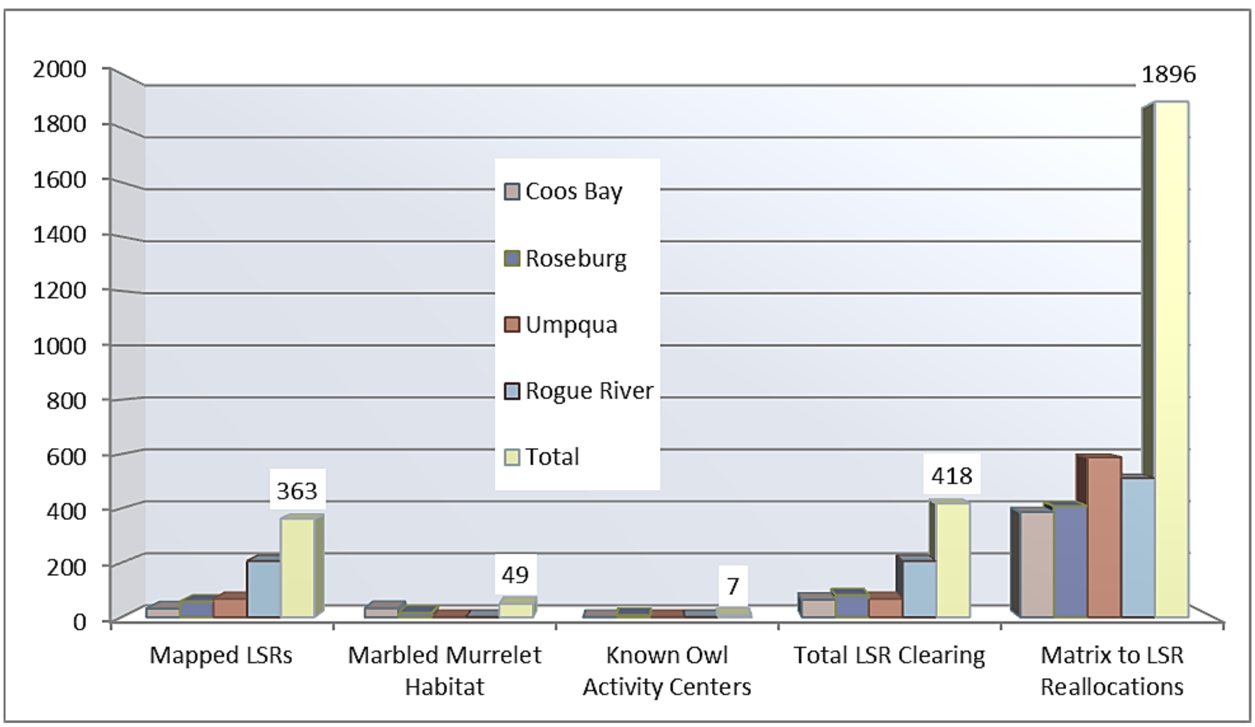


Figure 4.1-9. Comparison of Total LSR Acres Cleared by the Pacific Connector Pipeline Project and Total Acres of Matrix Reallocated to LSR

RMP Amendments Related to LSRs on BLM Coos Bay District

BLM–1, Site-Specific Exemption from Requirement to Protect Marbled Murrelet Habitat in the BLM Coos Bay District

The Coos Bay District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMUs within parts of the Project right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Project right-of-way and would not change future management direction at any other location.

Existing known MAMU occupied sites were inventoried using BLM GIS layer data in 2006, and three occupied sites were identified that were in the pipeline corridor. Additional MAMU surveys were conducted in 2007, 2008, 2012 - 2014 within the project area. Nine additional occupied sites were identified from these surveys for a total of 12 occupied MAMU stands within the project area on the Coos Bay District. BLM delineated the extent of the occupied stands identified during the surveys and incorporated the newly identified stands into the GIS layer. All but one of the occupied stands within the project area on the Coos Bay District occur outside of mapped LSRs in lands currently allocated as Matrix in the NWFP. Stand C3070 lies entirely within mapped LSR 261. Approximately 34 acres of occupied MAMU stands would be cleared by the Pacific Connector pipeline on the Coos Bay District. Table 4.1.3.6-3 summarizes the known MAMU occupied stands that occur in the project area in the Coos Bay District. The map in figure 4.1-10 displays the known MAMU occupied stands in relation to the pipeline project.

TABLE 4.1.3.6-3

Known Occupied MAMU Stands within the Pacific Connector Pipeline Project Area in the Coos Bay District

MAMU Occupied Stand	Milepost Location	Acres Cleared a/, b/
C1080	MP 27.14-27.48	4
C3098	MP 32.04-32.48	5
C3075	MP 33.77-33.99	2
C3042	MP 33.84-33.90	1
C3093	MP 35.12-35.79	4
C3165	MP 35.89-36.11	<1
C3073	MP 36.49-37.15	5
C3090	MP 37.15-38.09	9
C3094	MP 38.09-38.18	1
C3095	MP 38.83-38.90	<1
C3070 c/	MP 41.89-41.97	1
C3092	MP 45.40-45.47	1
	Total	**34**

a/ Column may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).
b/ Cleared acres include the Pacific Connector pipeline construction corridor and temporary extra work areas.
c/ Occupied Stand C3070 lies entirely within LSR 261.
Data Source: BLM GIS data layers

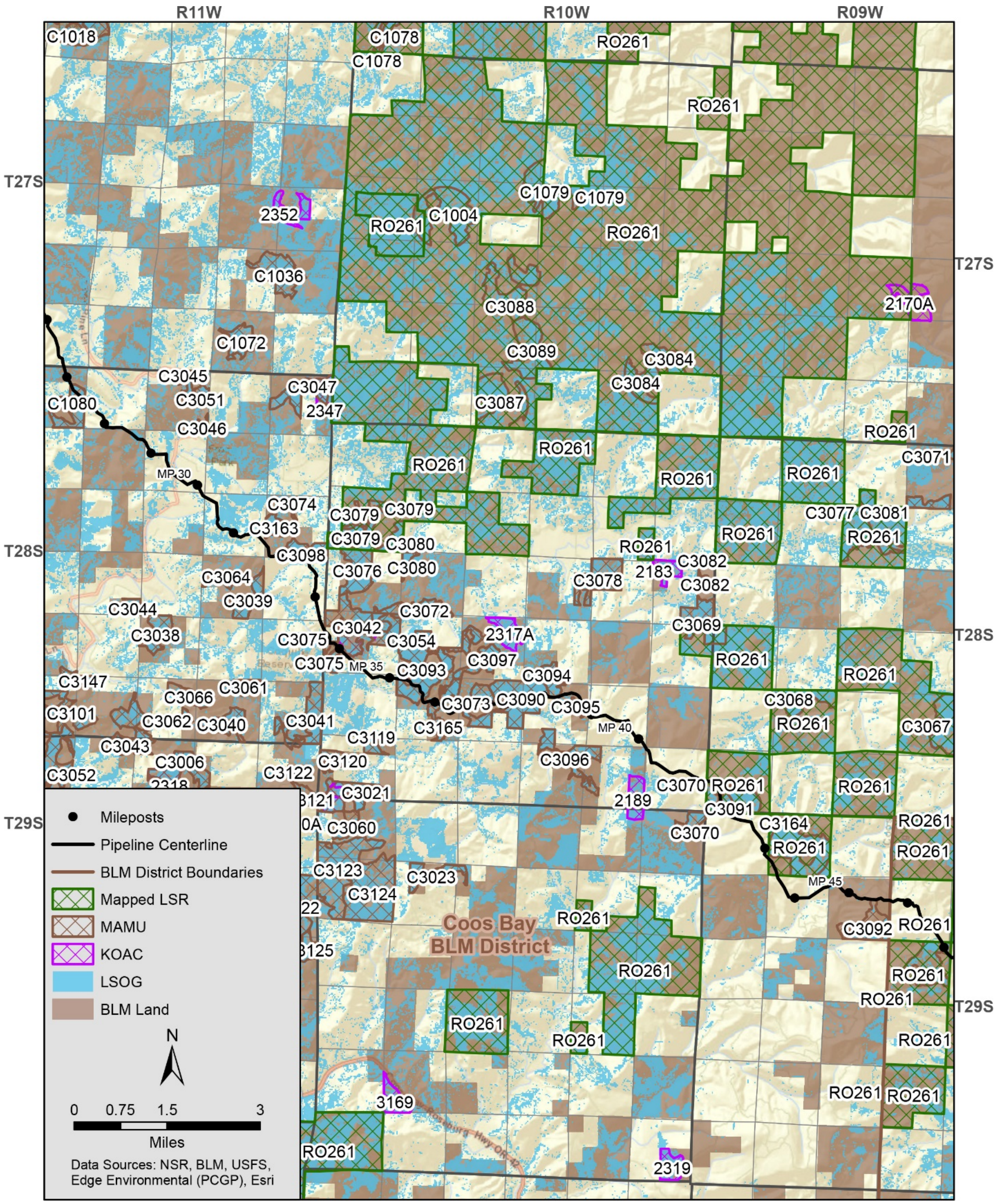


Figure 4.1-10. Map of Occupied MAMU Stands Within the BLM Coos Bay District Crossed by the Pacific Connector Pipeline Route

Amount and Quality of MAMU Habitat Affected by the Construction and Operation of the Pacific Connector Pipeline Project

Currently, based on the latest BLM GIS data layers there are approximately 1,225 acres of LSOG forest habitat within the 12 occupied MAMU stands affected by the Pacific Connector pipeline on the Coos Bay District. The Pacific Connector pipeline would require removing approximately 34 acres of forest vegetation in occupied MAMU stands from both the pipeline corridor and the TEWAs. Approximately 15 of these acres would be LSOG forest habitat. This would result in an approximate 1 percent reduction of the existing LSOG within these twelve occupied MAMU stands.

The area proposed to be added to LSR 261 is approximately 998 acres and is in the immediate vicinity of the occupied MAMU stands that would be affected (see figure 4.1-10). A large part of this area (approximately 611 acres) contains occupied MAMU habitat and is therefore unmapped LSR. The net reallocation of Matrix to LSR is 387 acres (see discussion for RMP Amendment BLM-4 below). Although this MAMU habitat is currently protected by the management direction in the Coos Bay RMP, including it as part of a designated LSR would provide additional protections and benefits for MAMU habitat. The additional protection would result from the area being protected not just because of the existing habitat condition but as a land allocation dedicated to the management of late-successional habitat. The additional benefits would result from the surrounding non-habitat areas being managed in the future to become LSOG forest, thereby creating larger contiguous blocks of habitat. The future management of these LSRs should not only protect habitat currently suitable to MAMUs, but also promote the development of additional MAMU habitat on the landscape. This would help to minimize the loss of unoccupied but suitable MAMU habitat. A summary of the acres that would be affected both directly and indirectly from the construction of the Pacific Connector pipeline is displayed in table 4.1.3.6-4 and figure 4.1-11.

TABLE 4.1.3.6-4

Comparison of Total Pacific Connector Pipeline Project Impacts (a/) on MAMU Stands and Matrix Reallocated to LSR (acres) in Coos Bay District

Coos Bay District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	15	3	155	173	101
Non- LSOG	19	5	33	57	284
Non-Forest	0	0	0	0	2
Total	**34**	**8**	**188**	**229**	**387**

Note: Columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
Data source: BLM, Forest Service GIS Data Layers

a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

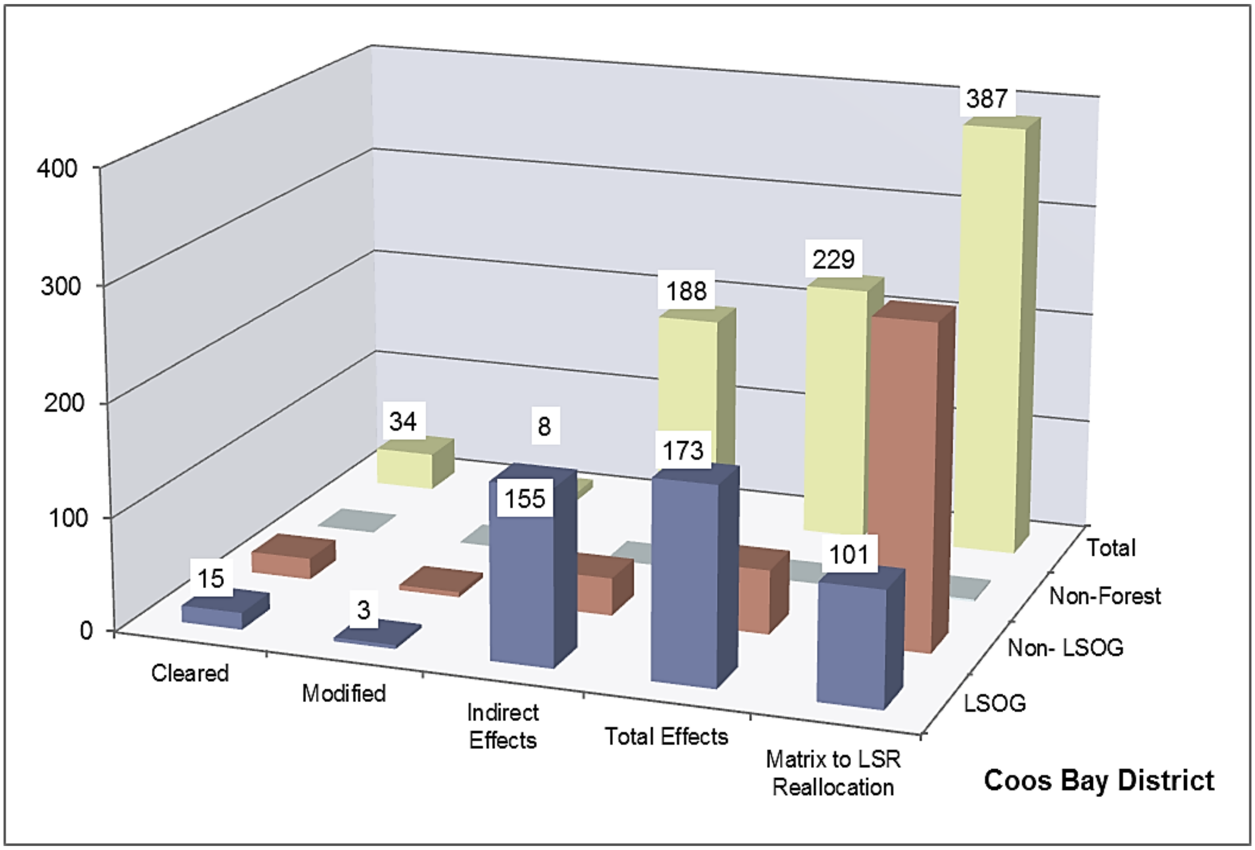


Figure 4.1-11. Comparison of Total Pacific Connector Pipeline Project Impacts on MAMU Stands and Matrix Reallocated to LSR (acres) in Coos Bay District

BLM-4, Reallocation of Matrix Lands to Late-Successional Reserves

The BLM Coos Bay District RMP would be amended to change the designation of approximately 387 acres from the matrix land allocation to the LSR land allocation in Sections 19 and 29, of T.28S., R.10W., W.M., Oregon.

This change in land allocation is proposed to provide partial mitigation for the potential adverse impact of the Pacific Connector pipeline on LSRs in the BLM Coos Bay District. This proposed amendment would change future management direction for the lands reallocated from Matrix to LSR. A map of the proposed reallocation is displayed as figure 4.1-12.

The primary management objective of the LSR land allocation is to protect and enhance conditions of late-successional and old-growth forest ecosystems that serve as habitat for LSOG–related species. Currently, based on the most recent BLM GIS data there are approximately 31,793 acres of LSOG forest, which comprises approximately 45 percent of LSR 261. If constructed, the part of the Pacific Connector pipeline in the Coos Bay District would remove approximately 32 acres of forest vegetation in LSR 261. This would include the removal of forest vegetation from both the pipeline corridor and the TEWAs. Approximately 2 of the 32 acres would be LSOG forest habitat.

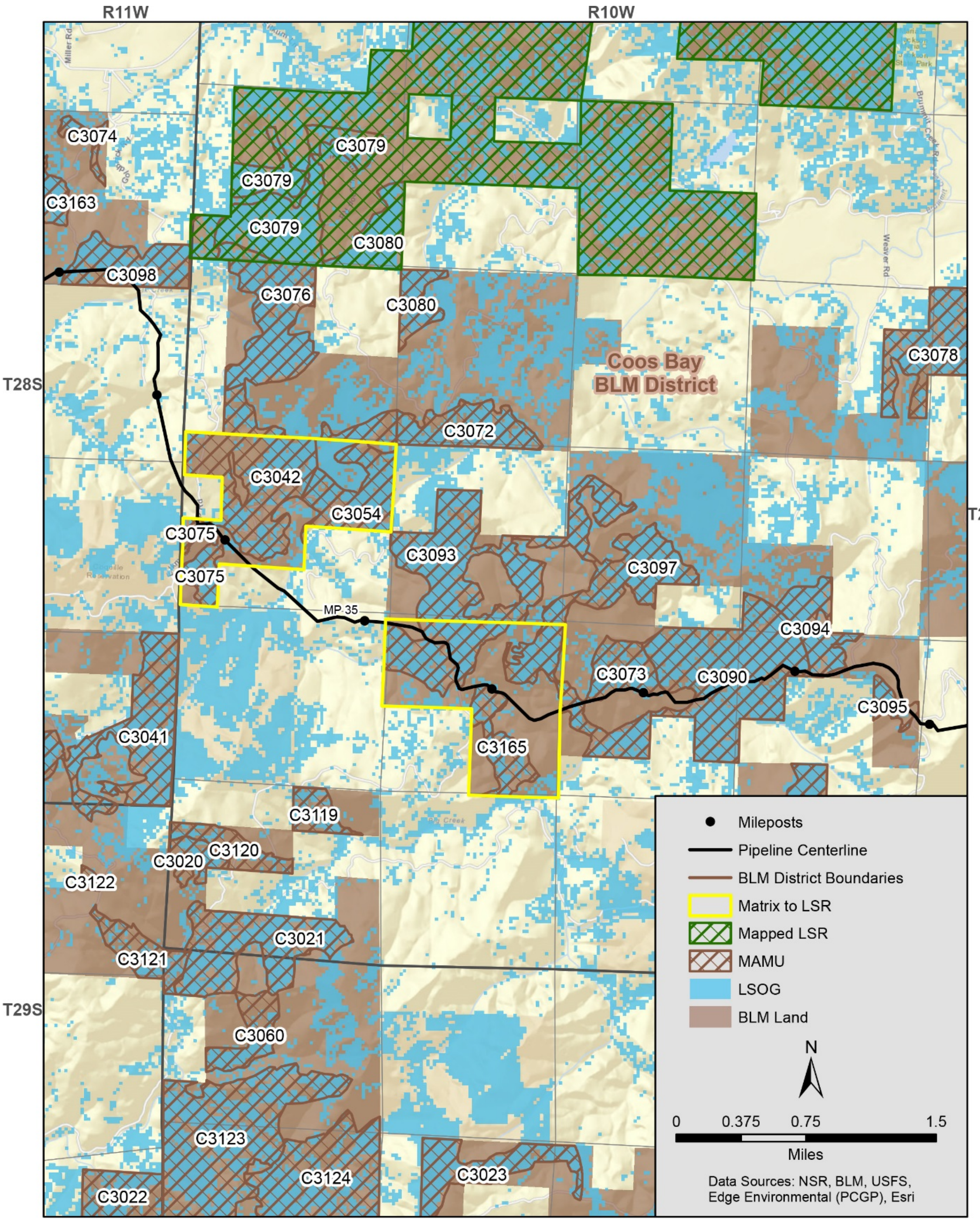


Figure 4.1-12. Map of Reallocation from Matrix to LSR and MAMU Stands Within the BLM Coos Bay District

The area proposed to be allocated to LSR 261 is approximately 998 acres. There are, however, approximately 611 acres of occupied MAMU stands within this proposed area. The occupied MAMU stands are managed by the standards and guidelines for LSRs as unmapped LSRs. Therefore, the net reallocation of Matrix lands to LSR equals approximately 387 acres (998 minus 611), of which approximately 101 acres are LSOG forest. The approximately 32 acres of clearing in LSR 261 described above includes the clearing that would occur within the reallocated acres (see figure 4.1-12 for a depiction of the acres proposed for reallocation and the area of occupied MAMU stands).

This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Pacific Connector pipeline on LSR 261 in the BLM Coos Bay District. When acres reallocated from Matrix to LSR are compared to the acres of LSR that would be cleared by construction, the proposed amendment reallocates approximately 12 times more acres to LSR than would be cleared by the Pacific Connector pipeline. In addition to the impacts from the removal of forest vegetation in LSR 261, there would be additional impacts from the acres modified by UCSAs and from the acres indirectly affected through the creation of new edges and fragmentation of older forest. A comparison of the total acres affected in LSR 261 and the acres of reallocation are displayed in table 4.1.3.6-5 and figure 4.1-13.

TABLE 4.1.3.6-5

Comparison of Total Pacific Connector Pipeline Project LSR Impacts (a/) and Acres of Matrix Reallocated to LSR, Within BLM Coos Bay District LSR 261

Coos Bay District LSR 261	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	2	0	14	16	101
Non- LSOG	30	3	42	75	284
Non-Forest	0	0	0	0	2
Total	**32**	**3**	**56**	**91**	**387**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).
Data source: BLM, Forest Service GIS data layers
a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

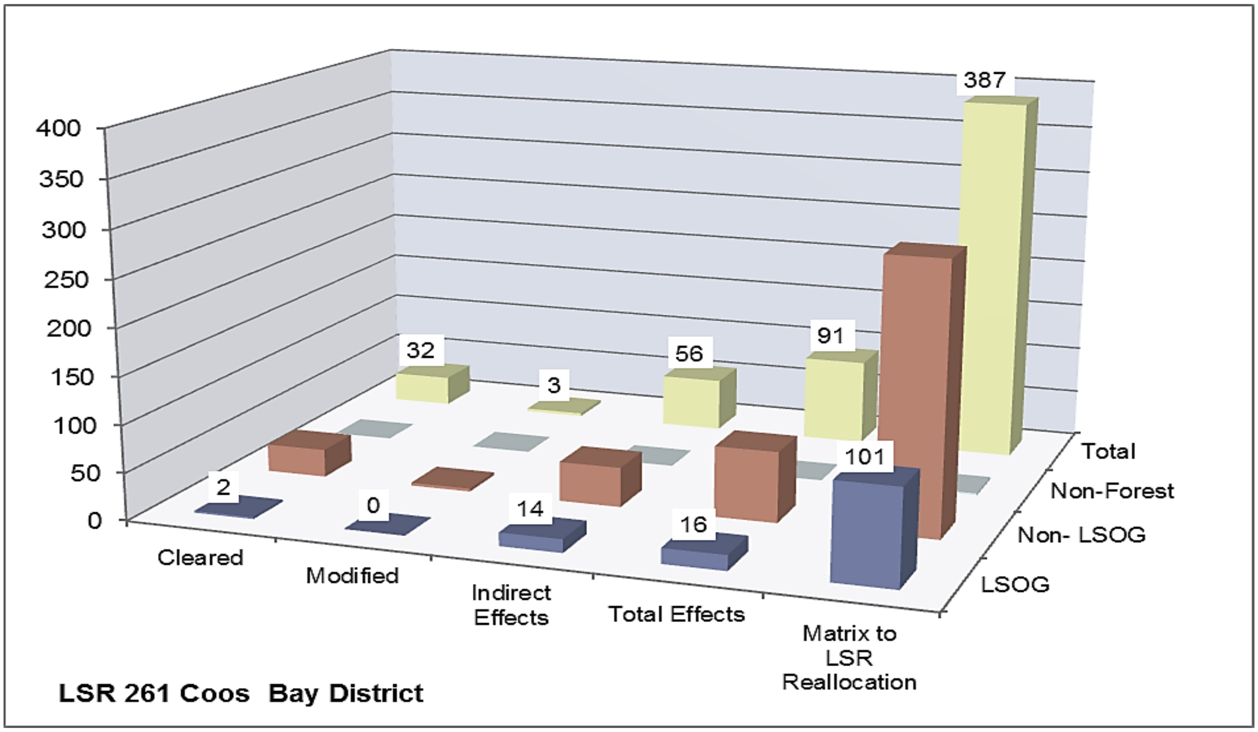


Figure 4.1-13. Comparison of Total Pacific Connector Pipeline Project LSR Impacts and Matrix Reallocated to LSR (acres) Within BLM Coos Bay District LSR 261

Impact on the Functionality of LSR 261 on the BLM Coos Bay District

The functionality of LSR 261 relates directly to the goals and objectives for LSRs and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the Pacific Connector pipeline would affect these characteristics.

- **Quantity** — The overall quantity of LSOG habitat within LSR 261 on the Coos Bay District would increase with the proposed RMP amendment. There are approximately 998 acres that would be designated as LSR 261, approximately 611 of those acres are currently unmapped LSR MAMU stands and the other 387 acres are Matrix. The Pacific Connector pipeline would remove approximately 2 acres of LSOG habitat but the reallocation from Matrix lands would add 101 acres of LSOG habitat for a net increase of 99 acres of LSOG habitat in LSR. There is also approximately 364 acres of LSOG within the 611 acres of unmapped LSR that would be included within mapped LSR 261. The management direction for these 611 acres would not change. Overall, this would increase the current level of LSOG habitat within mapped LSR 261 from 31,793 acres to 32,256 acres or by about 1 percent.
- **Quality** — The area of LSR 261 that would be affected by the Pacific Connector pipeline is highly fragmented due to both the land ownership pattern and past management activities. Like most LSRs on BLM lands, LSR 261 comprises checkerboard sections or even smaller parcels of land. The area proposed for reallocation to LSR 261 contains some large blocks of LSOG habitat as well as occupied MAMU stands (see figure 4.1-12). This reallocation would consolidate habitat in an area that is highly fragmented. Consolidating habitat is one of the management objectives for LSR 261(see appendix H, section 2.2.1.1).

The connectivity within LSR 261 would increase by decreasing distances between individual LSR parcels and reduce the amount of "edge" adjacent to existing occupied MAMU stands over time. With the reallocation of Matrix to LSR and the consolidation of larger blocks of LSOG habitat the quality of the LSOG habitat within LSR 261 would be improved.

- **Distribution —** The distribution of LSOG habitat within LSR 261 would remain largely unchanged with the proposed reallocation of Matrix to LSR RMP amendment. To the extent there are minor changes they would be beneficial due to the location of the proposed reallocation. The reallocation would occur within a current gap between the northern and southeastern portions of LSR 261 and would provide some additional connectivity within LSR 261 in this area.
- The off-site mitigation action would provide added protection to the quantity, quality, and distribution of LSOG habitat by improving the potential to decrease initial fire suppression response times and thereby increase the potential to control fires before they become high-intensity fires that threaten LSOG forests. Protecting LSOG forest from loss due to high-intensity fire is also one of the management objectives for this area.

The RMP amendment and off-site mitigation actions for LSR 261 in the BLM Coos Bay District have been designed with the goal that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat.

Aggregated Impact of the Pacific Connector Pipeline Project on Mapped and Unmapped LSRs in the BLM Coos Bay District

Approximately 101 acres of the 387 acres of Matrix lands being reallocated contain LSOG forest habitat. A comparison of the total LSR acres that would be affected by the proposed Pacific Connector pipeline in the BLM Coos Bay District (in both mapped and unmapped LSRs) and the Matrix acres reallocated to LSR is in table 4.1.3.6-6 and figure 4.1-14.

TABLE 4.1.3.6-6

Comparison of the Pacific Connector Pipeline Project Total Impacts (a/) on LSRs and Matrix Reallocated to LSR (acres), Within BLM Coos Bay District

Coos Bay District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	17	3	164	184	101
Non- LSOG	47	7	73	127	284
Non-Forest	0	0	0	0	2
Total	**64**	**10**	**237**	**311**	**387**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) in both mapped and unmapped LSR.

Data source: BLM, Forest Service GIS Data Layers

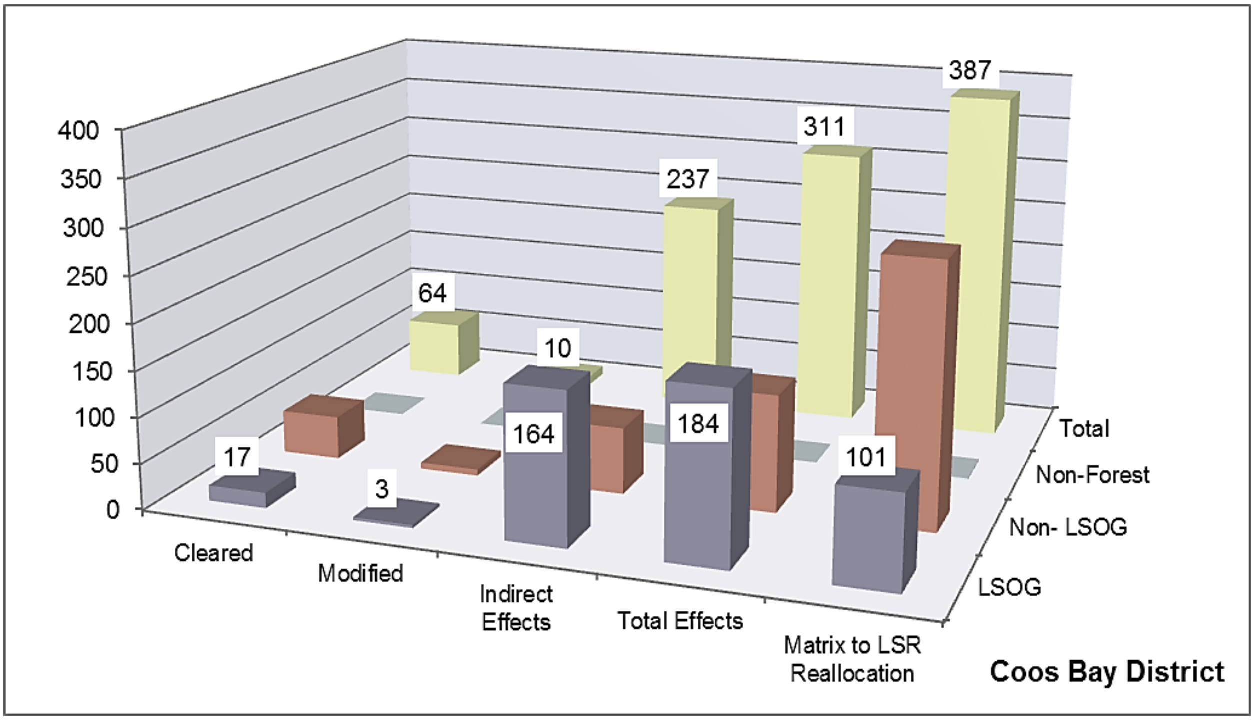


Figure 4.1-14. Comparison of Total LSR Acres Affected by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, Within BLM Coos Bay District

Approximately 64 acres of LSR lands would be cleared by the construction of the Pacific Connector pipeline in the Coos Bay District. Approximately 17 of these acres would be LSOG forest habitat. The proposed amendment would reallocate more than six times the amount of LSOG forest that would be cleared for the construction of the Pacific Connector pipeline.

Mitigation Actions

Off-site mitigation actions would provide added protection to the quantity, quality, and distribution of LSOG habitat. The BLM Coos Bay District is proposing to construct three heli-ponds to help with fire suppression efforts in LSR 261. Protecting LSOG forest from loss due to high-intensity fire is also one of the management objectives for LSR 261. Two of the heli-ponds would be in the East Fork Coquille River watershed and the other in the Middle Fork Coquille River watershed (see figure 4.1-15). High-intensity fire has been identified as the factor most affecting LSOG forest habitats on federal lands in the area of the NWFP (Moeur et al. 2011). Construction of the pipeline and associated activities would remove both mature and developing stands and could increase fire suppression complexity; however, the corridor would also provide a fuel break that could aid in suppression efforts. Within the East/Middle Fork watersheds, there is an over 18-mile gap between helicopter accessible waterholes. Quick response time is imperative for successful control of wildfires. Most water sources in this area are low in the drainage and accessible only by truck. Heli-ponds at these locations would reduce the 18-mile gap to approximately 6 miles and would enable a 2- to 3-mile radius for aerial application. Fire control is necessary to protect LSRs and endangered species habitat should a wildfire occur. These heli-ponds would reduce initial attack response times in both the mapped and unmapped LSRs that would be affected by the Pacific Connector pipeline and increase the potential to control fires before they become high-intensity fires that threaten LSOG forests.

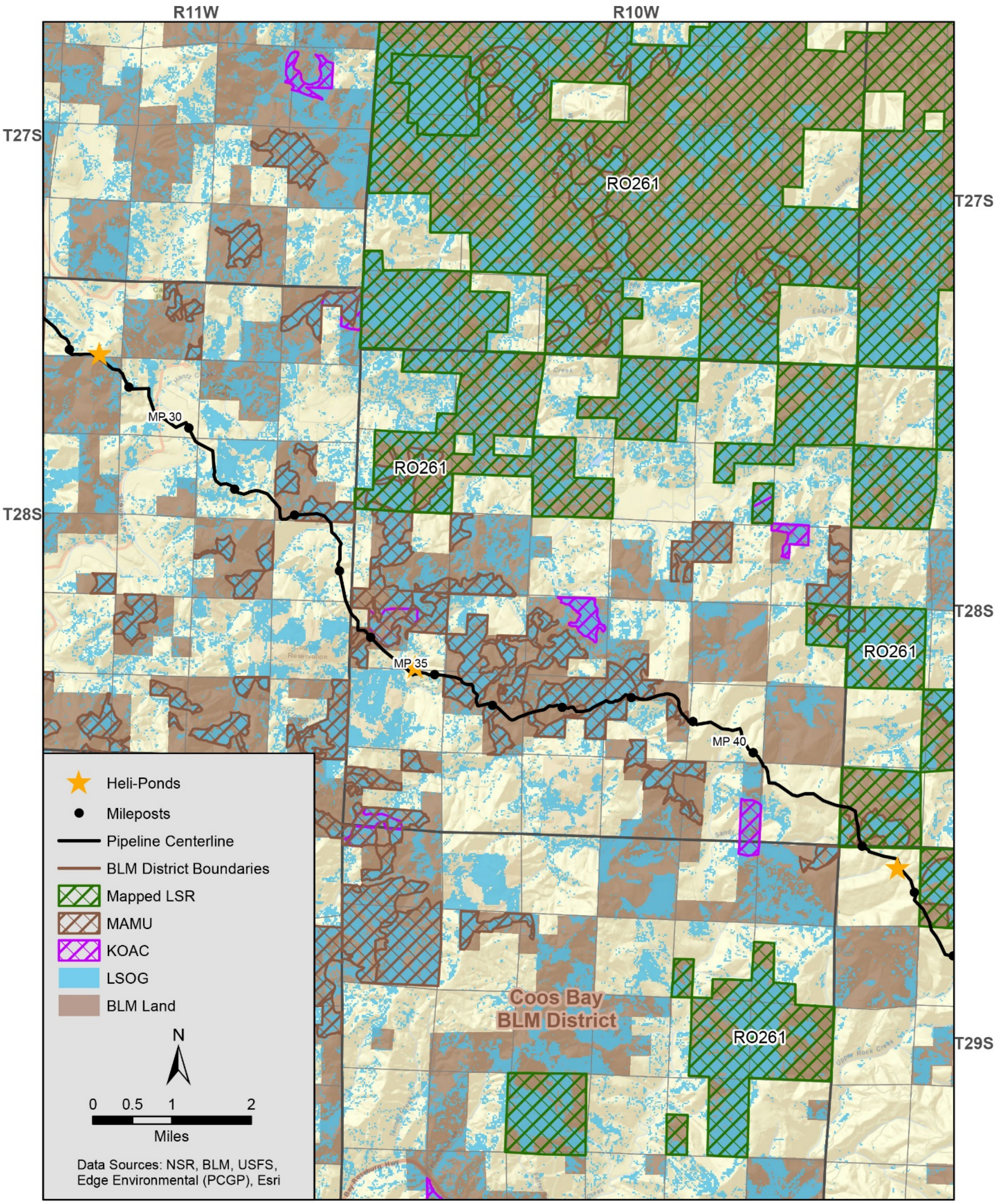


Figure 4.1-15. Map of Off-site LSR Mitigation Proposals in the BLM Coos Bay District

Together with the reallocation action, these off-site mitigation measures have been designed with the goal that the overall impact of the Pacific Connector pipeline would be either neutral or beneficial to the creation and maintenance of LSOG habitat in LSR 261.

RMP Amendments Related to LSRs on BLM Roseburg District

BLM–1, Site-Specific Exemption for Requirement to Protect MAMU Habitat in the BLM Roseburg District

The BLM Roseburg District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMUs within the Project right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Project right-of-way and would not change future management direction at any other location.

Existing known MAMU occupied sites were inventoried using BLM GIS layer data in 2006, and one occupied site was in the pipeline corridor on the Roseburg District. Additional MAMU surveys were conducted in 2007-2008 and 2012-2014 within the pipeline project area, and three additional occupied sites were identified on the Roseburg District. Two of these occupied sites (R3051 and R3052) were identified and delineated after the preparation of the 2014 PCGP DEIS. Both of these sites are located in MAMU Zone 2. BLM delineated the extent of the stands identified during the surveys and incorporated the newly identified stands into the GIS layer. Three of the four occupied stands within the project area on the Roseburg District occur outside of mapped LSRs on lands that are currently allocated as Matrix. The other stand lies within mapped LSR 261. Approximately 19 acres of occupied MAMU stands would be cleared by the Pacific Connector pipeline (see table 4.1.3.6-7). The map in figure 4.1-16 displays the known MAMU occupied stands in relation to the Pacific Connector Pipeline Project.

TABLE 4.1.3.6-7

Known Occupied Marbled Murrelet Stands in the Roseburg District within the Pacific Connector Pipeline Project Area

Marbled Murrelet Occupied Stand	Milepost Location	Acres Cleared a/
R3035 b/	MP 46.90-47.10	3
R3036	MP 51.04-51.29	3
R3051	MP 54.18-54.44	12
R3052	MP 60.85-61.66	1
		Total 19

Note: Columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).

a/ Acres cleared equals the clearing in the Pacific Connector pipeline corridor and the temporary extra work areas.

b/ Occupied Stand R3035 lies entirely within LSR 261.

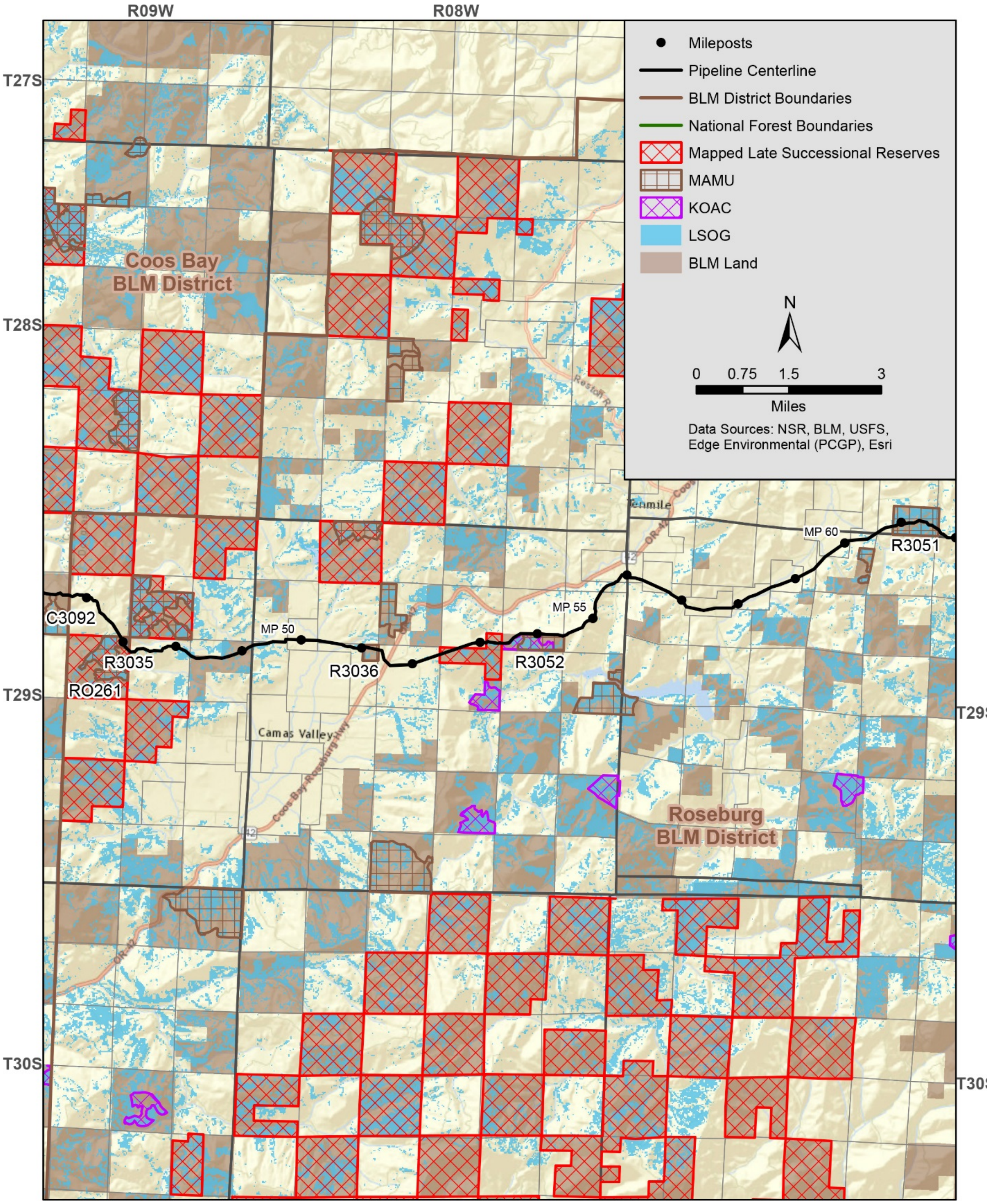


Figure 4.1-16. Map of Occupied MAMU Stands in the Pacific Connector Pipeline Corridor on the Roseburg District

Amount and Quality of MAMU Habitat Affected by the Construction and Operation of the Pipeline Project

The amount of MAMU habitat that would be affected both directly and indirectly is displayed in table 4.1.3.6-8 and figure 4.1-17.

TABLE 4.1.3.6-8

Comparison of Total Acres of Occupied Marbled Stands Impacted (a/) by the Pacific Connector Pipeline and Acres of Matrix to LSR Reallocation

Roseburg District	Cleared	Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
	Direct Effects				
LSOG	4	2	42	48	286
Non- LSOG	14	3	25	43	123
Non-Forest	0	0	0	0	0
Total	**19**	**5**	**67**	**91**	**409**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Pacific Connector pipeline total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

Data Source: BLM, Forest Service GIS Data Layers

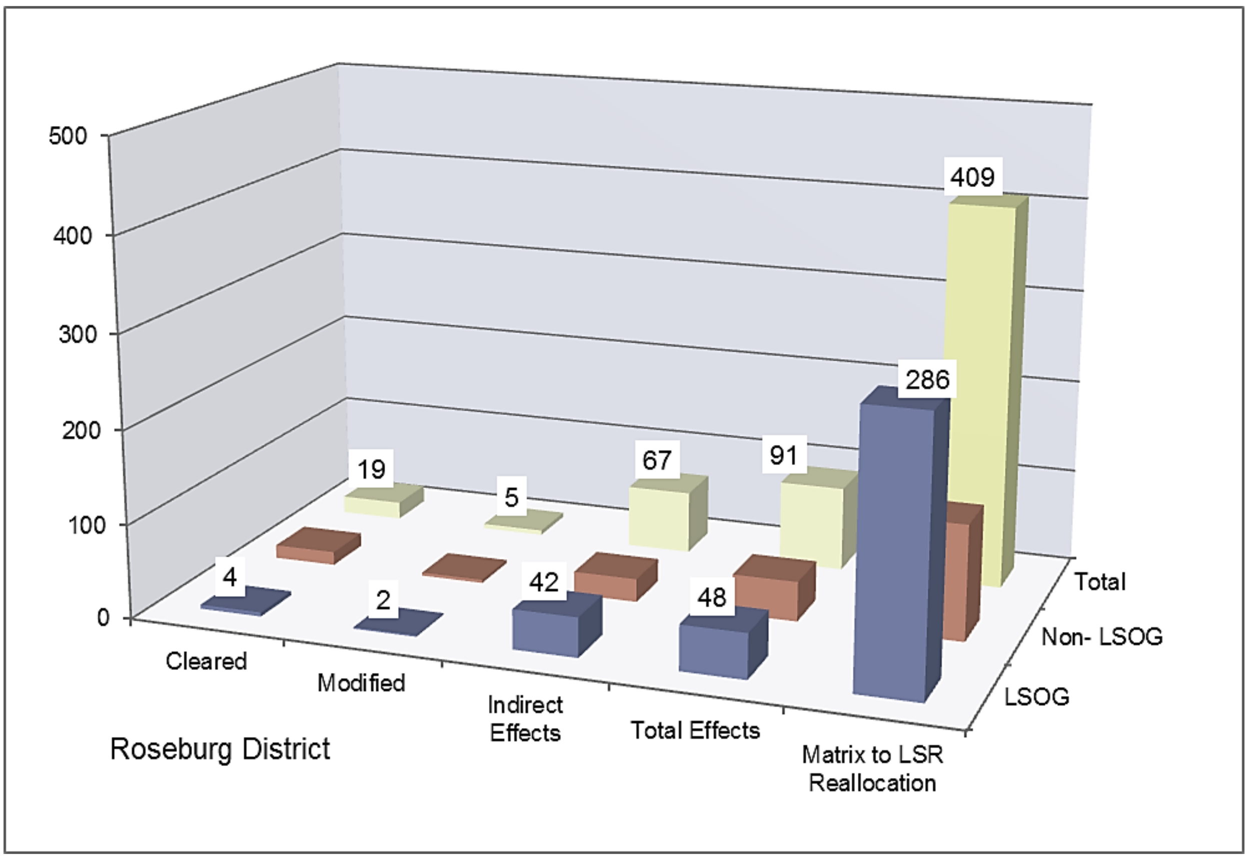


Figure 4.1-17. Total Acres of Occupied MAMU Stands Affected by the Pacific Connector Pipeline Project in the BLM Roseburg District

The Pacific Connector Pipeline Project would remove approximately 19 acres of occupied MAMU stands in the BLM Roseburg District. Approximately 6 of these acres would be located in MAMU Zone One and the remaining 13 acres in MAMU Zone Two. The proposed Matrix to LSR reallocation for LSRs in the BLM Roseburg District is outside of MAMU Zone 1 but is within MAMU Zone 2 and contains suitable habitat for MAMUs. Two of the affected MAMU stands on the Roseburg District are adjacent to affected MAMU occupied stands in the BLM Coos Bay District. The proposed Matrix to LSR reallocation in the BLM Coos Bay District also contains suitable MAMU habitat and is in MAMU Zone 1. The proposed Matrix to LSR reallocation on the Coos Bay District is near the area where MAMU are affected by the project on both the BLM Coos Bay and Roseburg Districts (see figures 4.1-12 and 4.1-22, see also appendix H, section 2.4.4 for additional discussion). The future management of these LSRs should not only protect habitat currently suitable to MAMUs, but also promote the development of additional MAMU habitat on the landscape. These reallocations would help to minimize the loss of unoccupied but suitable habitat. The total proposed amendments for MAMU on the BLM Coos Bay and Roseburg Districts are discussed in section 4.1.3.7 of this EIS.

BLM-2, Site-Specific Exemption from Requirement to Retain Habitat in KOACs in the BLM Roseburg District

The BLM Roseburg District RMP would be amended to waive the requirements to retain habitat in KOACs at three locations (see figures 4.1-18 to 4.1-20). This is a site-specific amendment applicable only to the Project right-of-way and would not change future management direction at any other location. The RMP for the Roseburg District requires retaining habitat within KOACs. By definition, KOACs are within Matrix lands and therefore would be addressed as unmapped LSRs.

Amount and Quality of KOACs Affected by the Construction and Operation of the Pipeline Project

Currently, based on the latest BLM GIS data layers, there are approximately 197 acres of LSOG forest habitat within the three KOACs that would be affected by the Pacific Connector pipeline on the BLM Roseburg District. Even though measures were taken to minimize impacts, habitat would still be affected by the pipeline project. While removal of LSOG forest habitat would be kept to 2 acres, there would also be impacts from the UCSAs and the indirect impacts of new edge and fragmentation of forest habitat. The total impacts from the pipeline on KOACs are displayed below in table 4.1.3.6-9 and figure 4.1-21.[22]

[22] A portion of KOAC P2199 overlaps Occupied MAMU site R3052. While there would be no overlap in the acres directly impacted by construction of the pipeline, there is approximately 6 acres of overlap in indirect effects. Therefore in tables displaying the indirect effects to all unmapped LSR (MAMU + KOAC) there is approximately 6 acres that are double counted.

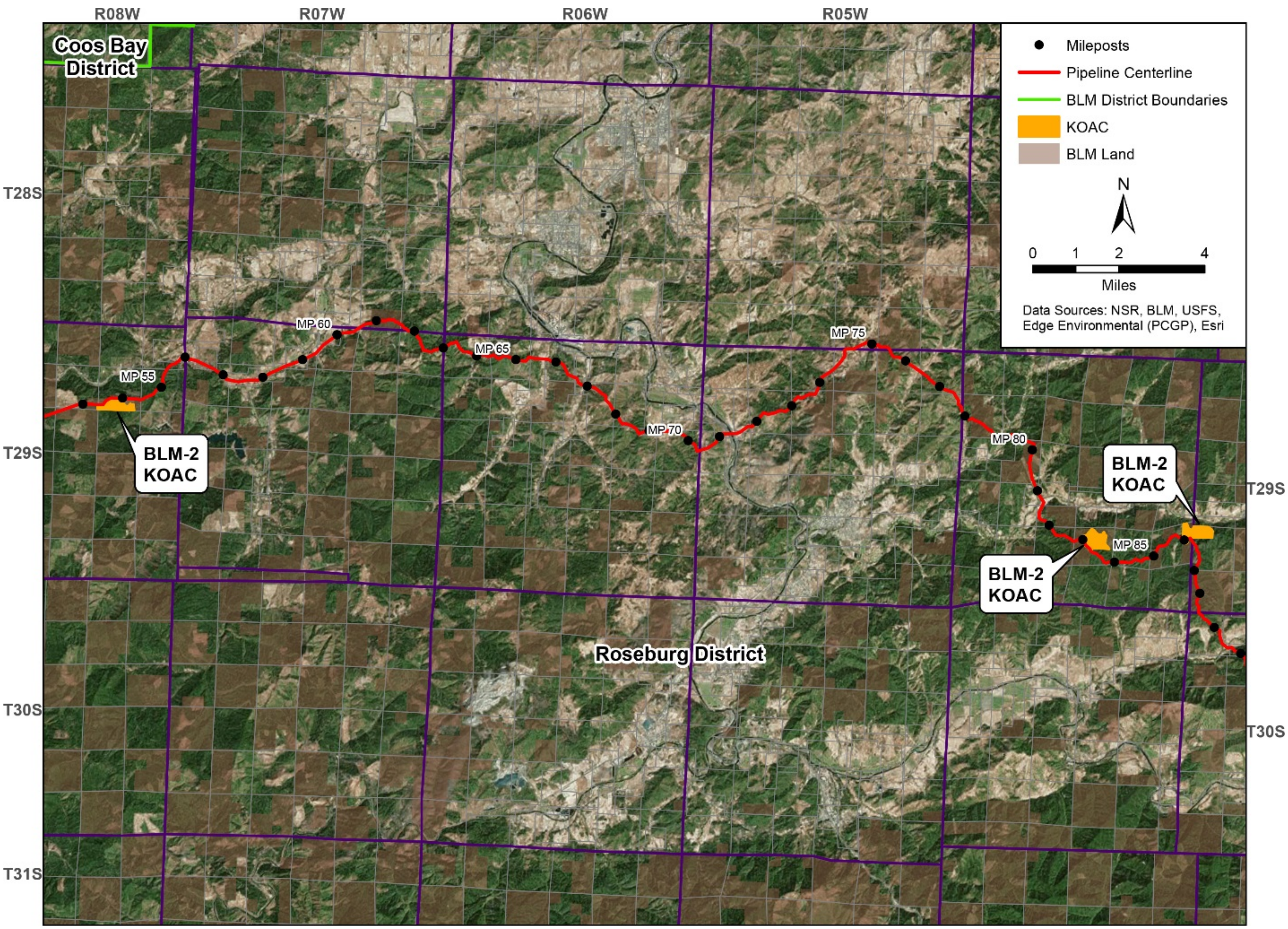


Figure 4.1-18. Map of KOAC Sites Crossed by the Pacific Connector Pipeline Project in the BLM Roseburg District

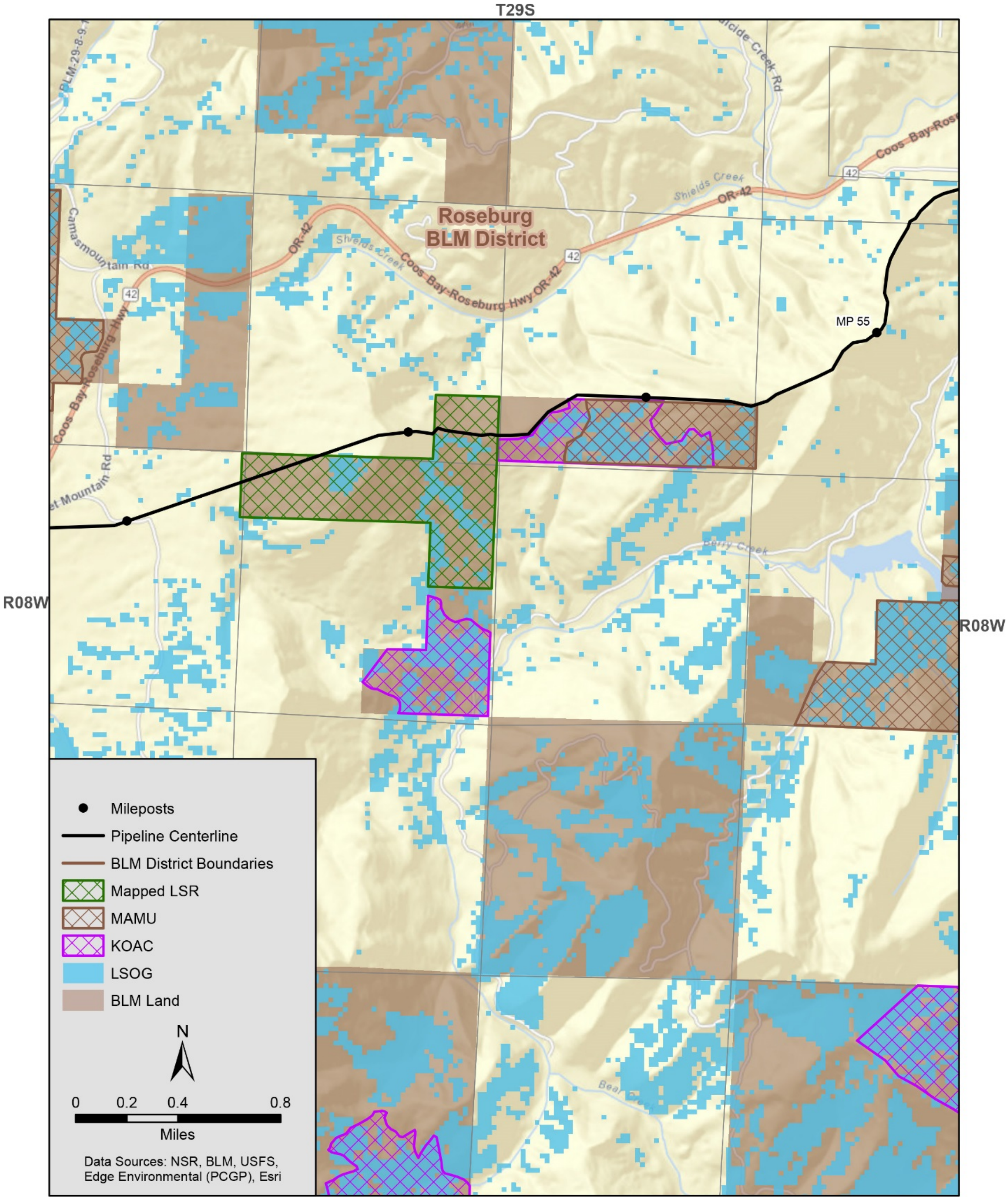


Figure 4.1-19. Map of KOAC P2199 and the Pacific Connector Pipeline, BLM Roseburg District

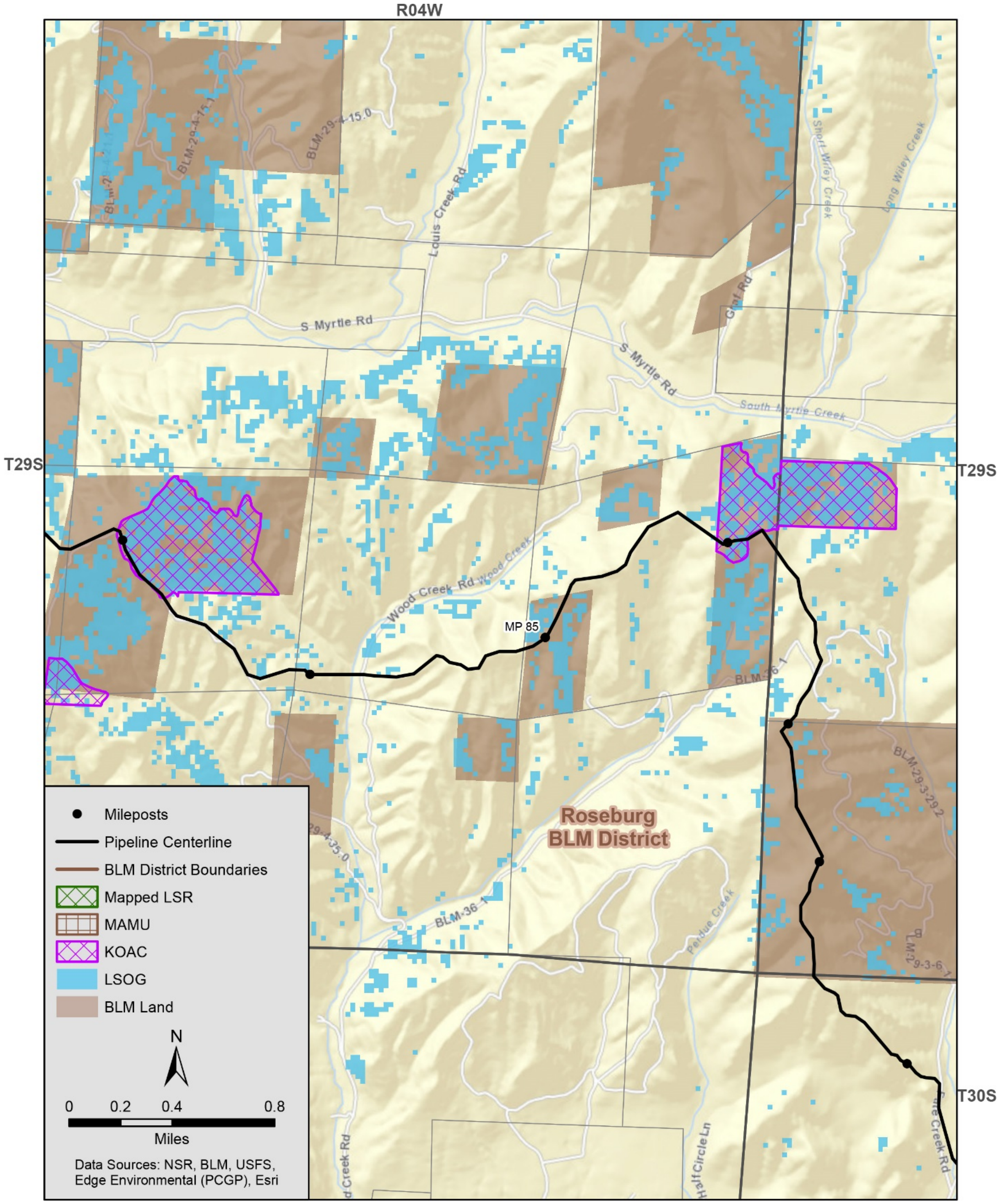


Figure 4.1-20. Map of KOACs P0361 and P2294 and the Pacific Connector Pipeline, BLM Roseburg District

TABLE 4.1.3.6-9

Summary of Total KOAC Acres Affected (a/) by the Pacific Connector Pipeline Project in the BLM Roseburg District

Roseburg Dist. KOACs	Direct Impacts: Cleared	Direct Impacts: Modified	Project Indirect Impacts	Project Total Impacts
LSOG	2	5	24	31
Non- LSOG	5	3	6	15
Non-Forest	0	0	0	0
Total	**7**	**9**	**30**	**46**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Total project impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: BLM, Forest Service GIS Data Layers

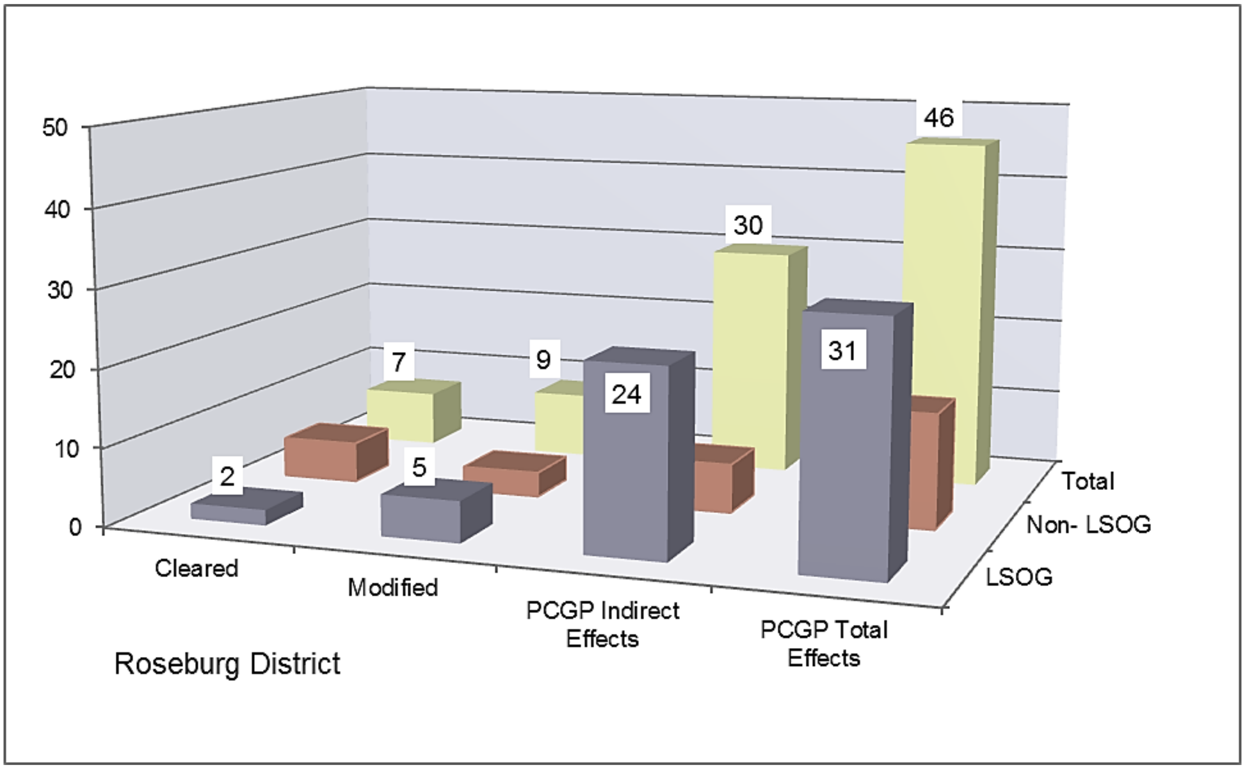


Figure 4.1-21. Summary of Total KOAC Acres Affected by the Pacific Connector Pipeline Project in the BLM Roseburg District

BLM-3, Reallocation of Matrix Lands to Late-Successional Reserves

The BLM Roseburg District RMP would be amended to change the designation of approximately 409 acres from the Matrix land allocation to the LSR land allocation in Sections 32 and 34, of T.291/2 S., R.7W., and section 1 T.30S. R.7W., W.M., Oregon.

This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Pacific Connector pipeline on LSRs in the Roseburg District. This proposed amendment would change future management direction for the lands reallocated from Matrix to LSR. A map of the proposed reallocation is displayed in figure 4.1-22.

The primary management objective of the LSR land allocation is to protect and enhance conditions of LSOG forest ecosystems that serve as habitat for late-successional and old-growth related species. Currently, based on the latest BLM GIS data there are approximately 31,793 acres of LSOG forest habitat in LSR 261. If constructed, the part of the Pacific Connector pipeline in the BLM Roseburg District would remove approximately 11 acres of forest vegetation in LSR 261. This includes the removal of forest from both the pipeline corridor and the TEWAs. Approximately 1 of these acres is LSOG forest habitat. The area proposed for reallocation to LSR is approximately 409 acres of Matrix lands, of which approximately 286 acres are LSOG forest. In addition to the impacts from the removal of forest vegetation in LSR 261, there would be impacts from the acres modified by UCSAs and the acres indirectly affected through the creation of new edges and fragmentation of older forest. A comparison of the total acres affected in LSR 261 and the acres of reallocation are displayed in table 4.1.3.6-10 and figure 4.1-23 below.

The acres that would be reallocated would become part of mapped LSR 259. This LSR is adjacent to LSR 261 and is also near the area of the Pacific Connector pipeline (see appendix H, section 2.2.2.4). LSR 259 has similar priorities and recommendations as LSR 261 (see appendix H, section 2.2.1.1). One of the key objectives for LSRs 261 and 259 is to increase the stand sizes of contiguous LSOG habitat. A key recommendation for these LSRs is risk management activities to reduce the probability that a major stand-replacing event or events that degrade habitat quality would occur. The primary purpose of risk reduction activities in these LSRs is to reduce the probability of large-scale loss of late-successional habitat. Another purpose of risk reduction activities is to reduce the probability of late-successional habitat loss in stands with important features such as nest stands for NSOs, stands containing other key species, or stands containing larger blocks of interior habitat or providing meaningful localized connectivity.

In addition, the area around LSR 259 provides a better opportunity to consolidate LSOG habitat as evidenced by the high percentage of LSOG forest in the acres proposed for reallocation. The reallocation would increase the quantity of LSOG habitat in LSR 259 by 286 acres. It would also improve the quality of LSOG habitat within the LSR due to the larger LSOG patch size and the consolidation of habitat in this area. Reallocation in this area would also improve the distribution of LSOG habitat between LSR 259 and LSR 261, which is important in this area due to the highly fragmented land ownership patterns (see appendix H, section 2.2.2.4). For these reasons, reallocating acres to LSR 259 is being considered for mitigation for the impacts in LSR 261.

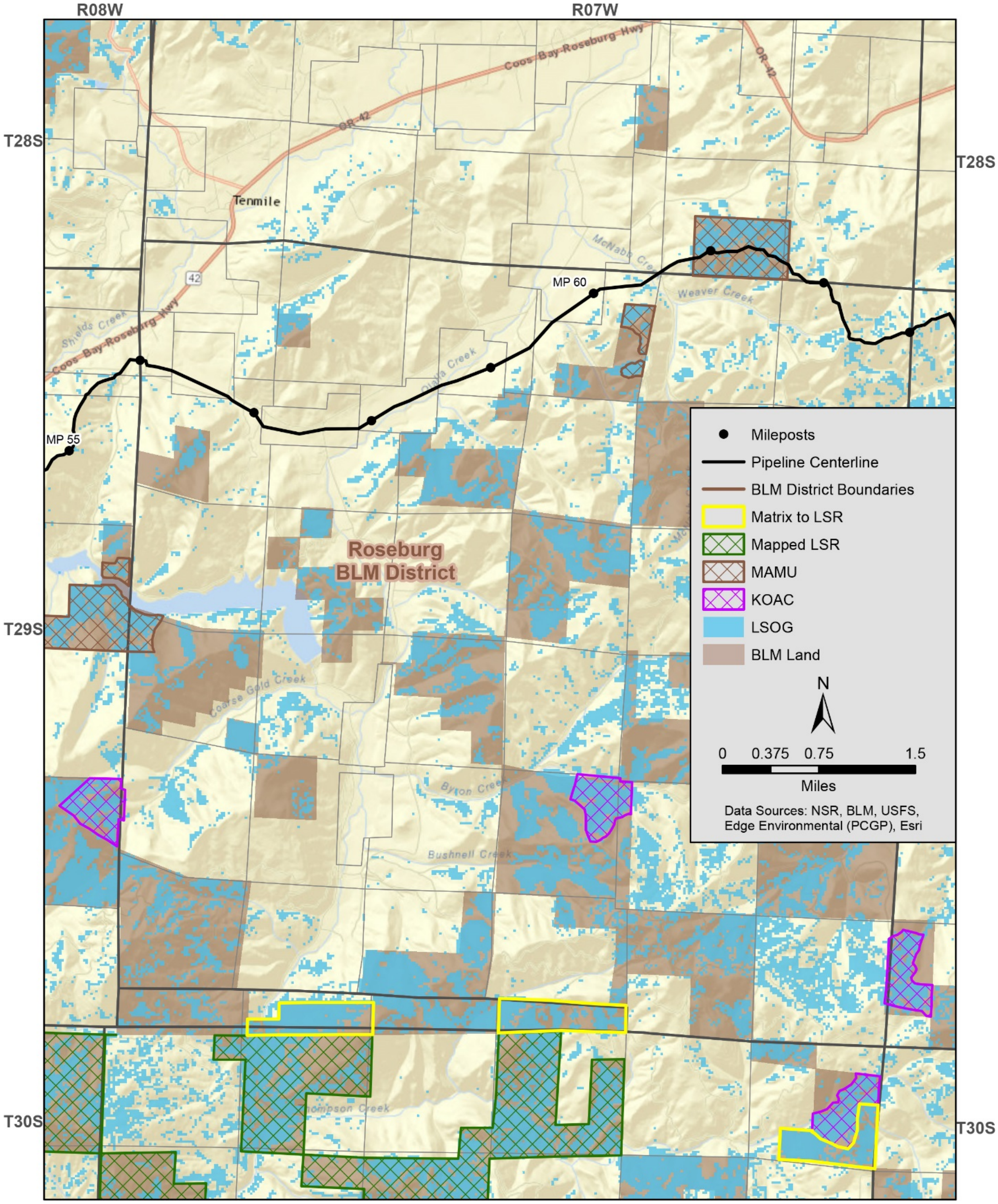


Figure 4.1-22. Map of Proposed Matrix to LSR Reallocation and LSOG Habitat in the BLM Roseburg District

TABLE 4.1.3.6-10

Comparison of the Total LSR Acres Affected (a/) by the Pacific Connector Pipeline Project and Matrix Reallocated to LSR, Roseburg District LSR 261

Roseburg District LSR 261	Direct Impacts: Cleared	Direct Impacts: Modified	Project Indirect Impacts	Project Total Impacts	Matrix to LSR Reallocation
LSOG	1	<1	16	17	286
Non- LSOG	10	1	17	28	123
Non-Forest	0	0	0	0	0
Total	**11**	**1**	**33**	**45**	**409**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Total project impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

Data source: BLM, Forest Service GIS Data Layers

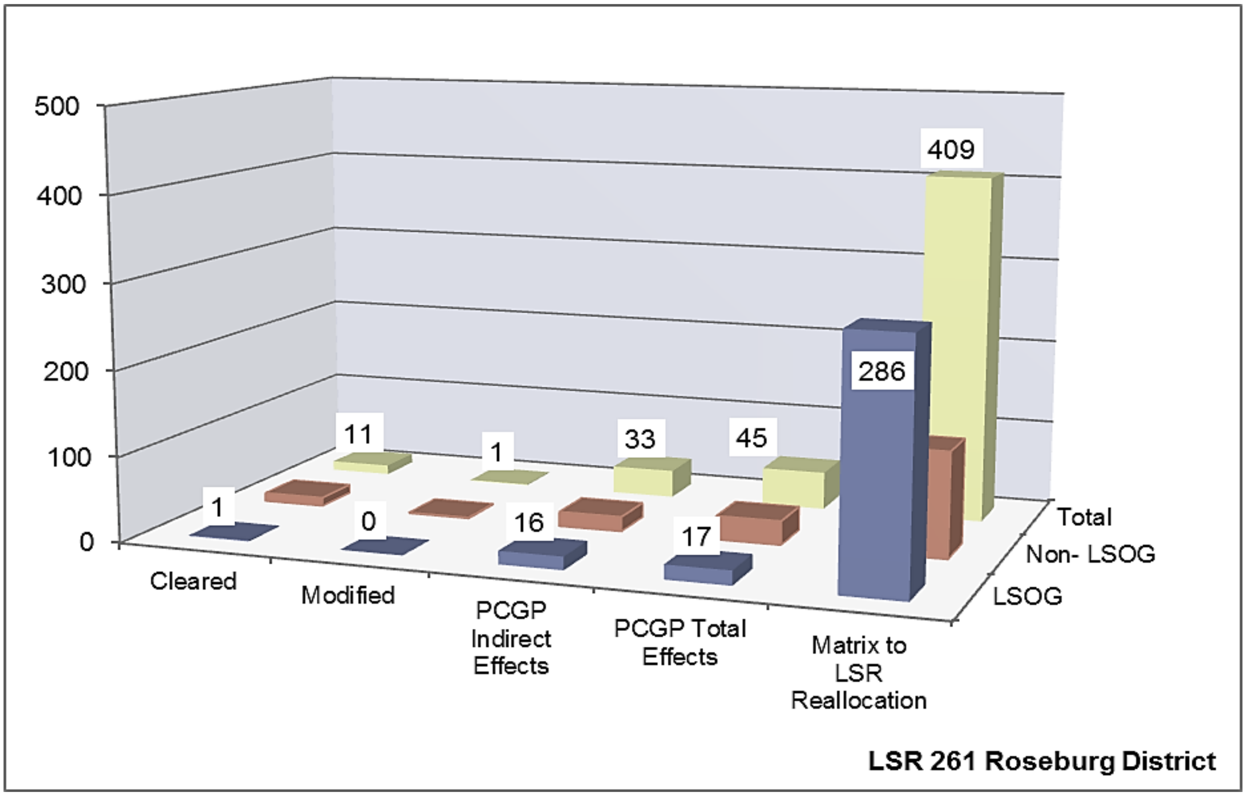


Figure 4.1-23. Comparison of Total LSR Acres Affected by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, BLM Roseburg District LSR 261

Impact on the Functionality of LSR 261 on the BLM Roseburg District

The functionality of LSR 261 relates directly to the goals and objectives for LSRs and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the Pacific Connector Pipeline Project would affect these characteristics.

- **Quantity**: The overall quantity of LSOG habitat in LSRs on the BLM Roseburg District would increase slightly with the construction of the Pacific Connector pipeline and RMP amendment. The Pacific Connector pipeline would remove approximately 1 acre of LSOG habitat, but would reallocate approximately 286 acres of LSOG habitat with the RMP amendment. This would represent a net increase of 285 acres of LSOG habitat.[23]

- **Quality:** The area of LSR 261 that would be affected by the Pacific Connector pipeline is highly fragmented due to both the land ownership pattern and past management activities. The area contains a high degree of edge with little or no interior forest habitat (see figure 4.1-15). The area proposed for reallocation contains some large blocks of LSOG habitat as well as an adjacent KOAC (see figure 4.1-22). This reallocation would consolidate habitat in an area that is highly fragmented. LSRs on BLM land comprise checkerboard sections or even smaller parcels of land. The intent of the reallocations is to better connect these pieces by decreasing distances between individual LSR parcels and reduce the amount of "edge" adjacent to existing occupied MAMU stands. Consolidating habitat is one of the management objectives for this area. With the reallocation of Matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSR LSOG habitat would be improved.
- **Distribution**: The distribution of LSOG habitat within LSR 261 would remain largely unchanged with the Pacific Connector pipeline and the reallocation of Matrix to LSR RMP amendment. To the extent there are minor changes they would be beneficial due to the location of the proposed reallocation. The reallocation would occur between the southern edge of LSR 261 and the northern edge of LSR 259 and would provide some additional connectivity within LSR 259 in this area.
- The off-site mitigation action would provide added protection to the quantity, quality, and distribution of LSOG habitat by improving the potential to decrease initial fire suppression response times and thereby increase the potential to control fires before they become high-intensity fires that threaten LSOG forests. Protecting LSOG forest from loss due to high-intensity fire is also one of the objectives for this area.

The RMP amendments and off-site mitigation actions for LSR 261 in the BLM Roseburg District have been designed with the goal that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat. A discussion on the total amendments to LSR 261 on the BLM Coos Bay and Roseburg Districts is in section 4.1.3.7 of this EIS. Additional information can also be found in section 2.2.2.5 of appendix H.

Aggregated Impact of the Pacific Connector Pipeline Project on Mapped and Unmapped LSRs in the BLM Roseburg District

The construction of the Pacific Connector pipeline in the BLM Roseburg District would also affect LSR 223 (see figure 4.1-24). Currently, based on the latest BLM and Forest Service GIS data there are approximately 20,557 acres of LSOG forest habitat, which comprise approximately 31 percent of LSR 223. The pipeline would remove approximately 46 acres of forest from LSR 223, of which approximately 13 acres would be LSOG forest. In addition to the acres cleared, there would be impacts from acres modified by UCSAs and indirect impacts from the creation of new edge and the fragmentation of forest habitat. The total impacts on LSR 223 in the BLM Roseburg District are displayed in table 4.1.3.6-11 and figure 4.1-25.

---

[23] The acres would be reallocated to LSR 259, which is next to LSR 261; see discussion in Amendment BLM-3, Reallocation of Matrix Lands to Late-Successional Reserves above for the reasons reallocation in LSR 259 is being considered as mitigation for LSR 261.

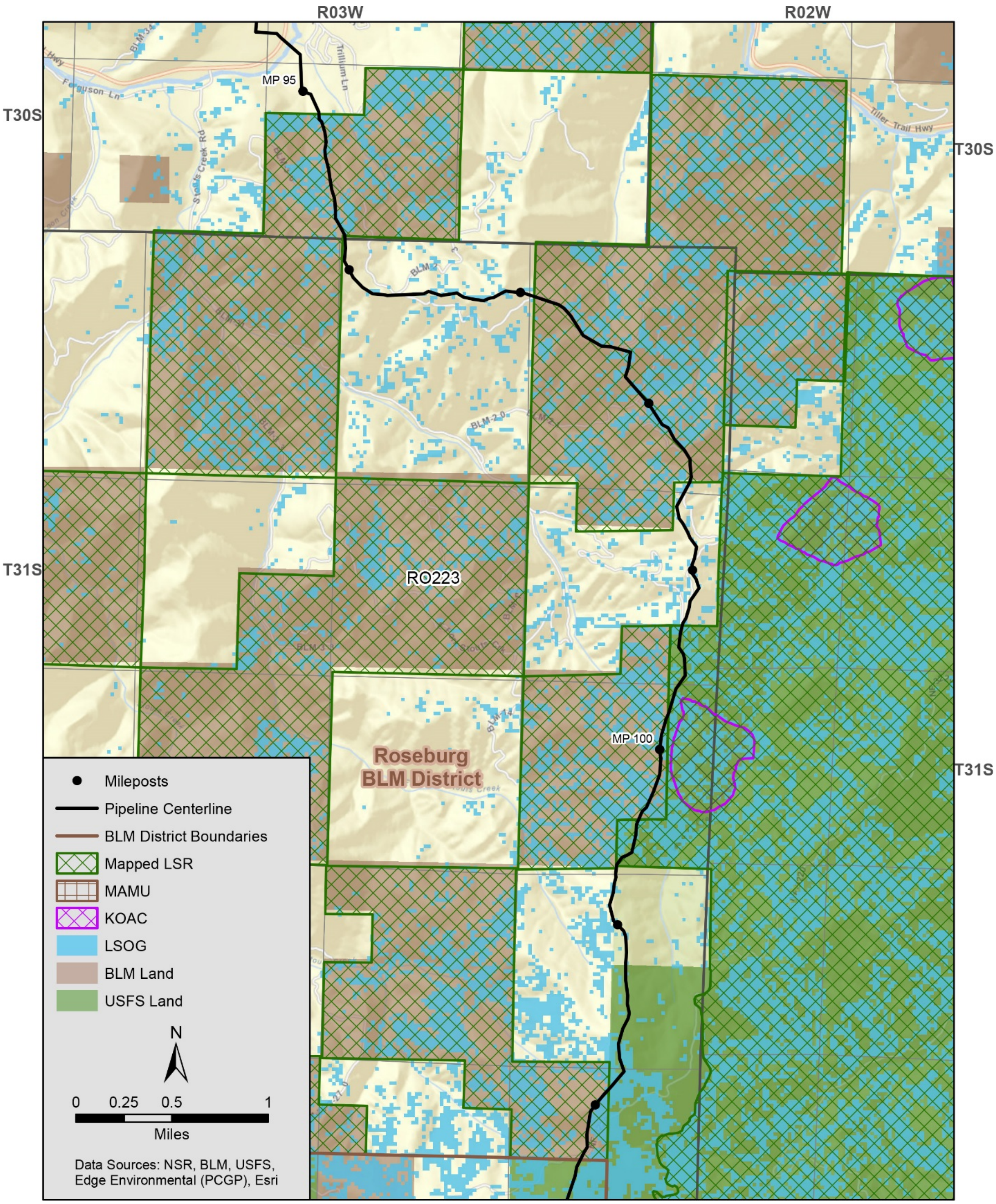


Figure 4.1-24. Map of LSR 223 Crossed by the Pacific Connector Pipeline Project in the BLM Roseburg District

TABLE 4.1.3.6-11

Summary of Total LSR 223 Acres Affected (a/) by the Pacific Connector Pipeline Project in the BLM Roseburg District and Acres of Matrix Reallocated to LSR

Roseburg District LSR 223	Cleared (Direct Impacts)	Modified (Direct Impacts)	Project Indirect Impacts	Project Total Impacts
LSOG	13	8	103	124
Non-LSOG	34	13	42	88
Non-Forest	0	0	0	0
Total	**46**	**22**	**145**	**212**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Total project impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

Data source: BLM, Forest Service GIS Data Layers

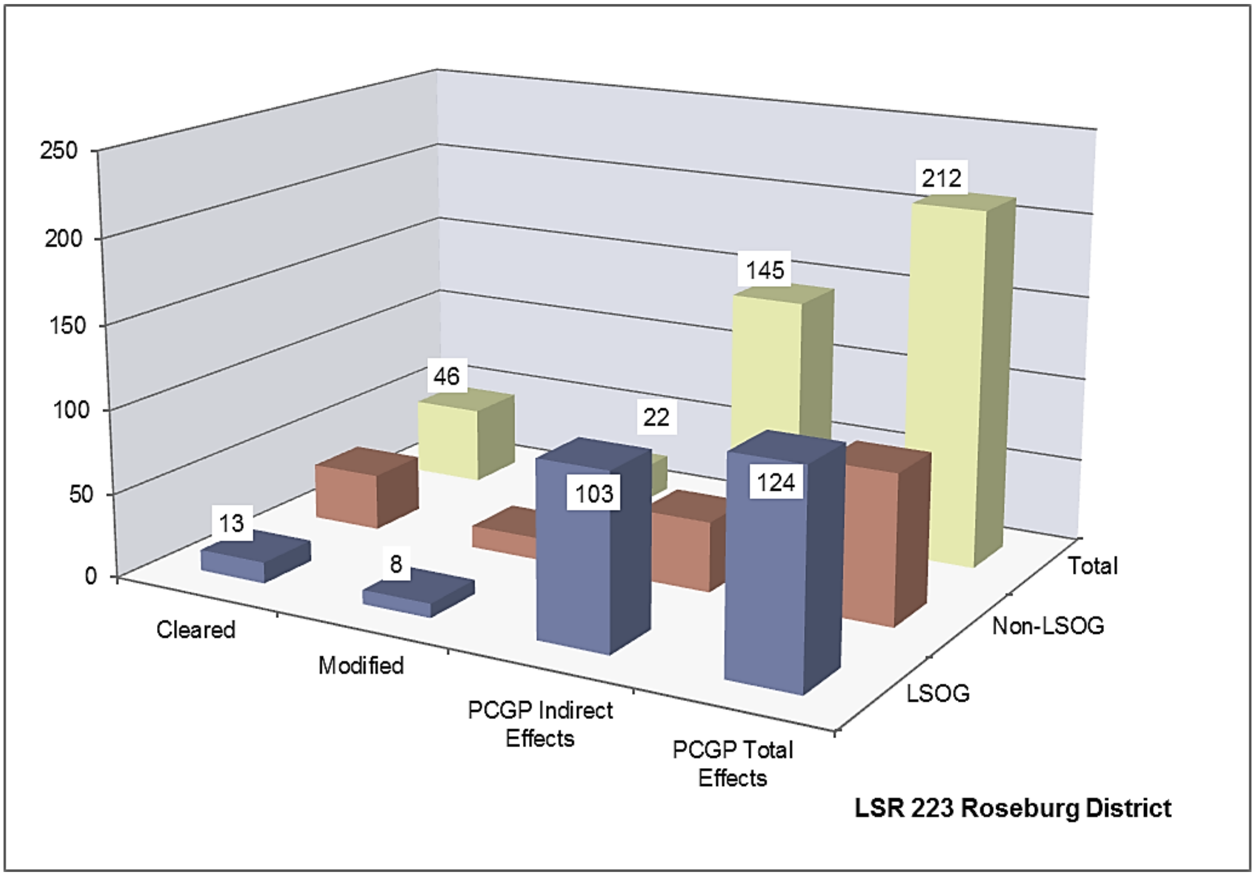


Figure 4.1-25. Summary of Total LSR 223 Acres Affected by the Pacific Connector Pipeline Project on the BLM Roseburg District

In addition to the impacts of the Project corridor on LSR 223 in the BLM Roseburg District, there are also potential off-site impacts on LSR 223 from road reconstruction that would be necessary to accommodate the trucks that would be hauling the sections of pipe. These trucks are longer than typical trucks that use forest roads and some road widening and curve realignment may be necessary to safely allow for this truck traffic. In LSR 223 on the BLM Roseburg District it is estimated that approximately 2 acres of road widening would occur within LSR. Although this road widening would occur to the extent possible within the existing clearing limits, it is probable that some additional clearing of forest vegetation would be necessary to accommodate the road reconstruction. It is estimated that this would be a maximum of two acres and would occur along an existing road opening.

There are no proposed amendments to reallocate Matrix lands to LSR 223 in the BLM Roseburg District. This is due primarily to the lack of suitable LSOG forest habitat in the Matrix near the LSR and the pipeline. There is, however, a proposed amendment to reallocate Matrix lands to LSR 223 in the Umpqua National Forest, which borders the east side of the BLM Roseburg District and is discussed below. The Pacific Connector pipeline would also affect LSR 223 on the Umpqua National Forest. The combined effects on LSR 223 in the BLM Roseburg District and Umpqua National Forest, the Matrix to LSR reallocation, and the proposed mitigation actions are evaluated in section 4..1.3.7 of this EIS (see also section 2.3.1.4 of appendix H).

Approximately 286 acres of the 409 acres of Matrix lands that would be reallocated in the BLM Roseburg District contain LSOG forest habitat. A comparison of the total LSR acres that would be affected by the Pacific Connector pipeline in the BLM Roseburg District in both mapped LSRs (261 and 223) and unmapped LSRs (MAMU and KOACs), with the Matrix acres reallocated to LSR is in table 4.1.3.6-12 and figure 4.1-26.[24] A total of approximately 81 acres of LSR lands would be cleared by the construction of the pipeline project in the BLM Roseburg District. Approximately 19 of these acres would be LSOG forest habitat. The proposed amendment would reallocate approximately 15 times the amount of LSOG forest that would be cleared with the construction of the Pacific Connector pipeline.

TABLE 4.1.3.6-12

Comparison of Total LSR Acres Affected (**a/**) by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, BLM Roseburg District

Roseburg District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	19	15	177	193	286
Non- LSOG	61	21	87	169	123
Non-Forest	0	0	0	0	0
Total	**81**	**36**	**265**	**362**	**409**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) in both mapped and unmapped LSRs.
Data source: BLM, Forest Service GIS data layers

[24] A portion of KOAC P2199 overlaps Occupied MAMU site R3052. While there would be no overlap in the acres directly impacted by construction of the pipeline, there is approximately 6 acres of overlap in indirect effects. Therefore in tables displaying the indirect effects to all unmapped LSR (MAMU + KOAC) there is approximately 6 acres that are double counted.

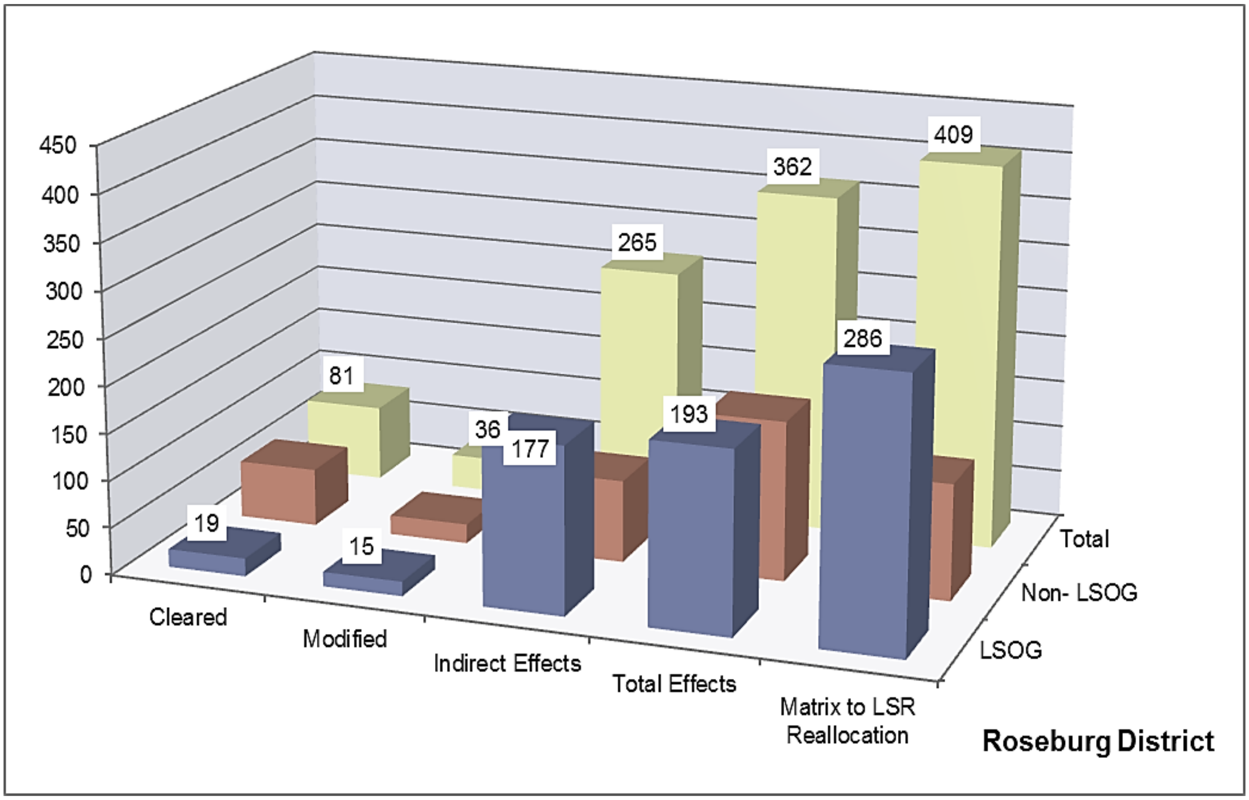


Figure 4.1-26. Comparison of Total LSR Acres Affected by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, BLM Roseburg District

Mitigation Actions

In addition to the reallocation of Matrix lands to LSR, the off-site mitigation actions include hazardous fuels reduction through creating a 1,000-acre fuel break adjacent to the Pacific Connector Pipeline Project corridor in the South Umpqua River watershed and aiding fire suppression efforts through the creation of six dry hydrants in the South Umpqua River, Myrtle Creek, and Middle South Umpqua River watersheds (see figure 4.1-27). These mitigation actions have been designed to complement the mitigation actions being considered in the Umpqua National Forest to benefit LSR 223.

On July 30, 2015 the Stouts Fire started near Milo Oregon and had grown to over 26,000 acres by September 1, 2015. The fire burned into portions of LSR 223 and the proposed pipeline corridor between MP 96 and 105 (see figure 4.1-28 for MP locations). In addition, fire suppression activities occurred along the proposed pipeline route from approximately MP 104.5 to MP 109. At the time this FEIS was being prepared the fire was still burning and the full extent of impacts to LSR 223 were unknown. Once the fire has been controlled the BLM and Forest Service will assess the impacts and develop post-fire strategies and recommendations. We know from fire incident reports some of the LSOG forest in LSR 223 in the vicinity of the proposed pipeline has been impacted by the fire. Therefore the impacts of the proposed pipeline project on LSOG habitat in LSR 223 displayed in figure 4.1-29 above may change. Changes to the proposed 1,000 acre fuel break described below can be expected since portions of that proposed fuel break occur within the fire perimeter and fire suppression activities. There may be changes to other proposed mitigation actions in this area as well once post fire assessments have been completed.

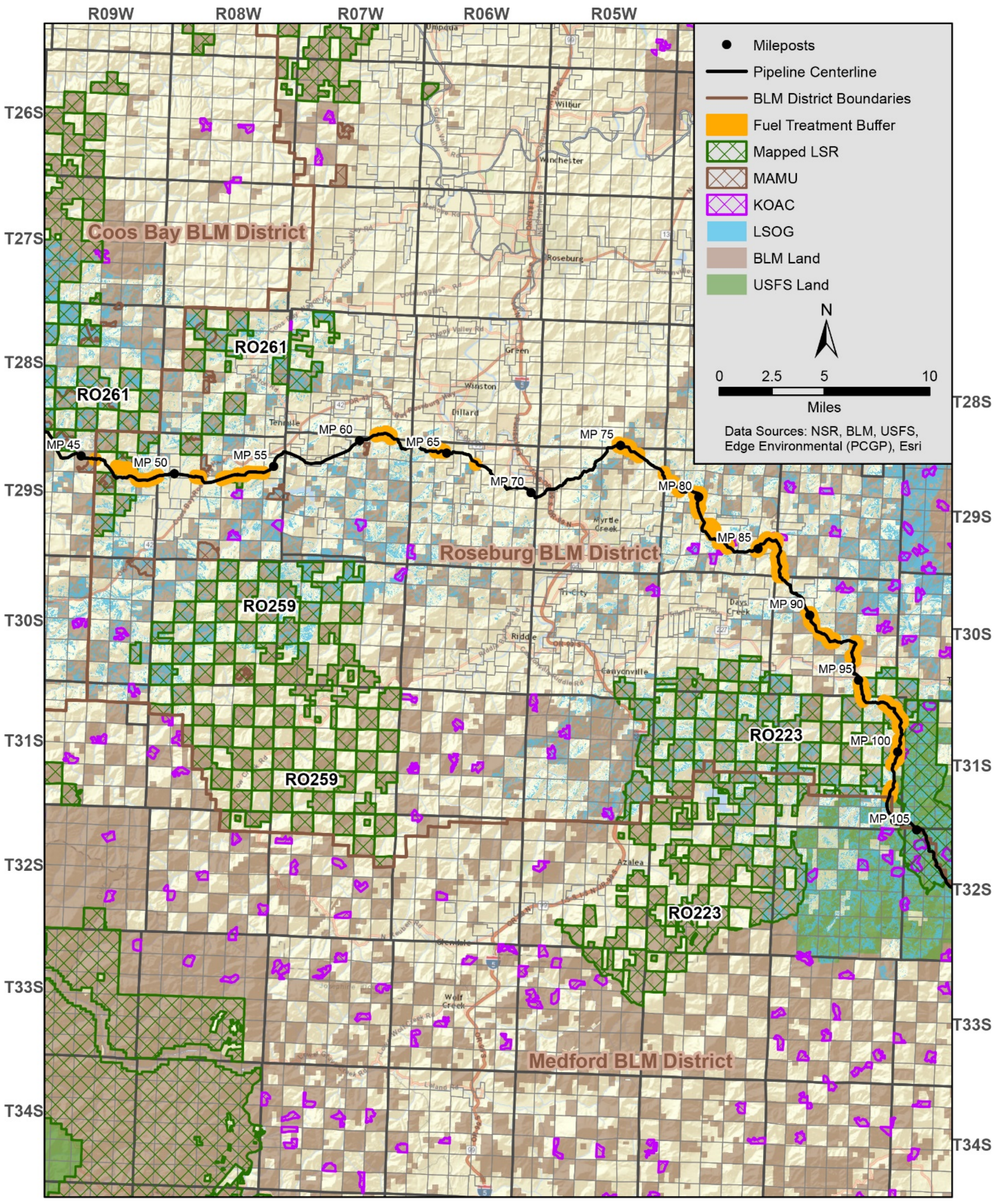


Figure 4.1-27. Map of Proposed Off-site LSR Mitigation Actions in the BLM Roseburg District

1,000-Acre Fuel Break

High-intensity fire has been identified as the single factor most affecting late-successional and old growth forest habitats on federal lands in the area of the NWFP (Moeur et al. 2011). Construction of the pipeline and associated activities would remove both mature and developing stands and increase fire suppression complexity; however, the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire. This segment is part of the Days Creek to Shady Cove fuel break and ties in with similar projects in the Umpqua National Forest.

Six Dry Hydrants

By installing dry hydrants, the water source is disturbed only once, and there are several other advantages. Fire vehicles would not need to be really close to the water to fill up, decreasing the risk of contamination, and they can fill from some water sources that would otherwise need to be modified for use. Areas that have had restoration work for fish populations could still be safely accessed for fire suppression. Overall, better water sources would improve suppression success and therefore help protect natural resources.

LRMP Amendments Related to LSRs on the Umpqua National Forest.

UNF-4, Reallocation of Matrix Lands to Late-Successional Reserves

The Umpqua National Forest LRMP would be amended to change the designation of approximately 588 acres from the Matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W., Oregon; and Sections 13 and 24, T.32S., R.3W., W.M., Oregon.

This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Pacific Connector pipeline on LSR 223 in the Umpqua National Forest. This proposed amendment would change future management direction for the lands reallocated from Matrix to LSR. A map of the proposed reallocation is displayed in figure 4.1-28.

The primary management objective of the LSR land allocation is to protect and enhance conditions of LSOG forest ecosystems that serve as habitat for LSOG–related species. Currently, based on latest BLM and Forest Service GIS data, there are approximately 20,557 acres of LSOG forest habitat, which comprises approximately 31 percent of LSR 223.

If constructed, the part of the Pacific Connector pipeline in the Umpqua National Forest would be about 11 miles long, of which about 5 miles would traverse through LSR 223. The Pacific Connector pipeline would clear approximately 67 acres, of which approximately 23 acres are LSOG forest. The area proposed for reallocation to LSR 223 is approximately 588 acres of Matrix lands, of which approximately 431 acres are LSOG forest. When acres reallocated from Matrix lands to LSR are compared to the acres of LSR that would be cleared by the Pacific Connector pipeline, the proposed amendment would reallocate nearly nine times more acres to LSR than would be cleared for the Pacific Connector pipeline corridor. In terms of LSOG habitat, the proposed amendment would reallocate almost 19 times more acres to LSR than would be cleared for the Pacific Connector pipeline corridor.

In addition to the impacts from the removal of forest vegetation in LSR 223, there would be additional impacts from the acres modified by UCSAs and the acres indirectly affected through the creation of new edges and fragmentation of older forest. A comparison of the total acres affected in LSR 223 and the acres of reallocation are displayed in table 4.1.3.6-13 and figure 4.1-29 below.

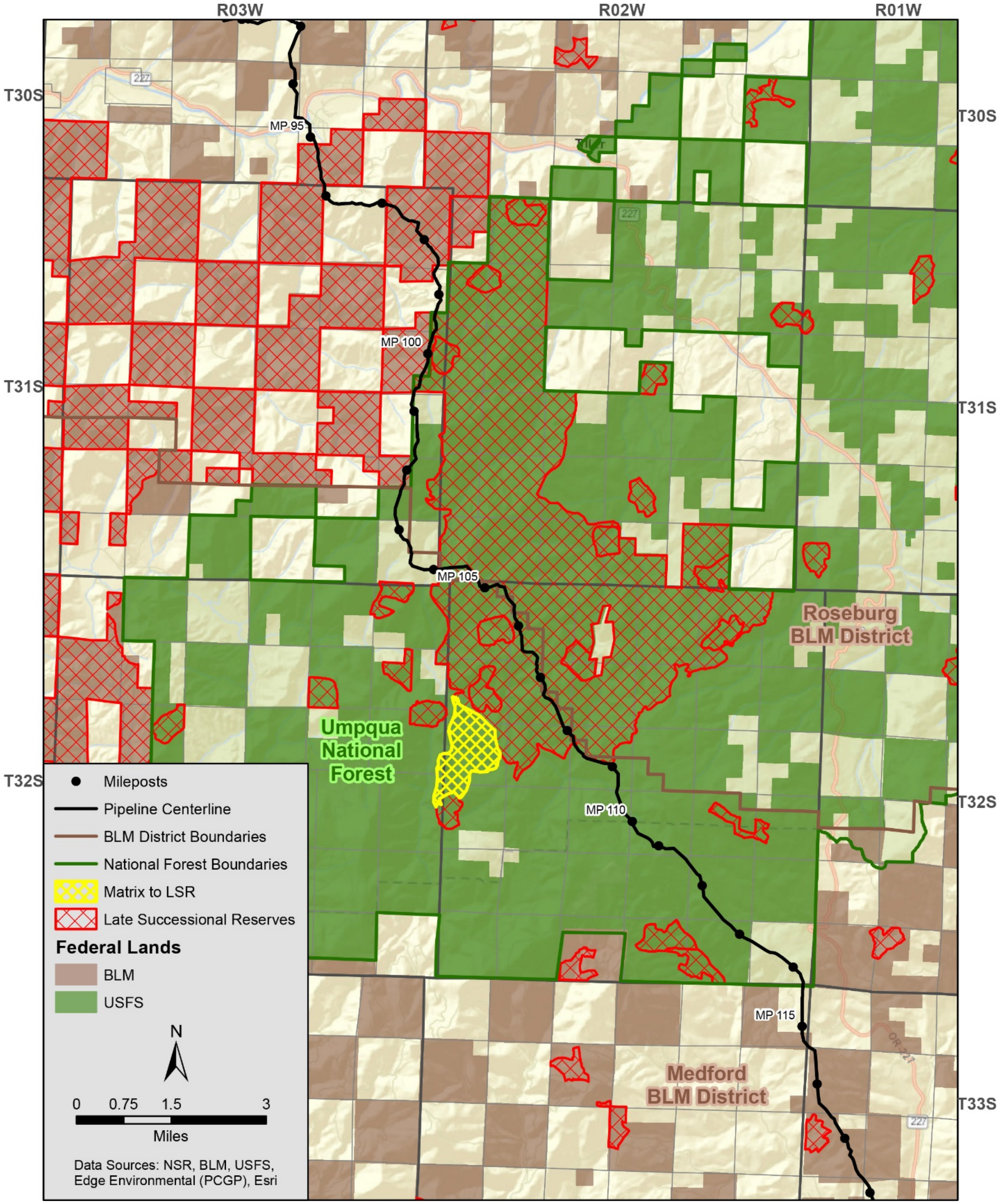


Figure 4.1-28. Proposed Matrix to LSR Reallocation, Umpqua National Forest

TABLE 4.1.3.6-13

Comparison of LSR 223 Acres Affected (a/) by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, Umpqua National Forest

Umpqua National Forest LSR 223	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	23	6	168	**197**	431
Non- LSOG	45	11	73	**129**	157
Non-Forest	0	0	0	**0**	0
Total	**67**	**17**	**241**	**325**	**588**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

Data source: BLM, Forest Service GIS Data Layers; Cox 2010

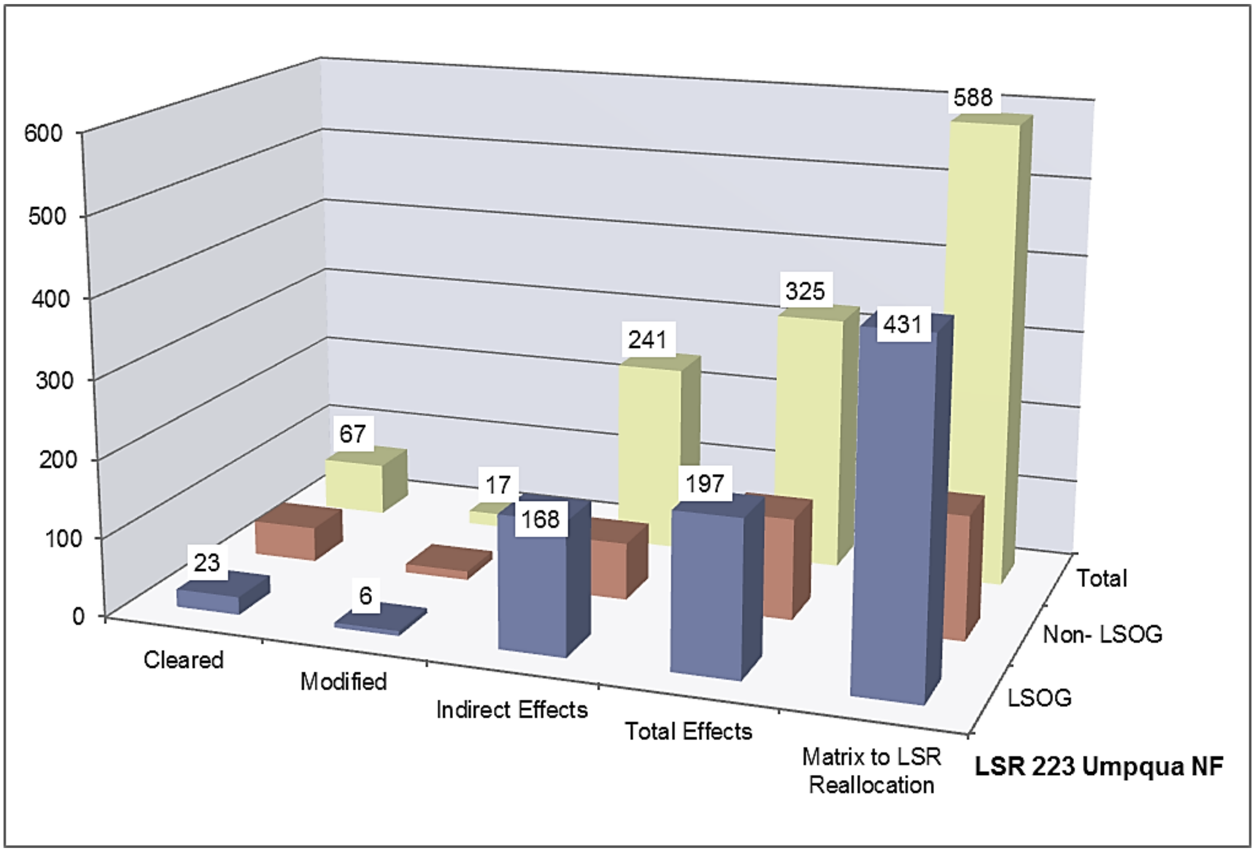


Figure 4.1-29. Comparison of Total LSR 223 Acres Affected by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, Umpqua National Forest

In addition to the impacts of the Pacific Connector pipeline corridor on LSR 223 in the Umpqua National Forest, there are also potential off-site impacts on LSR 223 from road reconstruction that would be necessary to accommodate the trucks that would be hauling the sections of pipe. These trucks are longer than typical trucks that use forest roads and some road widening and curve realignment may be necessary to safely allow for this truck traffic. In LSR 223 on the Umpqua

National Forest, it is estimated that approximately 2.5 acres of road widening would occur. Although this road widening would occur to the extent possible within the existing clearing limits, it is probable that some additional clearing of forest vegetation would be necessary to accommodate the road reconstruction. It is estimated that this would be a maximum of 2.5 acres and would occur along an existing road opening.

Impact on the Functionality of LSR 223 on the Umpqua National Forest

The functionality of LSR 223 relates directly to the goals and objectives for LSRs and can be measured by the quantity, quality and distribution of LSOG forest habitat in the LSR and how the Pacific Connector pipeline would affect these characteristics.

- **Quantity**: The overall quantity of LSOG habitat in LSR 223 on the Umpqua National Forest would increase with the proposed LRMP amendment. The Pacific Connector pipeline would remove approximately 23 acres of LSOG habitat but the reallocation would add 431 acres of LSOG habitat for a net increase of 408 acres. This would increase the current level of LSOG habitat in LSR 223 from 20,557 acres to 20,965 acres or by approximately two percent.
- **Quality**: The area proposed for reallocation to LSR 223 contains some large blocks of LSOG habitat and would also be located immediately adjacent to two KOACs, providing further consolidation of LSOG habitat and increased protection of NSO habitat within LSR 223 (see figure 4.1-27). With the reallocation of Matrix to LSR and the consolidating of larger blocks of LSOG habitat the quality of the LSOG habitat within LSR 223 would be improved.
- **Distribution**: The distribution of LSOG habitat within LSR 223 would remain largely unchanged with the Pacific Connector pipeline and the reallocation of Matrix to LSR LRMP amendment. To the extent there are minor changes they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the southwest edge of the LSR providing for some additional connectivity within LSR 233 and the nearest LSRs to the south and west.
- The off-site mitigation would improve the quantity, quality, and distribution of LSOG habitat in LSR 223 over time by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacement fire and reducing fragmentation through road decommissioning and stand-density management.

The mitigation actions for LSR 223 in the Umpqua National Forest have been designed with the goal that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 223.

Umpqua National Forest Mitigation Actions

To compensate for the direct and indirect impacts associated with the Pacific Connector pipeline in the LSR land allocation, off-site mitigation actions have also been developed by the Forest Service (see figure 4.1-30). For the purposes of this discussion, indirect impacts of the corridor are modeled by age class of vegetation and an associated estimate of edge impacts. Indirect impacts on LSOG forest are estimated to extend 100 meters on each side of the corridor. Indirect impacts for non-LSOG forest are estimated to extend 30 meters on each side of the corridor. No indirect impacts are estimated to non-forested areas. These proposed off-site mitigation actions include:

- accelerating development of larger trees by pre-commercial thinning young stands;
- replacing constituent elements of habitat by placing LWD in units, creating snags, controlling noxious weeds, and restoring meadows;
- reducing the risk of stand-replacing fire by stand-density management, commercial thinning, and fuels reduction treatments; and
- reducing habitat fragmentation by decommissioning roads and accelerating the development of interior stand conditions by stand-density management.

The additional off-site mitigation actions would increase the effectiveness of the LSOG forest habitat added to LSR 223 by improving the quantity, quality, and distribution of LSOG forest habitat over time. These off-site mitigation actions are consistent with the management recommendations for LSR 223 (see appendix H, section 2.2.2.2).

On July 30, 2015 the Stouts Fire started near Milo, Oregon, and had grown to over 26,500 acres by September 1, 2015. The fire burned into portions of LSR 223 and the proposed pipeline corridor between MP 96 and 105 (see figure 4.1-28 for MP locations). In addition, fire suppression activities occurred along the proposed pipeline route from approximately MP 104.5 to MP 109. At the time this FEIS was being prepared, the fire was still burning and the full extent of impacts to LSR 223 was unknown. Once the fire has been controlled, the BLM and Forest Service will assess the impacts and develop post-fire strategies and recommendations. We know from fire incident reports that some of the LSOG forest in LSR 223 in the vicinity of the proposed pipeline has been impacted by the fire. Therefore, the impacts of the proposed pipeline project on LSOG habitat in LSR 223 displayed in figure 4.1-29 above may change. Changes to the proposed 2,285-acre fuel break described below can be expected since portions of that proposed fuel break occur within the fire perimeter and fire suppression activities. There may be changes to other proposed mitigation actions in this area as well once post-fire assessments have been completed.

Road Decommissioning (7.6 miles)

Although the Pacific Connector pipeline has been routed to avoid LSOG habitat as much as possible, the pipeline would create edge impacts that would affect interior stand microclimates and cause habitat fragmentation within LSR 223 that cannot be avoided. Edge is the effect of an opening on microclimate in adjacent stands (Chen et al. 1993). Edge impacts introduced by roads (or corridors) are highly variable and depend on aspect, road width, vegetation crossed, and other variables. Edge impacts are greatest when there is a high contrast in structure and composition between a newly created opening and the adjacent landscape (Harper et al. 2005). Thus, edge impacts are greatest when they affect interior stand habitats of older forests and lowest when the new opening is similar to the surrounding landscape, such as adjacent to an existing road or in a recent clearcut.

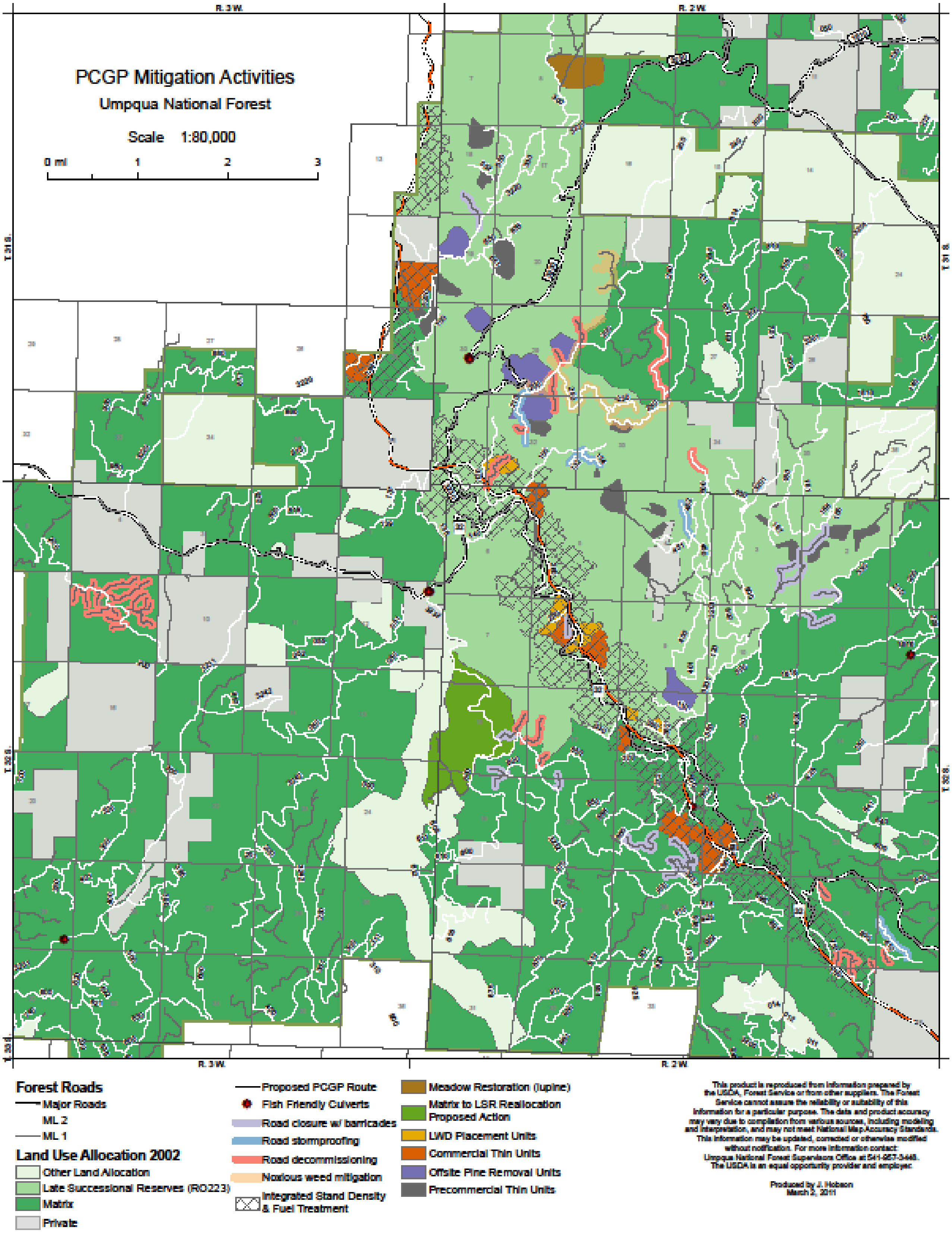


Figure 4.1-30. Proposed Off-site Mitigation Actions in the Umpqua National Forest

Decommissioning roads with appropriate restoration measures would presumably reverse edge impacts and habitat fragmentation caused by existing roads and create habitat for a variety of animals (Switalski et al. 2004). The effect of edge reduction by road decommissioning is highly variable for the same reasons described for the edge impacts created by constructing a road. Agency field experience has shown that road decommissioning reduces the edge impacts over time by revegetating road surfaces and eliminating road corridors. Revegetating selected roads in conjunction with the density management proposed for adjacent plantations would block up forested habitat and reduce edge impacts and fragmentation in a period of about 40 years as planted trees became pole sized (5 to 9 inches diameter at breast height [dbh] and 20 to 40 feet tall).

Published data on rate and pattern of edge reduction associated with decommissioning roads are not available (Baker 2011), but a comparison of the predicted beneficial effect of road decommissioning to edge impacts that would be associated with the Pacific Connector pipeline is useful, even if based on assumptions.[25] Using an assumed edge reduction over time of 50 feet on each side of the road, decommissioning 7.6 miles of road would reduce existing road-related edge impacts on an estimated 92 acres (7.6*5280*100/43560).

Linear edge provides another measurement of the edge effect. Approximately 5.9 miles of the Pacific Connector pipeline would be located within LSR 223, creating 11.8 miles of new edge within LSR 223. Proposed road decommissioning would revegetate 7.6 miles of roads, removing approximately 15.2 miles of existing edge over time.

Stand-Density Management

Stand-density management is proposed in early and mid-seral Douglas-fir or ponderosa pine plantations that were planted. The purpose of this mitigation action is to restore stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime by enhancing and accelerating the physical and biological services for associated flora and fauna within LSR 223. Table 4.1.3.6-14 below displays the acres of density management activities occurring in LSR 223 and Matrix.

TABLE 4.1.3.6-14

Stand-Density Management Activities in LSR 223 and Matrix

Treatment Type	LSR 223 Acres	Matrix Acres	Riparian Reserve Acres
Pre-commercial Thinning	377	40	42
Off-Site Pine Restoration	398		15
Commercial Thinning	138	406	35
Total	**913**	**446**	**92**

Source: Forest Service GIS; Hobson 2010

Pre-commercial thinning is proposed for overstocked plantations to accelerate the development of late-successional and old-growth forest characteristics in LSR 223. Managing stand density would increase growth rates, decrease susceptibility to stand-replacing fire, and diversify stand structure in otherwise relatively homogenous stands. This accelerated development would also reduce fragmentation and edge impacts and would help maintain the ability of these stands to respond to changed environmental conditions from either natural or human-caused disturbances. A majority of the pre-commercial thinning acres are within 1 mile of the pipeline right-of-way. Placing the

[25] This approach is consistent with CEQ Regulations for NEPA, 40 CFR 1508.22.

off-site mitigation activities close to the actual pipeline corridor increases their effectiveness by affecting lands within, or near, the home ranges of individual species affected by the pipeline habitat changes. Because the mitigation actions address ecological processes like the edge effect, placing the mitigation action near the edge impacts would increase the effectiveness of the mitigation action by restoring ecosystem structures near the acres that would be affected by the pipeline. The stand-density management activities in Matrix lands would improve timber productivity by increasing growth rates, which would partially offset some of the lost timber management potential in the Matrix acres reallocated to LSR.

Integrated Stand Density and Fuel Break Treatments (2,285 acres LSR 223)

This prescription is intended accomplish two outcomes. First, it is intended to enhance LSOG habitat by increasing the growth, health, and vigor of the trees remaining in the stands; restoring stand density, species diversity, and structural diversity to those considered characteristic under a natural disturbance regime. Secondly, it is intended to reduce the probability of large-scale loss of LSOG from wildfires as part of a 10-mile-long and 0.5-mile-wide shaded fuel break extending from Stouts Creek on the Roseburg District to Trail Creek on the Medford District that represents a landscape-scale action to reduce the risk of damage to LSR from catastrophic wildfire. Fuels treatments are decided on a case-by-case basis and rely on fuel loading information as well as proximity to roads and other factors. Slash treatments may be as simple as lop and scatter to get the fuels in contact with the ground for more rapid decomposition, or they may involve piling, burning, or removal of fuel from the site for biomass energy or other uses.

Stand-density management over time would reduce existing edge impacts. There is no precise way to estimate the reduction in edge impacts with available data since stands have many different age classes, perimeters, and canopy closures. The estimated perimeter of the units proposed for integrated stand-density management and fuels treatment adjacent to the pipeline in LSR 223 is approximately 10 miles. Assuming some edge effect reduction within 100 feet of the perimeter of these units, density management would reduce edge impacts over time by an estimated 121 acres (10*5280*100/43560).

Snag Creation (175 acres LSR 223)

Snag creation is proposed as a mitigation action to replace snags lost in the pipeline right-of-way for habitat for cavity-nesting birds and denning sites for mammals (bats, bears, fishers, etc.). Snags would be lost from the pipeline corridor to facilitate pipeline construction and mitigate safety hazards for construction workers and from the removal of live trees that would have contributed to future snag habitat.

Approximately 4,200 snags within LSR 223 would be created by blasting tops from live trees (preferably trees with existing decay that makes them more suitable for cavity-nesting birds and/or as denning sites) or by inoculating living trees with heart rot decay fungi or other methods. Sites selected for snag creation would be within 0.5 mile of the pipeline right-of-way to develop snag habitat within (or near) the home ranges of cavity excavators being displaced by the pipeline corridor. Sites would be in mid and late seral stands.

The current direction is to manage CWD levels on a landscape perspective and to use land allocation as a consideration for where levels of CWD may occur overtime. DecAID (a tool for managing snags, partially dead trees, and downed wood for biodiversity in forests in Washington and Oregon) is a summary of the best available data on dead wood in Pacific Northwest ecosystems (Marcot et al. 2002). To use DecAID, planning areas should be large enough to encompass the range of natural variability in wildlife habitat types and structural conditions; it is suggested that planning areas be at least 20 square miles in size (12,800 acres). A reasonable objective is to manage for a range of conditions within the area, balancing areas with high densities of dead wood with moderate- and low-density areas (Marcot et al. 2002).

Wildlife and inventory data summarized in the DecAID Advisor can be applied to management and planning decisions at a range of spatial scales and geographic extents. The calculated tolerance levels (80, 50, and 30 percent) for wildlife data can be applied to stand-level management. However, it is not advised that a particular tolerance level be applied to all stands across a landscape. Analysis of snag levels in LSR 223 indicates that snags are below historic conditions (see appendix H, section 2.2.2.2). The objectives of the LSR land allocation and the location and size of the Pacific Connector pipeline make it appropriate to manage for high and moderate snag densities for this project. Snags should be managed at the 80 percent tolerance level in LSRs. However, most of the pipeline would be located along ridgetops that are prone to fire disturbance. Considering fuels, it would be appropriate to manage at a lower density of small snags and downed wood in both tolerance levels. The management recommendations for this area include a desired future condition of at least 4 snags per acre less than 20 inches dbh and 15 feet tall (Forest Service and BLM 1999: table 8). The target within the LSR treatment areas would be to manage snags densities at 16 per acre less than 10 inches dbh, of which 8 per acre are less than 20 inches dbh.

Large Woody Debris Placement (165 acres LSR 223)

One of the components of CWD is LWD, which consists of trees or portions of trees lying on the forest floor. LWD placement is proposed to accelerate the development of LSOG forest characteristics by restoring this habitat component to areas where LWD is lacking.

Large wood would be placed in or near areas that are also receiving stand-density management treatment. The large wood would be from trees cut from the pipeline corridor. Sites selected for LWD placement are within 0.5 mile of the pipeline right-of-way. As with the other off-site mitigation actions, placement of the mitigation activities close to the pipeline corridor can benefit species that would be affected by the vegetation changes within the corridor and would make these mitigation actions more effective. Sites for placement of LWD would be in early successional stands that are currently deficient in downed wood. The LWD placement is expected to vary to account for some of the range in variability found across the landscape. For 11- to 20-inch-diameter logs, densities would vary from 8 to 33 logs/acre. For logs greater than 20 inches diameter, densities would vary from 3 to 12 logs per acre. Logs would be approximately 40 feet in length, and the specified diameter (11 to 20 inches, and 20 inches plus) refers to the stem diameter at the midpoint of the 40-foot log.

Noxious Weed Treatment (6.7 miles)

Soils disturbed during pipeline construction and proposed mitigation activities would have the potential to disperse and generate potential seedbeds for noxious weeds. The proposed noxious weed treatment along 6.7 miles roads within LSR 223 would assist in mitigating potential adverse habitat impacts.

Meadow Restoration (80 acres)

There would be a loss of forest habitat buffering unique habitats and disruption to soil horizons within those habitats from the construction of the Pacific Connector pipeline. These actions would result in adverse impacts on native flora and fauna and increase the opportunities for invasion by non-native plant species. These impacts cannot be fully mitigated on site; therefore, restoration activities such burning, removal of encroaching conifers, and noxious weed control would be applied to an 80-acre meadow located in LSR 223.

Comparison of Total Adverse Direct and Indirect Impacts of the Pacific Connector Pipeline Project on Edge Impacts and Total Beneficial Direct and Indirect Impacts of Mitigation Actions on Edge Impacts in LSR 223

The acres of direct and indirect impacts of the Pacific Connector pipeline and the acres of direct and indirect impacts of various mitigation actions as related to the edge effect are shown in table 4.1.3.6-15 and figure 4.1-31. For the purposes of this comparison, indirect impacts of the corridor are modeled by the age class of vegetation and an associated estimate of edge impacts. Since there is no precise method for predicting indirect impacts, the following assumptions were used.

- Adverse indirect impacts of the Pacific Connector pipeline on LSOG habitat are estimated to extend 100 meters from the cleared edge on each side of the corridor.
- Adverse indirect impacts of the Pacific Connector pipeline for non-LSOG habitat are estimated to extend 30 meters from the cleared edge on each side of the corridor.
- No indirect impacts are estimated for non-forested areas since there would be no new edge created.
- Direct impacts of road decommissioning are estimated from the revegetation of an average road prism of 20 feet.
- The beneficial indirect impacts of road decommissioning are estimated to extend 50 feet on each side of the decommissioned road in all vegetation classes.
- The beneficial indirect effect of integrated stand-density fuels management treatments is estimated to extend 100 feet from the perimeter of the unit in all vegetation classes.
- Indirect impacts of other mitigation actions are not considered to reduce edge in this comparison.

TABLE 4.1.3.6-15

Comparison of Total Pacific Connector Pipeline Project Impacts (a/) on LSR 223 and Estimated Edge Reduction Effect (b/) of Proposed Off-site Mitigation Actions (Acres)

Umpqua National Forest (LSR 223)	Direct Effect	Indirect Effect	Total
Total Project Impacts on LSR 223			
Project Impacts	85	241	326
Proposed Off-site Mitigation			
Road Decommissioning	18	92	111
Stand-Density Management.	0	121	121
Total Mitigation	**18**	**213**	**232**

a/ Project direct impacts include corridor clearing, temporary extra work areas, and uncleared storage areas. Indirect impacts include 100 meters on each side of corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of corridor edge in non-LSOG.

b/ Direct edge reduction impacts include acres of decommissioned road revegetated (7.6*5280*20/43560) and indirect impacts include 50 feet on each side of decommissioned road and 100 feet along perimeter of stand-density treatments.

Data source: BLM, Forest Service GIS data layers; Hobson 2010

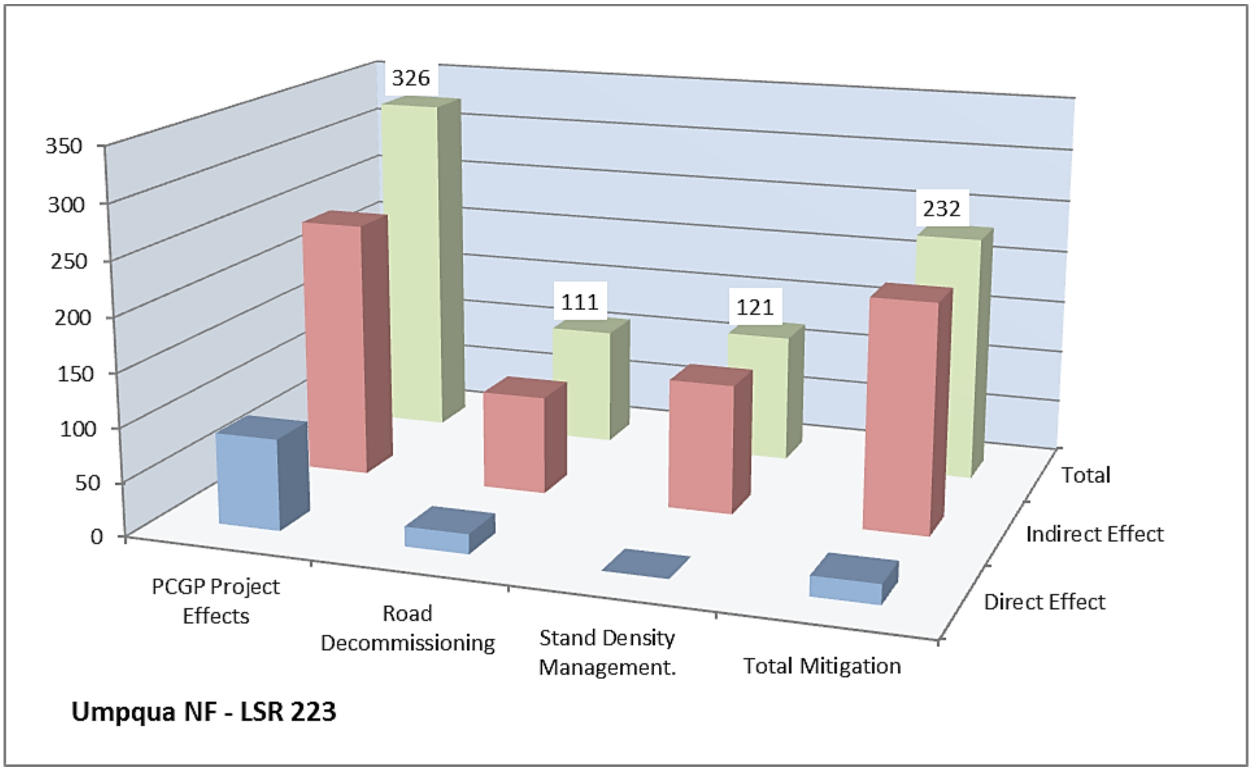


Figure 4.1-31. Comparison of Total Pacific Connector Pipeline Project Impacts on LSR 223 and Estimated Edge Reduction Effect of Proposed Off-site Mitigation Measures (acres)

The comparisons displayed are not one-to-one correlations, because the adverse impacts on edge would occur immediately with the construction of the pipeline and the reduction of edge effect from the off-site mitigation would occur over time. The comparison also does not take into consideration that the edge created by the construction of the pipeline would also reduce over time as the majority of the corridor (about 70 percent) would be re-forested. The comparison does display that some of the mitigation actions proposed would help reduce the amount of fragmentation in LSR 223 by reducing the amount of existing edge. Over time, this would allow for the formation of larger blocks of interior forest habitat.

LRMP Amendments Related to LSRs on the Rogue River National Forest

RRNF-7, Reallocation of Matrix Lands to Late-Successional Reserves

The Rogue River National Forest LRMP would be amended to change the designation of approximately 512 acres from the Matrix land allocation to the LSR land allocation in Section 32, T.36S., R.4E., W.M., Oregon.

This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Pacific Connector pipeline on LSR 227 in the Rogue River National Forest. The proposed amendment would change future management direction for the lands reallocated from Matrix to LSR. A map of the proposed reallocation is displayed in figure 4.1-32.

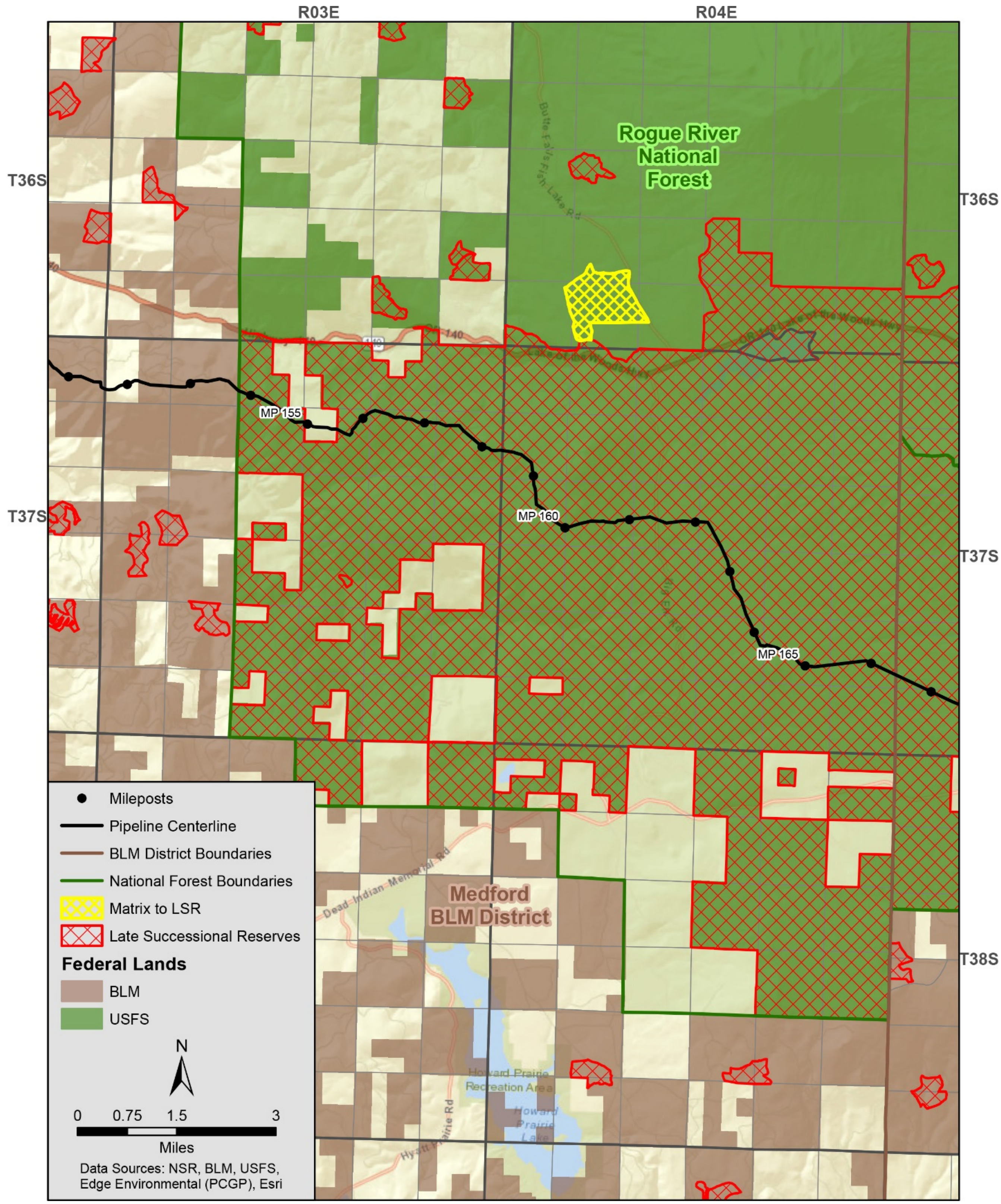


Figure 4.1-32. Map of Proposed Matrix Reallocated to LSR in the Rogue River National Forest

In the Rogue River National Forest, the Pacific Connector pipeline would lie entirely within LSR 227. Currently, based on the latest Forest Service GIS data, there are approximately 30,404 acres of LSOG forest habitat, which comprises approximately 30 percent of LSR 227. If constructed, the part of the Project on the Rogue River National Forest would be about 13.7 miles long and would clear approximately 206 acres of forest vegetation in LSR 227, of which approximately 55 acres are LSOG forest. The Matrix area proposed for reallocation to LSR is approximately 512 acres, of which approximately 333 acres are LSOG forest. When acres reallocated from Matrix to LSR are compared to the acres of LSR that would be cleared by the Pacific Connector pipeline, the proposed amendment would reallocate about 2.5 times more acres to LSR than would be cleared in the pipeline corridor. When comparing acres of LSOG habitat, the proposed amendment would reallocate about 6 times more acres of LSOG habitat than would be cleared by the Pacific Connector pipeline.

In addition to the impacts from the removal of forest vegetation in LSR 227, there would be additional impacts from the acres modified by UCSAs and the acres indirectly affected through the creation of new edges and fragmentation of older forest. A comparison of the total acres affected in LSR 227 and the acres that would be reallocated are displayed in table 4.1.3.5-16 and figure 4.1-33 below.

TABLE 4.1.3.6-16

Comparison of Total LSR Acres Affected (a/) by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, Rogue River National Forest LSR 227

Rogue River National Forest LSR 227	**Direct Impacts**		**Indirect Impacts**	**Total Impacts**	**Matrix to LSR Reallocation**
	Cleared	**Modified**			
LSOG	55	21	350	426	333
Non- LSOG	143	48	184	375	179
Non-Forest	9	0	0	9	0
Total	**206**	**70**	**534**	**810**	**512**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).
a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: BLM, Forest Service GIS Data Layers, Cox 2010

In addition to the impacts of the Pacific Connector pipeline corridor there are also potential off-site impacts on LSR 227 from road reconstruction that would be necessary to accommodate the trucks that would be hauling the sections of pipe. These trucks are longer than typical trucks that use forest roads so some road widening and curve realignment may be necessary to safely allow for this truck traffic. It is estimated that approximately 4 acres of road widening would occur within LSR 227. Although this road widening would occur to the extent possible within the existing clearing limits, it is probable that some additional clearing of forest vegetation would be necessary to accommodate the road reconstruction. It is estimated that this would be a maximum of 4 acres and would occur along an existing road opening.

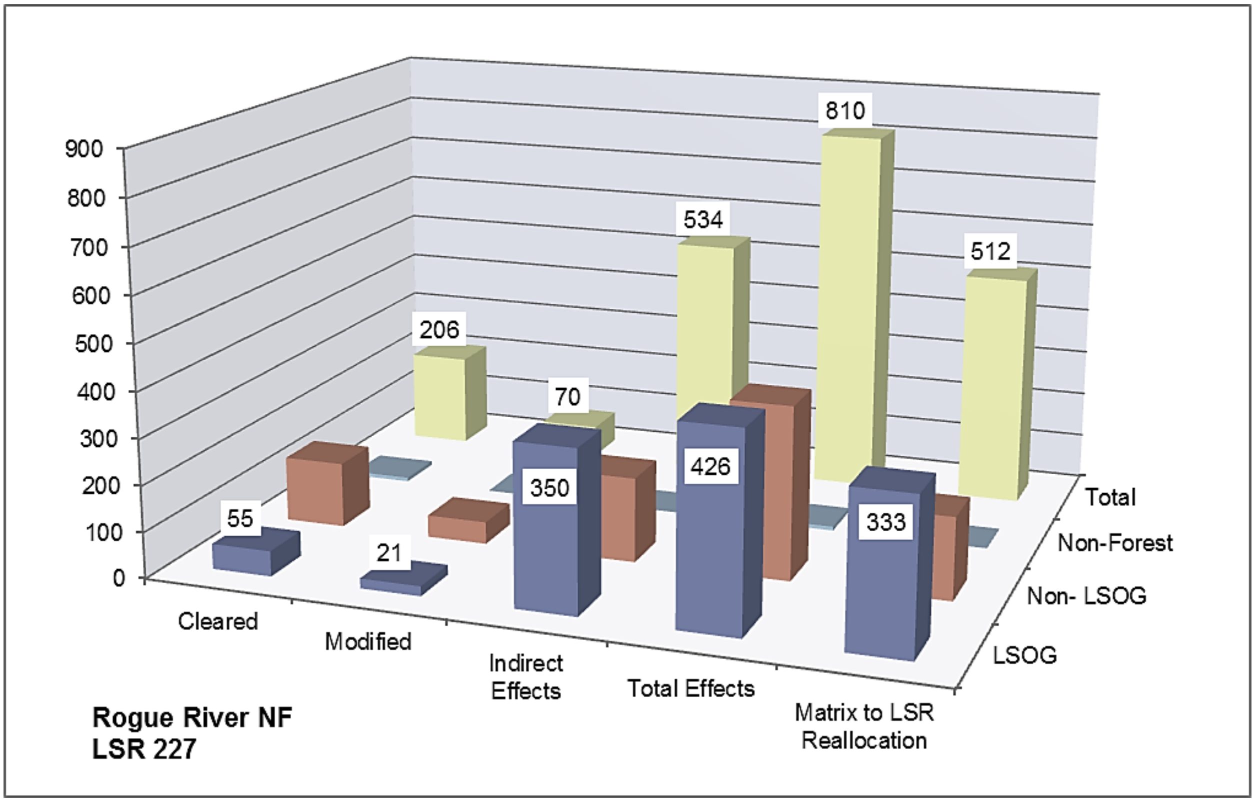


Figure 4.1-33. Comparison of Total LSR Acres Affected by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR, Rogue River National Forest LSR 227

Impact on the Functionality of LSR 227 on the Rogue River National Forest

The functionality of LSR 227 relates directly to the goals and objectives for LSRs and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the Pacific Connector Pipeline Project would affect these characteristics.

- **Quantity**: The overall quantity of LSOG habitat in LSR 227 on the Rogue River National Forest would increase with the proposed LRMP amendment. The Pacific Connector pipeline would remove approximately 55 acres of LSOG habitat but the reallocation would add 333 acres of LSOG habitat for a net increase of 278 acres. This would increase the current level of LSOG habitat within LSR 227 from 30,404 acres to 30,682 acres or by approximately 0.9 percent.
- **Quality**: The area proposed for reallocation to LSR 227 contains some large blocks of LSOG habitat. With the reallocation of Matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat within LSR 227 would be improved.
- **Distribution**: The distribution of LSOG habitat within LSR 227 would remain largely unchanged with the Pacific Connector pipeline and the reallocation of Matrix to LSR LRMP amendment. To the extent there are minor changes they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the north end of the LSR providing for some additional connectivity within LSR 227 and the nearest LSRs to the north.

- The off-site mitigation would improve the quantity, quality, and distribution of LSOG habitat in LSR 227 over time by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacing fire, and reducing fragmentation through road decommissioning and stand-density management.

The mitigation actions for LSR 227 in the Rogue River National Forest have been designed with the goal that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 227.

Rogue River National Forest Mitigation Actions

The lands in the Rogue River National Forest that would be affected by the Pacific Connector pipeline are all within LSR 227. The primary objectives for the off-site mitigation actions are to accelerate the development of LSOG forest habitat in LSR 227 through snag creation, woody debris placement, and density management, and to reduce LSOG forest habitat fragmentation through road decommissioning. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the Pacific Connector pipeline on LSR 227 in the long run. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 227 by improving the quantity, quality, and distribution of high-quality habitat. Figure 4.1-34 displays where the proposed off-site mitigation actions would occur.

Road Decommissioning (53.2 miles)

Although the Pacific Connector pipeline has been routed to avoid LSOG forest as much as possible, it would create edge impacts that may affect interior stand microclimates and cause habitat fragmentation within LSR 227 that cannot be avoided. Edge is the effect of an opening on microclimate in adjacent stands (Chen et al. 1993). Edge impacts introduced by roads are highly variable and depend on aspect, road width, vegetation crossed, and other variables. Edge impacts are greatest when there is a high contrast in structure and composition between a newly created opening and the adjacent landscape (Harper et al. 2005:768). Thus, edge impacts are greatest when they affect interior stand habitats of older trees and least when the new opening is similar to the surrounding landscape, such as when it is adjacent to an existing road or in a recent clearcut.

Decommissioning roads with appropriate restoration measures would presumably reverse edge impacts and habitat fragmentation caused by existing roads and create habitat for a variety of animals (Switalski et al. 2004). By discouraging vehicular access, road decommissioning also eliminates disturbance (noise, presence, etc.) caused by human intrusion. This potentially benefits nesting behavior in particular for the NSO. The effect of edge reduction by road decommissioning is highly variable for the same reasons described for the edge impacts created by constructing a road. Agency field experience has shown that road decommissioning reduces edge impacts over time by revegetating road surfaces and eliminating road corridors. Revegetating selected roads in conjunction with the density management proposed for adjacent plantations would block up forested habitat and reduce edge impacts and fragmentation in a period of about 40 years as planted trees became pole sized (5 to 9 inches dbh and 20 to 40 feet tall). Published data on the rate and pattern of edge reduction associated with decommissioning roads are not available (Baker 2011), but a comparison of the predicted beneficial effect of road

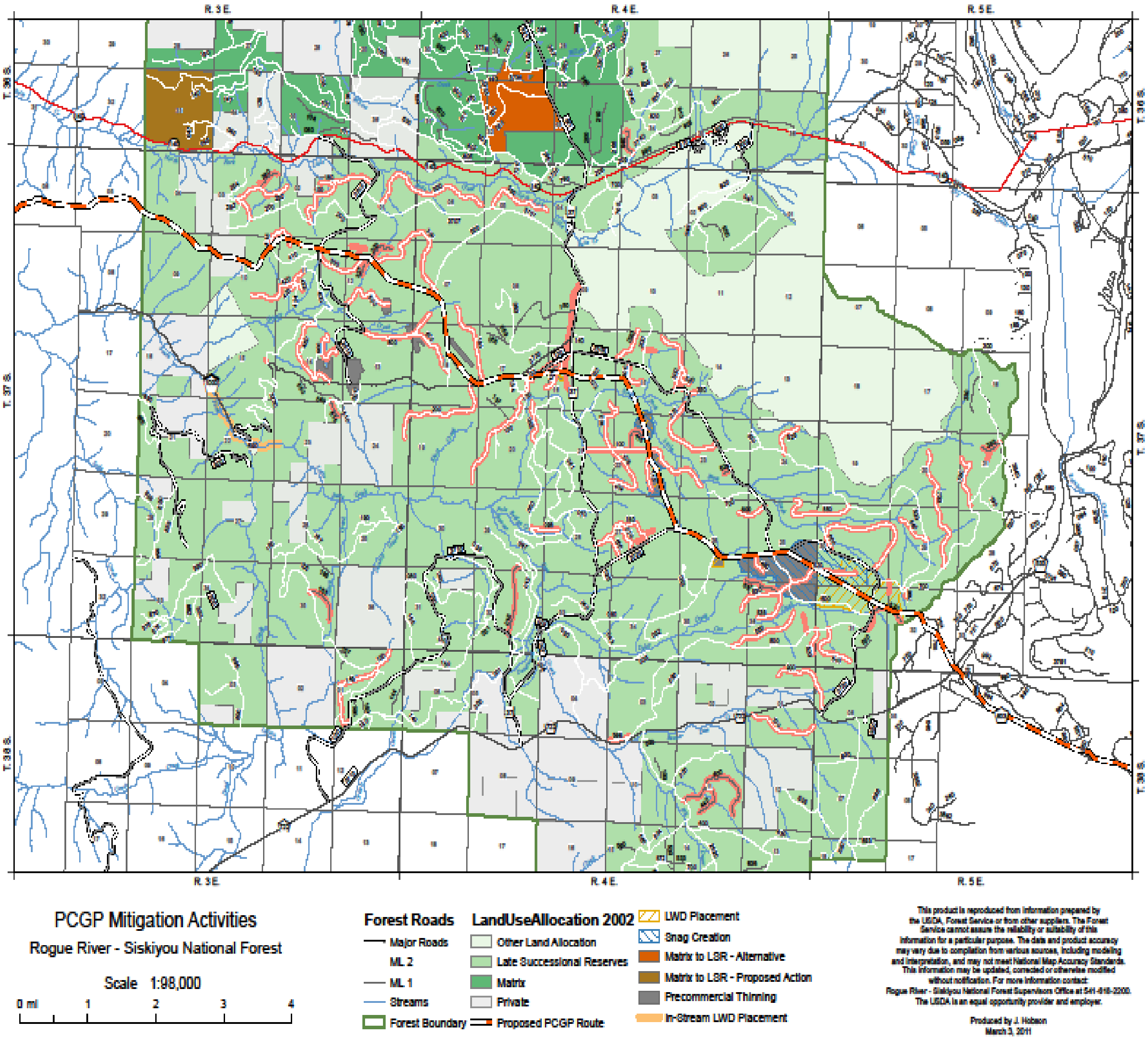


Figure 4.1-34. Proposed Off-site Mitigation Actions in the Rogue River National Forest

decommissioning on edge impacts associated with the Pacific Connector pipeline is useful, even if it is based on assumptions.[26] Using an assumed edge reduction over time of 50 feet on each side of the road, decommissioning 53.2 miles of roads would reduce existing road-related edge impacts on an estimated 645 acres.[27]

Linear edge provides another measurement of edge effect. Approximately 13.6 miles of the Pacific Connector pipeline would be located within LSR 227, creating 27.2 miles of new edge within LSR

[26] This approach is consistent with CEQ Regulations for NEPA, 40 CFR 1508.22.

[27] This value is reached by converting the square footage of the edge reduction of 50 feet on either side of 53.2 miles of road to be decommissioned to acres. Using 5,280 feet as the standard length of a mile, and 43,560 square feet as the conversion factor for feet to acres, the equation is as follows: (length x width)/square feet per acre, which is ((53.2*5280 ft) *100 ft)/43,560 = 644.8 (or 645 when rounded to the nearest whole acre).

227. Proposed road decommissioning would revegetate 53.2 miles of roads, removing approximately 106.4 miles of existing edge over time. Fragmentation in the context of impacts on the LSR land allocation is the process of reducing the size and connectivity of stands that compose a forest. The conversion of large tracts of old-growth forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics.

To provide an indication of the impacts of the proposed Pacific Connector pipeline corridor and proposed road decommissioning on fragmentation, the Forest Service conducted a stand-level analysis, considering stands that fall within 100 meters of the pipeline corridor (Forest Service 2010). All stands that overlapped the 100-meter buffer were included in the analysis out to the stand edges beyond the buffer. The only changes examined in this analysis were natural growth and development of trees and the off-site mitigation activities. Natural events, such as wildfire and storms, were not modeled because of their stochastic nature and the relatively limited size of the analysis area. Within the modeled stands, it was assumed that there would be no forest management harvest activities during the 60 years modeled beyond activities already planned. Future management activities would need to be consistent with the LRMP in effect at the time the Project is implemented.

Construction of the pipeline would result in the fragmentation of LSOG forest in LSR 227 and would increase the fragmentation index (ratio of edge to acres) in modeled stands (those within 100 meters of the pipeline) by about 1 percent.[28] After 60 years, normal stand growth would reduce this ratio by about 3 percent. With implementation of proposed road decommissioning, the ratio of edge acres would decrease by about 34 percent. A decrease in the ratio of edge to opening means that patch sizes of forested areas have increased. LSR 227 currently has 1,445 patches of mature forest greater than 1 acre in size that lie within 100 meters of the edge of the pipeline corridor. Pacific Connector pipeline construction would increase fragmentation by passing through and dividing some of these patches, with a net increase of five patches. The current average patch size throughout the LSR is about 7 acres, which is not projected to change within the next 60 years. With the proposed road decommissioning and road closures, the size of patches within 100 meters of the pipeline would increase to an average of 14.5 acres within 60 years. This would be consistent with a reduction in the edge to opening ratio discussed above.

In terms of interior patches (LSOG areas that are at least 1 acre in size and at least 100 meters from a hard edge), there are currently 779 interior patches in LSR 227. Eight of these (about 1 percent of the interior patches) would be fragmented by the pipeline corridor. In 60 years, interior patches are projected to increase to 856 interior patches, a 9 percent increase from the current condition. With the proposed road decommissioning, the number of interior patches would increase by about 16 percent to 927, and the average size of the patches would increase from about 6.5 acres to 13.9 acres, an increase in size of over 100 percent.

There are approximately 233 miles of road in LSR 227. The proposed road decommissioning would create a 23 percent reduction in road mileage in this LSR. Current road density in LSR 227 is about 3.3 miles per square mile. With the proposed road decommissioning, it would be reduced

[28] Changes in edge:area ratios are more meaningful as relative numbers rather than absolute values, so percentages are used to express changes in values.

to about 2.5 miles per square mile. Reductions in road density that would occur within 0.25, 0.5, and 1 mile of the pipeline corridor are shown in the table 4.1.3.6-17 below.

TABLE 4.1.3.6-17

Reductions in Road Density Within 0.25, 0.5, and 1 mile of the Pacific Connector Pipeline Corridor

Road Density	Existing Road Density (miles/square mile)	With Road Decommissioning (miles/square mile)
LSR 227	3.3	2.5
Within 0.25 mile of pipeline	3.9	1.7
Within 0.5 mile of pipeline	4.1	1.7
Within 1 mile of pipeline	4.2	2.5

Stand-Density Management (600 Acres)

Pre-commercial thinning is proposed for overstocked plantations to accelerate the development of LSOG forest characteristics in LSR 227. Managing stand density would increase growth rates, decrease susceptibility to stand-replacing fire, and diversify stand structure in otherwise relatively homogenous stands. This accelerated development would also reduce fragmentation and edge impacts and would help maintain the ability of these stands to respond to changed environmental conditions from either natural or human-caused disturbances. All 600 acres are within 0.5 mile of the pipeline right-of-way. Placing the off-site mitigation activities close to the actual pipeline corridor would increase their effectiveness by affecting lands within, or near, the home ranges of individual animals and species affected by the pipeline habitat changes. As the mitigation actions address ecological processes like edge impacts, placing the mitigation within or near the edge impacts increases the effectiveness of the mitigation by restoring ecosystem structures and processes on some of the acres also affected by the pipeline. Thinning young stands would, over time, reduce existing edge impacts. There is no precise way to estimate the edge effect reduction with available data because stands have many different age classes, perimeters, and canopy closures. The estimated perimeter of the units proposed for thinning is approximately 3.0 miles. Assuming some edge reduction within 100 feet of the edge of these units, density management would reduce edge impacts over time by an estimated 36 acres ((3*5280)*100/43,560).

Fuels treatments for the slash generated by stand-density management are decided on a case-by-case basis and rely on slash loading information as well as proximity to roads and other factors. Slash treatments may be as simple as "lop and scatter" (cutting slash into smaller pieces and scattering) to get the fuels in contact with the ground for more rapid decomposition, or they may involve piling and burning, jackpot or under-burning, or removal of slash from the site for biomass energy or other uses.

Snag Creation (600 acres)

Snag creation is proposed as a mitigation action to replace snags lost in the pipeline right-of-way for habitat for cavity-nesting birds and denning sites for mammals (bats, bears, fishers, etc.). Snags would be lost from the pipeline corridor to facilitate pipeline construction or to mitigate safety hazards for construction workers.

Approximately 1,200 snags would be created by blasting tops from live trees (preferably trees with existing decay, which makes them more suitable for cavity-nesting birds and/or as denning sites),by inoculating living trees with heart rot decay fungi, or by other methods. Sites selected for snag creation would be within 0.5 mile of the pipeline right-of-way to develop snag habitat within (or near) the home ranges of cavity excavators being displaced by the pipeline corridor. Sites would be in mid-successional stands or around the edges of early successional stands that are currently deficient in snags (see appendix H, section 2.3.2.1). Stand data for the plant associations in this area (which is an indication of undisturbed forest snag levels) show these stands have an average of about four snags per acre in the 11- to 20-inch-diameter range, and an additional four snags per acre greater than 20 inches in diameter.

If the tree diameters in the stands prevent snag creation in the greater than 20-inch-diameter size class, additional snags in the smaller size class (11- to 20-inch-diameter) would be created to make up for the deficit. For sites bordering early successional stands, snags would be created within 100 yards of the stand boundary at the same trees per acre levels described above.

Large Woody Debris Placement in Plantations

Large wood placement in plantations is proposed to accelerate the development of LSOG forest characteristics by restoring this habitat component to plantations where LWD is lacking. Any wood used in this mitigation would come from the project corridor. No additional trees outside the corridor would be harvested to provide LWD, so this mitigation is necessarily limited by the amount of LWD that can be provided from the corridor. LWD used in this mitigation would be staged at appropriate locations and placed with a helicopter.

The first priority in restoration with respect to LWD would be to ensure that that the Pacific Connector pipeline itself meets LRMP standards after construction is completed. After LWD standards within the corridor have been met, any additional LWD would be available for placement in the adjacent units identified below.

Large wood would be placed in plantations that are also receiving stand-density management treatment. The large wood would be from trees cut from the pipeline corridor. Sites selected for downed woody material placement would be within 0.5 mile of the pipeline right-of-way. As with the other off-site mitigation actions, placement of the mitigation activities close to the pipeline corridor can benefit species that would be affected by the vegetation changes within the corridor and would make these mitigation actions more effective. Sites would be in early successional stands that are currently deficient in downed wood.

The large wood placement piece count per acre is expected to vary to account for some of the range in variability found across the landscape. For 11- to 20-inch-diameter logs, treatments would average about 10 pieces on each treated acre but densities would vary from 8 to 33 logs per acre. For 20-inch-plus-diameter logs, an average of 5 pieces would be placed on each treated acre, but densities would vary from 3 to 12 logs per acre. Logs would be approximately 40 feet in length, and the specified diameter (11- to 20-inch and 20-inch plus) refers to the stem diameter at the midpoint of a 40-foot log.

Comparison of Total Direct and Indirect Impacts of the Pacific Connector Pipeline Project and the Beneficial Impacts of Off-site Mitigation Actions on Edge Effect

Acres of direct and indirect impacts of the Pacific Connector pipeline and the acres of direct and indirect impacts of various mitigation actions as related to a reduction in edge impacts are shown in table 4.1.3.6-18. For the purposes of this comparison, indirect impacts of the Pacific Connector pipeline are modeled by the age class of vegetation and an associated estimate of edge impacts.

Since there is no precise method for predicting indirect impacts, the following assumptions were used.

- Indirect impacts for LSOG habitat are estimated to extend 100 meters from the cleared edge on each side of the corridor.
- Indirect impacts for non-LSOG habitat are estimated to extend 30 meters from the cleared edge on each side of the corridor.
- No indirect impacts are estimated for non-forested areas since there would be no new edge created.
- Direct impacts of road decommissioning are estimated from the revegetation of an average road prism of 20 feet.
- Indirect impacts of road decommissioning are estimated to extend 50 feet on each side of the decommissioned road in all vegetation classes.
- The indirect effect of stand-density management is estimated to extend 100 feet from the perimeter of the unit in all vegetation classes.
- Indirect impacts of other mitigation actions are not considered to reduce edge in this comparison.

Using these assumptions, combined direct and indirect impacts of the Pacific Connector pipeline and proposed mitigation actions are shown in table 4.1.3.6-18 and figure 4.1-35.

TABLE 4.1.3.6-18

Comparison of Total Pacific Connector Pipeline Project Impacts (a/) on LSR 227 and Estimated Edge Reduction Effect (b/) of Proposed Off-site Mitigation Actions (acres)

Rogue River National Forest (LSR 227)	Direct Effect	Indirect Effect	Total
		Total Project Impacts on LSR 227	
Project Impacts	276	534	810
		Proposed Off-site Mitigation	
Road Decommissioning	129	645	774
Stand-Density Management.	0	36	36
Total Mitigation	**129**	**681**	**810**

a/ Project direct impacts include corridor clearing, temporary extra work areas, and uncleared storage areas. Indirect impacts include 100 meters on each side of corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of corridor edge in non-LSOG

b/ Direct edge reduction impacts include acres of decommissioned road revegetated (53.2*5280*20/43560) and indirect impacts include 50 feet on each side of decommissioned roads and 100 feet along the perimeter of stand-density treatments.

Data source: BLM, Forest Service GIS data layers; Hobson 2010

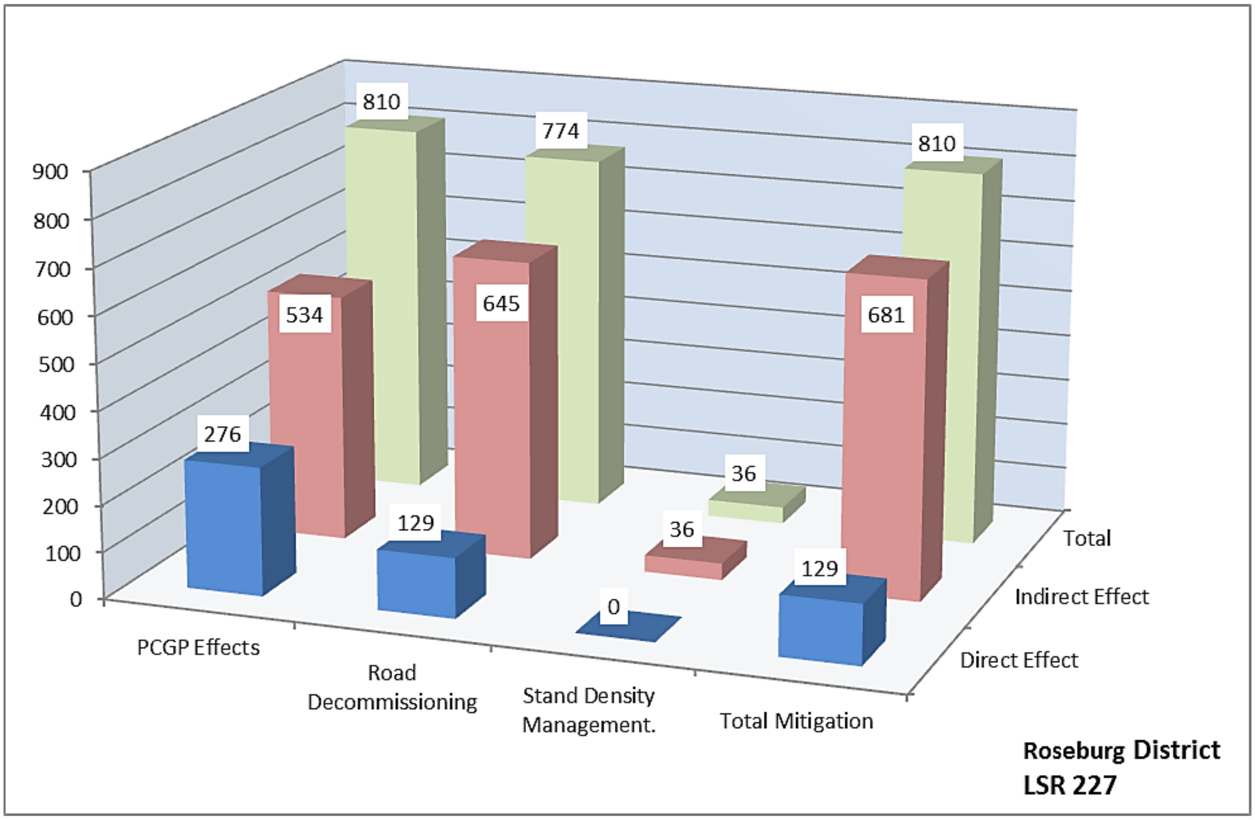


Figure 4.1-35. Comparison of Total Pacific Connector Pipeline Project Impacts on LSR 227 and Estimated Edge Reduction Effect of Proposed Off-site Mitigation Actions (acres)

4.1.3.7 Aggregated Federal Land Management Plan Amendments

This section of the EIS considers the aggregate impacts of BLM and Forest Service proposed LMP amendments for the Pacific Connector pipeline as they relate to LMP objectives. This analysis is focused on the aggregate impact the amendments for the Pacific Connector pipeline, along with any other past, present, or foreseeable future LMP amendments, may have on meeting the objectives in the LMPs of the BLM and Forest Service. For the Forest Service, this analysis will contribute to the evaluation of the significance of the Forest Service LMP amendments as related to the forest planning process defined at 36 CFR 219.10(f) (see section 4.1.3.4).

There are two types of LMP amendments proposed for the Pacific Connector pipeline. The first type is site-specific, project-specific amendments. These amendments would apply only to the Pacific Connector pipeline and those lands within the boundaries of the proposed Right-of-Way Grant. These site-specific amendments are administrative actions that would make provision for the Pacific Connector pipeline by waiving certain management directions or standards and guidelines in order for the project to be in conformance with LMPs (see table 4.1.3.7-1 for a summary of these amendments). The second type is land allocation amendments. These amendments would reallocate Matrix lands to LSR. These land allocation amendments are mitigation actions that would apply to federal lands outside the Pacific Connector project area; applicable standards and guidelines would apply to future management actions within these areas (see table 4.1.3.7-2 for a summary of these amendments).

In addition to considering the aggregate impact of the LMP amendments at the planning level, this section of the EIS also addresses the effects of the proposed off-site mitigation actions in the CMP on both BLM and Forest Service lands. The off-site mitigation actions are related to a number of LMP amendments because they have been designed with the goal that the management objectives in the LMPs would still be met if the Pacific Connector pipeline was built. The off-site mitigation actions have been specifically designed to address two broad strategies that were part of the NWFP: the strategy for managing LSOG forest habitat and the ACS.

These off-site mitigation actions would be implemented concurrently with, or subsequently to, construction of the Pacific Connector pipeline. Some mitigation actions may require additional site-specific analysis before they could be implemented. Therefore, to varying degrees, these mitigation actions are being considered at a programmatic level in this EIS. Any future analysis for these mitigation actions would tier to this EIS (see appendix F of this EIS for further discussion and a description of the proposed mitigation actions).

TABLE 4.1.3.7-1

Summary of Proposed Site-Specific Amendments of BLM and Forest Service LMPs for the Pacific Connector Pipeline Project

Amendment	Unit	Amendment Description
BLM/Forest Service-1	All BLM and Forest Service jurisdictions	Applicable BLM District RMPs and National Forest LRMPs would be amended to exempt certain known sites within the area of the proposed Pacific Connector right-of-way grant from the management recommendations required by the 2001 "Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines."
BLM-1	Coos Bay and Roseburg Districts	The Coos Bay and Roseburg District RMPs would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMU within the Pacific Connector right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM.
BLM-2	Roseburg District	The RMP for the Roseburg District would be amended to exempt the Pacific Connector Pipeline Project from the requirement to retain habitat in KOACs at three locations.
RRNF-2	Rogue River National Forest	The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the Big Elk Road at about MP 161.4 in Section 16, T.37S., R.4E., W.M., Oregon, from foreground retention (Management Strategy 6, LRMP page 4-72) to foreground partial retention (Management Strategy 7, LRMP page 4-86) and allow 10 to 15 years for amended VQO to be attained.
RRNF-3	Rogue River National Forest	The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the PCT l at about MP 168 in Section 32, T.37S., R.5E., W.M., Oregon, from Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) to Modification (USDA Forest Service Agricultural Handbook 478) and to allow 5 years for amended VQOs to be attained.
RRNF-4	Rogue River National Forest	This proposed amendment does not change VQOs, but instead allows more time to meet the VQO of Middleground Partial Retention as seen from Highway 140. The Rogue River National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO of Middleground Partial Retention between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T.37S., R.3E., W.M., Oregon.
RRNF-5	Rogue River National Forest	The Rogue River National Forest LRMP would be amended to allow the Pacific Connector pipeline right-of-way to cross the Restricted Riparian land allocation. This would potentially affect approximately 2.5 acres of the Restricted Riparian management strategy at one perennial stream crossing on the South Fork of Little Butte Creek at about MP 162.45 in Section 15, T.37S., R.4E., W.M., Oregon.
RRNF-6	Rogue River National Forest	The Rogue River National Forest LRMP would be amended to waive limitations on areas affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected Management Strategies.
UNF-1	Umpqua National Forest	The Umpqua National Forest LRMP would be amended to change the standards and guidelines for Fisheries (Umpqua National Forest LRMP, page IV-33, Forest-Wide) to allow the removal of effective shading vegetation where perennial streams are crossed by the Pacific Connector right-of-way.

TABLE 4.1.3.7-1

Summary of Proposed Site-Specific Amendments of BLM and Forest Service LMPs for the Pacific Connector Pipeline Project

Amendment	Unit	Amendment Description
UNF-2	Umpqua National Forest	The Umpqua National Forest LRMP would be amended to change prescriptions C2-II (LRMP IV-173) and C2-IV (LRMP IV-177) to allow the Pacific Connector pipeline route to run parallel to the East Fork of Cow Creek for approximately 0.1 mile between about MPs 109.68 and 109.78 in Section 21, T.32S., R.2W., W. M., Oregon.
UNF-3	Umpqua National Forest	The Umpqua National Forest LRMP would be amended to waive limitations on the area affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way. The standards and guidelines for soils (LRMP page IV-67) require that not more than 20 percent of the project area have detrimental compaction, displacement, or puddling after completion of a project.
WNF-1	Winema National Forest	The Winema National Forest LRMP would be amended to change the standards and guidelines for Management Area 3 (LRMP page 4-103-4, Lands) to allow the Pacific Connector pipeline corridor in Management Area 3 from the Forest Boundary in Section 32, T.37S., R.5E., W.M., Oregon, to the Clover Creek Road corridor in Section 4, T.38S, R.5. E., W.M., Oregon.
WNF-2	Winema National Forest	The Winema National Forest LRMP would be amended to allow 10 to 15 years to achieve the visual standard of Foreground Retention where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately MP 168.8 in Section 33, T.37S., R.5E., W. M., Oregon.
WNF-3	Winema National Forest	The Winema National Forest LRMP would be amended to allow 10 to 15 years to meet the visual standards for Scenic Management, Foreground Partial Retention, where the Pacific Connector right-of-way would be adjacent to Clover Creek Road from approximately MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T.38S., R.5E., W.M., Oregon, and Sections 7 and 18, T.38S., R.6E., W.M., Oregon.
WNF-4	Winema National Forest	The Winema National Forest LRMP would be amended to waive restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected management areas.
WNF-5	Winema National Forest	The Winema National Forest LRMP would be amended to waive restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in Management Area 8, Riparian Area (Management Area 8).

TABLE 4.1.3.7-2

Summary of Proposed Land Allocation Amendments of BLM and Forest Service LMPs for the Pacific Connector Pipeline Project

Amendment	Unit	Amendment Description
BLM-3	Roseburg District	The Roseburg District RMP would be amended to change the designation of approximately 409 acres from the Matrix land allocations to the Late-Successional Reserves (LSR) land allocation in Sections 32 and 34, T. 29 1/2S., R. 7W.; and Section 1, T.30S., R.7W., Willamette Meridian (W.M.), Oregon.
BLM-4	Coos Bay District	The Coos Bay District RMP would be amended to change the designation of approximately 387 acres from the Matrix land allocation to the LSR land allocation in Sections 19 and 29 of T.28S., R.10W., W.M., Oregon.
RRNF-7	Rogue River National Forest	The Rogue River National Forest LRMP would be amended to change the designation of approximately 512 acres from the Matrix land allocation to the LSR land allocation in Section 32, T.36S., R.4E., W.M., Oregon.
UNF-4	Umpqua National Forest	The Umpqua National Forest LRMP would be amended to change the designation of approximately 588 acres from the Matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W., W.M., Oregon; and Sections 13 and 24, T.32S., R.3W., W.M., Oregon.

LMP Amendments

This section will consider the aggregate effect of the amendments on meeting LMP objectives for each unit of the BLM and Forest Service. All of the BLM Districts that would be affected by the Pacific Connector Pipeline Project are currently undergoing LMP revisions. On March 9, 2012, the BLM issued an NOI (77[47] FR 14414-14416) initiating the revision process for the Western

Oregon Planning Area. On April 24, 2015, the BLM released the Draft Resource Management Plan/Draft Environmental Impact Statement and the public comment period ended on July 23, 2015. A decision on the plan revisions is not expected until spring 2016. The revisions will not amend existing BLM LMPs; they will replace them and as such are not amendments to the current plans. The revision process will consider the Pacific Connector pipeline in the analysis of the management situation[29] as a pending right-of-way action being considered by FERC. At this time, it is not known how the LMPs may change but all future projects will have to conform to the new plans once they are in place. Prior to the implementation of new LMPs, all project proposals are evaluated for consistency with existing plans. For these reasons, the BLM LMP revisions for the Western Oregon Planning Area are not evaluated in this analysis.

Proposed amendment BLM/Forest Service-1 applies to all of the BLM Districts and National Forests affected by the Pacific Connector Pipeline Project. This amendment would exempt certain known sites of survey and manage species within the area of the pipeline corridor from the Management Recommendations required by the 2001 Survey and Manage ROD (Forest Service and BLM 2001a). The analysis of this proposed amendment is included in sections 4.1.3.4 and 4.7.3 of this EIS and in appendix K of this EIS. The analysis includes an evaluation of the reasonable assurance of species persistence for all of the survey and manage species impacted by the Pacific Connector pipeline. The analysis considers the persistence of the affected species at multiple scales; project, management unit and federal lands subject to the NWFP. The analyses indicated that with the proposed project design features, monitoring, and pipeline re-routes, species persistence would be reasonably assured for all of the affected survey and manage species. For these reasons, the analysis in sections 4.1.3.4 and 4.7.3 and appendix K of this EIS is not repeated in this section.

<u>Aggregate Impact of Proposed Amendments to the BLM Coos Bay LMP</u>

There are three proposed amendments to the Coos Bay District LMP (see tables 4.1.3.7-1 and 4.1.3.7-2 above). Each proposed amendment is discussed in more detail in sections 4.1.3.4 and 4.1.3.6. Collectively, the proposed amendments would affect management objectives on approximately 421 acres of the 329,700-acre Coos Bay District (see table 4.1.3.7-3). There are no other proposed or foreseeable LMP amendments at this time, and there have been no past amendments to this LMP related to LSRs or survey and manage species except for the 2001 ROD amending standards and guidelines for survey and manage.

TABLE 4.1.3.7-3

Summary of Proposed Amendments to the Coos Bay District LMP

BLM/FS-1	**BLM-1**	**BLM-4**
32 survey and manage sites potentially impacted	34 acres of occupied MAMU habitat removed	387 acres of Matrix reallocated to LSR

Proposed amendment BLM-4 affects the most acres of land managed by the Coos Bay District; it would affect future management on approximately 387 acres. The outcome of this amendment would be a management change from the objective of providing commercial timber products to an objective where the primary emphasis would be the creation and maintenance of late-successional forest habitat. The Pacific Connector pipeline would remove approximately 17 acres of LSOG

[29] Refer to federal regulations at 43 CFR 1600 for a description of the BLM resource management planning process.

habitat in LSR compared with the 101 acres of LSOG that would be reallocated to LSR for a net increase of 84 acres. There are currently about 136,000 acres[30] of LSR on the Coos Bay District, and the addition of 387 acres to LSR 261 would represent an increase of approximately 0.28 percent. While beneficial to species dependent on LSOG forest, the change would represent a very small percentage of the overall acres dedicated to LSR on the Coos Bay District. Similarly the change in potential timber harvest from reallocating Matrix lands to LSR would also be small (less than 1 percent) and is not expected to change the objective for timber management since it would not prevent attainment of the probable sale quantity on the Coos Bay District during the present planning cycle. In addition, BLM's mitigation action requiring that the applicant acquire approximately 387 acres of private timberlands to backfill the Matrix acres reallocated to LSR would maintain the potential for future timber supply. All of the proposed amendments on the Coos Bay District are related to the management direction for maintaining habitat for late-successional species. Collectively, the amendments would affect management direction on approximately 421 acres or about 0.13 percent of the Coos Bay District. With the reallocation of 387 acres of Matrix to LSR, the acquisition of 387 acres of timber lands to backfill the Matrix acres, and ensuring that the persistence of survey and manage species is not affected, no measurable changes in the overall objectives and management direction in the Coos Bay District LMP have been identified.

<u>Aggregate Impact of Proposed Amendments to the BLM Roseburg District LMP</u>

There are four proposed amendments to the Roseburg District LMP (see tables 4.1.3.7-1 and 4.1.3.7-2 above). Each proposed amendment is discussed in more detail in sections 4.1.3.4 and 4.1.3.6. Combined the proposed amendments would affect management objectives on approximately 435 acres of the 425,588-acre Roseburg District (see table 4.1.3.7-4). There are no other proposed or foreseeable LMP amendments at this time and there have been no past amendments to this LMP related to LSRs or survey and manage species except for the 2001 ROD amending standards and guidelines for survey and manage. Proposed amendment BLM-3 affects the most acres of land managed by the Roseburg District; it would affect future management on approximately 409 acres.

TABLE 4.1.3.7-4

Summary of Proposed Amendments to the Roseburg District LMP

BLM/FS-1	**BLM-1**	**BLM-2**	**BLM-3**
108 survey and manage sites potentially impacted	19 acres of occupied MAMU habitat removed	7 acres of KOAC habitat removed	409 acres of Matrix reallocated to LSR

The outcome of this amendment would be a management change from the objective of providing commercial timber products to an objective where the primary emphasis would be the creation and maintenance of late-successional forest habitat. The Pacific Connector pipeline would remove approximately 19 acres of LSOG habitat in LSR compared with the 286 acres of LSOG that would be reallocated to LSR, for a net increase of 267 acres. There are currently about 186,423 acres[31] of LSR on the Roseburg District, and the addition of 409 acres to LSR 259 would represent an increase of approximately 0.22 percent. While beneficial to species dependent on LSOG forest, the change would represent a very small percentage of the overall acres allocated to LSR on the

[30] This number does not include acres of unmapped LSR consisting of occupied MAMU stands and KOACs.
[31] This number does not include acres of unmapped LSR consisting of occupied MAMU stands and KOACs.

Roseburg District. Similarly, the change in potential timber harvest from reallocating Matrix lands to LSR would also be small (less than 1 percent) and is not expected to change the objective for timber management because it would not prevent attainment of the probable sale quantity on the Roseburg District during the present planning cycle. In addition the mitigation proposed by the BLM to have the applicant acquire approximately 409 acres of private timberlands to backfill the Matrix acres reallocated to LSR would maintain the potential for future timber supply. All of the proposed amendments on the Roseburg District are related to the management direction for maintaining habitat for late-successional species. Collectively, the amendments would affect management direction on approximately 435 acres or about 0.10 percent of the Roseburg District. With the reallocation of 409 acres of Matrix to LSR, the acquisition of 409 acres of timber lands to backfill the Matrix acres, and ensuring the persistence of survey and manage species is not affected, no measurable changes in the overall objectives and management direction in the Roseburg District LMP have been identified.

Aggregate Impact of Proposed Amendments to the BLM Medford District and the Klamath Fall Resource Area of the Lakeview District LMPs

There is only one amendment proposed to the LMPs for these BLM Districts: BLM/FS-1, waiver of survey and manage protection requirements for the Pacific Connector Pipeline Project. This amendment is addressed in sections 4.1.3.4 and 4.7.4 of this EIS and appendix K. There are no other present or foreseeable future amendments and there have been no past amendments to these LMPs related to survey and manage species except for the 2001 ROD amending standards and guidelines for survey and manage. Therefore, there are no other amendments to consider for either BLM management unit.

Aggregated Impact of Proposed Amendments to the Umpqua National Forest LRMP

There are five proposed amendments to the Umpqua National Forest LMP for the PCGP project (see tables 4.1.3.7-1 and 4.1.3.7-2 above). Each proposed amendment is discussed in more detail in sections 4.1.3.4 and 4.1.3.6. Combined, the proposed amendments would affect management objectives on approximately 659 acres of the 963,129-acre Umpqua National Forest (see table 4.1.3.7-5). There is a previously proposed programmatic forest plan amendment for unique and mosaic habitats on the Umpqua National Forest. The proposed amendment would allow commercial harvest of timber and firewood within 150 feet of inventoried openings when the purpose is to maintain or restore the diverse vegetative species composition, stand structure and ecological functions of these unique habitats. The Pacific Connector Gas Pipeline Project does not impact any of the “unique and mosaic habitat” areas on the Umpqua National Forest and therefore there is no aggregated impacts related to this previously proposed amendment and the proposed amendments for the Pacific Connector Pipeline Project There have been no past amendments to this LMP related to LSRs or Survey and Manage species except for the 2001 ROD amending standards and guidelines for Survey and Manage.

TABLE 4.1.3.7-5

Summary of Proposed Amendments to the Umpqua National Forest LRMP

UNF-4	**UNF-1**	**UNF-6**	**UNF-2**	**BLM/FS-1**
588 acres Matrix reallocated to LSR	3 acres of effective shade removed	<154 acres detrimental soil conditions	1 acre parallel perennial stream	107 survey and manage sites potentially impacted

Proposed amendment UNF-4 affects the most acres of land managed by the Umpqua National Forest; it would affect future management on approximately 588 acres. The outcome of this amendment would be a management change from the objective of providing commercial timber products along with other multiple uses to an objective where the primary emphasis would be the creation and maintenance of late-successional forest habitat. The Pacific Connector pipeline would remove approximately 23 acres of LSOG habitat in LSR compared with the 431 acres of LSOG habitat that would be reallocated to LSR for a net increase of 408 acres. There are currently about 375,160 acres[32] of LSR on the Umpqua National Forest, and the 588 acres added to LSR 223 would represent an increase of 0.16 percent. While beneficial to species dependent on LSOG forest, the change would represent a very small percentage of the overall acres allocated to LSR on the Umpqua National Forest. Similarly, the change in potential timber harvest would also be small (less than 0.14 percent) and is not expected to change the objective for timber management since it would not prevent attainment of the probable sale quantity on the Umpqua National Forest during the present planning cycle. The other proposed amendments are site-specific and would apply only to the Pacific Connector pipeline. Collectively, the proposed amendments affect a very small percentage of the Umpqua National Forest (about 0.06 percent) and with the reasonable assurance that persistence of the affected survey and manage species would not be affected, no measurable changes in management objectives or expected outputs of goods and services have been identified.

Aggregate Impact of Amendments to the Rogue River National Forest LMP

There are seven proposed LMP amendments to the Rogue River National Forest LMP (see tables 4.1.3.7-1 and 4.1.3.7-2 above). Each proposed amendment is discussed in more detail in sections 4.1.3.4 and 4.1.3.6. Collectively, the proposed amendments would affect management objectives on approximately 674 acres of the 632,000-acre Rogue River National Forest (see table 4.1.3.7-6). There are no other proposed or foreseeable LMP amendments at this time and there have been no past amendments to this LMP related to LSRs or survey and manage species except for the 2001 ROD amending standards and guidelines for survey and manage.

TABLE 4.1.3.7-6

Summary of Proposed Amendments for the Rogue River National Forest LRMP

RRNF-7	**RRNF-2**	**RRNF-3**	**RRNF-4**	**RRNF-6**	**RRNF-5**	**BLM/FS-1**
512 acres Matrix added to LSR	5 acres visual impact at Big Elk Road	5 acres visual impact at Pacific Crest Trail	9 acres of visual impact on Hwy 140	<196 acres detrimental soil conditions	<3 acre of Restricted Riparian crossed	36 survey and manage sites potentially impacted

Proposed amendment RRNF-7 would affect the most acres of land managed by the Rogue River National Forest; it would affect future management on approximately 512 acres. The primary difference would be a management change from the objective of providing commercial timber products along with other multiple uses to an objective where the primary emphasis would be the creation and maintenance of late-successional forest habitat. The Pacific Connector pipeline would remove approximately 55 acres of LSOG habitat in LSR compared with the 333 acres of LSOG that would be reallocated to LSR, for a net increase of 278 acres to LSR 227. There are

[32] This number does not include acres of unmapped LSR consisting of KOACs.

presently about 187,745 acres[33] of LSR on the Rogue River National Forest and the 512 acres would represent an increase of 0.27 percent. While beneficial to species dependent on LSOG forest, the change would represent a very small percentage of the overall acres allocated to LSR on the Rogue River National Forest. Similarly, the change in potential timber harvest would also be small (less than 0.27 percent) and is not expected to change the objective for timber management since it would not prevent attainment of the probable sale quantity on the Rogue River National Forest during the present planning cycle. The other proposed amendments are site-specific and would apply only to the Pacific Connector pipeline. All of the proposed amendments combined affect a very small percentage of the Rogue River National Forest (about 0.11 percent) and, with the reasonable assurance that persistence of the affected survey and manage species would not be affected, no measurable changes in management objectives or expected outputs of goods and services have been identified.

Aggregate Impact of Proposed Amendments to the Winema National Forest LMP

There are six proposed amendments to the Winema National Forest LMP (see tables 4.1.3.7-1 above). Each proposed amendment is discussed in more detail in section 4.1.3.4. Collectively, the proposed amendments would affect management objectives on approximately 128 acres of the one million plus acre Winema National Forest (see table 4.1.3.7-7). There are no other proposed or foreseeable LMP amendments on the Winema National Forest at this time.

TABLE 4.1.3.7-7

Summary of Proposed Amendments to the Winema National Forest LRMP

WNF-1	**WNF-2**	**WNF-3**	**WNF-4**	**WNF-5**	**BLM/FS-1**
17 acres of impact in MA 3	3 acres visual impact at Dead Indian Road	50 acres visual impact on Clover Creek Road	<63 acres detrimental soil condition	4 acres in MA 8 in a detrimental soil condition	45 survey and manage sites potentially impacted

There are no proposed land reallocation amendments to the Winema National Forest LMP that would affect future management. All of the proposed amendments are site-specific and would apply only to the Pacific Connector pipeline. Collectively, the proposed amendments affect a very small percentage of the Winema National Forest (about 0.01 percent) and, with the reasonable assurance that persistence of the affected survey and manage species would not be affected, no measurable changes in management objectives or expected outputs of goods and services have been identified.

Land Allocation LMP Amendments in Relation to Mapped LSR

All of the proposed LMP amendments reallocating Matrix lands to LSR in the Coos Bay and Roseburg Districts and in the Umpqua and Rogue River National Forests are listed in table 4.1.3.7-2. The amendments for each unit are evaluated in section 4.1.3.6 of this EIS. This section considers the aggregate effects of these amendments in relation to mapped LSR. Mapped LSRs are large areas that were designated at the NWFP level and often overlap the boundaries of BLM and Forest Service management units. Two of the mapped LSRs that would be affected by the Pacific Connector Pipeline Project overlap district and/or forest boundaries. LSR 261 would be

[33] This number does not include acres of unmapped LSR consisting of KOACs

affected in both the BLM Coos Bay and Roseburg Districts, and LSR 223 would be affected in both the BLM Roseburg District and the Umpqua National Forest.

LSR 261

The following discussion relates to the overall impacts of the Pacific Connector pipeline on LSR 261 and the overall acres being reallocated to LSR in the vicinity of LSR 261.

The total impacts to LSR 261 from the proposed Pacific Connector pipeline on both the BLM Coos Bay and Roseburg Districts are displayed in table 4.1.3.7-8 and figure 4.1-36. The impacts include the direct impacts that would occur from construction (the acres cleared plus the acres

TABLE 4.1.3.7-8

Comparison of Total LSR 261 Acres Affected (a/) by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR

LSR 261	Direct Effects		Project Indirect Effects	Project Total Effects	Matrix to LSR Reallocation
	Cleared	Modified			
LSOG	3	0	30	33	387
Non- LSOG	40	4	59	103	407
Non-Forest	0	0	0	0	2
Total	**43**	**4**	**89**	**136**	**796**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Project total effects include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late-successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) on Coos Bay and Roseburg Districts.
Data source: BLM, Forest Service GIS Data Layers

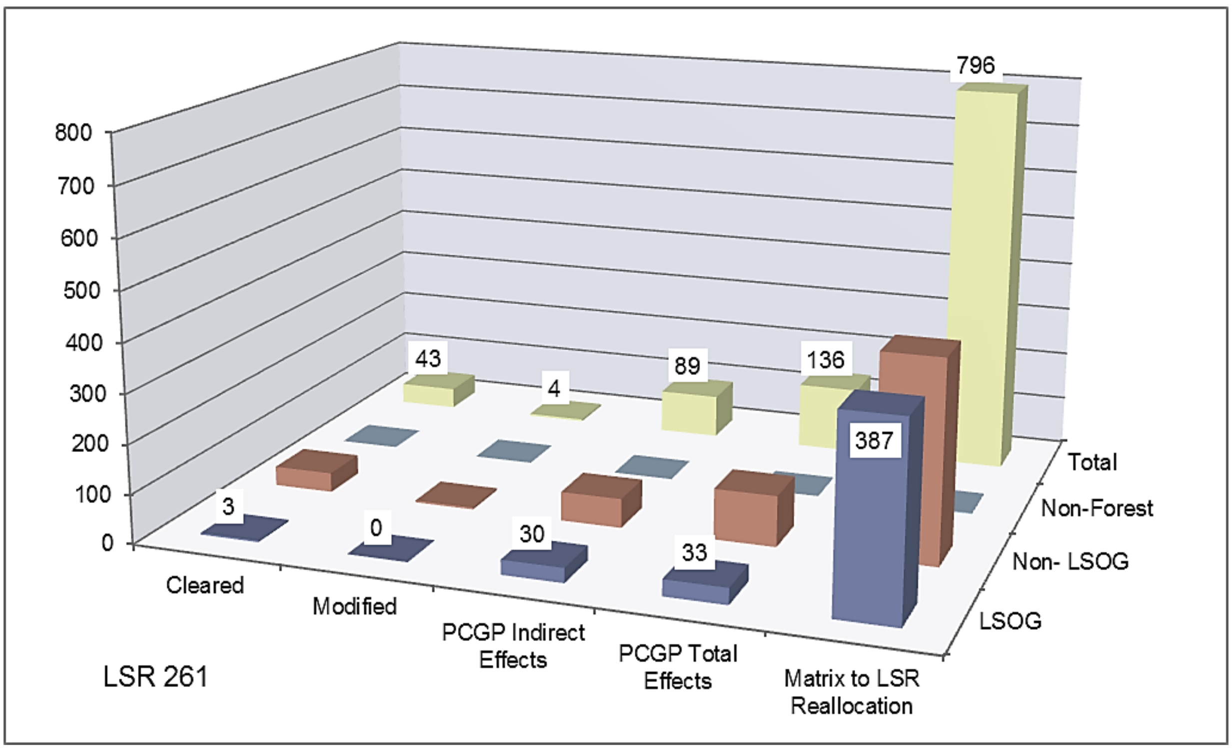


Figure 4.1-36. Comparison of Total LSR 261 Acres Affected by the Pacific Connector Pipeline Project and the Acres of Matrix Reallocated to LSR

modified by UCSAs) as well as the indirect impacts that would occur from the creation of new edge and the fragmentation of existing LSOG forest habitat. The indirect effects are measured as extending for 100 meters from the cleared edge on each side of the corridor in LSOG forest and 30 meters on each side of non-LSOG forest.

In considering the total impacts to LSOG forest habitat in LSR 261, there would be approximately 33 acres affected (including both direct and indirect impacts) compared to the approximately 387 acres of LSOG forest habitat being reallocated. The amendments would reallocate slightly more than 13 times the amount of LSOG forest habitat than would be affected. In considering the total impacts to forest habitat in LSR 261, there would be approximately 136 acres affected (including both direct and indirect impacts) compared to the 796 acres of Matrix lands being reallocated. The amendments would reallocate almost 6 times more forest habitat than would be affected.

Proposed Off-site Mitigation Actions

In addition to the reallocation of Matrix lands to LSR, the off-site mitigation actions on the Roseburg District include hazardous fuels reduction through creating a 1,000-acre fuel break adjacent to the Pacific Connector pipeline corridor in the South Umpqua River watershed and aiding fire suppression efforts through the creation of six dry hydrants in the South Umpqua River, Myrtle Creek, and Middle South Umpqua River fifth-field watersheds. The Coos Bay District is proposing to construct three heli-ponds. Two of them would be in the East Fork Coquille watershed and the other in the Middle Fork Coquille watershed.

- 1,000-Acre Fuel Break: High-intensity fire has been identified as the single factor most affecting LSOG forest habitats on federal lands in the area of the NWFP (Moeur et al. 2011). Construction of the pipeline and associated activities would remove both mature and developing stands and increase fire suppression complexity. However, the pipeline corridor would also provide a fuel break. Actions to reduce fuels adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. This type of mitigation would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire. This segment is part of the Days Creek to Shady Cove fuel break and ties in with similar projects in the Umpqua National Forest.
- Six Dry Hydrants: By installing dry hydrants, the water source is disturbed only once, and there are several other advantages. Fire vehicles would not need to be very close to the water to fill up, decreasing the risk of contamination, and they can fill from some water sources that would otherwise need to be modified for use. Site-specific riparian and aquatic restoration efforts would be maintained, and/or enhanced by the installation of dry hydrants that offer safe and effective access for fire suppression equipment. Overall, better water sources would improve suppression success and therefore help protect natural resources.
- Three heli-ponds: Within the East Fork/Middle Fork Coquille fifth-field watersheds, there is an 18-plus-mile gap between water sources accessible to helicopters. Quick response time is imperative for successful control in wildfire situations during the initial attack. Most water sources in this area are low in the drainage and accessible only by truck. Heli-ponds at these locations would reduce the 18 mile gap to approximately 6 miles and would enable a 2- to 3-mile radius for aerial application. Fire control is necessary to protect LSRs and endangered species habitat should a wildfire occur. Development of these heli-ponds would reduce initial attack response times in both the mapped and unmapped LSRs that

would be affected by the Pacific Connector pipeline and increase the potential to control fires before they become high-intensity fires that threaten LSOG forests.

Impact on the Functionality of LSR 261 on the Roseburg and Coos Bay Districts

The functionality of LSR 261 relates directly to the goals and objectives for LSRs (see section 4.1.3.6) and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the Pacific Connector Pipeline Project would impact these characteristics.

- **Quantity:** The overall quantity of LSOG habitat within LSR 261 on the Coos Bay and Roseburg Districts would increase with the proposed LMP amendments. The Project would remove approximately 3 acres of LSOG habitat in LSR 261 but the reallocation would add 387 acres of LSOG habitat for a net increase of 384 acres[34]. This would increase the current level of LSOG habitat in LSR 261 from 31,793 acres to 32,177 acres or by approximately 1.2 percent.
- **Quality:** The area of LSR 261 that would be affected by the Pacific Connector pipeline on both the Coos Bay and Roseburg Districts is highly fragmented due to both the land ownership pattern and past management activities. The area proposed for reallocation to LSR 261 contains some large blocks of LSOG habitat as well as occupied MAMU stands and an adjacent KOAC. This reallocation would consolidate habitat in an area that is highly fragmented. LSR 261, like most LSRs on BLM land, is comprised of checkerboard sections or even smaller parcels of land. The intent of the reallocations is to better connect these pieces by decreasing distances between individual LSR parcels and reduce the amount of "edge" adjacent to existing occupied MAMU stands and KOACs. With the reallocation of Matrix to LSR and the consolidating of larger blocks of LSOG habitat the quality of the LSOG habitat within LSR 261 would be improved.
- **Distribution:** The distribution of LSOG habitat within LSR 261 would remain largely unchanged with the proposed Pacific Connector pipeline and the reallocation of Matrix to LSR RMP amendments. To the extent there are minor changes they would be beneficial due to the location of the proposed reallocation. The reallocation would occur within a current gap between the northern and southeastern portions of LSR 261 and between LSR 261 and LSR 259 which would provide some additional connectivity within LSR in these areas.
- The off-site mitigation actions on the Coos Bay and Roseburg Districts would provide added protection to the quantity, quality, and distribution of LSOG habitat by improving the potential to decrease initial fire suppression response times and thereby increase the potential to control fires before they become high-intensity fires that threaten LSOG forests. Protecting LSOG forest from loss due to high-intensity fire is also one of the objectives in the LSRA for this LSR.

The Matrix to LSR reallocations and the off-site mitigation actions on both the Coos Bay and Roseburg Districts have been designed with the goal that, overall, the impact of the Pacific Connector pipeline on LSR 261 would be either neutral or beneficial to the creation and maintenance of late-successional habitat. With the increase in the acres of protected LSOG habitat

[34] 286 of these acres would be reallocated to LSR 259 which is next to LSR 261, see discussion in section 4.1.3.6 BLM-3, Reallocation of Matrix Lands to Late Successional Reserves for the reasons reallocation in LSR 259 is being considered as mitigation for LSR 261.

and the formation of larger habitat blocks in areas where fragmentation was a major concern in the LSRA, the overall functionality of LSR 261 would be maintained or improved.

LSR 223

The following discussion relates to the overall impacts of the Pacific Connector pipeline on LSR 223 and the overall acres being reallocated to LSR in the vicinity of LSR 223.

The total impacts to LSR 223 from the proposed Pacific Connector pipeline on both the Umpqua National Forest and BLM Roseburg District are displayed in table 4.1.3.7-9 and figure 4.1-37. The impacts include the direct impacts that would occur from the construction of the pipeline project (the acres cleared plus the acres modified by UCSAs) as well as the indirect impacts that would occur from the creation of new edge and the fragmentation of existing LSOG forest habitat. The indirect effects are measured as extending for 100 meters from the cleared edge on each side of the corridor in LSOG forest and 30 meters on each side of non-LSOG forest.

TABLE 4.1.3.7-9

Comparison of Total LSR 223 Acres Affected (a/) by the Pacific Connector Pipeline Project and Acres of Matrix Reallocated to LSR

LSR 223	Cleared (Direct Effects)	Modified (Direct Effects)	Project Indirect Effects	Project Total Effects	Matrix to LSR Reallocation
LSOG	35	15	271	321	431
Non- LSOG	78	24	115	217	157
Non-Forest	0	0	0	0	0
Total	**113**	**39**	**385**	**538**	**588**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Project total effects include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) in the BLM Roseburg District and Umpqua National Forest.

Data source: BLM, Forest Service GIS Data Layers, Cox 2010

In considering the total impacts to LSOG forest habitat in LSR 223, there would be approximately 321 acres affected (including both direct and indirect impacts) compared to the approximately 431 acres of LSOG forest habitat being reallocated. The amendments would reallocate slightly more than 1.3 times the amount of LSOG forest habitat that would be affected. The off-site mitigation proposed in the Roseburg District would add another 1,000 acres of fuel treatment in addition to the 2,284 acres proposed in the Umpqua National Forest. Collectively, these actions would provide for increased prevention of LSOG forest habitat loss due to intensive fire.

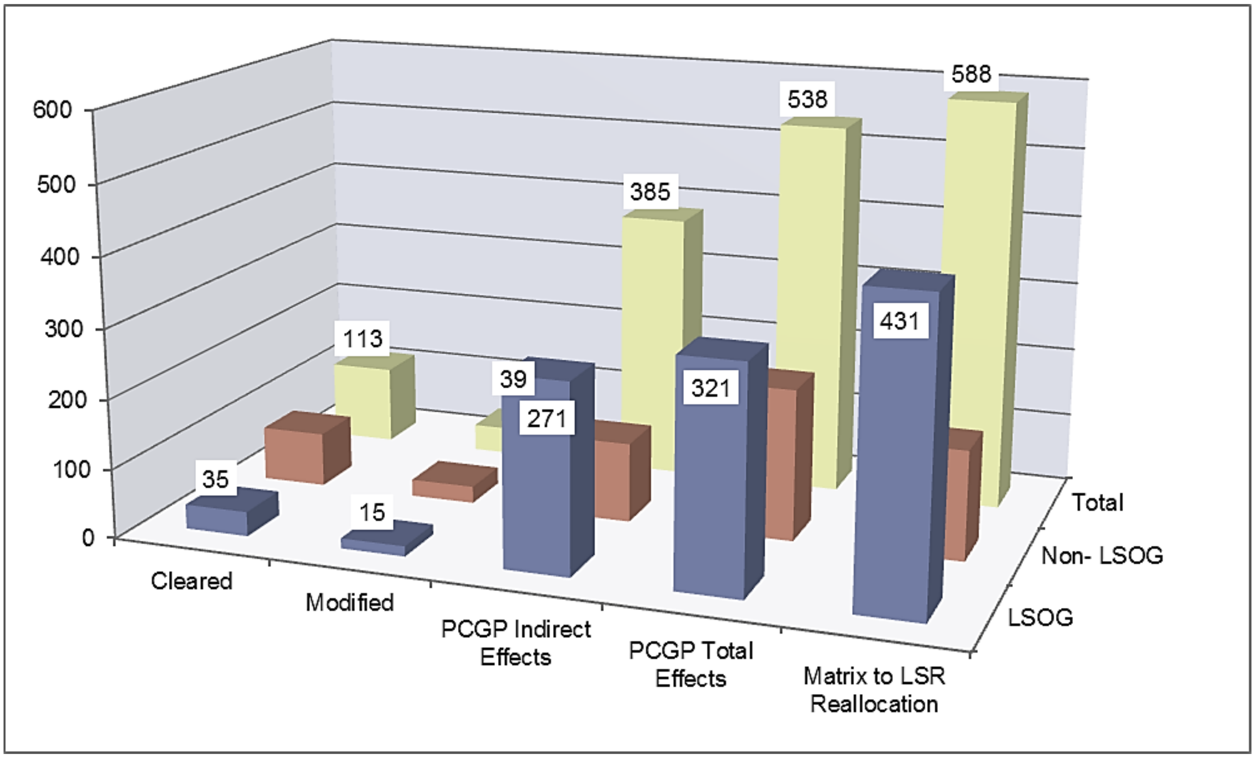


Figure 4.1-37. Comparison of Total LSR 223 Acres Affected by the Pacific Connector Pipeline Project and the Acres of Matrix Reallocated to LSR

Proposed Off-site Mitigation Actions

A Mitigation Plan was developed to ensure that the goals and objectives of the LMPs related to LSR would be achieved. Mitigation actions include:

- Creation of snags on 175 acres that are below desired snag densities for LSRs.
- Placing CWD on 165 acres in units that are currently below desired levels for CWD.
- Closing and decommissioning 7.6 miles of roads to reduce fragmentation and develop interior stand habitat over time.
- Thinning approximately 2,081 acres of overstocked stands, and underburning approximately 1,128 acres in LSRs to reduce fire risk and accelerate development of LSR characteristics.
- Integrated stand density and fuel break treatments on 2,285 acres in LSR 233 to restore stand density, species diversity, structural diversity, and control the spread and intensity of wildfire within forested stands prone to fire activity.

While the primary mitigation action for the effects of the pipeline on LSR 223 would be to replace affected acres with additional acres of LSOG forest habitat that are currently outside of the LSR, the additional off-site mitigation actions proposed are consistent with the recommendations in the LSRA for LSR 223. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the Pacific Connector pipeline on LSR 223 in the long term. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 223 by improving the quantity, quality, and distribution of high-quality habitat. The fuels treatment is part of a long fuel break extending from

Stouts Creek on the Roseburg District to Trail Creek on the Medford District, a landscape-scale mitigation action designed to reduce the risk of damage to LSR from catastrophic wildfire.

Impact on the Functionality of LSR 223 on the BLM Roseburg District and the Umpqua National Forest

The functionality of LSR 223 relates directly to the goals and objectives for LSRs and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the proposed Pacific Connector pipeline would impact these characteristics.

- **Quantity:** The overall quantity of LSOG habitat within LSR 223 on the Umpqua National Forest and Roseburg District would increase with the proposed LRMP amendment. The Project would remove approximately 35 acres of LSOG habitat but the reallocation would add 431 acres of LSOG habitat for a net increase of 396 acres. This would increase the current level of LSOG habitat in LSR 223 from 20,953 acres to 20,953 acres or by approximately 1.9 percent.
- **Quality:** The area proposed for reallocation to LSR 223 contains some large blocks of LSOG habitat and would also be located immediately adjacent to two KOACs, providing further consolidation of LSOG habitat and increased protection of NSO habitat within LSR 223. With the reallocation of Matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat in LSR 223 would be slightly improved.
- **Distribution:** The distribution of LSOG habitat within LSR 223 would remain largely unchanged with the proposed Project and the reallocation of Matrix to LSR LRMP amendment. To the extent there are minor changes, they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the southwest edge of the LSR providing for some additional connectivity with the nearest LSRs to the south and west.
- The off-site mitigation actions would improve the quantity, quality, and distribution of LSOG habitat in LSR 223 by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacement fire and reducing fragmentation through road decommissioning and stand-density management.

The Matrix to LSR reallocation and the off-site mitigation actions on both the Roseburg District and the Umpqua National Forest have been designed with the goal that the overall impact of the Project on LSR 223 would be either neutral or beneficial to the creation and maintenance of late-successional habitat. With the increase in the acres of protected LSOG habitat and the inclusion of large LSOG habitat blocks, the overall functionality of LSR 223 would be maintained or improved.

Aggregate LMP Amendments and Off-site Mitigation Actions Related to LSR

Collectively, there are a total of seven proposed LMP amendments that would affect LSR in order to accommodate construction of the Project. Table 4.1.3.7-10 summarizes the proposed amendments.

TABLE 4.1.3.7-10

Summary of Proposed BLM and Forest Service LMP Amendments for LSR

BLM/Forest Service Management Unit	Reallocate Matrix Land to LSR a/	Exemption from Requirement to Protect MAMU Habitat b/	Exemption from Requirement to Retain Habitat in KOACs c/
BLM Coos Bay District	BLM-4 Proposal to reallocate 387 acres of Matrix Land to LSR 261	BLM-1 Proposal to waive requirement on twelve occupied MAMU stands	None
BLM Roseburg District	BLM-3 Proposal to reallocate 409 acres of Matrix Land to LSR 259	BLM-1 Proposal to waive requirement on four occupied MAMU stands	BLM-2 Proposal to waive requirement on three KOACs
Forest Service Umpqua National Forest	UNF-4 Proposal to reallocate 588 acres of Matrix land to LSR 223	None	None
Forest Service Rogue River National Forest	RRNF-7 Proposal to reallocate 512 acres of Matrix land to LSR 227	None	None

a/ Reallocated acres would become part of mapped LSRs.
b/ Occupied MAMU stands outside of mapped LSRs are designated as un-mapped LSRs.
c/ All KOACs are outside of mapped LSRs and are designated as un-mapped LSRs.

The total amount of LSR acres affected by the Pacific Connector pipeline directly and indirectly across all BLM and Forest Service lands and the total amount of Matrix proposed for reallocation to LSR are displayed in table 4.1.3.7-11 and figure 4.1-38.

TABLE 4.1.3.7-11

Summary of the Total LSR Acres Affected Directly and Indirectly (a/) by the Pacific Connector Pipeline Project and Total Acres of Matrix Reallocated to LSR

	Mapped LSR			Unmapped LSR			Total LSR			Total
Unit	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Overall Effect	Matrix to LSR
BLM Districts										
Coos Bay	35	56	91	40	181	220	75	237	312	387
Roseburg	80	177	257	37	87	124	116	265	381	409
Total BLM	115	234	348	76	268	344	191	502	692	**796**
Forest Service National Forests										
Umpqua	85	241	325	0	0	0	85	241	325	588
Rogue River	276	534	810	0	0	0	276	534	810	512
Total Forest Service	361	775	1,135	0	0	0	361	775	1,135	**1,100**
Total Overall	**475**	**1,008**	**1,483**	**76**	**268**	**344**	**552**	**1,276**	**1,828**	**1,896**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Project total effects include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: BLM, Forest Service GIS data layers, Cox 2010

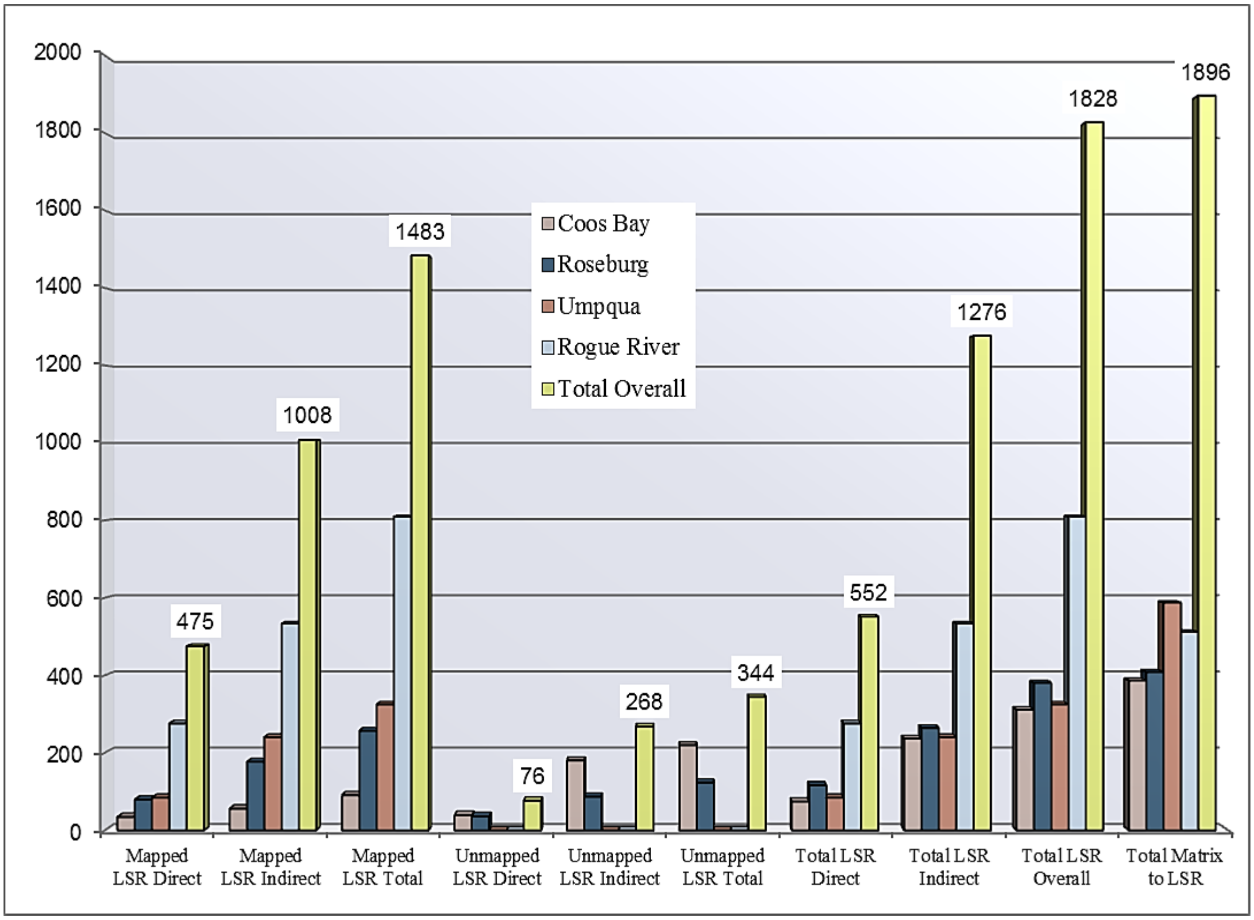


Figure 4.1-38. Comparison of Total LSR Acres Affected by the Pacific Connector Pipeline Project and Total Acres of Matrix Reallocated to LSR

Unmapped LSRs for the most part were avoided with the routing of the Pacific Connector pipeline due to their smaller size and greater dispersal, except for BLM Coos Bay District, where numerous occupied MAMU stands are concentrated in the area of the proposed route (see figure 4.1-10). Mapped LSRs would be affected the most on NFS lands where the proposed route is in the general vicinity of large LSR areas, especially in the Rogue River National Forest (see figures 4.1-28 and 4.1-32).

Comparing the Matrix acres proposed for reallocation to LSR with the total LSR acres that would be directly and indirectly affected by the Pacific Connector pipeline, the ratio is slightly more than one to one. It should be noted, however, that a high percentage of the overall impact (slightly more than two-thirds) would be from the indirect effects of the pipeline project that would result from the creation of new edge and fragmentation of forested habitat. There is no precise way to measure the indirect impacts or compare them to the impacts of removing forest vegetation for the project. In considering the objectives of LSRs, a more important comparison is the overall impact the project would have on LSOG habitat with the amount of LSOG habitat that would be reallocated to LSRs (see table 4.1.3.7-12 and figure 4.1-39).

TABLE 4.1.3.7-12

Comparison of Total LSR Acres by Habitat Type Affected (a/) by the Pacific Connector Pipeline Project and Total Acres of Matrix Reallocated to LSR

Habitat Type	Total Cleared	Total Modified	Total Indirect Effects	Total Effects	Total LSR Reallocation
LSOG	114	46	859	1,018	1,151
Non-LSOG	296	87	417	800	743
Non-Forest	19	0	0	9	2
Totals	**418**	**133**	**1,278**	**1,828**	**1,896**

a/ Project impacts include (direct effects) cleared acres (corridor and TEWAs) and modified acres (UCSAs), and (indirect effects) 100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG.

Data source: BLM, Forest Service, GIS Layers; Cox 2010

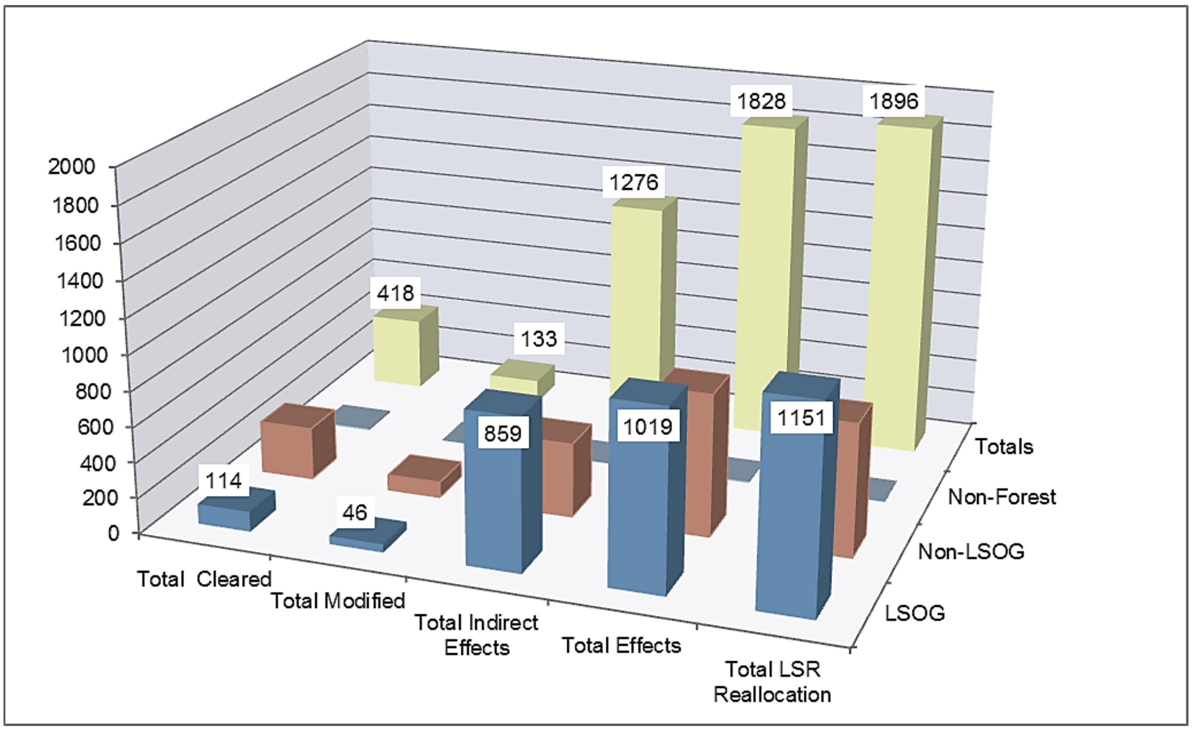


Figure 4.1-39. Comparison of Total LSR Acres Affected by Pacific Connector Pipeline Project and Total Acres of Matrix Reallocated to LSR

In comparing the acres of LSOG habitat that would be reallocated to LSR with the total acres of LSOG habitat in LSRs that would be cleared by the Pacific Connector pipeline, the ratio would be approximately 10 to 1. This is due in part to the efforts both to avoid LSOG habitat in the routing of the Pacific Connector pipeline and to identify larger blocks of LSOG habitat in the Matrix areas proposed for reallocation. Comparing the acres of LSOG habitat proposed for reallocation to LSR with the total LSR acres of LSOG habitat that would be directly and indirectly affected by the Project results in a ratio of approximately 1.1 to 1.

Total Off-site Mitigation Actions Related to LSR

A summary of the proposed off-site mitigation actions for LSRs on BLM and NFS lands is described in table 4.13.7-13. The mitigation actions are designed to accomplish two main objectives. The first objective is to enhance the development of LSOG habitat and its constituent elements. The second objective is to reduce the risk of losing LSOG habitat to intensive fires.

For the BLM lands, the focus of the mitigation actions would be to reduce the risk of LSOG habitat loss from intensive fire. This focus is due primarily to the highly fragmented ownership pattern in the area of the proposed Pacific Connector pipeline and the few remaining large blocks of LSOG habitat. Because of these factors, protecting the remaining LSOG habitat in the LSRs is the highest priority. The proposed development of the three heli-ponds, the six dry hydrants, and the 1,000 acres of fuel hazard reduction are spread across the Coos Bay and Roseburg Districts in the area of the Pacific Connector pipeline and would provide added protection and reduced fire response times for both the mapped and un-mapped LSRs in this area (see figures 4.1-15 and 4.1-27).

TABLE 4.1.3.7-13

Summary of Proposed Off-site Mitigation Actions for LSR Impacts on BLM and NFS Lands

BLM/Forest Service Management Unit	Fire Hazard Reduction	Road Decommissioning	Stand-Density Management	Coarse Woody Debris Enhancement	Other Treatments
BLM Coos Bay District	Development of three heli-ponds	–	–	–	–
BLM Roseburg District	Development of six dry hydrants	–	Fuel hazard reduction on 1,000 acres	–	–
Forest Service Umpqua National Forest	–	7.6 miles of road decommissioning	913 acres of stand-density management Fuel break treatments on 2,285 acres	Snag creation on 175 acres and LWD placement on 165 acres	80 acres of meadow restoration and 81 acres (a/) of invasive plant treatment
Rogue River National Forest	–	53.2 miles of road decommissioning	Pre-commercial thinning of 600 acres	Snag creation and LWD placement on 600 acres	–
Totals	**9 Sites**	**60.8 Miles**	**4,798 Acres**	**940 Acres**	**161 Acres**

a/ Estimated acres based on 50 feet of treatment on each side of 6.7 miles of road (6.7*5280*100/43560).
Data source: BLM, Forest Service GIS Layers

For the NFS lands, the focus of the off-site mitigation actions would be on (1) reducing the risk of LSOG habitat loss from intensive fire and (2) enhancing the development of LSOG habitat in LSRs. The NFS lands in the vicinity of the Pacific Connector pipeline provide greater opportunities for LSOG habitat enhancement due to the large LSR areas and the larger blocks of LSOG habitat. The proposed treatments include more than 60 miles of road decommissioning, more than 1,500 acres of stand-density management, approximately 2,285 acres of integrated fuel hazard reduction/stand-density management, and approximately 940 acres of CWD enhancement. The integrated fuel hazard reduction treatments in the Umpqua National Forest are designed to tie into the treatments in the Roseburg District to provide for continuous fuel hazard reduction along the corridor on both BLM and Forest Service lands in this area.

A portion of the Forest Service off-site mitigation actions have been designed to partially compensate for the fragmentation of LSOG habitat that would occur with the construction of the Pacific Connector pipeline in LSRs 223 and 227. These off-site mitigation actions include road decommissioning and stand-density management activities. Table 4.1.3.7-14 and figure 4.1-40 compare the impacts that would occur from the construction of the project and the estimated amount of edge effect reduction that would occur over time with the off-site mitigation actions.

TABLE 4.1.3.7-14

Comparison of Total Pacific Connector Pipeline Project Impacts (a/) on LSRs 223 and 227 and Estimated Edge Reduction Effect (a/) of Proposed Off-site Mitigation Actions on Forest Service Lands (Acres)

LSR 223 and 227	Direct Effect	Indirect Effect	Total
	Total LSR Acres Affected on Forest Service Lands		
Pacific Connector Pipeline Project Impacts	361	774	1,135
	Proposed Off-site Mitigation Actions on Forest Service Lands		
Road Decommissioning	147	737	884
Stand-Density Management.	0	157	157
Total	**147**	**894**	**1,041**

a/ Project direct effects include corridor clearing, temporary extra work areas, and uncleared storage areas. Indirect effects include 100 meters on each side of the corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of corridor edge in non-LSOG.
b/ Direct edge reduction effects include acres of decommissioned roads revegetated (60.8*5280*20/43560) and indirect effects include 50 feet on each side of decommissioned roads and 100 feet along perimeter of stand-density treatments.
Data source: BLM, Forest Service GIS data layers, Hobson 2010

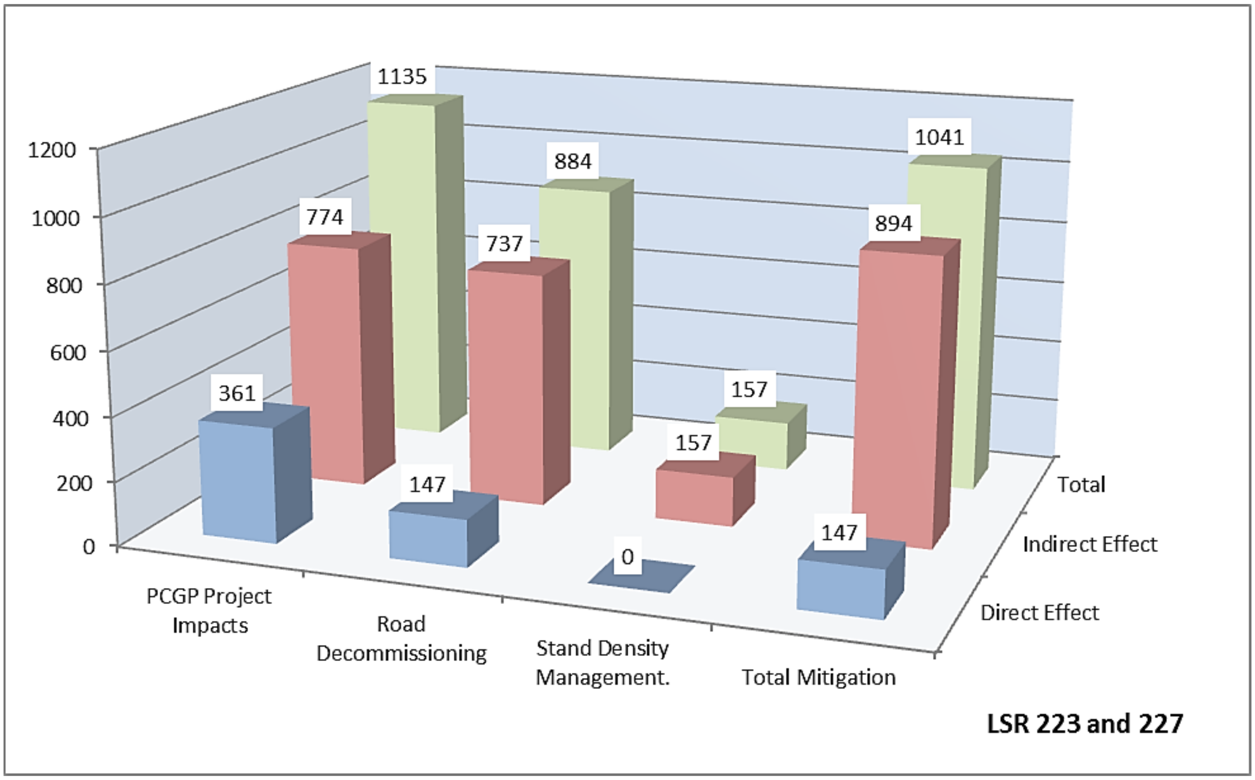


Figure 4.1-40. Comparison of Total Pacific Connector Pipeline Project Impacts on LSRs 223 and 227 and Estimated Edge Reduction Effect of Proposed Off-site Mitigations on NFS Lands (acres)

A more detailed discussion of these off-site mitigation actions and the assumptions used in estimating edge reduction effects is included in section 4.1.3.6. The purpose of the comparison here is to show the total amount of off-site mitigation on Forest Service lands that has been designed to compensate for the indirect effects of edge fragmentation. In comparing the indirect beneficial effects of the off-site mitigation with the indirect effects of the Pacific Connector pipeline on LSRs (which is an estimate of the edge and fragmentation impacts), the ratio is slightly more than one to one. This is not a one to one comparison, however, because the adverse impacts would occur at the time of construction whereas the beneficial effects of edge reduction would occur over several decades. This comparison, however, does not consider the beneficial effects of the on-site mitigation in edge reduction that would also occur over time from the reforestation of the project corridor except for a 30-foot area over the center of the pipeline.

Summary of Aggregate LMP Amendments and Off-site Mitigation Actions Related to LSR at the Province Level

The NWFP included a comprehensive monitoring program to evaluate progress toward meeting the respective LMP's desired outcomes (Forest Service and BLM 1994a: E-1 to E-12). In 1995, a scientifically based interagency monitoring program was developed (Mulder et al. 1999). The monitoring program is composed of six modules designed to answer key questions. The modules include tracking the status and trends of watershed conditions, LSOG forests, social and economic conditions, tribal relationships, and the populations and habitats of MAMU and NSO. The module for LSOG habitat monitoring characterizes the status and trend of older forests to answer the key question: "Is the NWFP maintaining or restoring late-successional and old-growth forest ecosystems to desired conditions on federal lands in the NWFP area?" Monitoring results are evaluated and reported in one-year and five-year intervals.[35] The 15-year LSOG forest monitoring report was completed in 2011 (Moeur et al. 2011).

The monitoring program for LSOG habitat is based on physiographic provinces. The use of provinces allows differentiation between areas of common biological and physical processes. The provinces are useful for stratifying monitoring findings according to the climatic, topographic, and social gradients across the NWFP area that create significant differences in potential natural vegetation, current vegetation, natural disturbance regime, historical land use, and land ownership (Moeur et al. 2005). The 12 provinces used in the NWFP are shown on figure 4.1-41. The Pacific Connector Pipeline Project would affect LSRs in 3 of the 12 provinces: the Oregon Coast Range, Oregon Klamath, and Oregon Western Cascades provinces. Figure 4.1-42 illustrates the provinces crossed by the Pacific Connector pipeline route.

[35] Monitoring results for the first 10 and 15 years are documented in a series of general technical reports that are available online at http://www.fs.fed.us/pnw/publications/gtrs.shtml.

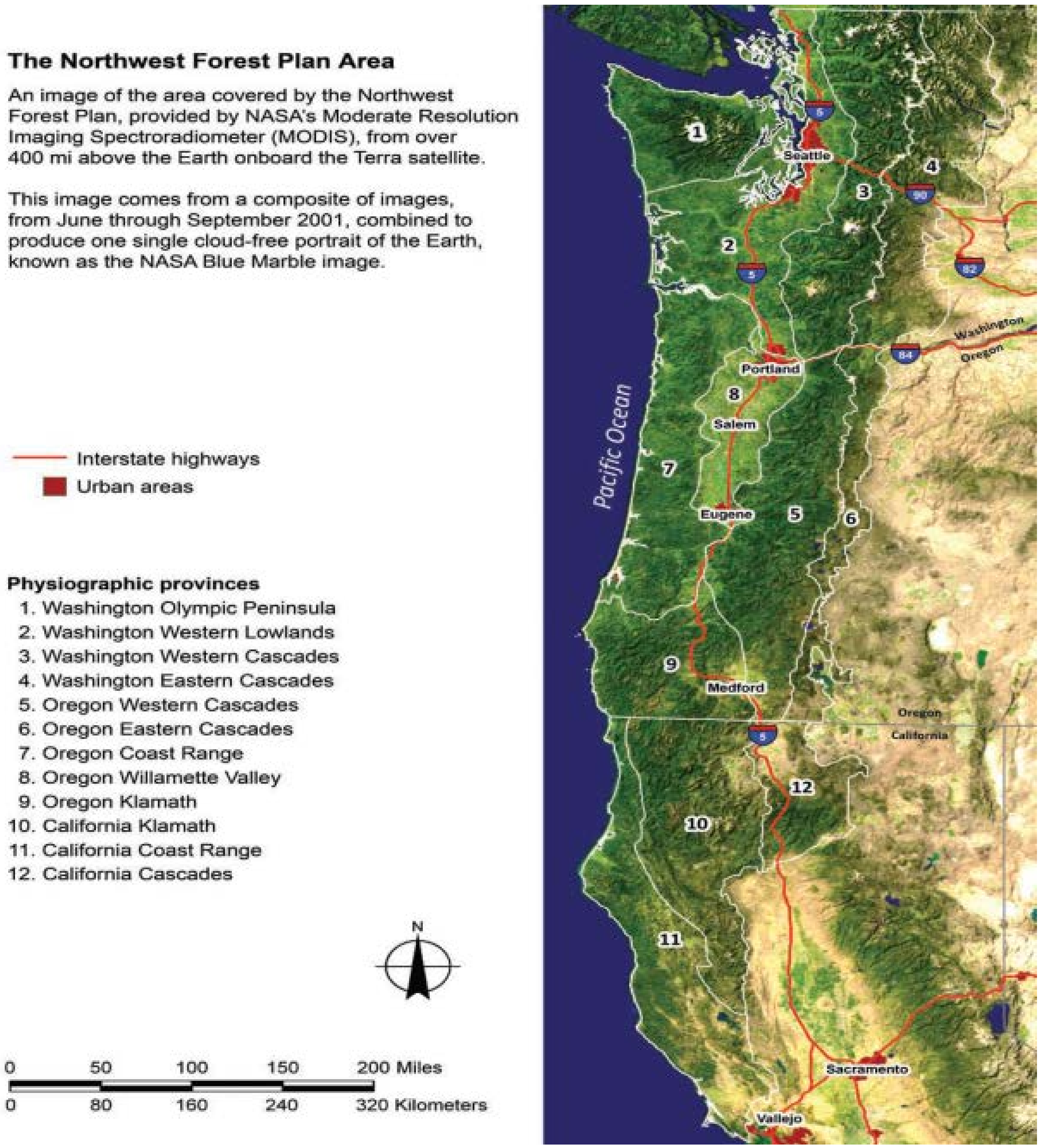


Figure 4.1-41. Physiographic Provinces of the Northwest Forest Plan

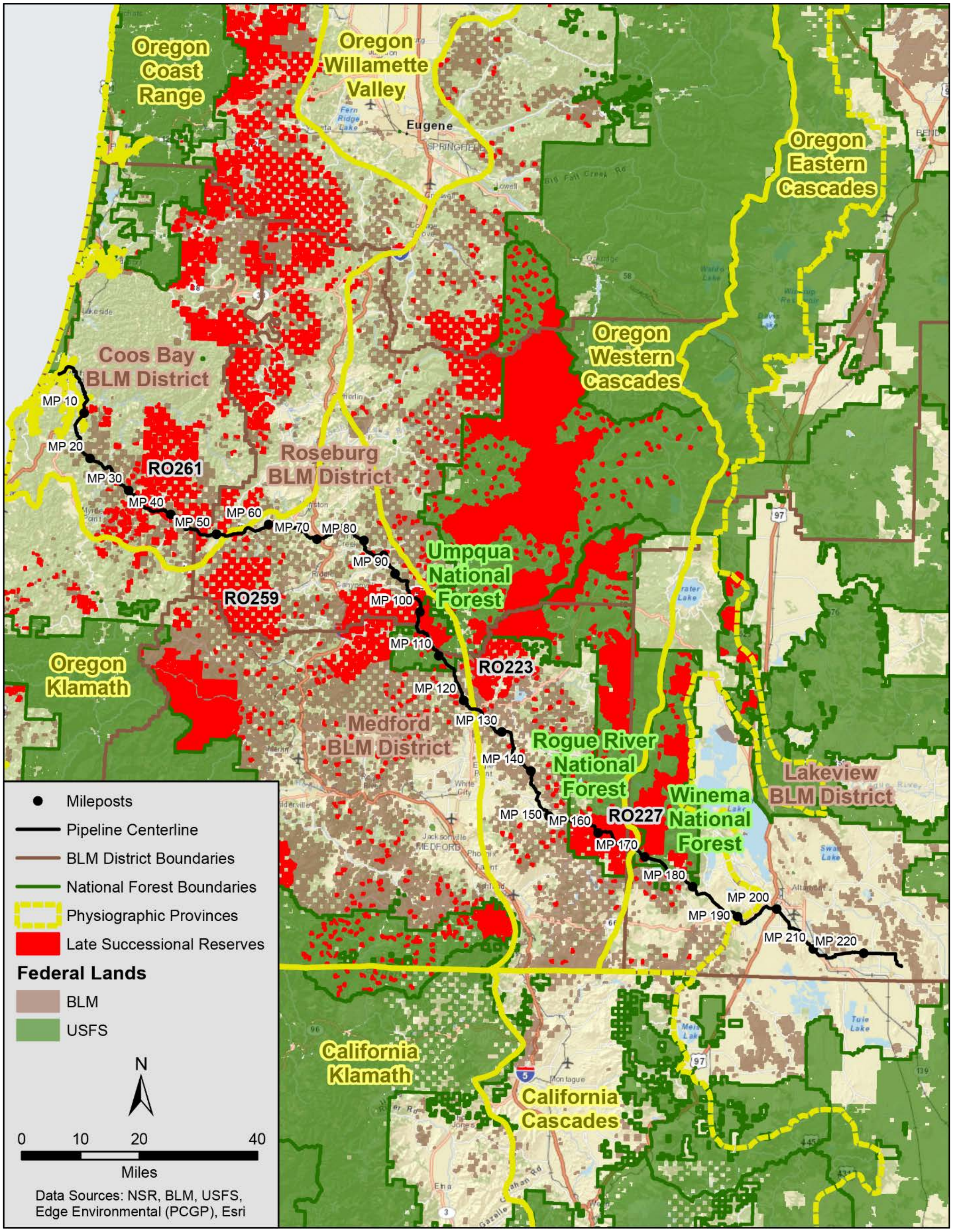


Figure 4.1-42. Map of Physiographic Provinces Crossed by the Pacific Connector Pipeline Project

Table 4.1.3.7-15 and figure 4.1-43 provide a summary of the total LSOG acres in LSRs that would be affected directly and indirectly by the Pacific Connector pipeline and the total acres of LSOG habitat reallocated to LSR by province.

TABLE 4.1.3.7-15

Comparison of Total Pacific Connector Pipeline Project Effects (a/) on LSOG Habitat in LSRs and LSOG Habitat in Matrix Reallocated to LSR by Province (Acres)

Province	Direct Effects: Cleared	Direct Effects: Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
Oregon Coast Range	21	5	207	**233**	101
Oregon Klamath	37	20	303	**361**	717
Oregon Western Cascades	55	21	350	**426**	333
Total	**114**	**46**	**860**	**1,020**	**1,151**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).
a/ Project effects include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth [LSOG] forest).
Data source: BLM, Forest Service GIS data layers

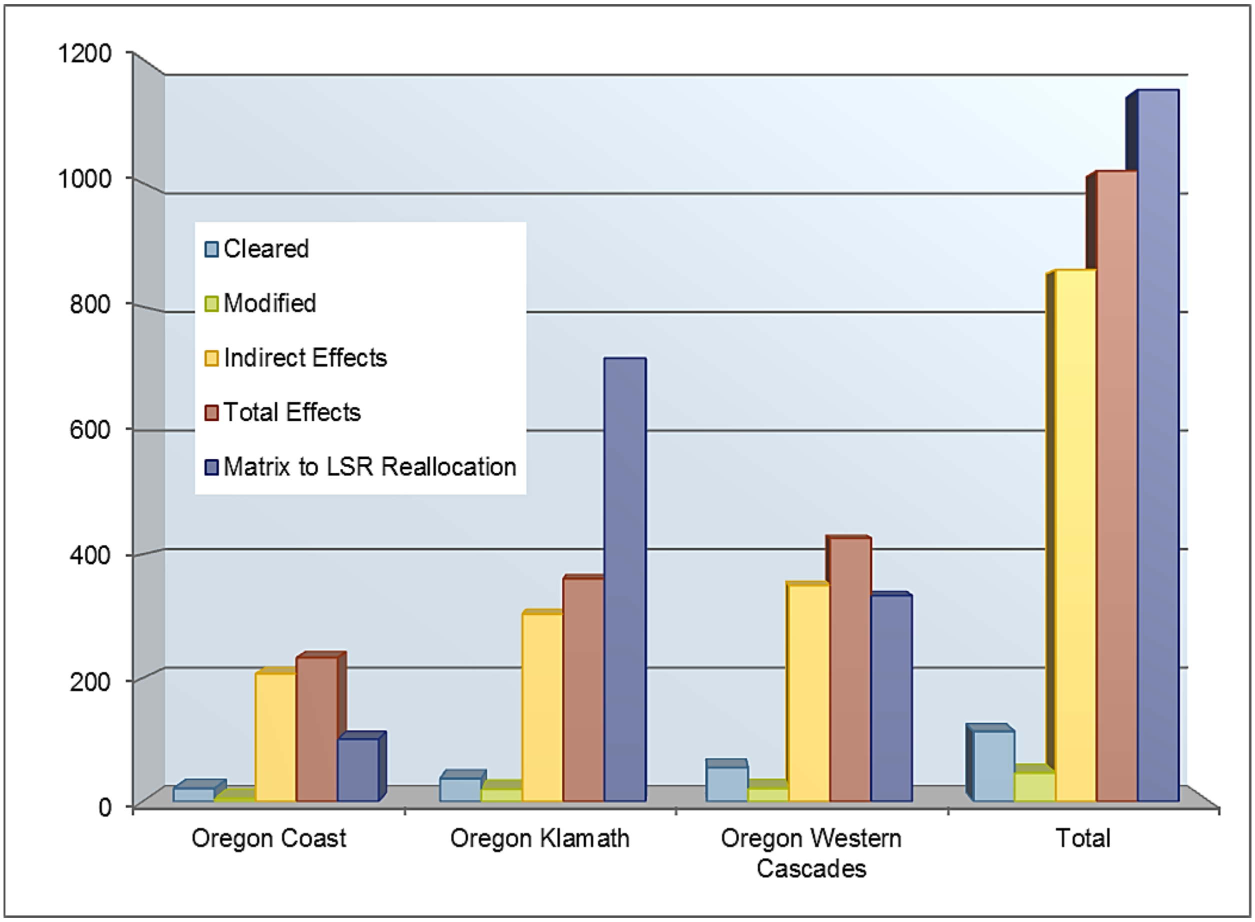


Figure 4.1-43. Comparison of Total Pacific Connector Pipeline Project Impacts on LSOG Habitat in LSRs and LSOG Habitat in Matrix Reallocated to LSR by Province (acres)

As illustrated by table 4.1.3.7-15 and figure 4.1-43, the impacts on LSOG habitat in LSRs from the Pacific Connector pipeline would be spread across three provinces, with the majority of the impacts occurring in the Oregon Klamath and Oregon Western Cascade Provinces, including the majority of the LSOG forest acres reallocated to LSR. Although a small portion of the pipeline would also cross the Oregon Eastern Cascades Province in the Winema National Forest, it would not affect any LSRs in that province.

Table 4.1.3.7-16 summarizes the proposed off-site mitigation actions for LSRs on BLM and Forest Service lands by province. Maps of the proposed off-site mitigation actions are displayed in figures 4.1-15, 4.1-27, 4.1-30 and 4.1-34.

TABLE 4.1.3.7-16

Summary of Proposed Off-site Mitigation Actions for LSR Impacts on BLM and Forest Service Lands by Province

Physiographic Province	Fire Hazard Reduction	Road Decommissioning	Stand-Density Management	Coarse Woody Debris Enhancement	Other Treatments
Oregon Coast Range	Development of three heli-ponds	–	–	–	–
Oregon Klamath	Development of six dry hydrants	7.6 miles of road decommissioning	Fuel hazard reduction on 1000 acres a/ 913 acres of stand-density management Fuel break treatments on 2,285 acres	Snag creation on 175 acres and LWD placement on 165 acres	80 acres of meadow restoration and 81 acres (b/) of invasive plant treatment
Oregon Western Cascades	–	53.2 miles of road decommissioning	Pre-commercial thinning of 600 acres	Snag creation and LWD placement on 600 acres	–
Totals	**9 Sites**	**60.8 Miles**	**4,798 Acres**	**940 Acres**	**161 Acres**

a/ A small portion of these acres would be within the Oregon Coast Province.
b/ Estimated acres based on 50 feet of treatment on each side of 6.7 miles of road (6.7*5280*100/43560)
Data source: BLM, Forest Service GIS Layers

The monitoring data from the 2011 LSOG forest monitoring report suggest a slight net loss of LSOG forest over the NWFP area, from 33.2 percent of federal forest in 1994–1996 to 32.6 percent in 2006–2007. This estimate includes loss from natural disturbances and timber harvesting, as well as the estimated gains from LSOG forest recruitment. The net change was positive in some provinces and negative in others. For the Oregon Coast, Oregon Klamath, and Oregon Western Cascades Provinces, the estimated net loss was 3.0, 1.1, and 7.9 percent, respectively (Moeur et al. 2011).

Similar to the findings of previous monitoring reports, wildfire was the most significant cause of LSOG habitat loss over the NWFP area. Most of the LSOG forest losses on federal lands (approximately 184,000 acres) were associated with wildfire, including several large fire events in the Oregon Klamath and Oregon Western Cascades Provinces. Most of the LSOG forest loss on federal land was from reserves and almost 90 percent of those losses were associated with wildfire. Less than 0.5 percent of the LSOG habitat loss on federal lands was associated with timber harvesting. The 2011 monitoring report concluded that the risk of loss of LSOG habitat to wildfire will continue to be a critical consideration for policies affecting LSOG forests (Moeur et al. 2011).

The proposed LMP amendments and off-site mitigation actions incorporated into the Proposed Action (see section 2.1.4 of this EIS) are consistent with the findings in the 2011 LSOG forest monitoring report. The LMP amendments have been designed to increase the overall acres of LSOG habitat within LSRs in each of the provinces affected (see table 4.1.3.7-15 and figure 4.1-43). The off-site mitigation measures (see table 4.1.3.7-16) have been designed to both reduce the risk of loss of LSOG forest to wildfire and enhance the creation and maintenance of LSOG habitat in LSRs. The proposed LMP amendments and off-site mitigation actions have been designed with the goal that the overall impact of the Pacific Connector pipeline would be neutral or beneficial to the creation and maintenance of LSOG habitat within LSRs.

Summary of LMP Amendments Related to MAMU and Off-site Mitigation Actions at the Province Level

In addition to the NWFP monitoring module for LSOG forests, the monitoring program also includes a module that assesses status and trends in MAMU populations and nesting habitat to answer the key questions: "Are the MAMU populations associated with the NWFP Plan area stable, increasing, or decreasing?" and "Is the NWFP maintaining and restoring MAMU nesting habitat?" (Mulder et al. 1999).

The monitoring for MAMU is also based on the same provinces as the LSOG forest monitoring as well as MAMU zones. There are two zones based on distance from the coast. In Oregon, Zone 1 extends approximately 35 miles inland. Zone 2, which extends approximately 12 miles farther, is defined for survey purposes and was not included in the monitoring report for Oregon and California (Raphael et al. 2011). Figure 4.1-44 is a map of the provinces and zones for MAMUs.

All of the occupied MAMU stands that would be affected by the Pacific Connector pipeline are located on BLM lands (12 stands in the Coos Bay District and 4 stands in the Roseburg District). Most of the stands (14 of the 16) are within Zone 1 and the Oregon Coast Range Province. Two of the stands in the Roseburg District fall within MAMU Zone 2 and the Oregon Klamath Province. Table 4.1.3.7-17 and figure 4.1-45 summarize the total amount of LSOG habitat that would be affected by the Pacific Connector Pipeline Project in occupied MAMU stands and the amount of LSOG habitat that would be reallocated to LSRs in the nearby vicinity by Province.

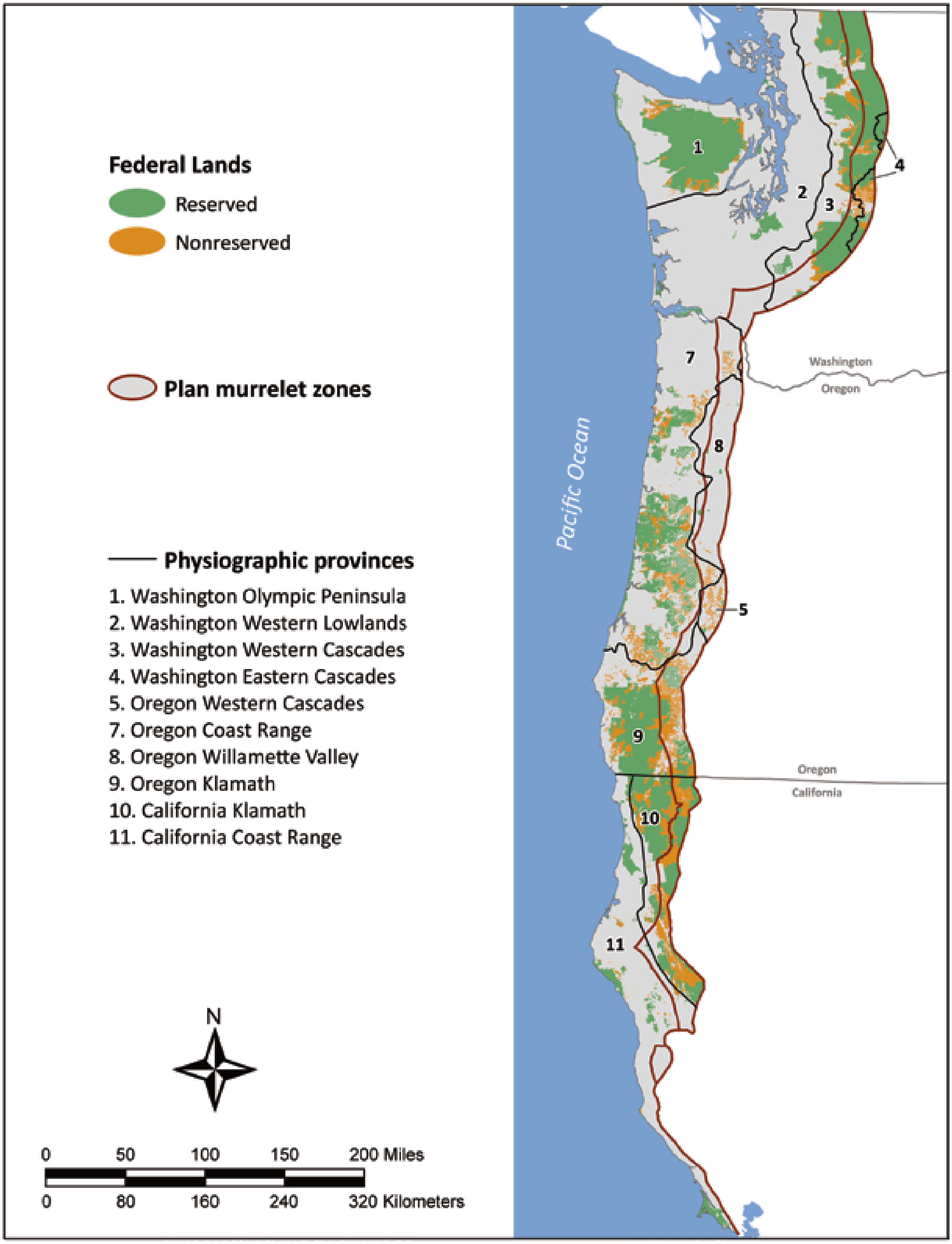


Figure 4.1-44. Map of Physiographic Provinces and MAMU Zones

TABLE 4.1.3.7-17

Comparison of Total LSOG Habitat Acres in Occupied Marbled Murrelet Stands Impacted a/ by the Pacific Connector Gas Pipeline Project and Acres of LSOG Habitat in the Matrix to LSR Reallocation by Province

Province	Acres Cleared	Acres Modified	Acres Indirect Effects	Total Effects	Matrix to LSR Reallocation
Oregon Coast	16	3	163	182	101
Oregon Klamath	3	2	34	39	286
Total	**19**	**5**	**197**	**221**	**387**

a/ Pacific Connector Pipeline Project impacts include (direct effects) cleared acres (corridor and TEWAs) and modified acres (UCSAs), and (indirect effects) 100 meters on each side of the cleared corridor edge in LSOG.
Data Source: BLM, FS, GIS Layers

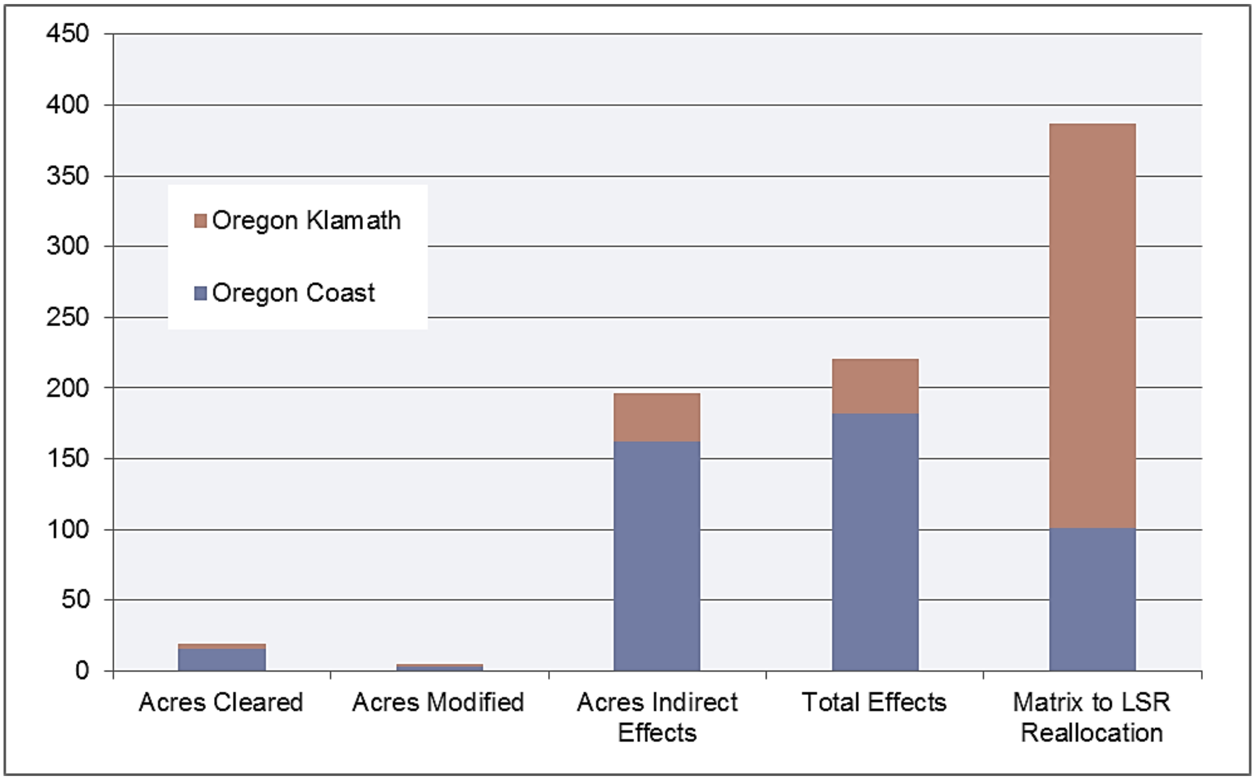


Figure 4.1-45. Comparison of Total LSOG Habitat Acres in Occupied MAMU Stands Affected by the Pacific Connector Pipeline Project and Acres of LSOG Habitat in the Matrix to LSR Reallocation by Province

Approximately two-thirds of the higher suitability nesting habitat for MAMU within the NWFP area occurs on federal lands. Almost 90 percent of that habitat on federal land is protected under various reserve allocations. Based on monitoring data, the rate of loss of higher suitability habitat on reserved lands has been about 3.0 percent over the 10-year period from 1996 to 2006, with most of the loss due to wildfire, especially in Oregon. In the Oregon Coast Range Province, the loss of higher suitability habitat in federal reserves over the same period was approximately 2.4 percent (Raphael et al. 2011). The 2011 MAMU monitoring report found that fire was the major cause of loss of nesting habitat on federal lands since the LMP was implemented and that MAMU population size is strongly and positively correlated with the amount of nesting habitat, suggesting that conservation of remaining nesting habitat and restoration of currently unsuitable habitat is key to MAMU recovery (Raphael et al. 2011).

The proposed LMP amendments and off-site mitigation actions proposed by the BLM are consistent with the findings in the 2011 MAMU monitoring report. The LMP amendments have been designed to increase the overall acres of LSOG habitat within LSRs and a portion of the Matrix to LSR reallocation is in an area that contains a high concentration of occupied MAMU stands. The 387 acres of Matrix proposed for reallocation to LSR 261 on the Coos Bay District is all within MAMU Zone 1 and in the immediate vicinity of the occupied MAMU stands that would be affected by the Pacific Connector pipeline (see figure 4.1-12 above). The total amount of acres proposed for designation to mapped LSR 261 on the Coos Bay District is about 998 acres, with a large portion of this area (approximately 611 acres) containing occupied MAMU stands. Although this MAMU habitat is currently protected by the management direction in the Coos Bay RMP, designating it as part of LSR 261 would provide additional protections and benefits for MAMU. The additional protection would result from the area being protected, not just because of the existing MAMU occupation but as a land allocation dedicated to the management of late-successional habitat. The additional benefits would result from the surrounding non-habitat areas being managed in the future to become LSOG habitat, thereby consolidating larger contiguous blocks of nesting habitat over time. This is consistent with the findings in the 2011 MAMU monitoring report of the need to protect existing nesting habitat and restore currently non-suitable habitat. The off-site mitigation actions (see section 2.1.4 of this EIS) have been designed to reduce the risk of loss of LSOG forest in occupied MAMU stands from wildfires. This is also consistent with the findings in the 2011 monitoring report that wildfire has been the major cause of the loss of nesting habitat since the NWFP was implemented.

Off-site Mitigation Actions and the Aquatic Conservation Strategy

The Pacific Connector Pipeline Project would cross 19 fifth-field watersheds on BLM and NFS lands. Sixteen of these watersheds are within the NWFP area and have federal lands that are subject to the ACS. A detailed analysis of consistency with the ACS for the Pacific Connector pipeline in each watershed is addressed in section 4.1.3.5 and in appendix J. Off-site mitigation measures that are a part of the proposed action (see table 2.1.4.3-1 for a complete list of actions) would help ensure that watershed function would be maintained or restored during construction and operation of the Pacific Connector pipeline as required by the ACS. These measures and how they address the nine ACS objectives are also considered in detail in section 4.1.3.5 and in appendix J. A number of these off-site mitigation actions have been designed to restore or improve aquatic conditions within Riparian Reserves. Proposed off-site mitigation actions that would occur within Riparian Reserves include:

- Approximately 85 miles of road decommissioning, of which approximately 14 miles are within Riparian Reserves. Decommissioning roads can substantially reduce sediment delivery to streams (Madej 2000; Keppeler et al. 2007). Proposed road decommissioning would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Pacific Connector pipeline would occur.
- Approximately 57 miles of road resurfacing, of which approximately 21 miles are within Riparian Reserves. Road surfacing reduces sediment by capping existing fine textured sediments in the running surface of a gravel road with coarser rock or by paving. Paving

all but eliminates traffic-generated sediments. Drainage repair reestablishes out-sloping, cross-drains and in some cases ditchlines to ditch-relief culverts. These actions have the effect of getting water off the road before it can enter streamcourses.

- Approximately 28 miles of instream LWD projects. Placement of LWD in streams adds structural complexity to aquatic systems by creating pools and riffles, trapping fine sediments, and can contribute to reductions in stream temperatures over time (Tippery et al. 2010).
- Thirteen fish passage culverts. Old culverts may block fish passage either by poor design or by failure over time. Removing these blockages and replacing them with fish-friendly designs can allow fish to access previously unavailable habitat.

The Pacific Connector Pipeline Project would impact approximately 5.2 miles of Riparian Reserve. A comparison of the miles of Riparian Reserves that would be impacted by the Pacific Connector pipeline and the miles of off-site mitigation actions within Riparian Reserves is displayed in table 4.1.3.7-18 and figure 4.1-46.

TABLE 4.1.3.7-18

Summary of Miles of Riparian Reserves Impacted by the Pacific Connector Pipeline Project and Proposed Off-site Mitigation Actions in Riparian Reserves on BLM and Forest Service Lands

BLM/Forest Service Management Unit	Riparian Reserves Impacted (miles)	LWD Placement in Streams (miles)	Road Decommissioning (miles)	Road Surfacing (miles) a/	Fish Passage Improvements (sites)	Other Treatments
Coos Bay District	1.6	8.6	0	3.6	0	
Roseburg District	0.4	5.0	0	3.5	5	Culvert replacement (2 sites)
Medford District	1.6	12.1	1.4	14.0	1	Road Storm-proofing
Lakeview District	0.1	0	0.2 b/	0	0	Riparian Vegetation (6 miles), Culvert Replacement (1 site)
Umpqua National Forest	0.8	0	0.5	0	7	Road Storm-proofing
Rogue River National Forest	0.2	1.5	6.7	0	0	Stream Crossing Repair (32 sites),
Winema National Forest	0.5	1.0	5.2	0	0	Riparian Planting (0.5 miles), Stream Crossing Repair (26 sites)
Totals	**5.2**	**28.2**	**14.0**	**21.1**	**14**	

a/ Estimate of miles based on number of stream intersects and a 600 ft. Riparian Reserve width.
b/ This is a road closure project.
Data source: BLM, Forest Service GIS Layers

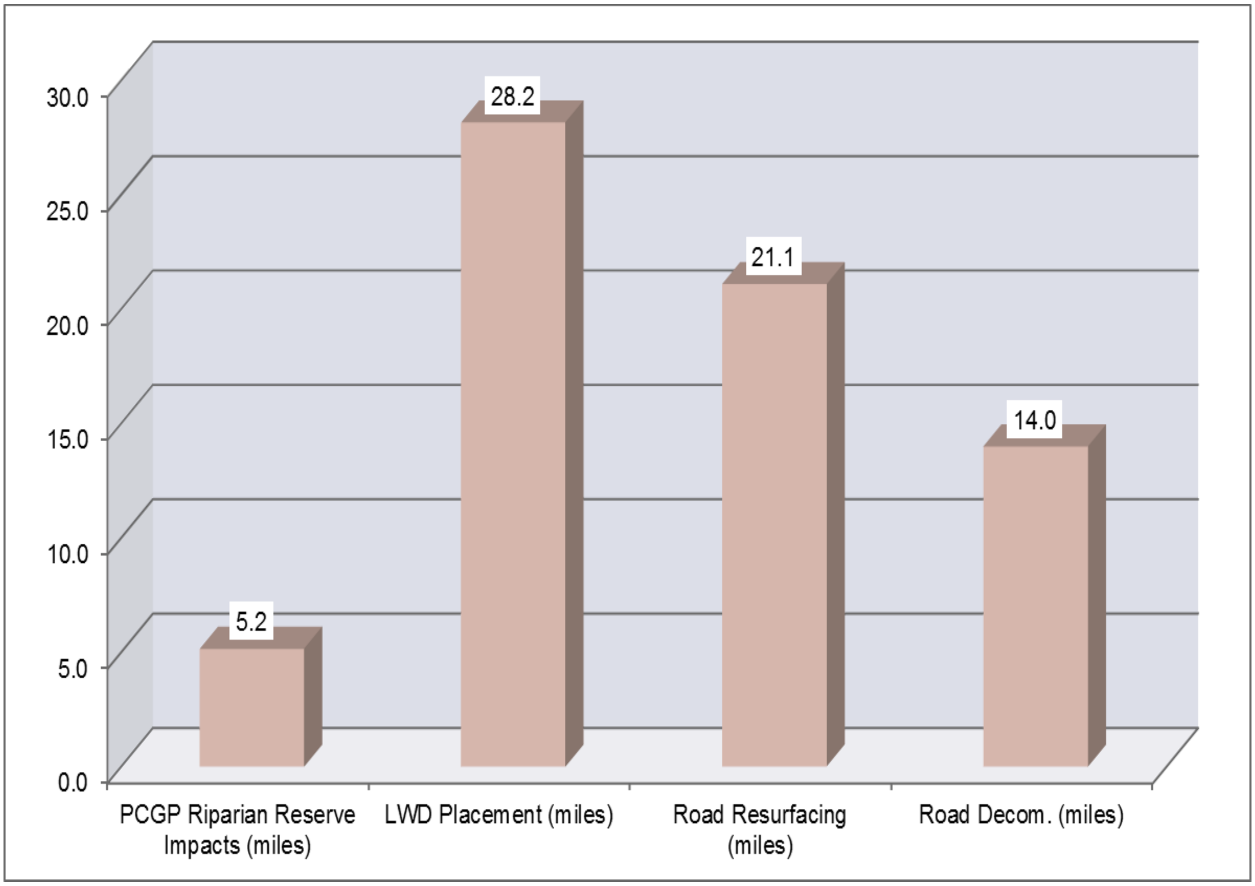


Figure 4.1-46. Comparison of Miles of Riparian Reserve Impacted by the Pacific Connector Pipeline Project and the Miles of Proposed Off-site Mitigation Actions within Riparian Reserves

The proposed mitigation actions would restore or improve approximately 12 miles of Riparian Reserves for every mile of Riparian Reserve that would be impacted by the Pacific Connector pipeline. With the proposed off-site mitigation actions and the on-site mitigation designed to minimize impacts to aquatic systems, watershed conditions on the affected BLM and Forest Service lands would be maintained or improved.

4.1.3.8 Connectivity/Diversity Blocks on BLM Lands

Within the Coos Bay District and Roseburg District BLM, Matrix lands are further segregated into General Forest Management Areas and Connectivity/Diversity Blocks. General Forest Management Areas are managed for multiple uses including commodity production. Connectivity/Diversity Blocks are managed to provide for habitat connectivity for old-growth dependent and associated species within the General Forest Management Area. Connectivity/Diversity Blocks are managed to maintain a minimum of 25 percent of each block in late successional condition both long term and short term. Late-successional stands within Riparian Reserves and other allocations contribute toward this percentage (BLM 1995b: 22; BLM 1995d: 152). Table 4.1.3.8-1 shows Connectivity/Diversity Blocks crossed by the Pacific Connector Pipeline Project on the Coos Bay and Roseburg Districts, BLM. Although the Pacific Connector pipeline would remove LSOG forest in all but one of the Connectivity/Diversity Blocks, table 4.1.3.8-1 shows that none of the blocks fall below the 25 percent LSOG threshold established in the RMPs. There are no Connectivity/Diversity Blocks crossed on the Medford District or in the Klamath Falls Resource Area of the Lakeview District.

TABLE 4.1.3.8-1

Connectivity/Diversity Blocks Crossed by the Pacific Connector Pipeline Project, Coos Bay and Roseburg Districts, BLM

Milepost a/	BLM District	BLM Block No.	Acres b/	Acres > 80 Years of Age	Acres > 80 Years of Age Removed by ROW	Resulting Acres > 80 Years of Age	Resulting % Acres > 80 Years of Age
33.7-39.15	Coos Bay	CB-1	2,975	1,759	3	1,756	59.0
53.12-54.41	Roseburg	1	621	489	1	488	78.6
60.89-61.63	Roseburg	3	219	219	3	216	98.6
82.7-83.3	Roseburg	11	1,146	807	4	803	70.0
79.7-80.7	Roseburg	12	883	383	4	379	42.9
87.0-87.5	Roseburg	38	639	224	1	223	35.0
93.6-93.9	Roseburg	39	319	224	0	224	70.0

a/ Mileposts are approximate, may include private lands, and may not be continuous.
b/ Acres of late successional and old-growth (LSOG) forest in Coos Bay Block 1 are from the Big Creek Watershed Assessment (BLM 1995b: 97). Acres of LSOG in Roseburg Blocks are from GIS analysis in appendix R of this EIS.

4.2 GEOLOGICAL RESOURCES

The following section describes geological resources and potential impacts related to the various aspects of the Project, including the Jordan Cove LNG terminal and the Pacific Connector pipeline and associated facilities.

4.2.1 Jordan Cove LNG Terminal

4.2.1.1 Geologic Setting

The Jordan Cove LNG terminal would be within a parcel of currently vacant industrial zoned land that historically was part of the Henderson Ranch, but was known as the Ingram Yard when owned by the Menasha and Weyerhaeuser companies. The South Dunes Power Plant would be within a parcel that was historically part of the Jordan Ranch, and later was the site of a mill operated by the Menasha and Weyerhaeuser companies between 1961 and 2003. The mill complex has been dismantled. The geological settings for the LNG terminal, connecting utility corridor, and power plant are generally the same; on the bay side of the North Spit of Coos Bay.

The Jordan Cove LNG terminal is situated within the Pacific Border geomorphic province. The terminal would be located at the western edge of the coastal headlands of the central Coast Range, on the North Spit of Coos Bay, which marks the southern edge of the Coos Dune Sheet. A dune sheet is a dune field that is partially anchored by vegetation.

The terminal site is at the eastern edge of the CSZ, the active convergent plate boundary between the subducting Explorer, Juan de Fuca, and Gorda Plates and the overriding North America Plate. The tectonic regime has dominated the geologic evolution of the landscape in the Jordan Cove project area. The converging tectonic plates have resulted in the accretion of marine deltaic sediments and volcanic seamounts, referred to as the Siletzia terrane, to the western edge of the North American Plate (Heller and Ryberg 1983). Sediments derived from the ancestral Klamath Mountains became lithified into the bedrock units at the site (Beaulieu and Hughes 1975).

The LNG terminal site is underlain by loose to dense fill and a relatively clean fine grained sand which is in turn underlain by a weathered sandstone. Fill depths are typically 10 to 15 feet at the Ingram Yard and up to 25 feet at the mill site. The clean fine grained sand is a dune sand of Holocene and Pleistocene age (Peterson et al. 2005) with thicknesses of over 100 feet.

Bedrock underlies these sands and includes Eocene marine interbedded siltstones and sandstones of the Coaledo Formation (Baldwin et al. 1973). The upper member of the Coaledo Formation is composed of gray, coarse to fine-grained weathered, very dense, weakly cemented sandstone with silt and minor amounts of coal. Weathered sandstone is generally encountered beneath the dune sands to a depth of about 125 feet (GRI Geotechnical and Environmental Consultants [GRI] 2007a). The upper Coaledo Formation also underlies alluvial deposits in the Kentuck Slough.

Jordan Cove completed 11 deep borings GRI (2007a) at the location of the LNG storage tanks. These subsurface explorations identified sand extending to depths of 124 to 133 feet. Organic debris, shell fragments, and scattered wood were encountered at some of the borings at various depths within the sand. A 4-foot-thick layer of wood debris interpreted as a buried log was encountered at 35.5 feet in one of the borings. When encountered, the sandstone extended to maximum depths explored (ranging from 146.5 to 200.3 feet). Scattered wood debris was encountered at a depth of 129 feet in one boring. Scattered low-grade coal was encountered below a depth of 155 feet in one boring (GRI 2007a). Organic mill waste was encountered in the fill at the ground surface at the Ingram Yard and also in several landfills in the vicinity of the mill site. A Black & Veatch report dated May 2, 2014, summarizes additional geotechnical subsurface investigations performed in 2012 and 2013 at the Jordan Cove site.

Jordan Cove conducted an overwater geophysical seismic reflection survey between the LNG terminal site and the Southwest Oregon Regional Airport located on the east side of Coos Bay navigation channel. The subsurface profile is shallow bedrock, which becomes progressively deeper toward Pony Slough (southeast of the airport), to a depth of approximately 150 feet below the bay floor (GRI 2007a).

Impacts to surface geology would be limited primarily to the construction phase of the LNG terminal, when the topographic features at specific locations on the site would be altered. Construction site preparation would require clearing and grading of the site to an approximate elevation of +30 feet in the LNG storage tank area and approximately +46 feet in the process areas. Individual excavations would be made for equipment foundations. Following completion of foundations, the site would be filled, compacted, and brought up to final grade. Final grading and landscaping would consist of gravel surfaced areas, asphalt surfaced areas, concrete paved surfaces, grass areas, and construction of the storm surge barrier.

Grading of the areas to be occupied by the terminal facilities would entail approximately 2.5 mcy of cut and fill. Any material remaining from that work, including final grading and landscaping, would be used to raise the elevation of the South Dunes Power Plant site and the access/utility corridor. No blasting would be required during any phase of construction of the LNG terminal because the entire site consists of unconsolidated material. Any shoreline areas disturbed by construction would be armored to protect against erosion or shifting beyond the Jordan Cove Project design limits. Construction of the slip and access channel would change the surface geology of the site as a result of excavation and dredging. See sections 2.1.1.3 and 2.1.1.12 of this EIS for additional discussion of dredging and dredged material disposal.

4.2.1.2 Mineral Resources

In 2008, the principal mineral production of Oregon in order of value was crushed stone, construction sand and gravel, Portland cement, diatomite, and crude perlite (USGS 2008). Crushed stone and construction sand and gravel continued to account for 73 percent of Oregon's total non-fuel mineral production value of $398 million.

Mineral resources available in Coos County, Oregon, include chromium, gold, clay, manganese, sand and gravel, silica, stone, and titanium. There are 11 producing mines within 5 miles of the LNG terminal. The closest mines are 1.3 miles to the southeast (a sand and gravel pit at the airport), and 1.5 miles to the northeast (Coos-Sand Corp.; silica, sand and gravel) (USGS 2004a, 2004b).

Coal was mined historically in Coos Bay, starting in 1855 until the early decades of the twentieth century. There were probably 40 coal mines in the field, with total production estimated at about 3 million tons by 1944 (Mason and Erwin 1955). Henry Haines was said to have discovered a coal mine at Glasgow in the late 1850s, but soon abandoned it (Dodge 1898). The closest major productive coal mine was known as the Libby, which operated until about 1920, located south of city of Coos Bay at the head of Coalbank Slough.

Based on studies of coal and natural gas resources in the Coos Bay area completed in the 1970s and 1980s (Newton 1980; Mason and Hughes 1975), coal may occur at depths within or below sandstone at the site. Natural gas may also occur at depth within the underlying sandstone. Initial exploratory tests (Sproule Associates, Inc. 2004, 2005, 2006) indicate a promising but unproven coal gas resource in the Coaledo coals of the basin. This prospect carries risk commensurate with an exploration play and could require several years to reach commerciality. Gas in place in Coos Bay is estimated to be 1,166 Bcf. The majority of the gas (93 percent) is held in the Lower Coaledo coals. There are no coal mines within 150 feet of the LNG terminal, and there are no operating oil and gas wells in proximity to the LNG terminal.

Construction and operation of the LNG terminal would not affect any known mineral resources or the recovery of any mineral resources. Nor would development of the site have any impacts on future oil and gas exploration or production elsewhere in the county.

4.2.1.3 Seismic-Related Hazards

Commenters expressed concerns over faults, ground shaking, and tsunamis associated with the CSZ. These issues are discussed in detail in the following paragraphs. Jordan Cove would be required to design the LNG terminal facilities to resist stringent natural hazard design conditions including earthquakes and tsunamis.

The primary geologic hazard for the LNG terminal is the CSZ, which can generate strong horizontal and vertical ground motions and tsunami waves. At its nearest point, the CSZ is located 13 kilometers (km) (8.0 miles) from the site. Over the past 170 years, the Coos Bay area has experienced moderate to low seismic activity within the active CSZ (Wong 2005). There have been no recent earthquakes of magnitudes greater than 3.0 on the Richter scale within a 50-km (31-mile) radius of the site. However, numerous earthquakes of magnitude 4.0 or greater have been historically recorded in or near western Oregon. An earthquake off the coast of Crescent City, California (275 km or 170 miles away) in 2005 with an estimated magnitude 7.0 and one off the coast of Newport, Oregon (105 km or 65 miles away) in 2004 with an magnitude of 4.9 were felt near the site (GRI 2013a). Geological evidence suggests that large megathrust earthquakes have also occurred along the CSZ during the Holocene epoch, prior to the written historical record.

Commenters have asked that the USGS paper 1661, which evaluates the repeatability of large earthquakes along the CSZ, be taken into consideration. This information has been incorporated into the 2014 USGS National Seismic Hazard maps that were released July 15, 2014. These maps indicate the probabilistic ground motion accelerations predicted at the Jordan Cove site have not increased significantly (less than 5 percent) compared to those provided in the 2008 USGS National Seismic Hazard maps.

Infrequent, but potentially large, earthquakes occur when the offshore boundary (the CSZ) between the Juan de Fuca and North American plates ruptures suddenly. Researchers believe that the last major earthquake occurred on January 26, 1700, and produced a tsunami that was recorded in Japan (Clague et al. 2000; Satake et al. 1996). This offshore earthquake is estimated to have been a magnitude 9.0 event. In addition to intense, long-duration ground shaking, these earthquakes resulted in up to about 3 feet of vertical ground subsidence locally along Oregon coastal areas near the offshore fault rupture zone (Peterson et al. 1997; Leonard et al. 2004). They can also result in coastal subsidence and tsunamis that can impact low-lying coastal areas.

Geological studies indicate that megathrust earthquakes have occurred numerous times in pre-history (Nelson et al. 2006). The recurrence interval between megathrust events has been irregular and ranges from about 100 to 1,000 years (Atwater and Hemphill-Haley 1997). Typical recurrence intervals are thought to be on the order of 400 to 600 years (Clague et al. 2000). Recent work by Goldfinger et al. (2012) suggests that while the average recurrence interval for full-margin Cascadia events is 520 years, the southern Cascadia margin has a repeat time of 220 years.

Another seismic source significant to the Jordan Cove site is the Blanco Transform Fault Zone. The Blanco Transform Fault Zone is an ocean transform fault related to the movement of tectonic plates that begins about 100 miles off of Cape Blanco (approximately 25 miles south of Coos Bay) and extends in a northwest direction to about 300 miles off of Newport, Oregon. During the past 40 years, approximately 1,500 earthquakes of magnitude 4.0 or greater and many thousands of smaller earthquakes have occurred along this fault zone. Only the largest of these earthquakes are detectable by land-based seismographs along the Oregon coast. The risk of a major tsunami from an earthquake in the Blanco Transform Fault Zone is low because the tectonic plates slip laterally with little vertical displacement of the ocean floor (Zhang 2008).

Through consultation with DOGAMI, 11 faults located within 150 km (93 miles) of the LNG terminal were treated as individual seismic sources in the seismic hazard model in the Site-Specific Seismic Hazard Study (GRI 2014). The 3 closest faults are the CSZ (13 km or 8 miles), the South Slough (16 km or 10 miles), and the Coquille Anticline (30 km or 18.6 miles). There are 3 faults within 67 km (41.6 miles) of the site, and 5 within 133 km (82.6 miles) of the site. The CSZ, a megathrust fault, has the greatest potential maximum moment magnitude (Mw) of 8.3 to 9.0. The estimated maximum potential Mw of the other faults range from 6.3 to 7.7 (GRI 2014).

Briggs (1994) indicated the possibility of a Holocene-active fault located in Pony Slough, immediately southeast of the LNG terminal site. However, the seismic reflection profile obtained specifically for the Jordan Cove terminal did not indicate the presence of a fault either at Pony Slough or across the bay from the Jordan Cove terminal (GRI 2013b; Madin 2006).

As further discussed below, Jordan Cove would design and construct its facilities in a manner that takes geological conditions into consideration. This includes implementing site-specific measures during site preparation and construction of structural foundations that are capable of resisting severe earthquake ground motions and associated ground deformations.

Soil Liquefaction and Lateral Spreading

Loose to medium dense sands and some softer, low-plasticity, fine-grained soils (such as sandy silts) can experience increased pore water pressure during an earthquake if saturated and subject to cyclic shear stresses of a sufficient magnitude and duration. Under certain conditions, the material would lose most of its shear strength and deform as a viscous fluid (complete liquefaction). Lateral spreading involves lateral displacement of large, surficial blocks of soil as a result of liquefaction of a saturated surface layer and can develop in gentle slopes and move toward a free face, such as a river channel. Displacement occurs in response to the combination of gravitational forces and inertial forces generated by an earthquake. Where a free face exists, the loose saturated fill soils encountered at depths of about 10 to 25 feet may be susceptible to lateral spreading.

The majority of the sandy soils encountered below the fill at the LNG terminal site are dense enough to resist liquefaction during design-level earthquakes. Analyses indicate the potential for liquefaction in a relatively consistent zone below the water table in the upper 15 feet of the soil profile corresponding to historical fill. Liquefaction is also predicted at depths ranging from 25 to 45 feet in zones that do not appear to be continuous across the site. Of these liquefiable zones, the majority of the predicted liquefaction would occur at depths of 30 to 40 feet (Black & Veatch 2014). Based on the liquefaction analysis performed by B&V, the existing soils at the Jordan Cove site have the potential to experience liquefaction settlements for a Safe Shutdown Earthquake event range between 0.4 and 7.4 inches depending on location, with the largest settlements occurring at the shoreline. Lateral spreading displacements for existing soils at LNG terminal site range between 0 and 39 inches depending on location again with large settlements occurring at the shoreline. Lateral spreading displacements for existing soils at the South Dunes Power Plant site range between 0.8 and 19 inches depending on location if subjected Safe Shutdown Earthquake level ground motions (Black & Veatch 2014) with the largest settlements occurring at the shoreline.

We received comments on the DEIS on soil liquefaction at the LNG terminal and South Dunes site. Liquefaction/lateral spread mitigation would consist of ground improvement by vibro-compaction using on-site sand. The goal of vibro-compaction is to densify the in-place sand by imparting vibrations to the ground using a downhole vibrator (vibroflot). The vibroflot is jetted to the depth of interest using water and/or air and then clean sand flows from shallow to greater depths, and the sand is compacted. As the vibroflot is withdrawn further compaction is performed, and sand is typically placed at the ground surface to supply material to flow down around the vibroflot.

Vibro-compaction would be implemented using regular 7-foot by 7-foot and 9-foot by 9-foot patterns. The 7-foot by 7-foot pattern is planned for areas where Seismic Category I structures are located at the LNG terminal site, while for areas where Seismic Category II and III structures are located a 9-foot by 9-foot pattern is planned. Vibro-compaction is planned to the bottom of the liquefiable soils, which is at approximately elevation -30 feet at the LNG terminal site, and elevation -20 feet at the South Dunes Power Plant site and along the utility corridor.

Following ground improvement, testing consisting of cone penetrometer soundings would be performed to confirm the required soil consistency was achieved. To provide adequate structure support, ground improvement for liquefaction mitigation would extend a distance of approximately 30 feet from the outside edge of foundations. Similar to the other facilities on the North Spit, the risk of liquefaction at the Highway 101–Trans-Pacific Parkway interchange site is most significant to depths of about 25 feet, and denser materials were encountered below this depth. In addition, the existing Highway 101–Trans-Pacific Parkway intersection embankments are susceptible to lateral spreading displacements during a design-level earthquake. The proposed improvements at the Highway 101–Trans-Pacific Parkway intersection would be constructed to meet the Oregon Department of Transportation (ODOT) seismic design requirements considering liquefaction and lateral spreading.

The explorations completed at the Kentuck Slough wetland mitigation site encountered soft and loose alluvial soils to depths of about 100 feet in some areas. The loose sand and low plasticity silts encountered are susceptible to liquefaction. The higher plasticity silts and clays encountered are not liquefiable. As no permanent facilities are proposed at the mitigation site, there would be no appreciable impacts from liquefaction at that site.

Subsidence

Modeling of megathrust earthquake ruptures on the CSZ indicates sequences of interseismic uplift and coseismic coastal subsidence. The predictions for coastal subsidence are locally constrained by features such as submerged trees and buried intertidal marshes interpreted to be associated with the 1700 CSZ earthquake. This repeated coastal subsidence pattern has been documented along the length of the CSZ (Atwater et al. 1995; Clague 1997; Goldfinger 2003). Leonard et al. (2004) presents profiles of coastal deformations from Northern California to Southern Canada based on this geologic information. The subsidence information indicates the largest coastal subsidence of 3 to 6 feet occurred in Northern Oregon and Southern Washington with subsidence ranging from 0 to 3 feet elsewhere. Leonard et al. (2004) estimated an average of 2 feet of coseismic subsidence occurred in this area during the 1700 earthquake. Leonard et al. (2004) also estimated the coseismic subsidence in the Coos Bay areas would range from 0 to about 5 feet during a future 8 to 9 magnitude megathrust earthquake located along this portion of the CSZ.

Subsidence estimates for the area have been updated as part of the recent tsunami modeling completed for the southern Oregon coast (Witter et al. 2011) and site-specific modeling completed for the Jordan Cove Project (CHE 2013a). These studies indicate the maximum subsidence at the LNG terminal project site for the specified Design Tsunami Earthquake event occurring on the CSZ is on the order of 7.6 feet.[36]

Tsunami Hazards

The west coast of the United States has historically been subject to minor inundation from tsunamis generated by distant earthquakes in South America, Alaska, and Japan. Kelsey et al. (2005) noted that tsunamis generated from these distant subduction zone earthquakes have minor inundation effects because of the long diagonal approach of tsunami waves to the west coast from these sources. Based on this explanation, observations made around the Indian Ocean following the 2004 megathrust Sumatran earthquake, and recent modeling (DOGAMI 2012a) indicate a tsunami generated by a megathrust earthquake on the CSZ would present the greatest tsunami inundation risk at the LNG terminal site.

The impacts and hazards of tsunamis to an industrialized area were well illustrated during the 2011 Tohoku, Japan, earthquake. This tsunami was generated by an offshore subduction zone earthquake; subsidence occurred and increased the tsunami impacts significantly in some areas. Because similar earthquake and subsidence are of concern off of the Oregon coast, the lessons learned from this earthquake regarding subsidence, runup, scour, and foundation performance, provide a useful case history for evaluating hazards at the LNG terminal site.

[36] Provided in Jordan Cove's 2nd Supplemental Response to the FERC staff's Environmental Information Request dated August 9, 2013, filed with the FERC on October 1, 2013.

DOGAMI produced tsunami hazard maps for a tsunami generated by a megathrust earthquake on the CSZ for most of the Oregon coast in 1995 (Priest 1995), 2002 (Priest et al. 2002), and in 2012 (DOGAMI 2012a). All studies include runup scenarios that vary wave height and coseismic subsidence. The 1995 and 2012 maps are included in the site-specific seismic hazard study conducted by GRI (Zhang 2012; CHE 2013a).

Witter et al. (2011) recommend utilizing the most likely tsunami scenario (M1) or the large splay fault scenario (L1), which encompasses 80 to 95 percent of the hazard, for land use planning and future revisions to the building code along the Oregon coast. For the Jordan Cove Project, a tsunami modeling study was performed (CHE 2013a) for the same seismic source event as was used to determine the Safe Shutdown Earthquake hazard (which has a 2,475-year return period). Predictions concerning the amount of sea level change along the Oregon coast vary; sea level is predicted to decrease in some areas on the coast, primarily due to tectonic rise along the coast (CHE 2014). A National Research Council report (2012) concluded that "for the Washington, Oregon, and California coasts north of Cape Mendocino, sea level is projected to rise 24 inches over the next century." This sea level rise is countered by an estimated tectonic uplift of from about 6 to 20 inches along the coast over the next 100 years. Therefore, sea level change was not used as a factor in the tsunami modeling study. The results of the study, provided below, indicate that the LNG terminal facilities, including protective tsunami berms, are at elevations that exceed the design-level tsunami run-up levels.

The Kentuck Slough wetland mitigation site is frequently underwater during wet portions of the year, and the 2012 DOGAMI mapping confirms it is located within the estimated tsunami inundation zone. As no permanent facilities are proposed at the mitigation site, there would be no appreciable impacts from tsunami inundation at the Kentuck Slough wetland mitigation site. The existing Highway 101–Trans-Pacific Parkway interchange is also located in the tsunami inundation zone.

Given the uncertainty associated with tsunami hazards at the LNG terminal site, Jordan Cove has included in its design barriers surrounding the LNG storage tanks. The LNG storage tanks would be located within an area enclosed by a tsunami barrier with a peak crest elevation of +60 feet and base elevation of the LNG storage tanks would be at elevation +30 feet. The barrier is proposed to be constructed of compacted, dense sand. In the event that it is determined through consultation with DOGAMI, that a more robust interior barrier core is required, cement treated sands would be considered for barrier construction. The design-level tsunami is based on a 2,475-year return period event (including tidal effects, subsidence, and a 1.3 increase factor to account for modeling uncertainties), which has a peak run-up elevation of +32.6 feet (this effective elevation value includes +7.6 feet of co-seismic subsidence). A 2,475-year return period event is same event that is used to determine the Safe Shutdown Earthquake motion used for the design of the most critical LNG facilities. The tsunami barrier also serves as a containment basin that has sufficient volume to contain the contents of one 160,000 m^3 LNG storage tank. The barrier and the elevation of the LNG storage tanks, as well as the minimum +46 feet elevation for all LNG terminal process facilities, including the South Dunes Power Plant, have been designed to meet the recently revised state guidelines for protection from anticipated storm surges and tsunami inundation. The elevation of the access corridor and the South Dunes Power Plant would be raised to about +46 feet, which is above the design-level tsunami run-up elevation. The extent of potential wave action from a tsunami on the western tsunami berm is considered minimal due to the relative elevations of the maximum wave heights in relation to the berm protection height.

For the berm slopes subject to the design-level tsunami, erosion control measures and wave runup protection would be used. Slopes would be protected against tsunami runup using cement treatment, concrete cellular mattresses, grout-injected geotextile fabric mattresses (fabriform), or other suitable means as determined during detailed design. The erosion control measures would be designed in accordance with the ODOT Erosion Control Manual, where applicable.

Jordan Cove's tsunami model assumes that structures (e.g., jetties, barriers, dunes) would remain immobile throughout the tsunami event. Design of the barrier wall considers the effects of tsunami waves, including scour and deposition in the path of the scenario tsunamis, flow velocities, any highly probable impact loads from potential floating objects including adrift vessels and barges, breaking waves, prolonged inundation, and the effects of tectonic subsidence (prolonged changes in tidal elevation inherent in the earthquake source scenarios used for tsunami generation).

Based upon the Jordan Cove tsunami study performed for the Project, the first tsunami wave would arrive at the beach approximately 20 minutes after the a major CSZ earthquake occurs. It would reach the Jordan Cove LNG terminal location about 5 minutes later. Maximum inundation near the site would occur about 40 minutes after the earthquake, and the second tsunami wave would arrive about 55 minutes after the earthquake, and would compound on the retreating water from the first wave in some places. The third wave would arrive about 72 minutes after the earthquake, but would be substantially smaller than the first two. The model predicts that modifying the landscape for the LNG terminal would result in slightly smaller waves and less water spilling into the Henderson Marsh. Construction of the slip would result in some localized wave patterns. According to geologists researching tsunami hazards in southern Oregon (including Dr. George Priest), the most critical work to ensure public safety related to tsunamis is to provide accurate maps of the tsunami danger zone and educate the public on what to do when they feel a big earthquake (The Oregonian 2008). The major shaking from the earthquake would be the clearest warning of an approaching tsunami.

We received comments regarding concerns over potential tsunami impacts on LNG vessels at the terminal. There are two tsunami scenarios to address. The first scenario would be a distant earthquake event in Alaska or Japan that would result in a tsunami with a relatively long lead time (12 to 24 hours) before reaching the Oregon Coast. Coast Guard policies would prohibit ships from entering Coos Bay until after the tsunami arrival period. All ships in Coos Bay, including the LNG vessel, would be directed to depart the harbor. LNG vessels at the terminal would face the bay and would be manned with the power on when berthed. Therefore, the LNG vessels could depart quickly from the Jordan Cove terminal in the event of a distant tsunami and in response to notice and instructions from the Coast Guard.

The second scenario involves a large earthquake capable of generating a tsunami from the nearby CSZ. It is calculated that it would take approximately 20 to 25 minutes for a large tsunami generated from the CSZ to reach Coos Bay after the earthquake event occurs, which would provide time for LNG vessels to disconnect from the berth and to reconnect with the tug boats. The tethered LNG vessel and the three tug boats would hold their position under power to offset the advancing wave and currents. The tsunami wave is predicted to impact the bow of the ship head on. If the LNG vessel is traversing the channel during the tsunami, the tugs would also provide assistance as described above. The Emergency Planning and Response Team for Jordan Cove, which comprises numerous agencies, including the Coast Guard, ODE, Oregon Fire Marshall, Oregon Marine Board, police and sheriff departments, fire departments, and Jordan Cove experts, has reviewed and approved the LNG vessel procedures for dealing with a potential tsunami.

Another commenter stated that the area west of the terminal is low lying and could be swamped by a potential tsunami wave. The area west by northwest of the Jordan Cove terminal and parallel to the shoreline is a high dune that provides considerable protection from a direct tsunami wave inundation. A commenter indicated concerns that the predicted tsunami wave height may not be accurate, and therefore the LNG terminal would be at risk from inundation by a potential tsunami wave. State-of-the-art hydrodynamic modeling studies have been performed for an earthquake on the CSZ with a return period of 2,475 years. As indicated above, this is the same return period criteria used to define the Safe Shutdown Earthquake, which is used for the design of critical LNG facilities. These studies predict that the maximum elevation of a potential tsunami wave at the location of Jordan Cove's LNG terminal would be +32.6 feet (this elevation includes +7.6 feet for co-seismic subsidence) and includes a 1.3 factor to account for modeling uncertainties. The crest elevation of the berm surrounding the LNG storage tanks at the terminal would be +60 feet, and the grade elevation of the liquefaction processing area at the terminal would be +46 feet. Therefore, Jordan Cove's LNG terminal would be protected and should be able to safely handle the design tsunami event.

A comparison was made by a commenter to the 2011 Tohoku earthquake in Japan. The most likely cause of tsunamis at the Jordan Cove site would be earthquakes caused by vertical offsets along the CSZ, which are of the same type of offsets that triggered the tsunamis from the 2011 Tohoku earthquake. The offsets selected for determining the design tsunami are consistent with the maximum considered earthquake magnitudes predicted for the CSZ by the USGS and the associated vertical offsets predicted by DOGAMI. The tsunami generated by 2011 Tokohu earthquake did cause damage to one LNG terminal in Japan (the Minato Gas Plant). The low-lying LNG terminal is located in Sendai and was not well protected from tsunami inundation. Even though it was subjected to inundation depths of 4 meters, there was no damage to the LNG tanks, no release of LNG or any safety hazard was reported as result of the tsunami. However, there was operational damage to piping, buildings, pipe supports, and electrical systems and it took a year to bring the plant back into service. Based on observations, the Japanese recommend the LNG plants be either be elevated above tsunami elevation levels or be protected adequately by berms. The Jordan Cove LNG terminal would be both elevated and well protected by tsunami berms. We therefore conclude that the site-specific tsunami studies, coupled with Jordan Cove's proposed mitigation measures, indicate that the site is not unsuitable because of tsunami hazards.

Volcanic Hazards

The terminal site is over 100 miles west of the nearest volcanic hazard area. Although a future eruption of the Mt. Mazama volcano is possible, the terminal site would not be directly affected by the various types of volcanic eruption hazards at this distance (USGS 1997). It is noted that volcanic ash clouds can affect the atmosphere over much larger areas, but such clouds would not impact the terminal infrastructure.

4.2.1.4 Site-Specific Geotechnical Investigation and Seismic Hazard Analysis

Geotechnical Site Characterization

The LNG terminal site is relatively flat and ranges in elevation from +20 feet to +50 feet. Groundwater levels range between 9 and 13 feet below the ground surface. A number of geotechnical investigations were performed at the site between 2005 and 2014 and are summarized in table 4.2.1.4-1. The results of a previous investigation at the site performed in 1997 were also used.

TABLE 4.2.1.4-1

Summary of Geotechnical Investigations for the Jordan Cove Project

Year Borings Performed	Company	Appendix	Borings (number)	CPTs (number)	Notes
1997	GRI	D	B-1 through B-6 (6)	None	GRI Report (2007a,b, 2013a,b)
2005	GRI	A	B-7 through B-17 (11)	C-7, C-8, and C-13 (3)	GRI Report (2007a,b, 2013a,b)
2005	GRI	B	B-4, B-5, B-6 (3)	C-2, C-20, C-24, C-25, C-26 (5)	GRI Report (2007a,b, 2013a,b)
2005	GRI	C	B-1 through B-8 (8)	None	Data Only
2006	Insitu-Tech.	E	Five Borings for Pressuremeter Testing (5)	None	GRI Report (2007a,b, 2013a,b)
2012	GRI	J.2	B-1 through B-12 (12)	None	Power Plant Area, Data Report Only (Nov. 2012)
2013	GRI / Black & Veatch	6.16-1	BVV-101 through BVB-162 (71)	BVS-101 through BVS 156 (55)	GRI Report (2014), Data Only
		Total:	**116**	**63**	

CPT – cone penetration test

A total of 116 borings were drilled at the site to depths ranging from 30 feet to 296.5 feet. In addition, the investigations included 63 cone penetration tests to depths ranging from 24 feet to 78.6 feet, pressure-meter tests, 17 test pits to depths of 12.5 feet, shear wave velocity measurements to depths of 296 feet, piezometers, infiltration tests, and a pump test.

Based on subsurface investigations performed by GRI (2013b, 2014), the subsurface of the Jordan Cove LNG terminal site is typically mantled with relatively clean, fine-grained sand to the maximum depth of 296 ft explored. Boring data indicate that the upper 10 to 15 feet of the sand deposit is loose to medium dense fill with standard penetration blow counts ranging from less than 5 to 20. In some areas, the thickness of the fill soils is as much as 25 feet. However, the transition to the underlying dune sand was indiscernible based on visual observation. The sand typically contains a trace of silt and is brown near the ground surface and transitions to gray below depths of 27 to 50 feet. Below the fill, the sand ranges from medium dense to very dense with standard penetrometer test blow counts ranging from 20 to 50+ or refusal. Some logs characterize the very dense sand below a depth of 125 feet as weathered sandstone, while other logs characterize the same material as very dense sand, weakly cemented. Isolated zones of shells, organic material, coal seams are present within the profile. Below a depth of about 15 feet, the cone tip resistance ranges from about 100 tons per square foot to more than 300 tons per square foot.

Liquefaction analyses performed by GRI have identified two potential zones where limited liquefaction may occur at the site: (1) saturated sand between the depths of 10 and 15 feet below ground surface (bgs) corresponding to historical fill and (2) discontinuous sand lenses between depths of 25 feet and 45 feet. Estimated liquefaction settlements of the existing unimproved LNG terminal site ranged between 0.4 and 7.6 inches depending on location, with the largest settlement occurring at the shoreline.

The measured shear velocity (V_s), in feet per second (fps), of the soil profile was as follows:

- 0 to 35 feet bgs V_s = 650 fps
- 35 to 75 feet bgs V_s = 750 fps
- 75 to 115 feet bgs V_s = 1050 fps
- 115-180 feet bgs V_s = 1500 fps
- 180-250 feet bgs V_s = 2000 fps
- Below 250 bgs V_s = 2900 fps

The average shear wave velocity in the upper 100 feet of the soil profile is about 750 fps. This shear wave velocity along with the observation that the soil profile is very dense sand characterizes the area as Site Classification D in accordance with the provisions of the 2009 IBC (2010 Oregon Structural Specialty Code) and ASCE 7-05.

Controlling Seismic Events

Based on deaggregation of seismic sources from the GRI Probabilistic Seismic Hazard Analysis (PSHA), the controlling seismic source is a megathrust earthquake occurring on the CSZ. The Jordan Cove LNG terminal is located 13 km (8.0 miles) from the CSZ at its nearest point. In its PSHA, GRI has considered two different scenario events for the CSZ megathrust earthquake. These are a megathrust earthquake with a moment magnitude of 8.3 and a megathrust earthquake with a moment magnitude of 9.0. Both scenario events are given an equal weighting in the PSHA. The CSZ also is the controlling seismic source for tsunamis, which is a significant hazard for the site.

Design Ground Motions

Design ground motions for the terminal site were determined based on site-specific seismic hazard analysis prepared for the LNG terminal by GRI in accordance with requirements of NFPA 59A-2006 and the 2010 Oregon Structural Specialty Code (2009 IBC). The design ground motions for the LNG terminal recommended by GRI are as follows:

- The site-specific Maximum Considered Earthquake (MCE) ground motion parameters based on site response analysis are S_{MS} = 1.50g and S_{M1} = 1.50g. The site-specific MCE peak horizontal ground acceleration based on site response analysis is 0.48g.
- The site-specific Design Earthquake (DE) ground motion parameters adjusted for site effects (which are two-thirds of the MCE value adjusted for site effects) are S_{DS} = 1.00g and S_{D1} = 1.00g. The site-specific DE peak horizontal ground acceleration is 0.32g.
- The Operating Basis Earthquake (OBE) was taken as the earthquake ground motion having a probability of exceedance of 10 percent in 50 years (Return Period = 475 years). The GRI-recommended site-specific OBE design ground motion response spectra at the ground's surface has a peak horizontal ground acceleration (i.e., zero period acceleration) based on site response analysis of 0.27g. The peak site-specific vertical OBE design surface acceleration is 0.30g.

- The Safe Shutdown Earthquake (SSE) was taken by GRI as equal to an earthquake motion that has a probability of exceedance of 2 percent in 50 years (Return Period = 2,475 years), in accordance with NFPA-59A-2006. The GRI-recommended site-specific SSE design ground motion response spectra has an SSE peak horizontal ground acceleration at the ground surface of 0.48g. The vertical SSE design ground motion has a peak vertical ground surface acceleration of 0.53g. The GRI site-specific hazard analysis satisfied the ground motion criteria provided in NFPA 59A-2006.

Proposed/Necessary Site Improvements

The LNG terminal site would undergo extensive earthwork. Some commenters expressed concern that the facility would not be founded on stable ground. This concern is addressed below in the following paragraphs.

The cut and fill for the LNG terminal is largely balanced for the movements of the materials from the LNG slip, the leveling of the LNG terminal site, and placement on the South Dunes Power Plant site (see table 4.2.1.4-2). However, approximately 60,000 cy of sand materials would be transported via trucks from the LNG terminal site to the Kentuck Slough wetland mitigation site for creation of the estuarine wetland. This fill is necessary to establish the appropriate vertical profile to establish tidelands influenced habitat once the dike protecting the existing Kentuck golf course is breached. For additional information regarding the Kentuck Slough wetland mitigation site, see discussion in sections 2.1.1.12 and 4.4.3 of this EIS.

TABLE 4.2.1.4-2

Cut/Fill Quantities

Area	Cut (CY)	Fill (CY)
LNG Storage Tank and Storm Barrier area	None	1,500,000
Liquefaction Process Area	1,100,000	440,000
Marine Slip – Land-based excavation	2,300,000	520,000
Marine Slip – Dredging	1,500,000	1,500,000
Access Channel – Dredging	1,300,000	0
Removal of Earthen Berm Between Slip and Channel – Dredging	500,000	0
Access Road /Utility Corridor	5,000	90,000
Kentuck Slough Filling	0	60,000
Southwest Oregon Regional Safety Center Filling	0	245,000
South Dunes Power Plant Filling – from Slip via Trucks and Slurry Line	0	3,500,000
TOTAL	**6,755,000**	**6,755,000**

The LNG storage tanks would be supported on mat foundations. Buildings, process equipment, and pipe rack foundations would be supported with drilled pier foundations, spread footings, or mats. GRI has recommended that where mat foundations are used, the shallow upper zone of the site soils be improved to mitigate the potential for seismic soil liquefaction. Where necessary, Jordan Cove is currently proposing to utilize dynamic compaction and/or roller recompaction to improve the shallow zones and compaction grouting for the deeper zones. Final design decisions for foundation improvements would be done during detailed engineering and submitted to the FERC for review prior to permitting construction to proceed.

Proposed Foundation Design

The grade elevation in the LNG storage tank area is currently proposed to be +30 feet. The existing grade in this area is about elevation 20 feet; therefore, about 10 feet of compacted fill would be placed to achieve the finished grade in the tank area. Significant cuts of up to 15 to 20 feet would be required in the liquefaction process area. The tsunami barrier would be designed to contain the contents of one 160,000 m^3 LNG storage tank. The barrier and the elevation of the LNG storage tanks, as well as the minimum +46 feet elevation for all LNG terminal process facilities, including the South Dunes Power Plant, have been designed to meet the recently revised state guidelines for protection from anticipated storm surges and tsunami inundation. The elevation of the access corridor and the South Dunes Power Plant would also be raised to about +46 feet. The new slip would be created from an existing upland area. The inside dimensions at the toe of the slope of the slip measure approximately 800 feet along the north boundary and approximately 1,500 feet and 1,200 feet along the western and eastern boundaries, respectively. The minimum water depth within the slip is -45 feet NAVD88. The northern side slope is anticipated to be initially constructed at 3H:1V, and the top of the slope is proposed at elevation +25 feet NAVD88. The eastern side of the slip would be used for an LNG berth, and the northern end would be used for a tractor tug dock (figure 1.1-1).

The LNG tank structures would be supported on a mat foundation, which would be base isolated with a Friction Pendulum bearing system. The base isolators would be located between concrete slabs with a thickness of about 2.6 feet each. The top of the lower concrete slab would be founded at about elevation +30 feet. Buildings, process equipment, and pipe rack foundations would be supported with drilled pier foundations, spread footings or mats founded on improved subgrade. Conditions are provided and included as part of this FEIS that assure that final foundation designs would satisfy both the FERC Seismic Guidelines and the 2010 Oregon Structural Safety Specialty Code.

The design of the facility is currently at the FEED level of completion. Jordan Cove has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the terminal if the Project is authorized by the Commission. Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Further, the timing of the production of this information should occur as indicated below. Therefore, **we recommend that:**

- **<u>Prior to commencing final design of the LNG terminal</u>, Jordan Cove should file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following:**

  a. final geotechnical investigations necessary to support all final foundation designs in satisfying the criteria stated in the application and subsequent data request responses. These investigations would include how the identified potential zones of liquefaction at the terminal site would be mitigated and the details of the liquefaction mitigation method(s), procedures, plan extent, and verification methods proposed to verify mitigation of liquefaction potential;

b. detailed calculations of seismic slope stability and lateral movements anticipated after the liquefaction mitigation is implemented to verify the stability of critical structures for the LNG terminal design earthquake motions;

c. final foundation design recommendations, including foundation design and/or liquefaction mitigation measures for all structures including the LNG storage tanks;

d. final Seismic Design Criteria for all Seismic Design Category I and II structures, systems, and components that satisfy the criteria stated in the application and subsequent data request responses;

e. a final list of Seismic Category assignments for all structures, systems, and components; and

f. final Quality Control and Quality Assurance procedures to be used for design.

- **<u>Prior to commencing with procurement, fabrication, or construction of the LNG terminal</u>, Jordan Cove should file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following information:**

a. final seismic specifications to be used in conjunction with the procuring Seismic Design Category I and II equipment;

b. site preparation drawings and specifications;

c. final and construction documents (drawings, calculations, specifications, etc.) for Seismic Category I and II structures, systems and components including the LNG tanks and Seismic Isolation Design Review Report; and

d. final Quality Control and Quality Assurance procedures to be used for procurement, fabrication and construction.

The Seismic Isolation system for the LNG storage tanks should comply with the design, analysis, and testing requirements of Chapter 17 of ASCE 7-05 and the additional requirements below. Peer Review of the design should be performed as required by Chapter 17. Calculations, testing and design documents that demonstrate that the requirements of Chapter 17 were satisfied have not yet been filed by Jordan Cove. Therefore, **we recommend that:**

- **<u>Prior to commencing final design of the LNG storage tanks</u>, Jordan Cove should file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the following information:**

a. non-linear response history analysis of the LNG tank and isolation system. The analysis would simultaneously include all three components of ground motion. The response spectra of the time history vertical component of motion envelope the site-specific vertical design response spectra developed for the Project facilities. The horizontal components should be rotated so that one of the components for each set of motions is the maximum component of response at the isolated period of the tank and isolation system;

b. non-linear analyses for both maximum and minimum design liquid levels of the LNG tanks;

c. **separate non-linear analysis to account for variations of design stiffness, minimum values of friction, and other properties as required by Sections 17.5 and 17.2.4.1 of ASCE 7-05; and**

d. **documentation that the lateral displacement capacity of the seismic isolation bearings is not less than 24 inches.**

Because we recognize the project area is located in an area of high seismicity, our regulations in 18 CFR 380.12(h)(5)[37] recommend that a special inspector be contracted by Jordan Cove to observe the work performed to ensure the quality and performance of the seismic resisting systems. Jordan Cove did not indicate in their submittals that a special inspector would be employed by them to observe construction of the facilities. Therefore, **we recommend that:**

- **Prior to construction, Jordan Cove should file with the Secretary documentation that it would employ a special inspector during construction to perform duties described in Section 6 of NBSIR84-2833, Data Requirements for the Seismic Review of LNG Facilities.**

4.2.2 Pacific Connector Pipeline

The pipeline would be constructed by conventional cross-country techniques as described in section 2.4.2.1. Typical pipeline trench depth would range from 6 to 10 feet, although it would be deeper at stream crossings with scour concerns or areas with geological hazards. In Class 1 areas with normal soils, the pipeline would have 36 inches of cover, and 24 inches of cover in Class 1 areas with consolidated rock. Excavation of the trench would encounter a range of soil and rock materials. Special construction methods for crossing rugged terrain were also previously discussed in section 2.4.2.2.

The proposed route would cross a wide variety of terrain and geological conditions. The proposed route was evaluated for seismic, landslide, erosion and scour, mine, and volcanic hazards that may potentially occur across or near the alignment and that could adversely affect the pipeline. In addition, an evaluation was made of the potential impact that pipeline construction and operation could have on the natural geological environment and geological processes in the pipeline vicinity. During route planning, Pacific Connector identified and attempted to avoid geological resource areas and hazards.

Pacific Connector selected the proposed route with input from agencies, stakeholders, and land managers/owners to avoid areas with high risk of geological hazards. The initial proposed route was changed in numerous locations to avoid high hazard areas as more detailed data were collected. During construction, Pacific Connector would implement site-specific construction techniques and BMPs to mitigate local geological hazards that could not be completely avoided. The following sections discuss these hazards and how they would be mitigated.

4.2.2.1 Surface and Bedrock Geology

The proposed route crosses four main physiographic provinces west to east: the Coast Range, Klamath Mountains, Cascade Range, and Basin and Range. The proposed route begins within the Klamath Basin, which is part of the larger Basin and Range physiographic province of the

[37] NBSIR84-2833, Data Requirements for the Seismic Review of LNG Facilities

Great Basin; an area characterized by ridges and valleys that are separated by faulting (Burns 1998). The route would then head westward over the High Cascades sub-province, a chain of geologically active volcanoes with high andesitic peaks, and the Western Cascades sub-province, an ancestral range of deeply eroded (extinct) volcanoes. The proposed route then passes through the Klamath Mountains physiographic province, which consists of several complex geological terrains composed of metamorphosed and fractured volcanic and marine sedimentary rocks. The proposed route would proceed over the Coast Range physiographic province, an area underlain by estuarine and alluvial deposits in lowland areas and sedimentary rocks in the uplands, and terminate at the Oregon Coast. Between the mountain ranges are several valleys, predominantly filled with recent alluvial materials. Some of the major river valleys and their tributaries crossed by the proposed route heading west to east include the Coquille River Valley, Umpqua River Valley, Rogue River Valley, and Klamath River Valley (see section 4.4 of this EIS for more information about waterbodies).

The pipeline alignment is located within varying soil and lithologic units ranging from soft sediments to hard granite and basaltic rock. Unconsolidated silt, sand, and cobbles occur locally in streambeds, alluvial fans, and valley floodplains in all four physiographic provinces. Detailed descriptions of geology along the proposed route are included in Table B-1 in Appendix B of the *Geologic Hazards and Mineral Resources Report* (GeoEngineers 2013e) filed with Resource Report 6 of Pacific Connector's application to the FERC. Below is a west to east description of the physiographic provinces crossed by the pipeline.

Coast Range

The proposed route passes through the southernmost part of the Coast Range province for approximately 71 miles (approximately MP 0 to MP 71). The Coast Range is 30 to 60 miles wide and averages 1,500 feet in elevation, although the highest point (Mary's Peak) reaches an altitude of 4,097 feet (Orr and Orr 2000).

The Coast Range is composed of relatively soft marine sedimentary rock units that overlie basalt at depth. The wet conditions of the western slopes of the Coast Range, along with steep terrain composed of relatively weak rock, contribute to an active erosional environment with frequent landslides.

Uplift of the Coast Range deposits has deformed the bedrock units with folds and faults. Coastal uplift of the present Coast Range over the past 10 to 15 million years has been simultaneous with stream incision and coastal erosion and depositional processes. Ocean-cut terraces exist near the shoreline, some of which have been elevated to altitudes of up to 1,600 feet (Orr and Orr 2000). Low-lying areas near the coast are underlain by modern beach deposits, sand dunes, estuarine mud and alluvial sediments.

Klamath Mountains

The proposed route passes through the northeast corner of the Klamath Mountain physiographic province for approximately 49 miles (approximately MP 71 to MP 120). The province has a rugged landscape of high peaks and deep canyons, with a total local relief of 2,000 to 5,000 feet (Baldwin 1964). The highest peak of the Klamath Mountains is Mt. Ashland, at 7,530 feet (Burns 1998). Most of the Klamath Mountain physiographic province is composed of highly deformed volcanic and marine sedimentary rocks, as well as metamorphic terranes. The physiographic province also contains deformed pieces of the oceanic crust and granitic intrusive bodies (Walker and MacLeod 1991). Bedrock is often intensely metamorphosed and fractured.

The proposed route passes through three tectonic geological terranes in the Klamath Mountain segment of the alignment. West to east and youngest to oldest, these terranes are: (1) the Franciscan and Dothan belt; (2) the Western Jurassic terrane; and (3) the Western Paleozoic and Triassic terrane. The alignment crosses through the northernmost part of the Franciscan and Dothan belt, an area composed of turbidite sandstone, mudstone, and chert formed on the continental slope and subsequently scraped off the ocean floor during accretion. East of the Franciscan and Dothan belt, the alignment passes through the northern section of the Western Jurassic terrane, an area composed of volcanic flows and ash altered to greenstone, ophiolite, and metamorphosed ocean sediments, including conglomerate, siltstone, and sandstone. Between the Western Jurassic terrane and the Western Paleozoic and Triassic terrane, the alignment crosses the White Rock pluton (a large body of intrusive igneous rock that solidified within the crust). The Western Paleozoic and Triassic terrane is composed of metamorphosed pieces of ocean crust (ophiolites) and metamorphosed ocean-island basalt (Orr and Orr 2000).

Cascade Range

Approximately 60 miles (approximately MP 120 to MP 190) of the route crosses Oregon's southern Cascade Range. The Cascades consist of two north-south trending mountain chains: (1) the older, more weathered Western Cascades; and (2) the younger, higher-elevation High Cascades. The Western Cascades drain westward and reach altitudes of 5,800 feet. The southern High Cascades drain toward the east and the west and reach altitudes of up to 9,493 feet at the summit of Mt. McLoughlin (USGS 2006).

Precipitation of 60 to 100 inches annually on the western side of the Cascades results in extreme weathering of bedrock and soil deposits and larger rivers (Orr and Orr 2000). Both the Western Cascades and the High Cascades consist primarily of volcanoes formed as a result of the subduction of the Juan de Fuca oceanic plate beneath the North American continental plate. The Western Cascades terrain consists of deeply dissected volcanoes that formed between about 42 and 8 to 10 million years ago (USGS 2006). The volcanoes of the High Cascades began erupting about 5 million years ago. As the High Cascades volcanoes erupted, their magma chambers emptied and collapsed, creating calderas (large craters). Crater Lake, north of the pipeline alignment in Klamath County, is one of these calderas. During the Quaternary, andesitic cones formed the range's notable high peaks.

After the formation of the high-altitude andesitic peaks, volcanic activity in the High Cascades has continued intermittently to the present. Minor volcanic vents manifest near the pipeline alignment. These include Brown Mountain, which is a Quaternary-aged volcano situated about 3 miles north of the proposed route near MP 167.

Repeated glaciation of the High Cascades during the Pleistocene Epoch produced glacial U-shaped valleys, cirques, and jagged mountain ridges. No active glaciers exist along or near the pipeline alignment.

Basin and Range

Approximately 35 miles (approximately MP 190 to MP 225) of the easternmost portion of the proposed route passes through the southwestern corner of the Basin and Range province in Oregon, a geographic area named the Klamath Basin. The Basin and Range province contains the Upper Klamath Lake and Lower Klamath Lake National Wildlife Refuge, which, unlike the rest of the province, drain to the Pacific Ocean via the Klamath River.

The Basin and Range is a complex series of alternating uplifted mountain blocks (horsts) and down-dropped basins (grabens). These mountain ranges and valleys are separated by generally north-south trending normal (extensional) faults. The altitude of the Basin and Range province is generally over 4,000 feet, and the summit of Steens Mountain in southeast Oregon reaches 9,670 feet.

Crustal extension is responsible for development of the Basin and Range physiographic province. The extension occurred in two phases, the first of which happened between 20 and 10 million years ago and produced widespread volcanic activity resulting in thousands of feet of basaltic flows and tuffs. The second phase of extension occurred in the last 10 million years and produced the distinct horst and graben block faulted topography.

The low precipitation and runoff rates east of the Cascades restrict the amount of erosional debris that can be transported from watersheds. As a result, sediment has accumulated in the basins, in thicknesses greater than 1,000 feet in some places. Eroded material is deposited in alluvial fans and channels around the margins of the basins and as marsh and lake deposits in the lower elevations. During the wetter and cooler periods of the ice ages, the basins were occupied by much larger lakes; at maximum extent, Pluvial Lake Modoc extended over the pipeline alignment from Klamath Marsh, north of Upper Klamath Lake, to the Tule Lake basin in northern California (Orr and Orr 2000).

4.2.2.2 Seismic Setting and Hazards

The proposed route crosses a complex geological area that has developed through extensive crustal deformation and volcanic activity. However, most of the pipeline construction area has experienced very few earthquakes during the period of historical record. Two primary mechanisms for generating earthquakes of design significance exist along the pipeline alignment: (1) a major, regional earthquake associated with the CSZ; and (2) local earthquakes associated with a seismic hot spot near Klamath Falls.

Geological maps of the pipeline area show many faults that cross the pipeline alignment or are located near the pipeline corridor (Walker and MacLeod 1991). With the exception of the Klamath Falls area, these mapped surface faults are not considered active and are not believed to be capable of renewed movement or earthquake generation (USGS 2002).

With the exception of the Klamath Falls area, historical earthquake activity has been generally quiet in the areas crossed by the pipeline. A total of 492 earthquakes have been recorded within 100 miles of the proposed route (Pacific Northwest Seismograph Network 2006). The majority of these were low magnitude; specifically, 52 percent were less than magnitude 4.0 and 94 percent were less than magnitude 5.0 (table 4.2.2.2-1).

TABLE 4.2.2.2-1

Historical Earthquakes within 100 Miles of the Proposed Pacific Connector Pipeline a/

Magnitude Range b/	Number of Earthquakes	Epicenter Distance From Alignment (miles)
3.0 to 3.99	306	5 to 100
4.0 to 4.99	163	3 to 99
5.0 to 5.99	19	8 to 100
6.0 to 6.99	4	9 to 74
7.0 to 7.99	1	82

a/ Earthquake catalog data from the USGS Earthquake (Comcat) Search (January 1, 2006, to August 28, 2013), Pacific Northwest Seismograph Network (2006) and the Earthquake Database for Oregon, 1833 to 1993 (Johnson et. al. 1994).
b/ Earthquakes with less than magnitude 3.0 are termed micro-earthquakes and are not usually felt (Reiter 1990). Earthquakes of magnitude 5.0 and greater are generally considered to have engineering significance.

Major historical earthquakes near the proposed route include two events in 1873: (1) an estimated magnitude 7.0 earthquake at the southwestern tip of Oregon; and (2) a magnitude 6.3 earthquake near Coos Bay. In addition, a magnitude 6.0 event occurred in 1938 approximately 75 miles south of Coos Bay. On September 21, 1993, two earthquakes occurred within about 2 hours with epicenters located about 15 miles northwest of Klamath Falls: a magnitude 5.9 event followed by a magnitude 6.0 earthquake (Yelin et al. 1994).

Many earthquakes of magnitude 2.0 and larger have occurred during historical times in the Klamath Falls area. Most earthquake epicenters are clustered northwest of Klamath Falls, near the southwest shoreline of Upper Klamath Lake. Epicenters of these earthquakes are typically at depths of about 3 to 5 miles. These events seem to be associated geographically with the boundary between the Basin and Range province and the Cascade Range province. The earthquake clusters also may be associated with volcanic activity (Cole and Bugni 1993).

The primary seismic hazards to pipelines include potential strong ground shaking, surface fault rupture, soil liquefaction (and related lateral spreading), earthquake-induced landslides, and regional ground subsidence. The degree of risk from these hazards varies and depends on several factors, including the magnitude (or size) of the earthquake, the distance of the earthquake origin from the pipeline facilities (lateral and vertical), soil/rock conditions, and slope angle of the ground.

Empirical reviews of historical earthquakes demonstrate that welded steel pipelines are not prone to failure due to earthquakes. A 1996 study of earthquake performance data for steel transmission lines and distribution supply lines operated by Southern California Gas over a 61-year period found that post-1945 arc-welded transmission pipelines in good repair have never experienced a break or leak during a southern California earthquake and are the most resistant type of piping, vulnerable only to very large and abrupt ground displacement (e.g., severe landslides), and are generally highly resistant to traveling ground wave effects and moderate amounts of permanent deformation (O'Rourke and Palmer 1994).

In addition to ground shaking, subsidence and ground rupture from seismic activity, tsunamis can be generated by strong ground motions associated with offshore earthquakes or submarine landslides. Coastal areas of Oregon, including Coos Bay, could experience the effects of tsunamis. The portion of the pipeline near the LNG terminal occurs in the relatively sheltered areas of Coos Bay, where the effects of a tsunami on the pipeline would be expected to be relatively minor (GeoEngineers 2013e).

Seismic hazards for the pipeline were evaluated by reviewing available historical data, by researching geological evidence of prehistoric earthquakes for the Pacific Northwest, and by qualitatively evaluating the potential risk to the pipeline along the overland sections of the alignment. Quantitative evaluation of the potential for liquefaction, lateral spreading, and tsunami inundation was accomplished for the Coos Bay crossing, where liquefaction and lateral spreading hazard were identified during the initial assessment.

Regional Seismicity

Recent research indicates that a major Cascadia earthquake affected coastal areas of the Pacific Northwest on January 26, 1700 (Satake 1996; Clague et al. 2000). This offshore earthquake is estimated to have been a magnitude 9.0 event. In addition to strong ground motion and long shaking duration, large Cascadia-type earthquakes can also result in coastal subsidence and tsunamis that can impact low-lying coastal areas. Geologic studies indicate that Cascadia-type earthquakes have occurred numerous times in pre-history (Nelson et al. 1996). The recurrence interval between Cascadia events has been irregular and ranges from about 100 to 1,000 years (Atwater and Hemphill-Haley 1997). Typical recurrence intervals are thought to be on the order of 400 to 600 years (Clague et al. 2000).

If a Cascadia-type earthquake occurred during the operating life of the pipeline, the ground shaking and possible ground subsidence would be strongest in the Coast Range province and in low-lying areas near Coos Bay. Although ground shaking would likely be felt throughout the length of the pipeline from a Cascadia event, hazards would diminish in the eastward direction, with increasing distance from the offshore epicenter. Regional ground subsidence would likely not pose a risk to the pipeline. Documented subsidence zones associated with the 1960 subduction zone earthquake in Chile (Plafker and Savage 1970) indicate subsidence on the order of 3 to 6 feet vertically distributed over a wide trough of approximately 60 miles. The resultant strain accrual on a welded steel pipeline distributed over that length of pipe is not considered significant.

Ground Shaking and Peak Horizontal Ground Acceleration

Using the historical seismicity record and the available data on Quaternary faults in the United States, the USGS (2009a) has produced probabilistic seismic hazard mapping for the United States in general, and for the region that would be crossed by the pipeline in particular. This mapping has generally been used to address two risk levels: (1) a 10 percent probability of exceedance in 50 years (475-year return period); and (2) a 2 percent probability of exceedance in 50 years (2,475-year return period). The output from the seismic hazard mapping includes estimates of the peak ground acceleration (PGA) and spectral accelerations for 0.2 and 1.0 second structural periods. The PGA values are given in percentages, or decimal fractions, of the acceleration of gravity (g). The acceleration resulting from gravitational forces (g) is defined as 32 feet/second^2. PGAs for the Pacific Connector Pipeline Project were calculated for the specific 475-year and 2,475-year return periods for each corresponding milepost interval of the pipeline alignment (GeoEngineers 2013e).

The 10 percent probability of exceedance in 50 years (475-year return period) is defined by the ASCE Technical Council on Lifeline Earthquake Engineering as the contingency design earthquake for pipeline design (ASCE 1984). The highest 475-year return period PGAs expected along the pipeline alignment are about 25 percent (MP 1.5 to 4.12R) of gravity. The University of Washington (2001) noted that these intensities are moderate and relate Instrumental Intensity VIII and a "Moderate to Heavy" potential damage to aboveground structures as described by the Modified Mercalli Intensity scale as follows:

> *Steering of cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.* (USGS 1931)

The USGS (1931) indicates that instrumental intensities of IX up to XII are seismic conditions where damage to pipelines may occur. The potential damage to buried pipelines from the ground shaking intensity at the site is, therefore, considered to be low.

Surface Rupture Potential from Faulting

Differential, or shear, movements of fault surfaces can be entirely subsurface, or they can extend to the ground surface as surface fault rupture. The nature of the shear movements at the surface depend on the character of fault movement. In general, surface fault rupture across a pipeline alignment can result in rapid differential ground displacements across the pipe, with displacement magnitudes ranging from a few inches to several feet.

Based on the USGS Faults and Folds Database (USGS 2010) and the DOGAMI geologic mapping (Black and Madin 1995; Personius 2002a; Mertzman et al. 2007; Mertzman 2008; Hladky and Mertzman 2002), the pipeline alignment crosses the following regional Quaternary and Holocene age fault zones:

- Lake of the Woods fault, near MPs 172 to 175;
- The Sky Lakes fault zone, east of Klamath Falls near MPs 174 to 182;
- West Klamath Lake fault zone, near MP 187;
- Lower Klamath Lake section of the Klamath Graben fault system near MPs 204 and 205 (4 crossings); and
- The South Klamath Lake section of the Klamath Graben fault system near MP 213.

The mapped Holocene age fault (defined by the USGS as active within the last 10,000 years) that would be crossed by the pipeline alignment occurs within the South Klamath Lake section of the Klamath Graben fault system, in the vicinity of Klamath Falls near MP 213. Review of USGS data sources (Personius 2002a, 2002b) does not provide potential earthquake magnitude along this fault, but provides other information about slip rate and fault length. Light detection and ranging (LiDAR) imagery of recent alluvial sediments in this area does not show linear features typical of fault movements at the ground surface. Recently acquired color stereo aerial photographs do not show linear features or changes in soil color indicative of fault movement at the ground surface. Pacific Connector has committed to engaging a geotechnical firm to evaluate and design the pipeline crossing (approximate MP 213) of the Klamath Graben Fault system, South Klamath Lake Section. This evaluation would be completed prior to pipeline installation.

Pacific Connector proposes to have the pipeline trenches carefully examined during construction by a qualified professional (following State of Oregon license standards for Professional Geologists and/or Professional Engineers) for evidence of stratigraphic offsets potentially related to ground rupture. If such features are observed, Pacific Connector would implement additional mitigation measures at these locations. Specific unique designs for fault mitigation would be developed at that time, however the intent would be to follow published guidance to estimate the potential amount and direction of fault offsets as well as the magnitude of strain accumulation at the pipe crossing location (Takada et al. 2001; Honegger and Nyman 2004). Such measures could include burying the pipe in a wide trench that was backfilled with loose gravel or sand, which would allow for relatively unrestrained movement of the buried pipe within the zone of fault movement.

Liquefaction Potential

The potential for soil liquefaction from an earthquake is a function of the intensity or strength of the earthquake shaking (high PGA), the duration of strong earthquake shaking, the nature of the soil (it must generally be loose to medium dense and granular such as silt or sand), and groundwater conditions (the soil must be saturated with a shallow groundwater table). In general, liquefaction that results in permanent ground deformation or buoyant displacement of buried pipelines has the potential to result in pipeline damage (O'Rourke and Liu 1999). The evaluation of liquefaction potential is complex and depends on numerous site parameters, including soil grain size, soil density, age of soil deposit, depth and gradient of water table, site geometry, static stresses, and design accelerations.

The potential for liquefaction along the pipeline was evaluated based on topography and soil conditions obtained from geological maps, NRCS soil surveys and, at some sites, limited geotechnical boring data. Liquefaction potential was identified for portions of the proposed route that would be expected to encounter loose to medium dense sandy soils (generally occurring in alluvial valleys or near rivers, streams, sloughs, lakes or other waterbodies). The characteristics were incorporated into a numerical liquefaction analysis used to characterize the potential risk of liquefaction. The numerical analysis was used to confirm liquefaction potential rather than used to predict liquefaction-induced settlement magnitude, which would be accomplished during pipeline design, in process and scheduled for completion during 2015. Based on the numerical analyses, sites that were underlain by strata with a safety factor against liquefaction of less than 1 are shown as having a "High" risk for potential liquefaction. These areas are listed in table 4.2.2.2-2 as having potential for liquefaction and/or lateral spreading. The potential for liquefaction and lateral spreading along the proposed route is characterized as low to high, unknown, or mitigated. Those listed as low potential include sites with subsurface conditions of fine-grained soils that are not susceptible to liquefaction or soils that are not expected to be saturated. Those listed as high potential include sites that are underlain by potentially saturated loose to medium dense granular soils. The unknown potential site is an area of private property where no site-specific subsurface information is available due to lack of access. Sites identified as mitigated include areas where the pipeline would be buried below the liquefiable materials (for protection from scour), or where the pipeline would be installed by HDD and would be beneath the anticipated zone of potential liquefaction or lateral spreading.

TABLE 4.2.2.2-2

Summary of Potential Liquefaction and Lateral Spreading Hazards

From MP	To MP	Feature	Liquefaction Potential/ Lateral Spreading Potential	Ownership
1.47R	2.20R	Haynes Inlet	High/High	Private, State
2.20R	4.20R	Haynes Inlet	High/Low	Private, State
6.20R	6.40R	Kentuck Inlet	High/High	Private, State
8.26R	8.47R	Willanch Slough	High/High	Private, State
11.0R	11.3R	Coos River	High a/	Private, State
10.10	10.40	Stock Slough	Low/Low	Private
10.80	11.40	Catching Slough	Low/Low	Private, State
15.72	15.77	Boone Creek	Low/Low	Private
22.60	23.10	North Fork Coquille River	Low/Low	Private
27.00	27.15	Park Creek (aka Middle Creek)	Low/Low	BLM, Private
29.41	30.20	East Fork Coquille River	Low/Low	Private
48.02	48.40	Deep Creek	Low/Low	County, Private, BLM
49.70	50.45	Middle Fork Coquille River	Low/Low	Private
55.80	56.60	Alluvial Valley	Low/Low	Private
56.90	59.00	Olalla Creek	Low/Low	Private
66.85	67.05	Willis Creek	High/High	Private
68.95	69.80	South Umpqua River #1	High a/	ODOT
88.20	88.65	Days Creek	Low/Low	Private
94.55	94.80	South Umpqua River #2	High a/	Private
122.55	122.75	Rogue River	High a/	Private, State
128.50	128.70	Indian Creek	Unknown b/	Private
132.01	132.14	Neil Creek	Low/Low	Private
191.60	199.00	Klamath Valley	High/Low	Private
199.00	201.00	Klamath River	High a/	Private, State, Reclamation
201.00	214.00	Lost River Valley	Low/Low	Private, State, Reclamation
217.10	218.33	Alluvial valley	Low/Low	Private
221.80	224.40	Alluvial valley	Moderate/Low	Private

a/ A potential for occurrence may exist, but hazard would be mitigated.
b/ Landowner permission to evaluate site was not granted.

Pipeline damage associated with liquefaction typically occurs where a sharp transition exists between liquefiable and non-liquefiable materials. Shear or bending movements at such sharp transitions can damage pipelines. In addition, liquefaction can change the buoyancy forces such that the pipeline may float if not mitigated during design. Mitigation for these conditions can include avoidance by routing around or under the potentially liquefiable materials, by reinforcing the pipe with thicker walls, and/or by weighting the pipe with a concrete coating. Pacific Connector proposes to cross four river crossings (Coos River, Rogue River, Klamath River, and South Umpqua River) using HDD and DP technology in order to minimize the environmental impacts of construction and to install the pipeline below zones of potentially liquefiable soil.

High liquefaction and/or lateral spreading potential were identified at six sites (Haynes Inlet, Kentuck Inlet, Willanch Slough, Willis Creek, Rogue River, and Klamath Valley) along the pipeline route. Pacific Connector would conduct numerical modeling for these sites prior to construction to estimate the magnitude of liquefaction-induced settlement and lateral spreading that would be expected during the design earthquake event. If the numerical modeling indicates that liquefaction settlement and/or lateral spreading would result in excessive pipe stress conditions, as analyzed by Pacific Connector, further mitigation design would be needed. Mitigation options may include deeper burial below the liquefiable soils, thicker pipe and/or weighting the pipe with a concrete coating, if necessary. Potential ground improvement measures would also be considered including vibroflotation, stone columns, compaction grouting, and deep dynamic compaction. Primary geotechnical factors involved in selecting the type of mitigation include: the depth of liquefiable soils, fines content, groundwater depth, the potential for obstructions (i.e., buried logs), and the density of overburden soils over the liquefiable soils.

Even with these measures, it is not possible to completely mitigate the risk of pipeline damage in Coos Bay resulting from lateral spreading during a megathrust seismic event. If such an event should occur and cause a pipeline failure in Coos Bay, the MLVs that would be installed on either side of the bay crossing would need to be shut to stop delivery of gas to the pipeline and isolate the damaged section. The pipeline would be inspected and repairs made to damaged sections of the pipeline as appropriate before the line would be placed back in service.

Liquefaction requires the presence of loose granular soils submerged in water (saturated). Areas along the proposed pipeline that are subject to being under water within the pipeline depth are generally limited to valley floors. The groundwater table is not expected to be encountered within the mountainous terrain. Excavations within the gently sloping valley floors crossed by the pipeline would be limited to the pipeline trench. The pipeline trench backfill is not considered to be of sufficient volume to liquefy during an earthquake. Moreover, the pipeline trench backfill is not expected to be placed in a sufficiently loose state to liquefy. Additionally, trench breakers would be installed in the pipeline trench at regular intervals to prevent the trench from capturing and conveying near surface groundwater.

Lateral Spreading Potential

In addition to settlement or pipeline buoyancy, the possibility exists that liquefaction could result in lateral spreading. Lateral spreading involves lateral displacement of surficial blocks of non-liquefied soil as the underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground is present or near a free face, such as along the banks of rivers, sloughs, canals, or lakes. If liquefaction were to occur within loose to medium dense saturated sand deposits, there would be a high potential for lateral spreading to occur along slopes or near a free face.

Because lateral spreading is associated with liquefaction of soils, the potential for lateral spreading along the pipeline alignment was evaluated based on the same criteria as liquefaction potential. If an area is characterized as having a high liquefaction potential and the topography is sloping or adjacent to a free face, then the potential for lateral spreading to occur as well is high. Lateral spreading can occur on very gentle slopes; therefore, all areas with liquefaction potential also are considered to have potential for lateral spreading. Identified areas of potential lateral spreading include areas of loose saturated fill soils in the North Spit area, the embankments of the existing Highway 101–Trans-Pacific Parkway intersection, and the existing levee fills and river channel in the northern portion of the Project.

Pacific Connector stated it would perform numerical modeling for pipeline locations where soil liquefaction–induced settlement and lateral spreading would be expected during an earthquake prior to final design of the pipeline project. In particular, numerical modeling would be performed for Haynes Inlet, Kentuck Slough, Willanch Slough, Cooston Channel, Willis Creek, Indian Creek, Klamath Valley, and the alluvial valleys between pipeline MPs 221.8 and 224.4 and between MPs 229.0 and 230.9. For any location where the analysis indicates that the pipeline would be subject to stresses during a seismic event, measures would be implemented to prevent damage and protect the pipeline during a seismic event. Pacific Connector would engage a pipeline engineering firm to evaluate specific hazards related to liquefaction and lateral spreading and design protective measures. Ground improvements or other mitigations would be designed to address lateral spreading risk areas.

Seismically Induced Landslides and Rockfalls

Strong ground shaking associated with an earthquake may induce landslide failures at great distances from the earthquake source (Keefer 1984). The potential exists, at least locally along portions of the proposed route, for ground shaking to induce rockfalls, landslides, or soil slumps (USGS 2010, 2002). Potential areas of seismically induced landslides include the mapped existing landslides summarized in Table B-2 of GeoEngineers (2013e) *Geologic Hazards and Mineral Resources Report* from Pacific Connector's application to the FERC.

Areas of potential ground shaking of sufficient intensity to initiate landslides or rockfalls include the areas of greatest seismic activity: the Klamath Falls region (with relatively recent events of magnitudes 5.9 and 6.0) and the Coos Bay region (with the potential for very large, long recurrence interval, megathrust events). The proposed route has been selected to avoid areas with a high potential for landslide and rockfall hazards to the extent practicable.

Landslide Hazards

An initial landslide hazards evaluation was conducted in three phases: initial office review; aerial reconnaissance; and surface reconnaissance. The purpose of the first phase study was to identify existing landslides as well as areas susceptible to landslides within one-quarter mile of the initial alignment by reviewing published maps and digital data (Burns et al. 2011a, 2011b), aerial photographs and LiDAR-generated hillshade models. The purpose of following two phases was to further evaluate only those landslide hazard sites that represent potentially moderate or high risk to the pipeline, based on the results of the previous phase of evaluation. These initial evaluation phases are described in greater detail below. No landslide hazards were identified at the aboveground facility locations.

Landslide Hazard Types and Their Effects on Pipelines

Many types of landslides occur that can affect property and public safety. However, most landslides can be placed in two general categories: (1) shallow-rapid landslides (debris slides/flows) and (2) deep-seated landslides. Shallow-rapid, or rapidly moving, landslides generally originate on very steep slopes, often where no prior indications of movement are present. In the Coast Range, especially in the Tyee formation, recurring debris flows produce debris chutes. These are evident by narrow concave gullies containing activity indicators such as bare rock, soil generation, and vegetation stratification. Fans and coalescing fans (from multiple chute discharges) form plains. Deep-seated landslide movement can occur where no previous movement is evident, but commonly occurs where topographic and vegetative indications of past or chronic slope movements are present.

Rapid-shallow landslides, inclusive of debris slides/avalanches and channelized debris flows, typically originate on very steep and strongly convergent hill slopes variously termed colluvial swales, hollows, or headwalls. Mass-movement of rapid-shallow landslides is typically triggered by large, infrequent storm events. Channel gradient and junction angle strongly influence the effect of the debris flow on the stream channel: scour, transport, or deposition. Related discussion of the assessment and protection for riparian and aquatic environments is provided in section 4.1 of this EIS and in the ACS technical report (appendix J). Deep-seated landslides range in depth from tens to hundreds of feet and can occur anywhere on a hill slope. The larger deep-seated landslide complexes may occupy several square miles of terrain. These features can usually be identified on topographic maps or aerial photos based on distinctive contour or vegetative patterns. Slope movement can vary from rapid to nearly imperceptible, and may entail small to large displacements. The greatest risk of deep-seated landslide movement arises from existing (dormant) features that can reactivate in response to land management practices, seismic activity, stream erosion and/or prolonged periods of precipitation.

Risk is greatest where the direction of slide movement is across (perpendicular to) the pipeline alignment. This typically occurs where the pipeline crosses a slope instead of descending straight down the fall line. Although the greatest risk is where a pipeline crosses a landslide, headward (upslope) expansion of the slide could eventually involve a pipeline located upslope of an active landslide.

Significant strain can develop within a pipeline from slope movements. Strain can develop slowly from a deep-seated landslide as a result of long-term slow movement, or it can develop quickly as a result of a single movement event. Shallow-rapid landslides are unlikely to induce long-term strain to a pipeline, but rather more likely to expose the pipe and result in a loss of support where it crosses a debris slide source area. Once mobilized into a debris flow, shallow-rapid landslides often have tremendous erosional potential. Debris flows that originate upslope of the pipeline also have the potential to scour, expose, and damage the pipeline by debris impact.

Rapidly Moving Landslide Risk Assessment

Rapidly moving landslides (RMLs) typically occur on steep (generally greater than 50 percent) slopes within zero-order stream basins (a zero-order basin is also known as a headwall swale, bedrock hollow or convergent slope immediately upslope of a first-order channel) and can mobilize into debris flows and torrents, traveling great distances along defined stream channels. These landslides generally occur quickly during heavy or prolonged storm events with little or no warning. DOGAMI, in cooperation with other agencies, produced a map of Potential Rapidly Moving Landslide Hazards in Western Oregon (Hofmeister et al. 2002). This map was limited to western Oregon because the vast majority of historical RML occurrence has been within that portion of the state. Pacific Connector has provided geologic hazards maps in the *Geologic Hazards and Minerals Resources Report* (GeoEngineers 2013e) that show the slopes in and around the pipeline alignment in western Oregon that have been mapped as potential RML hazards. Creation of the map involved the use of GIS modeling, checking and calibration with limited field evaluations, and making comparisons with historical landslide inventories. The intent was to identify areas that have some potential to be affected by RMLs so that they would be considered and evaluated appropriately.

The portion of the pipeline alignment that crosses the Coast Range physiographic province has the greatest risk of being affected by rapidly moving landslides because of rugged terrain composed of relatively weak sedimentary bedrock and relatively high precipitation rates. In particular, studies indicate that the Tyee Core Area within this province has a higher susceptibility to rapidly moving landslides than other areas of the pipeline (Robinson et al. 1999).

The potential for rapidly moving landslides to occur east of MP 166 (east of the Cascade Range) generally is considered to be relatively low based on geological conditions, relatively little rainfall, and statistically fewer past historical rapidly moving landslide occurrences (Hofmeister et al. 2002). Climate change models predict a drier climate east of the Cascade Range, including less snowpack (and snowmelt), more rain instead of snow in low elevation basins, lower summer and early fall streamflows, and decreased soil moisture (University of Oregon 2008). These conditions are not likely to increase the potential for rapidly moving landslides in this region. Slopes east of MP 166 were reviewed to identify high-risk sites based on general guidelines of the ODF (ODF 2000). Based on available topographic mapping, no slopes along the pipeline alignment east of MP 166 exceed 65 percent or appear to be at high risk of rapidly moving landslide occurrence.

Pacific Connector conducted an initial risk assessment to evaluate the potential risk where the pipeline alignment crosses the mapped hazard areas using some of the input parameters used for the DOGAMI model (Hofmeister et al. 2002). Depositional, transport, and source zones were primarily distinguished with a simplified approach based on slope/channel gradient without consideration of other factors such as stream junction angles.

The initial relative risk to the pipeline posed by the source, transport, and depositional zones are considered to be high, moderate, and low, respectively. If a pipeline was located within a rapidly moving landslide source area, the pipeline could lose support as a result of displacement of the slide mass, and could be subject to excessive strain depending on the orientation of the pipeline and the distance over which support was lost. Once mobilized into the “transport” zone, a rapidly moving landslide has the potential to erode and scour the slope and could potentially expose a buried pipe, at which time debris could impact and damage the pipeline. Based on research and empirical data, the scour potential is greater where rapidly moving landslides are confined within stream channels. This risk is discussed further in later sections.

Other factors that influence the potential risk from rapidly moving landslides include the slope form (geometry) and the orientation of the pipeline to the slope. For instance, convergent (concave) slopes are generally less stable and have a higher potential for landslide occurrence than planar or divergent slopes. In general, the risk of landslide occurrence and mobilization increases with slope gradient and with the degree of convergence (concavity).

Using LiDAR where available, 10-meter digital elevation model and aerial photography, Pacific Connector identified moderate and high risk rapidly moving landslide sites along the proposed route. Pacific Connector then conducted a surface reconnaissance of these sites to further evaluate potential risk.

A total of 304 pipeline segments were initially identified within rapidly moving landslide hazard areas. Based on the risk assessment, approximately 128 of these sites were considered to be a potentially moderate or high risk and were selected for further study. Site-specific reconnaissance was conducted in certain areas with the potential for shallow-rapid landslide hazards, as documented on Tables B-3a and B-3b of Appendix B in GeoEngineers (2013e).

Deep-seated Landslide Risk Assessment

Deep-seated landslides can range in thickness from tens to hundreds of feet and can occur anywhere on a slope. Larger landslides can usually be identified from topographic maps (including LiDAR) and aerial photographs. Movement can be complex, ranging from slow to rapid, and may include small to large slope displacements.

The greatest risk of deep-seated landslide movement is from existing (dormant) deep-seated landslides reactivating in response to human activity, seismic activity, stream erosion, or heavy precipitation. Assuming unchanged conditions, it is much less common for a deep-seated landslide to occur on a previously undisturbed and intact slope than reactivation of an existing landslide feature. Therefore, areas susceptible to deep-seated landslide movement were identified from existing geological maps and from topographic or photographic indications of historical or ancient landslide movement.

Table B-2 from GeoEngineers (2013e) lists the identified deep-seated landslides, the data source, and the initial risk to the pipeline. High hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline. Surficial, geomorphic, and vegetative features suggest that the landslide is active or dormant historic (past movement less than 100 years ago) (Keaton and DeGraff 1996). Moderate hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline, and where surficial, geomorphic and vegetative features suggest that the landslide is dormant-young (last movement 100 to 5,000 years ago) (Keaton and DeGraff 1996). Fifteen of the landslides were judged to pose a moderate to high potential risk to the pipeline. In these instances, Pacific Connector either rerouted its proposed route to avoid the hazard or assessed the feature further through aerial reconnaissance and risk assessment. The subsequent aerial reconnaissance of the deep-seated landslides identified as moderate to high risk included assessments of geomorphic and vegetative conditions. These data were incorporated into a model of potential risk related to each deep-seated landslide. Pacific Connector then identified potential alternative routes around moderate- to high-risk landslides that appeared to be active or to have the potential to reactivate. Six landslides were identified as posing a moderate to high potential risk and were evaluated further in the field. Five of these six landslides are located in Coos County within the Coast Range physiographic province.

Landslide Hazards Avoidance and Minimization of Adverse Effects

For the purposes of landslide hazard evaluation in this report, a distinction is made between the hazard associated with a landslide and the risk associated with that hazard. In the following discussions, statements of risk apply to the potential for damage or failure of the pipeline from earth movements. It is recognized that the consequences of a pipeline failure may be catastrophic and involve fire and/or explosion. However, those consequences are location-specific and are not considered in the following evaluations of risk to the pipeline. Pacific Connector has worked to avoid landslides along the proposed route. Ridgetops are generally considered to be stable and, therefore, an attempt has been made to route the vast majority of the pipeline along ridgetops.

Risks associated with landslides include both the risk that installation of the pipeline may adversely affect slope stability, and that post-construction land movements could damage the pipeline. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides. Appendix B from GeoEngineers (2013e) identifies where Pacific Connector's initial proposed route was changed to avoid identified landslides and landslide hazard areas.

Table B-2 from the GeoEngineers (2013e) indicates where reroutes were completed to avoid identified landslides. Tables B-3a and B-3b from the same report indicate where reroutes were incorporated into the proposed route to avoid moderate- and high-hazard RML hazard areas. All of the moderate- and high-hazard deep-seated landslides identified along the alignment were avoided where feasible during final route selection. Although most moderate- and high-hazard RML hazards were avoided, two moderate-hazard RML sites (MPs 18.1 to 18.2 on private land, and MP 36.9 on BLM land) could not be avoided. However, the risks to the pipeline at these sites are not considered hazardous enough to require additional mitigation or rerouting. Hazards include both the potential for the planned construction to adversely affect slope stability and the potential for post-construction landslide movement to damage the planned pipeline.

Pacific Connector has prepared and would implement the ECRP included in its POD to avoid and minimize impacts from pipeline construction, including reducing the potential for construction to adversely affect slope stability. Because the pipeline would cross extensive areas of rugged terrain, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. Monitoring higher-risk areas along the pipeline can aid in detecting landslide occurrence and movement so that action can be taken to prevent damage to the pipeline. Monitoring can range from visual surface observations from the air or ground to the use of strain gauges and subsurface instrumentation, such as inclinometers, to detect and measure slope movements (typically, these instrumentation methods are used only on pipeline segments affected by active slope movement).

All known hazardous landslides thought to pose a risk to the pipeline have been avoided through routing. At this time, no sites have been identified as requiring additional monitoring beyond the standard monitoring protocols for the entire pipeline. Pacific Connector and its consultants are confident that the methods used (LiDAR interpretation, helicopter-based reconnaissance, and ground-based reconnaissance) were adequate to evaluate the potential hazard posed by these specific landslides. Pacific Connector has agreed to perform additional ground-based observations and interpretations requested by FERC pending landowner access permission for the following Landslide Numbers: 34, 46, 50, 51, 56, 57, 76, 77, 80, and 83. Pacific Connector would develop monitoring protocols and/or mitigation measures prior to construction if warranted based on findings from the ground-based reconnaissance.

One commenter was concerned about the instability of slopes through which the pipeline is passing in the vicinity of MP 4 due to a previous slope failure and ground seepage. The commenter stated that this area was repaired by the county about 15 years ago. Aerial photograph review of this area during the investigation did not identify current slope instabilities.

However, if hazardous conditions are identified during pipeline construction, remedial or monitoring measures would be implemented by Pacific Connector.

Pacific Connector intends to implement a like level of landslide and pipeline easement monitoring currently performed on existing Williams-owned pipeline facilities in southwestern Oregon. Monitoring would consist of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

The purpose of the monitoring would be to detect potential movement or pipe strain before it compromised the structural integrity of the pipeline. If movement were detected, immediate action would be taken to reduce the risk to the pipeline. Every landslide is unique, and there are no standard methods for reducing or eliminating landslide-related risks to buried pipelines. However, in concept, initial response actions generally include measures to reduce the stresses in the pipeline caused by slide movements. Secondary response actions are directed at improving the stability of the slide so that movements in the vicinity of pipeline are halted or the impacts to the pipeline are minimized. Tertiary response actions involve rerouting the pipeline to avoid landslide hazards by relocating the pipeline to a safer location.

Exposure of the pipe by excavation is the initial response action typically taken to reduce stresses in the pipe. By exposing the pipe on both sides, the pipe is allowed to rebound to a position where it carries little residual stress.

Improvements in surface drainage also are important initial response measures. Typical drainage improvement measures include: (1) placement of impermeable liners over the ground surface to limit infiltration of precipitation and erosion; (2) ditching to divert surface water around landslide areas; and 3) routing surface flows across slide areas within tightline drain pipes. If surface drainage improvements would impact jurisdictional resources under Section 404 of the CWA these impacts would need to be permitted as appropriate. See section 4.4 of this EIS.

Once the landslide area is initially stabilized, a decision of permanent action must be made. Permanent mitigation can include repairs and stabilization of the landslide area. Permanent repairs can include drainage improvements, loading and/or stabilization of the toe of the slope, decreasing the load at the head of the slope, or retaining structures at the base or within the slope. If the landslide is large and complex and stabilization is not a reasonable option, rerouting the pipeline around the slide may be the preferred mitigation.

Specialized trench backfill is utilized where pipelines cross landslides or fault zones where differential movement or shearing across the pipeline is expected. For steep slopes, trench breakers and water bars are utilized to minimize the potential for erosion or mass wasting of trench backfill. Section 11.0 of the ECRP provides special backfill and compaction criteria for restoring site grades on slopes greater than 3H:1V. Specifications include use of structural fill, benching slopes to receive fill, and compaction of fill in lifts.

Because the geological and other natural hazards are considered significant to the design, construction, and operation of the facility, information on the final mitigation measures and monitoring protocols of the pipeline in areas which were not accessible during previous studies are required to evaluate slope stability conditions. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, stamped and sealed by the professional engineer-of-record registered in Oregon, the final monitoring protocols and/or mitigation measures for all landslide areas that were not accessible during previous studies, to evaluate slope stability conditions.**

Stream Migration and Scour Hazards

The principal hazard resulting from channel migration and streambed scour is complete or partial exposure of the pipeline within the channel from streambed and bank erosion, or within the floodplain from channel migration or avulsion. Related discussion of the assessment and protection for riparian and aquatic environments is provided in section 4.1 of this EIS and in the ACS technical report (appendix J). Minimizing the effects of migration and scour hazards to the pipeline can be accomplished with the following approaches.

- At each channel crossing, bury the pipe below the estimated depth of streambed scour. Where bedrock is encountered at shallower depths than the estimated scour depth, the elevation of competent bedrock represents the limit of scour.
- Where feasible, place the pipe into bedrock.
- Within floodplains adjacent to migrating channels, bury the pipe below the projected depth of the channel thalweg (the line of lowest elevation within a watercourse) within the 25-year and 50-year channel migration zones.
- Avoid stream crossings that are potentially hazardous to the integrity of the pipeline, and therefore to public safety, where possible.

The pipeline crossing streams also could provide a new path for groundwater to flow into the pipeline trenches even after following backfilling. Water diversion would be prevented by implementing the ECRP, which requires installing trench breakers around the pipeline and in the trench on slopes. Pacific Connector also would install trench plugs after the pipeline was installed in the trench and prior to trench backfilling. Pacific Connector would use sandbags (or foam, only if approved by regulatory agencies or the land management agency) for trench plug construction. Topsoil would not be used to fill the bags. Where necessary, Pacific Connector would use bentonite trench plugs to prevent flow from wetlands or streams into the trench and to preserve the original wetland and/or waterbody hydrology. Trench breakers and trench plugs would be keyed into the trench sidewalls.

Erosion and channel migration hazards to pipelines potentially exist on the banks and beds of stream channel crossings. No scour hazards, were identified at the pipeline aboveground facilities locations. Portions of the Coos Bay estuary, including the terminal delta areas of the Coos River and Catching Slough, also would be subject to scour from flood events, tidal currents, and tsunamis. Pacific Connector conducted analyses to assess the potential for channel migration and the depth of streambed scour in the streams and the estuary. The results of the migration and scour studies are summarized below and are discussed in detail in the *Channel Migration and Scour Analysis* report (GeoEngineers 2013f). Scour results for Haynes Inlet and the delta areas are presented in detail in the Coos Bay crossing scour evaluation technical report for the Pacific Connector Pipeline Project (CHE 2010a).

Fluvial erosion may represent a hazard to the pipeline where streams have the potential to expose the pipe as a result of significant lateral bank erosion (channel migration), avulsion, or widening and/or downcutting (scour) of the streambed. Lateral channel migration is the movement over time of an entire channel segment perpendicular to the direction of stream flow. Channel avulsion is the sudden abandonment of an active channel for a newly created, or previously abandoned, channel located on the floodplain. Channel widening is defined as the erosion and subsequent recession of one or both streambanks that widens the channel without changing the channel location. Streambed scour is erosion of the streambed resulting in the development of deep pools and/or the systematic lowering of the channel floor elevation. Streambed scour may also result from the passage of debris flows and debris torrents. Debris flows and torrents consist of large volumes of water, soil, rock fragments and boulders, wood and other organic materials moving rapidly downstream as a fluid through a defined channel. Debris flows and torrents often start as rapidly moving landslides that liquefy as the landslide mass progresses downslope.

All streams that would be crossed by the pipeline route were evaluated with respect to potential risk to the pipeline. The evaluation was conducted in two phases: a preliminary evaluation in which all stream crossings were ranked for potential risk, and detailed analyses of stream crossings posing potentially significant risk to the pipeline (GeoEngineers 2013c). Potential risk was evaluated based on the likelihood of migration, avulsion, and/or scour as determined through evaluations of aerial photographs and GIS data.

During the initial phase evaluation, 45 crossings were identified as Level 1, 10 crossings were identified as Level 2, and the remaining crossings were identified as Level 0. Level 0 crossings present very low risk from channel migration or streambed scour when standard pipeline construction methods are utilized. Level 1 stream crossings, though presenting a low to moderate erosion risk, do not pose a significant risk to the pipeline provided that standard pipeline construction techniques and BMPs are utilized. Level 2 stream crossings represent a high scour or migration risk and were analyzed in additional detail and on a case-by-case basis. Because portions of the alignment were revised after completion of the initial phase evaluation, the second phase also included reviewing all stream crossings along the final pipeline alignment, and evaluating the risk levels of any adjusted initial phase crossing locations. The full list of crossings and their assigned risk level from the initial phase is presented in Table B-4 in Appendix B of GeoEngineers (2013e) and in the *Channel Migration and Scour Analysis* report (GeoEngineers 2013f).

In addition to the 10 initial Level 2 stream crossings, Pacific Connector evaluated 12 Level 1 crossings during the second phase, for a total of 22 sites. These 22 sites were subjected to field reconnaissance and detailed analyses regarding potential migration, avulsion and/or scour. The approach to evaluating potential migration and scour includes three primary elements: (1) develop a geomorphic characterization for each site; (2) conduct detailed migration analyses as necessary; and (3) conduct detailed scour analyses as necessary. Steps 2 and 3 were conducted only at those sites where field reconnaissance confirmed the potential for migration and/or scour.

Pacific Connector estimated the 25-, 50-, and 100-year Channel Migration Zones (CMZs) for each crossing. The width of the CMZ identifies the distance the channel could travel in 25, 50, or 100 years, respectively, in the absence of confining structures. These were estimated based on historical channel occupation tracts, the character of migration in each reach, the maximum rate of lateral and downstream migration for each reach, and the locations of ancient and historic abandoned channels. Based on evaluations of each crossing, the 25-year CMZ best represents future migration potential for all crossings. The applicability of the 50-year CMZ depends on site-specific conditions, and the 100-year CMZ is least representative of future channel migration potential and channel location for all crossings. Based on a detailed analysis of the 25-year and 50-year CMZs, Pacific Connector would design all waterbody crossings for the 50-year condition. This level of design would be protective of the pipeline, and therefore public safety, given the level of natural channel migration at each site.

The scour analysis included surveying several channel cross sections upstream, downstream and at the crossing location; modeling channel hydrology and hydraulic conditions at each site; evaluating depth to bedrock beneath crossings; and calculating scour depths for multiple flow events based on the results of hydraulic modeling using HEC-RAS (Hydrologic Engineering Center-River Analysis System), geomorphic evaluation, and observed field conditions. Hydraulic output from HEC-RAS was used to evaluate stream scour for the 10-, 25-, and 50-year peak flow events. Return intervals were calculated from regional regression equations or peak discharge statistics from nearby USGS gaging stations (GeoEngineers 2013e).

Scour was analyzed at all identified Level 2 crossings along the pipeline alignment that display a high scour hazard; crossings where bedrock is identified shallower than pipeline burial depth were not analyzed further for scour. For the North Myrtle Creek and Middle Creek crossings, the alignment was shifted after the field data were collected and analysis completed. Scour results calculated for the original crossings were considered and adjusted in relation to the new crossing locations. The assessment of channel conditions at the new (proposed) crossings is based on an initial desktop interpretation of geomorphic conditions, and a follow-up site visit conducted in January 2007.

A summary of the scour results is presented below and in table 4.2.2.2-3. Potential scour from debris flows could occur where the pipeline crosses streams within rapidly moving landslide hazards.

TABLE 4.2.2.2-3

Summary of Scour Results using HEC-RAS

Stream Name at Crossing	Milepost	Expected Scour Depth Based on Interpreted Depth (feet) to Bedrock	Calculated Total Potential Scour Depth (feet) in Alluvium (10/25/50/100yr)	Ownership
Coos River	11.13R	-	3 b/	Private
Catching Slough	11.11	_	3 b/	Private
Middle (Park) Creek	27.04	2 - 7.0 a/	7.0/9.0/9.0/10.5 c/,d/	BLM
South Fork Elk Creek e/	34.46	--	4.0/5.0/5.0/6.0	Private
Olalla Creek	58.77	--	6.0/7.0/7.0/7.5	Private
North Myrtle Creek	79.12	--	5.0/6.0/6.0/6.5 c/	Private
South Umpqua River Crossing No. 2	94.73	0.7 - 8.7 a/	11.0/13.5/16.0/18.0 d/	Private
Rogue River	122.65	0.9 - 6.9 a/	13.5/16.5/18.5/20.5 d/	State

a/ Depth to bedrock interpreted from nearby boring logs and outcrops. Depth of scour is expected to be limited by bedrock.
b/ Results of CHE (2007) scour evaluation.
c/ Minimum scour depth calculated at October 2006 crossing location. Pipeline subsequently moved to current location.
d/ Calculated depth of scour assumes absence of bedrock.
e/ Alignment modification improves crossing conditions.

A site reconnaissance was performed at these crossings where they had the potential for scour based on the apparent gradient measured from 10-meter digital elevation model and LiDAR. Table B-3b of Appendix B from GeoEngineers (2013e) presents the data collected during the site reconnaissance and conclusions regarding the potential risk of rapidly moving landslide scour.

The pipeline alignment crosses streams that are within RML hazards mapped by DOGAMI. A site reconnaissance was performed at stream crossings that were within RML hazard areas and that had the potential for scour based on the apparent gradient measured from 10-meter digital elevation model and LiDAR.

Based on risk criteria, the stream crossing at MP 50 was initially identified as having a potential high risk of RML scour. Where no bedrock was observed within channel, and the stream gradient exceeded 15 percent, the channel was classified as high risk. Where the channel was composed of bedrock or the channel gradient was less than 15 percent, the channel was classified as low risk. RMLs typically occur on steep (greater than 50 percent) slopes (GeoEngineers 2007b). Based on the findings of subsequent site reconnaissance, the proposed route near MP 50 was rerouted to avoid this crossing.

Shallow bedrock was observed in the vicinity of Middle Creek, South Umpqua River Crossing No. 1, South Umpqua River Crossing No. 2, and Rogue River stream crossings (note that an HDD crossing method is proposed for the Rogue River at MP 122.7). At these crossings, depth to bedrock was interpreted based on observed bedrock contacts, outcrops, and borings drilled nearby. For each of these crossings, bedrock is likely to be encountered at shallower depths than the calculated scour depth. It is assumed that the upper elevation of competent bedrock represents the limit of scour for all flows at these crossings (GeoEngineers 2013e).

The Klamath River crossing is proposed to be completed using HDD methods. The HDD plan has the pipeline at a depth of at least 60 feet below the river bottom. Based on the anticipated burial depth, the potential risk of exposure by river scour is thought to be very low. Therefore, Pacific Connector does not plan to evaluate the potential scour depth of the Klamath River.

Potential scour depth from Coos Bay currents of approximately 3 feet was estimated at the pipeline crossing of the Coos River. The scour estimate is based on modeling the sediment as silt, and do not factor any sediment load in the Coos River, which results in very conservative scour estimates. Modeling results indicate that no significant scouring would occur over the pipeline from vessel-induced pressure fields or propeller wash. Pacific Connector proposes to cross the Coos River by HDD, which would place the pipeline well below the potential scour depth. Additional discussion of these areas is provided below.

Haynes Inlet and Coos Bay Tributaries Erosion and Scour Hazards

Pacific Connector conducted analysis and numerical modeling to assess the potential locations where erosion and scour could occur along the proposed route within Coos Bay. The results are described in separate reports (CHE 2007, 2010a) and are summarized in this EIS. Processes that were identified as potentially affecting the sediment cover over the pipeline or stability of the bottom in which the pipeline would be buried are:

- tidal currents (bottom scour);

- tidal channels and bay shoreline morphology (channel and dredged material disposal island migration and scour);
- waves generated by wind blowing over the surface of Coos Bay (bay bottom scour and shoreline erosion);
- effects by vessel wakes, pressure fields, and propeller wash of vessels operating in Coos Bay (bay bottom scour and shoreline erosion); and
- tsunami inundation and retreat.

Numerical models and analytical methods specific to each of the identified processes were applied to assess the scour hazard potential and to estimate the magnitude (depth) of erosion and scour in Coos Bay. To account for unexpected possible short-term migration of sediment resulting from currents or wind-generated waves, a conservative estimate of up to 1 foot of potential scour should be assumed. The following summarizes the findings as reported in CHE (2007, 2010a).

Based on very conservative estimates (CHE 2007, 2010a), the model output suggests that limited scour may occur along the pipeline trench within Coos Bay due to currents or extreme wind events.

The Haynes Inlet and tributaries within the Coos Bay estuary (Kentuck Slough, Willanch Slough, and Coos River) and adjacent areas were modeled to evaluate hydrodynamic conditions that could contribute to bay bottom and tidal channel scour and erosion. Specific attention in the modeling and analysis was addressed to areas of the pipeline adjacent to natural tidal channels, navigation channels, bridges, and dredged material disposal areas. These areas have been identified as having a higher potential (likelihood) of erosion and scouring hazards occurring, which can result in deleterious consequences to natural resources and the pipeline. In these cases the risk is assigned as high.

The findings indicate the following:

- No significant or limited bottom scour would occur along the pipeline in Haynes Inlet resulting from combined tidal and Haynes Inlet and Coos Bay tributaries flow during extreme events, if the cover of the buried pipeline is of the same material and quality as currently exists on the bottom. However, considering the generalization of bottom material, other random factors, and practical experience with previous projects, CHE (2010a) recommends that a 1-foot scour depth be assumed in the areas within Haynes Inlet and Coos Bay tributaries because of tidal and river flows for the entire length of the pipeline. To address this recommendation, Pacific Connector would maintain a minimum of 5 feet of cover through this area to compensate for the 1-foot potential scour depth.
- In the Coos River, more significant scour of approximately 3 feet was estimated at the pipeline crossing. Because sediment size here was assumed to be fine silt, and no sediment load was input into the model in the Coos River, this scour estimate is likely to be extremely conservative. Pacific Connector proposes to use HDD methods at this crossing, which would place the pipeline well below the potential scour of 3 feet.

Analysis of the Haynes Inlet estuary morphological changes was conducted to assess the erosion and scour hazards present along the proposed route. The geomorphologic analysis focused on three landforms in the Upper Coos Bay area that could potentially be a hazard to the pipeline because of possible long-term morphological changes. These areas included the Coos River delta, dredged material disposal sites and the navigation channel.

River delta meandering was investigated by comparison of historical NOAA navigation charts for the period 1862 to 1997. The charts were visually evaluated for recognizable delta and river thalweg location changes near the proposed route. Thalweg positions relative to one another were then measured at locations of noticeable change and tabulated for comparative analysis. It was found that meandering of the channel thalweg is limited and is within the level of accuracy of the analysis procedure. However, because of uncertainties with the accuracy of historical data, Pacific Connector considered thalweg meandering plus/minus 100 feet relative to the existing position. For the pipeline located in the vicinity of tidal channels, the pipeline burial depth would be 5 feet below the thalweg (low point) for a distance of 100 feet on either side of the channel thalweg.

The coastal areas of Oregon, including Coos Bay, could experience some effects of tsunamis generated by strong ground motions associated with offshore earthquakes and submarine landslides. The potential for scour in the Coos Bay estuary associated with hydrodynamic conditions generated from tsunami floodwaters was evaluated for the pipeline alignment. The tsunami generated scour analysis by CHE was based on current sea levels and did not account for or predict future sea level rise. It is expected that sea level rise would change (expand) areas subject to tsunami inundation; however, such sea level rise is not expected to significantly change the calculated scour within the areas of tsunami inundation.

GeoEngineers (2013e) conducted a review of recent tsunami modeling by DOGAMI that was completed for various magnitudes of earthquakes (DOGAMI 2012b, 2012c, 2012d, 2012e, 2012f, and 2012g). Hydrodynamic forces and sediment transport resulting from tsunami wave impact and flows in Coos Bay (Haynes Inlet) were evaluated for the pipeline alignment using a two-dimensional depth-averaged flow simulation and sediment transport model. The model is capable of simulating water level fluctuations (waves), currents, overland inundation, sediment transport, bottom morphology and water/sediment quality. The numerical model domain covered a region of approximately 900 square miles, starting approximately 40 miles offshore and extending throughout Coos Bay and up into the rivers and streams. Tsunami wave input was developed so as to match the ocean tsunami amplitude reported in the Tsunami Hazard Map of the Coos Bay Triangle, Coos County, Oregon (Priest et al. 2002).

A design tsunami event was simulated using a numerical model (CHE 2010a), whereby the tsunami waves inundated the barrier between the Pacific Ocean and Coos Bay, and propagated into Coos Bay over the dune and between the jetties. The modeling analysis showed that some temporary scour, followed by sedimentation, may occur in Coos Bay in the area of the pipeline alignment where it would cross Hayes Inlet during inundation of the tsunami (approximately 1 to 2 hours). In order to eliminate the concern of temporary scour, and to satisfy the conservative approach to scour analysis, CHE (2010a) recommended designing for a scour hazard depth of 3 feet.

Recent modeling for the Coquille River system does not indicate a potential risk for tsunami inundation at the pipeline crossing (MP 50.3) (Witter et al. 2011).

GeoEngineers (2013e) indicated that the pipeline would be susceptible to scour only within Coos Bay where it would cross Hayes Inlet (between MPs 1.7 and 4.1). Pacific Connector proposes to install the pipeline within Coos Bay with 5 feet of cover, which would protect the pipeline from scour resulting from regular tidal or current movements, or in the event of a tsunami.

Volcanic Hazards

The USGS assumed that a lahar flow (rapidly flowing mixture of rock and water originating from volcanoes) from Mt. Mazama (this is also known as the Crater Lake area, which is located about 45 miles to the northeast) could impact the Rogue River; however, the chances are remote because the Lost Creek reservoir would intercept the lahar. Two other sources of impacts are airborne tephra ejected from a volcano and a volcanic eruption near the pipeline. The tephra would not impact the pipeline because the pipeline would be buried. Based upon the USGS estimates, the chance of volcanic eruption near the pipeline is very low, less than 0.01 percent. Therefore, the chance of a volcanic event to affect the pipeline is very low.

Mine Hazards

Mine hazards potentially exist in areas underlain by or adjacent to underground mine workings and surface mines that have not been properly stabilized, closed, and made safe in accordance with applicable local, state, and federal laws. Pacific Connector identified surface and subsurface mines within 0.5 mile of the proposed construction right-of-way from USGS topographic maps, BLM and Forest Service databases, DOGAMI GIS data, published reports, published and unpublished maps, and county mineral overlay maps. No mine hazards, were identified at the aboveground facilities locations.

The primary hazards involve the potential for:

- subsidence in areas underlain by or adjacent to air shafts, tunnels, underground workings, and mine tailings;
- rockfalls and slides caused by the failure of unstable benches, slopes, and tailing piles in nearby surface mines, including those benches and slopes occurring within water-filled pits; and
- the presence of tailings or waste piles containing naturally occurring metals.

According to Pacific Connector's application (Table B-5 of Appendix B from GeoEngineers 2013e), the pipeline alignment was identified as being located within 500 feet of potential mine hazards based on the information provided in the databases at 22 locations. Fifteen of the 22 mines identified within 500 feet of the alignment are aggregate or quarry-related mines. The aggregate or quarry-related mines are likely to consist of open excavations. The primary potential hazards at these mines would be related to failure of steep slopes and/or high walls. These are expected to be localized conditions. Civil survey crews involved with surveying the right-of-way did not observe these conditions along or adjacent to the alignment. Consequently, these potential hazards are not expected to pose a threat to the pipeline.

The remaining non-aggregate-related mines were investigated by field reconnaissance on January 23 and 24, 2007, and June 13 and 15, 2007. The database indicated that these mines are located at MPs 9.8, 10.0, 16.2, 58.8, 75.3, 105.6, 108.7, 109.3, 109.4, 111.7, 142.6, and 150.5. The reconnaissance of these mines did not identify any apparent mine workings located within

500 feet of the pipeline alignment. Adits associated with the Nivinson Prospect/Mars Fraction Lode and Thomason mines were identified within 500 feet of the pipeline location. Therefore, a site-specific mine hazards assessment was completed for those prospects as well as the nearby Red Cloud Mine, and the findings of that study were provided in a stand-alone report dated August 23, 2007, and its 2009 addendum (GeoEngineers 2007c, 2009b). The following summarizes the report findings with regard to the proposed route.

Nivinson Prospect/Mars Fraction Mercury Mine

The pipeline alignment at MPs 108.6-108.7 does not cross the Nivinson Prospect mercury mine and is approximately 200 feet upslope from it. Based on documented excavated depths, trends, and distances from the pipeline, it was concluded from the field investigation that the adits of the Nivinson Prospect mercury mine likely do not extend into the right-of-way and do not pose a risk to the pipeline.

Red Cloud Mercury Mine

The pipeline alignment is approximately 400 feet west of the Red Cloud mercury mine at MP 109.3. No evidence of the mine was observed during site reconnaissance of the alignment.

Thomason Mine (Inactive)

The pipeline alignment at MP 109.4 crosses the mapped location of the Thomason Mine. No evidence of the Thomason Mine was observed during site reconnaissance of the alignment. Approximately 260 feet downslope of the mapped Thomason Mine location at MP 109.4, the proposed route crosses East Fork Cow Creek. The proposed route crosses the East Fork Cow Creek outside of the Thomason Mining Group boundaries and all other mining groups mapped by Brooks (1963).

4.2.2.3 Mineral Resources

Mineral resources that occur in the pipeline area include the following metals: chromite, copper, gold, manganese, mercury, and silver. Other mineral resources include basalt, cinders, coal, conglomerate, limestone, natural gas (including coal bed methane), sand and gravel, sandstone, shale, silica, talc, and tuff/breccia. Most of the non-metal minerals are mined to produce aggregate. Mineral resources, surface and subsurface mines, and oil and gas fields located within one-half mile of the Pacific Connector pipeline construction right-of-way were identified from USGS topographic maps, BLM and Forest Service mineral resource databases (including oil and gas leases, geothermal leases, and mining claims), ODOT aggregate resources GIS data, DOGAMI GIS data, published reports, published and unpublished maps, and county mineral overlay maps. Detailed maps showing mineral resources, mines, leases, mining claims, and related features are included in Appendix G of GeoEngineers (2013e).

Portions of the pipeline alignment cross six areas with county zoning that recognizes the potential for future mineral resource development. This zoning implies that mines and oil and gas wells could be sited at any location within these areas in the future as long as the zoning remains compatible with the resource extraction operations.

Table B-7 of Appendix B from GeoEngineers (2013e) identified the active, inactive, and planned mineral resources or mining sites (organized by MP) within 0.25 mile of the pipeline. Twenty mineral or mine locations were identified as within 500 feet of the pipeline.

Table B-8 of Appendix B from GeoEngineers (2013e) identified areas where the pipeline would cross: (1) areas where county land-use zoning allows mineral resource extraction, or (2) federal land that has been or is available for mineral resource or geothermal leases. Coos County recognizes six coal-basin resource areas between MPs 1.47R and 10.7; and one between MP 17.2 and 18.2. Thirty-eight oil and gas areas are located between MP 11.2 and 45.7 in Coos County. Two mine claims are located near MP 1.4R in Coos County. Seven oil and gas areas, two placer claims, four mines, seven lode claims, a chromite resource, and a quarry are located in the vicinity of the pipeline alignment between MPs 46.9 and 109.4 in Douglas County. Twenty-four oil and gas areas, eight lode claims, and a basalt resource are located in the vicinity of the pipeline alignment between MPs 115.4 and 166.4 in Jackson County. One lode claim, two mineral resource areas, one oil and gas area, and three geothermal resources areas are located in the vicinity of the pipeline alignment between MPs 170.6 and 220.6 in Klamath County.

The pipeline could potentially interfere with future mining and reclamation activities on lands adjacent to the right-of-way. Future expansions of surface mines near the pipeline right-of-way potentially could be limited or precluded in some cases because mineral resources could not be extracted from slopes immediately above or below the pipeline right-of-way or from beneath the pipeline. Similarly, the presence of the pipeline could limit or preclude the stockpiling of mineral resources or development of a processing area on slopes above or below the pipeline. These considerations also could limit or preclude reclamation activities at mine sites near the pipeline because of the potential to disturb the slopes above and below the pipeline and right-of-way. Any impact would be site-specific and would depend on topography, drainage, and subsurface conditions in that area.

4.2.2.4 Rock Sources and Permanent Disposal Sites

Pacific Connector has identified 42 potential rock source and permanent disposal sites that total approximately 175 acres along the proposed route. Of these 42 rock source/disposal sites, 20 sites—8 of which are TEWAs—are existing quarries/gravel pits (87 acres). These sites are listed in table 4.2.2.4-1.

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable

TABLE 4.2.2.4-1

Rock Source and/or Permanent Disposal Sites

Site	Size (acres)	Milepost	Land Use	Jurisdiction
Coos County				
TEWA-11.90-W	0.10	11.90	Mixed forest land, regenerating evergreen forest land	Private
TEWA 12.53-N	2.32	12.53	Clearcut forest land, transportation, communication, utilities corridors	Private
TEWA 14.60-N	0.61	14.60	Regenerating evergreen forest land, transportation, communication, utilities corridors	Private
TEWA 17.82-W	0.93	18.11	Timber, clearing, regenerating evergreen forest land	Private
TEWA 20.96	2.00	20.96	Clearcut forest land, regenerating evergreen forest land	Private
TEWA 27.86-N	0.47	27.86	Clearcut forest land, transportation, communication, utilities corridors, regenerating evergreen forest land	Private
TEWA 38.86-W/ Sandy Creek Quarry	4.51	38.93	Strip mines, quarries, and gravel pits, clearcut forest land, regenerating evergreen forest land, transportation, communication, utilities corridors	Private
TEWA 42.56-W (Plum Creek)	4.10	42.55	Regenerating evergreen forest land, clearcut forest land, transportation, communication, utilities corridors	Private
Douglas County				
Signal Tree Road Quarry – Sec.	1.22	45.86	Quarries	BLM Roseburg District
TEWA 45.84-W/	0.41	45.84	Evergreen forest land, regenerating evergreen forest land, transportation, communication, utilities corridors	Private
Signal Tree Road Quarry – Sec. 35	1.09	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 1	1.62	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 2	1.30	47	Quarries	BLM-Coos Bay District
Signal Tree Quarry Site – Sec. 15	1.75	47	Quarries	BLM-Roseburg District
TEWA 52.23-N	2.62	52.23	Quarries	Private
TEWA 54.83-W	0.50	54.83	Clearcut forest land	Private
Private Quarry Benedict Rd.	1.49	56.75	Quarries	Private
Kent Creek Commercial Quarry	17.52	63.90	Quarries	Private
Private Quarry DG 105	10.79	67.00	Quarries	Private
Roth – Existing Quarry #1	0.77	72.61	Quarries	Private
Roth – Existing Quarry #2	0.34	72.61	Quarries	Private
TEWA 75.28-W/ (BLM Quarry Site)	0.48	75.28	Abandoned quarry, Mixed forest land	BLM-Roseburg District
TEWA 77.72-N	1.08	77.72	Mixed forest land, herbaceous rangeland, transportation, communication, utilities corridors, streams and canals, evergreen forest land	Private
TEWA 79.85-N (BLM Quarry Site)	3.61	79.85	Quarries, transportation, communication, utilities corridors, regenerating evergreen forest land	BLM-Roseburg District
Pct Quarry DG-176	2.22	81.45	Quarries	Private
TEWA 84.19-W	1.06	84.19	herbaceous rangeland	Private
TEWA 93.01	0.55	93.01	Evergreen forest land	Private and BLM-Roseburg District
TEWA 94.52-W (Reclaimed Quarry) (Pvt DG-155)	23.42	94.56	Reclaimed Quarry, transportation, communication, utilities corridors, Commercial and services, transitional areas, nonforested wetlands, herbaceous rangeland,	Private

TABLE 4.2.2.4-1

Rock Source and/or Permanent Disposal Sites

Site	Size (acres)	Milepost	Land Use	Jurisdiction
Hatchet Quarry MP 102.30	2.00	102.30	Strip mines, quarries, gravel pit, transportation, communication, utilities corridors	FS-Umpqua
Rock Disposal MP 104.12	3.36	104.12	Mines, quarries, and gravel pits, transportation, communication, utilities corridors, regenerating forest land	FS-Umpqua
Jackson County				
TEWA 110.73 (Peavine Quarry)	15.87	110.73	Mines, quarries, gravel pit and evergreen forest	FS-Umpqua
Rock Source and Disposal MP 119.51	7.66	119.51	Mines, quarries, gravel pit, regenerating evergreen forest land, evergreen forest land	BLM-Medford District
TEWA 149.97-N	0.32	149.97	Deciduous forest land, transportation, communication, utilities corridors, mixed forest land	Private
TEWA 150.31-W (Heppsie Mountain Quarry)	5.56	150.31	Mines, quarries, and gravel pits, mixed rangeland, evergreen forest land, mixed forest land, transportation, communication, utilities corridors, regenerating evergreen forest land, clearcut forest land,	Private and BLM-Medford District
Rum Rye MP 160.41	4.91	160.41	Strip mines, quarries, and gravel pits	FS-Rogue River-Siskiyou
TEWA 160.54-W (Big Elk Cinder Pit) (Ichabod Rock Quarry)	15.26	160.54	Mines, quarries and gravel pits, transportation, communication, utilities corridors, evergreen forest land	FS-Rogue River-Siskiyou
Klamath County				
Rock Source and Disposal MP 180.56	7.76	180.56	Mines, quarries, gravel pit, transportation communication and utilities corridors, and regenerating forest land	Private
Rock Source and Disposal MP 180.71	2.95	180.71	Mines, quarries, gravel pits, Clearcut forest land	Private
Rock Source and Disposal MP 182.40	5.66	182.40	Quarries, gravel pits	Private
Rock Source and Disposal MP 201.61	4.96	201.61	Transitional areas, cropland and pasture, transportation communication and utilities corridors	Private
Rock Source and Disposal MP 224.95	7.60	224.95	Mines, quarries, gravel pits, shrub and brush rangeland, transportation communication and utilities corridors, evergreen forest land, transitional area	Private
TEWA (14) Total			**16.52**	
TEWAs associated with existing quarries (8)			**71.33**	
Existing quarries and rock source and disposal sites—Total			**86.97**	
TOTAL			**174.82**	

Source: GeoEngineers (2013e)

permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600. Table 7A-1 in Appendix 7 of RR 7 filed with Pacific Connector's application to the FERC lists the rock source and disposal sites, their sizes, approximate mileposts in relation to the pipeline, jurisdiction, existing land use, and the soil mapping unit and sensitive soil characteristics of the sites. Sensitive soil information was not provided for the existing quarry sites because soils at these sites have been significantly altered. Only the disposal sites (and not the TEWAs) listed in table 4.2.2.4-1 are being proposed for use as permanent disposal sites.

Of the 42 identified potential rock source and permanent disposal sites, 20 sites are existing quarries/gravel pits or abandoned quarries/gravel pits. Although some of the existing/abandoned sites appear to have land use types other than quarries/gravel pits, Pacific Connector does not intend to expand these sites beyond the existing or previously disturbed footprints. If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.2.2.5 Blasting During Trench Excavation

Blasting could be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs. The bedrock units where blasting could be necessary would consist primarily of volcanic and metavolcanic rocks in the Klamath Mountains and volcanic rocks in the Cascade Range as well as along the ridges in the Basin and Range physiographic province. In addition, local areas of well-lithified sedimentary rock may need to be blasted in the Coast Range.

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline as follows:

- No Potential – Areas containing deep soils and alluvial, fluvial, lacustrine, and estuarine sediments that could be readily excavated. General occurrence: the coastal and Klamath basin lowlands and the major valleys and floodplains in all of the physiographic provinces.
- Low Potential – Areas containing soft sedimentary rock and tuff that can typically be excavated without ripping. General occurrence: Coast Range, and local areas of the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- Moderate Potential – Areas containing fractured, faulted, or weathered metamorphic or volcanic rocks that generally can be excavated with ripping, but that could require local blasting. General occurrence: local areas in the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- High Potential – Areas containing hard or fresh plutonic (for example, granitic) and volcanic rocks that could not be excavated without blasting. General occurrence: local areas of the Klamath Mountains physiographic province, portions of the Cascade Range physiographic province, and local areas in the Basin and Range physiographic province.

Table 4.2.2.5-1 provides a summary of the blasting potential along the pipeline. Blasting would not likely be required to construct the first 78 miles of the pipeline because the materials are expected to consist of soil, sediments, and rippable sedimentary rocks. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment.

TABLE 4.2.2.5-1

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline

From MP	To MP	Blasting Potential	Material	Ownership
1.47R	60.0	None to Low	Soil, sediments, sedimentary rocks and valley fill	Private, State, BLM
60.0	70.1	None to Moderate	Sedimentary rocks and metamorphic rocks with local valley fill	Private, BLM
70.1	78.5	Low to Moderate	Sedimentary and metamorphic rocks	Private, BLM
78.5	88.7	High a/	Igneous rocks with sedimentary rocks and local valley fill	Private, BLM
87.7	89.2	None to Low	Sedimentary rocks with local valley fill	Private
89.2	89.6	High	Igneous rocks	Private
89.6	90.8	Moderate	Sedimentary rocks	Private, BLM
90.8	94.5	Low	Sedimentary rocks	Private, BLM
94.5	108.9	High	Sedimentary and igneous rocks with local valley fill	Private, BLM
108.9	109.5	Low	Landslide deposit	Private
109.5	112.3	Low	Soft igneous rock	Forest Service
112.3	135.4	Moderate to High	Igneous rock, tuffs, breccias, conglomerates, lahar deposits, local valley fill	Forest Service, Private, BLM, State
135.4	138.7	Moderate to High	Igneous and locally tuffaceous rock	Private, BLM
138.7	143.8	Moderate to High	Igneous rock, tuffs, breccias, conglomerates, lahar deposits, local valley fill	Private, BLM
143.8	145.6	Low	Landslide deposit (LS-57)	Private
145.6	172.0	High	Igneous rock and locally tuffaceous rock with local valley fill	Forest Service, Private
172.0	174.4	None	Thick soil	Forest Service, Private
174.4	181.1	High	Lava flows	Private, BLM,
181.1	182.9	Low	Unconsolidated volcanic deposits	Private
182.9	191.5	Moderate to High	Igneous rocks with local soil and sediment	Private, State
191.5	218.9	None to Moderate	Soft igneous rocks with local sediment and valley fill	Private, State, Reclamation
218.9	221.8	High	Igneous rocks	Private
221.8	227.7	None to Moderate	Soil, soft igneous rocks valley fill	Private, Reclamation
227.7	228.1	High	Igneous rocks	Private

a/ Blasting potential intermittently rated as None where pipeline crosses a valley floor or thick soil.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to minimize vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with the inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide site-specific Blasting Plans at least 5 working days prior to any proposed blasting-related activity, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work. The Blasting Plan would include the following information:

- explosive type, product name and size, weight per unit, density, and equivalent energy release ratio (N) (the blasting agent Ammonium Nitrate and Fuel Oil [ANFO] would not be allowed);
- delay type, sequence, and delay (ms);
- initiation method (detonating cord, blasting cap, or safety fuse);
- stemming material and tamping method;
- hole depth, diameter, and pattern;
- explosive depth, distribution, and maximum weight per delay;
- number of holes per delay;
- distance and orientation to nearest aboveground structure;
- distance and orientation to nearest underground structure, including pipeline;
- procedures for storing, handling, transporting, loading, and firing explosives, fire prevention, inspections after each blast, misfires, fly rock and noise prevention, stray current accidental-detonation prevention, signs and flagmen, warning signals prior to each blast, notification prior to blasting, and disposal of waste blasting material;
- seismograph company, personnel, equipment, and sensor location, if required;
- copies of all required federal, state, and local permits;
- blaster's name, company, copy of license, and statement of qualifications;
- magazine type and locations for explosives and detonating caps; and
- typical rock type and geology structure (solid, layered, or fractured).

Pre-blast inspections would be completed for structures and wells that are within the influence zone of the blasting. The pre-blast inspections would include but not be limited to an inventory of existing structural integrity and signs of structural distress such as cracks. Post-blasting inspections would include an inspection and comparison of the same elements observed for the pre-blast inspection. If blast related damage is identified by Pacific Connector inspectors and confirmed to be a result of the blasting activities, then damaged structures or wells would be returned to pre-construction conditions or better.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Every precaution would be taken to prevent damage to aboveground and underground structures during blasting operations; and every precaution would be taken to prevent injuries and damage to persons or inconvenience to the general public. Blasting mats or padding would be used on all shots where necessary to prevent scattering of loose rock onto adjacent property and to prevent damage to nearby structures and overhead utilities. Blasting would not begin until occupants of nearby buildings, residences, places of business, places of public gathering, and farmers have been notified sufficiently in advance to allow for protection of personnel, property, and livestock.

Blasting for trench excavation could result in impacts on wells, wetlands, slopes, structures, and other adjacent buried utilities, as described below. We conclude that use of Pacific Connector's proposed monitoring and mitigation measures would avoid or reduce the likelihood of local failures of unstable rock and soil, and damage to structures or utilities from blasting vibrations.

Water Wells and Springs

In general, vibration effects to wells would be expected to be limited to the immediate proximity of the blasting. A common measurement unit for vibration is the peak particle velocity (PPV) of blasting-induced ground motion in inches per second. Siskind (1999) summarizes information on four blasting studies conducted to evaluate vibration effects on wells. One study showed, "There were no physical vibration effects on the wells even as close as 300 feet." The maximum velocities for this testing ranged from 0.84 to 5.44 inches per second, with four of the five sites exceeding 2 inches per second. In another study, a well was tested for casing cement bond damage. The study indicated initial bond losses occurred at 4.7 inches per second. A third study indicated that wells outside the blast pattern were exposed to as much as 8.7 inches per second at a distance of 31 feet and no damage occurred; however, the construction details for these wells are not described in the Siskind (1999) report. Nearly all households in the Shady Cove area (between about MPs 122 and 123) obtain water from wells that are located in the vicinity of relatively high density development. Such development has included previous blasting and associated impacts to wells.

Pacific Connector developed a *Groundwater Supply Monitoring and Mitigation Plan* to identify monitoring and mitigation measures to prevent and/or minimize impacts to groundwater, including from blasting. The plan would include identification of groundwater supplies through records review, field surveys, and landowners; the determination of susceptibility of identified supplies, and pre- and post-construction monitoring at the landowners request and with the landowners permission. Should it be determined after construction that there has been an impact on groundwater supply (either yield or quality), Pacific Connector would work with the landowner to ensure a temporary supply of water, and if determined necessary, Pacific Connector would replace a permanent water supply. Mitigation measures would be coordinated with the individual landowner in order to meet the landowner's specific needs. Mitigation measures for groundwater wells, springs, and seeps would be specific to each property and would be determined during landowner negotiations. Pacific Connector would request approval for any specific mitigation measures in such cases from appropriate regulatory agencies and from land management agencies with specific jurisdiction. Yields from perennial springs could decrease if blasting vibrations damaged the related aquifer. Pacific Connector would request authorization from landowners to test and document the baseline condition, yield, and water quality of any private wells or springs being used as permitted water supplies within 200 feet of the pipeline construction right-of-way. This testing would occur before the pipeline construction started in the nearby area, and the testing results would be shared with the property owner, if requested. Data collected during the dry season may prove most useful in determining potential effects. Testing of non-permitted wells and springs may be necessary to determine whether these would be affected. Similar information would be gathered for any public water wells or water supply springs located within 400 feet of the pipeline construction right-of-way.

Maximum PPV of 2 inches per second would be specified at the locations of private and public water supply wells. In specific cases, vibration could be reduced by drilling relief boreholes between the portion of the trench being blasted and any private or public water wells located within 200 feet of the pipeline construction right-of-way. The number and location of the relief boreholes would be determined on a site-specific basis.

Any turbidity in wells or springs caused by the blasting vibrations would be expected to be temporary and would likely dissipate shortly after blasting or after the well was pumped several times. Water quality impacts to groundwater or springs from blasting agents, if any, would be expected to be temporary and localized because only small amounts of these agents generally would be needed for trench excavation.

Wetlands

Blasting could potentially redirect surface water and groundwater flows to and from wetlands. In addition, turbidity and blasting agent by-products could possibly temporarily degrade surface water and groundwater quality.

Any turbidity resulting from blasting is expected to be temporary and to dissipate shortly after blasting. Water quality impacts to wetlands from blasting agents, if any, would be expected to be temporary and localized because only small amounts of blasting agents generally would be needed for trenching. Specific blasting agents would be listed in the *Blasting Plan* prior to the initiation of any blasting. The use of ANFO would not be allowed.

Slopes

Unstable rock and soil slopes could locally fail as a result of blasting vibrations. Pacific Connector would complete a reconnaissance of slopes in the vicinity of the blasting, including measuring slope inclinations and observing areas adjacent to planned blasting locations for potential indicators of unstable slopes. Identified slope areas that could be impacted by blasting would be monitored and evaluated for hazards to people and property during the blasting operations.

Structures

Blasting vibrations and flying debris could potentially damage aboveground structures. If structures were present in areas where blasting was necessary, Pacific Connector would request authorization from landowners to inspect structures located within 200 feet of the pipeline construction right-of-way before and after blasting. Blasting mats or padding also would be used when blasting near structures to limit potential damage from flying rocks. To limit potential damage to structures, maximum ground motion velocities of 2 inches/second would be specified at the locations of structures, which is consistent with the language of the *Blasting Plan*.

As an additional precaution, Pacific Connector would require the contractor conducting blasting to limit the size of charges in accordance with the scaled distance factor (SD) guidelines developed by the Office of Surface Mining Reclamation and Enforcement (OSMRE). The SD is equal to the distance from the blast to an aboveground structure divided by the square root of the charge (pound per delay). For distances less than 300 feet, OSMRE states that the SD shall exceed 50.

Adjacent Pipelines and Buried Utilities

Blasting vibrations could potentially damage adjacent underground pipelines and utilities. In general, blasting would not be allowed within 10 feet of an existing pipeline or buried utility. In cases where blasting near an existing utility was necessary, the pipeline or utility owner would be notified in advance of the blasting, and measures would be taken to minimize the potential for utility damage.

4.2.2.6 Paleontological Resources

There are no state or federal laws or regulations that protect paleontological resources on private lands (Niewendorp, DOGAMI, personal communication, 2008). The Antiquities Act of 1906 protects "objects of antiquity" on federal lands. The Paleontological Resources Preservation Act of 2009 applies to federal lands including BLM and NFS lands, as well as "Indian" lands, but does not apply to private land.

4.2.3 Environmental Consequences on Federal Lands

4.2.3.1 Geologic Hazards on Federal Lands

The seismic hazard evaluation included surface rupture from faulting, liquefaction potential, and lateral spreading. For sites where data were available, the evaluation indicates that the seismic hazard risk to the pipeline is generally low. There is potential for surface rupture from faulting where the pipeline would cross traces of the Quaternary-age Sky Lakes fault zone near MP 174 within the Winema National Forest. As mitigation for this pipeline crossing, during construction Pacific Connector would have the pipeline trench carefully examined by a qualified professional for evidence of stratigraphic offsets potentially related to ground rupture. If such features are observed, Pacific Connector would implement additional mitigation measures, with the specific mitigation developed at that time. However, the intent would be to follow published guidance to estimate the potential amount and direction of fault offsets as well as the magnitude of strain accumulation at the pipe crossing location (Takada et al. 2001; Honegger and Nyman 2004). Such measures could include burying the pipe in a wide trench that was backfilled with loose gravel or sand, which would allow for relatively unrestrained movement of the buried pipe within the zone of fault movement.

Two areas crossed by the pipeline within BLM Coos Bay and Roseburg District lands (Park Creek near MP 27 and Deep Creek near MP 48, respectively), and one area within Reclamation lands (near MP 201 to MP 203) are characterized as having low potential for liquefaction and lateral spreading. Low potential include sites with subsurface conditions of fine-grained soils that are not susceptible to liquefaction or soils that are not expected to be saturated.

High liquefaction and/or lateral spreading potential were identified at one site near Reclamation land (MP 201) associated with the Klamath Valley/Klamath River along the proposed route. Pacific Connector would conduct numerical modeling for this site prior to construction to estimate the magnitude of liquefaction-induced settlement and lateral spreading that would be expected during the design earthquake event. If the numerical modeling indicates that liquefaction settlement and/or lateral spreading would result in excessive pipe stress conditions, as analyzed by Pacific Connector, further mitigation design would be needed. Mitigation options may include deeper burial below the liquefiable soils, thicker pipe, and/or weighting the pipe with a concrete coating, if necessary. The primary mitigation measure being considered by

Pacific Connector to address liquefaction risks is ground improvement. Potential ground improvement measures include vibroflotation, stone columns, compaction grouting, and deep dynamic compaction. Primary geotechnical factors involved in selecting the type of mitigation include: depth of liquefiable soils, fines content, groundwater depth, the potential for obstructions (i.e., buried logs), and the density of overburden soils over the liquefiable soils.

The potential exists locally along portions of the proposed route on federal lands for seismically induced ground shaking to induce rockfalls, landslides, or soil slumps. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides. Pacific Connector was able to modify its proposed route to avoid most moderate- and high-risk RML hazards; however, two moderate-risk RML sites could not be avoided, including one site at MP 36.92 on land managed by the BLM Coos District. Additional investigation of this site resulted in a final risk determination of low (GeoEngineers 2013e). The landslide risk at this site is not considered hazardous enough to require additional mitigation or rerouting. To minimize landslide risk, Pacific Connector would implement its ECRP during pipeline construction, which would reduce the potential for construction to adversely affect slope stability.

Because the pipeline would cross a predominance of rugged terrain within BLM and NFS lands, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. As part of its pipeline operation, Pacific Connector would conduct regular monitoring of the pipeline right-of-way, which would aid in detecting landslide occurrence or slope movement. On federal lands, Forest Service and BLM representatives would conduct monitoring with Pacific Connector personnel. Mitigation could include the use of shutoff valves. If movement is detected, immediate action would be taken to reduce the risk to the pipeline. Actions would include initial response to reduce the stresses on the pipeline, and follow-up actions to stabilize the slide. If the slide is large and complex enough such that stabilization would not be feasible, the pipeline could be relocated around the slide area.

Pacific Connector intends to implement a level of landslide and pipeline easement monitoring like that currently performed on existing Williams-owned pipeline facilities in southwestern Oregon. Monitoring would consist of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

Pacific Connector conducted analyses to assess the potential for channel migration and the depth of streambed scour in the waterbodies that would be crossed by the pipeline. Site-specific stream assessments were conducted by NSR on behalf of the BLM and Forest Service at crossings of perennial streams on federal lands (NSR 2014) for the purpose of providing direction on channel restoration, not to specifically address channel migration and/or depth of streambed scour. For each of these crossings, a site-specific crossing restoration plan was developed and submitted to FERC subsequent to issuance of the DEIS. The BLM and Forest Service consider these plans to be a supplement to the POD prepared by Pacific Connector.

4.2.3.2 Mineral Resources on Federal Lands

Oil and gas leases exist on BLM lands located between MPs 17 and 55, MPs 131 and 167, and around MP 205 (GeoEngineers 2013e). However, all of these leases are reported to be closed. In addition, the BLM is reported to have three areas of geothermal leases. These geothermal leases are located near MP 193 and between MPs 216 and 221. Mining claims on federal lands are reported to exist between MPs 74 and 119 as well as near MPs 140 and 170; records indicate that most of these claims are closed. A placer claim reported to exist on federal land near MP 1.5R is also indicated as being closed. Discussions with BLM and Forest Service staff indicate that no new mining resources permits have been submitted for operations on federal lands (Yamamoto 2012) since an evaluation was last completed in 2009.

The Green Butte Quarry was identified at MP 101.8 within the Umpqua National Forest. However, GeoEngineers (2013e) indicated that this quarry was never opened and there are no plans for its future development. The proposed route between MPs 108.6 and 110.9 avoids the Peavine Quarry within the Umpqua National Forest. The pipeline alignment at MP 150.5 is within approximately 100 feet northeast of the Heppsie Mountain quarry on BLM land. Based on aerial photograph review of the quarry depths, trends, and distances from the pipeline, it was concluded that the quarry likely would extend into a stable rock outcrop that currently parallels the proposed route and does not pose a risk to the quarry or the pipeline project (GeoEngineers 2013e). POD attachments include the *Blasting Plan*, *Right-of-Way Clearing Plan*, and *Right-of-Way Marking Plan*, all of which would serve to ensure the avoidance of quarries.

Near MP 109, the pipeline would be about 0.3 mile and 0.5 mile east of the Nivinson and Red Cloud mercury mines, respectively. Construction and operation of the pipeline would not affect these mines. The proposed route would cross areas mapped as volcanic and volcanogenic rocks at the current crossings of the East Fork Cow Creek. These bedrock units have not been identified as a significant source of naturally occurring mercury. Naturally occurring mercury in this area typically is associated with metamorphic bedrock units such as amphibolite.

The Forest Service reports that naturally occurring mercury exists in the vicinity of the Mars Prospect located near MP 108.7 (Broeker 2010b). Broeker concluded that naturally occurring mercury is present in the disrupted soil regolith and underlying bedrock strata throughout the upper reaches of the East Fork Cow Creek watershed. Although localized, mercury values are sufficiently high enough to have warranted exploration, development and minor production between the 1930s and 1960s. Geochemical analysis of six soil samples collected along a 2,000-foot section of Pacific Connector's previously proposed route in this area that crossed partly through the historic Thomason mining claims near the East Fork Cow Creek determined the area to have very low concentrations of naturally occurring mercury mineralization. Pacific Connector subsequently rerouted its proposed route in this area approximately 2,500 feet from where the samples were taken.

Based on the analytical results, mapped bedrock at the proposed route, and the distribution/location of mercury mines, it is unlikely that the soils underlying the currently proposed crossing of the East Fork Cow Creek would have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous crossing location and most likely would have lower levels. Additional details on the literature research, field observations and soil sampling and analysis completed for the prospects and mines located near MPs 108 to 110 are provided in GeoEngineers (2013e). Soil sampling and analysis results also support that mercury specific health and safety protocols would not be needed for the construction activities. It is expected that the planned erosion and sediment control measures described in the Pacific Connector's ECRP would protect the ecological health of upland and in-stream areas from the naturally occurring mercury concentrations.

The pipeline could potentially interfere with future mining and reclamation activities on lands adjacent to the right-of-way. Future expansions of surface mines near the right-of-way potentially could be limited or precluded in some cases because mineral resources could not be extracted from slopes immediately above or below the pipeline right-of-way or from beneath the pipeline. Similarly, the presence of the pipeline could limit or preclude the stockpiling of mineral resources or development of a processing area on slopes above or below the pipeline. These considerations also could limit or preclude reclamation activities at mine sites near the pipeline because of the potential to disturb the slopes above and below the pipeline and right-of-way. Any impact would be site-specific and would depend on topography, drainage, and subsurface conditions in that area.

4.2.3.3 Rock Sources and Permanent Disposal Sites on Federal Lands

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600.

Pacific Connector has identified 42 potential rock source and permanent disposal sites that total approximately 175 acres along the pipeline route. Of these 42 rock source/disposal sites, 22 are located within federal lands as shown in table 4.2.2.4-1. Fourteen of these sites have been previously used and disturbed by quarry operations and/or strip mining. Most of these sites continue to have ongoing quarry operations. Only the disposal sites (and not the TEWAs) listed in table 4.2.2.4-1 are being proposed for use as permanent disposal sites.

Pacific Connector does not intend to expand these sites beyond the existing or previously disturbed footprints. If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.2.3.4 Blasting During Trench Excavation on Federal Lands

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline.

Table 4.2.2.5-1 provides a summary of the blasting potential along the pipeline. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment. The potential for blasting on BLM lands includes the following areas: MPs 1.47R–60.0, 60.0–70.1, 70.1–78.1, 78.1–88.6, 89.6–90.8, 90.8–94.5, 94.5–109.4, 136.3–136.8, 136.8–138.7, 138.7–159.9, and 174.4–181.1. The potential for blasting on NFS lands includes the following areas: MPs 110.9–112.1, 112.1–135.4, 159.9–172.0, and 172.0–174.4. The potential for blasting on Reclamation lands includes the following area: MPs 191.7–227.2.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to minimize vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide a Blasting Plan at least five working days prior to any blasting-related activity, or two weeks prior to blasting on federal lands, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work.

4.2.3.5 Paleontological Resources on Federal Lands

Paleontological resources on federal lands are regulated, as outlined in 36 CFR Ch. 11 261.9 (i). Pacific Connector consulted with federal land management agencies for information on potential paleontological resources crossed by or within the pipeline right-of-way.

Potential Paleontological Resources on NFS Lands

Pacific Connector states that consultation with staff of the Real Estate and Mineral Resources Section of the Umpqua National Forest reported that there were no known paleontological resources on the portions of the pipeline right-of-way located within the boundaries of the Umpqua, Rogue River, and Winema National Forests. According to Paleontology Associates, only the Umpqua and Rogue River National Forests bear potentially favorable lithologic units for fossil content along the pipeline corridor. These units occur in:

- Umpqua National Forest MPs 106 to 109—Fisher formation-volcanic ash and lacustrine siltstone;
- Umpqua National Forest MPs 109.5 to 115.5—Little Butte and Colestin formations-tuffaceous sediments;
- Rogue River National Forest MPs 120 to 121—Colestin formation-tuffaceous sediments; and
- Rogue River National Forest MPs 155 to 158—No formal formation designation-tuffaceous sediments, lahars, waterlaid tuffs.

Based on the information provided regarding the lack of identified paleontological resources within the pipeline right-of-way on NFS lands, no measures appear necessary for the avoidance and minimization of adverse effects to paleontological resources on NFS lands. Pacific Connector does not plan to monitor for lithologic units on NFS lands.

Potential Paleontological Resources on BLM Lands

The BLM required an assessment of the potential for paleontological resources on the portion of the right-of-way located on the lands it manages. Pacific Connector completed an assessment that indicates there is a limited potential for encountering paleontological resources on BLM lands and only localized monitoring would need to occur during pipeline construction. The following sections summarize the findings from the paleontological resource assessment. The full assessment report is contained in the *Final Paleontology Assessment, Pacific Connector Gas Pipeline Project, Coos Bay to Malin, Oregon* (GeoEngineers 2013g).

A formal analysis of existing paleontological data was completed for the portions of the pipeline right-of-way on BLM lands. The analysis, completed by Dr. William Orr, who is recognized by the BLM as a qualified paleontologist, was conducted in general accordance with BLM Manual H-8270-1 (BLM 1998b).

Fossil-bearing rock formations along the portions of the right-of-way located on BLM lands range in age from the Jurassic period (almost 200 million years old) to the Pleistocene Epoch (about 12,000 years before present). Between MPs 17 and 54, the right-of-way on BLM lands almost entirely traverses Eocene units of the southern Coast Range. The units span the entire epoch, with a wide variety of clastics ranging from coarse conglomerates to very fine-grained deep water silts and shales. Paleocene Epoch intervals in the lower Roseburg Formation could potentially contain plants, invertebrates, reptiles (turtles) and odontocete cetacea (primitive toothed whales). In addition, Pleistocene intervals in localized swamp boggy areas of the Roseburg Formation could potentially yield bones of large Ice Age mammals.

The portion of the BLM lands in the Klamath Mountain interval between MPs 54 and 97 has some of the oldest and most complex rocks in Oregon. Because most of the Klamath rocks are mapped as tectonic accretionary terranes, even the most fragmentary fossils discovered would be significant.

BLM lands would be crossed between MPs 110 and 123, MPs 128 and 137, and MPs 167 and 172 in the Cascade Range. Two formations in this region, the Colestin and Little Butte, have a potential for producing plant fossils. Both of these formations were deposited in nonmarine, continental settings with volcanogenic ash, tuff and silts mixed with extrusive volcanics of basalt, basaltic andesite and related igneous rocks. Despite the wide range of ages and environments, the floral lists at any given site for either formation are limited. As a result, any new taxa recorded or salvaged in the course of the construction activities would add to the knowledge of the Cascade geologic history.

Between MPs 216 and 217, the pipeline right-of-way crosses BLM lands in the Basin and Range province. Lake sediments of Cascade ash dating between 5 million to 11,000 years ago in this area bear a limited, but stratigraphically important fauna.

Paleontology Field Monitoring Protocols for BLM Lands

Pacific Connector conducted a field survey of the above-referenced portions of the pipeline right-of-way that occur on BLM lands. The locations observed during the survey were selected using the results of the formal analysis of the existing data and a mile-by-mile evaluation of the geologic formations along the right-of-way.

The field survey results were used to classify the potential for encountering paleontological resources on BLM lands during construction. The classifications used for the project were consistent with classes 1 through 5 in the BLM Potential Fossil Yield Classification procedure (revised H-8270-1).

All but 1 mile of the right-of-way on BLM lands has been classified as meeting Class 3a or 3b, based on the formal analysis and the field survey. An approximately 0.25-mile segment from MP 216.5 to 216.75 is classified as Class 4a. For approximately 25 miles of the Class 3a or 3b lands, the BLM would require limited spot monitoring during pipeline construction because the potential presence of fossils cannot be completely eliminated. The 1-mile-long area not classified as Class 3 is divided into two approximately 0.5-mile-long areas classified as Class 1 and Class 2. To satisfy BLM requirements, Pacific Connector would continuously monitor both of these segments for the potential presence of paleontological resources during pipeline construction. The spot or continuous monitoring during construction would be conducted by a field paleontologist working under the supervision of the lead paleontologist.

Procedures for Recovering Significant Discoveries of Vertebrate or Invertebrate Fossil Remains on BLM Lands

Although the likelihood of discovering paleontologically significant fossils on BLM lands is considered remote, such a discovery could potentially occur during the proposed surveys, brush clearing, or construction activities. The field inspector or field paleontologist identifying a fossil of potential interest would be responsible for notifying the lead paleontologist immediately of the discovery. The lead paleontologist would, in turn, evaluate the significance of the finding relative to the salvage parameters. If the fossil was considered salvageable material, it would be recovered under the direction of the lead paleontologist and Pacific Connector. Pacific Connector proposes to designate the University of Oregon Museum of Natural and Cultural History as the repository for any salvageable material recovered from the portion of the pipeline right-of-way located on BLM lands.

4.3 SOILS AND SEDIMENTS

The five principal factors of soil formation include parent material, climate, relief, living organisms or biological activity, and time. In the project area, soils have formed as a result of these five factors and soil differences are primarily a result of the relative importance, or dominant influence, of the various soil formation factors.

4.3.1 Jordan Cove LNG Terminal

4.3.1.1 Shoreline Along the Waterway for LNG Vessel Marine Traffic

Jordan Cove conducted a study to evaluate shoreline impacts during the transit of LNG vessels in the waterway to and from the LNG terminal (CHE 2011b).[37] The analysis indicated that pressure fields in the Coos Bay navigation channel generated by LNG vessels would be less than those currently caused by deep-draft cargo ships using the Port. There would be a small increase in wake-generated sediment transport from LNG vessels combined with assisting tugs and escort boats. However, it is not expected that soils along the waterway would be adversely affected by the wave action from LNG vessel traffic in the waterway because the LNG vessels would transit the bay at slow speeds and would not produce wakes large enough to erode the shoreline.

4.3.1.2 Soil Composition

The NRCS Soil Survey of Coos County, Oregon, indicates that the LNG terminal tract comprises primarily Waldport Fine Sand (59D and 59E), Heceta Fine Sand (28), Dune Land (16), Waldport-Heceta Fine Sand (61D), and Udorthents (57) (NRCS 2012a). Coquille silt loam (12) is found at the Kentuck Slough wetland mitigation site. With the exception of the Coquille silt loam, these soils are predominantly sands. Soil types for the U.S. Highway 101–Trans-Pacific Parkway intersection are not listed in NRCS sources; however, the geotechnical investigation completed in this area indicates that soils consist of manmade fill composed predominately of sand.

Construction of the Jordan Cove Project (including temporary and permanent effects) would disturb a total of about 397 acres as shown in table 4.3.1.2-1. This would include about 45 acres of Dune Land soils, 56 acres of Heceta Fine Sand soils, 98 acres of Waldport Fine Sand soils, 119 acres of Waldport-Heceta Fine Sand, 49 acres of Udorthents, and less than 1 acre of Heceta-Waldport Fine Sand.

TABLE 4.3.1.2-1

Acres of Impacts at the Jordan Cove LNG Terminal, by Soil Type

Soil Type	Acres a/	Percent
Jurisdictional Project Area		
Heceta Fine Sand	35	21.2%
Waldport-Heceta Fine Sand	53	32.2%
Heceta-Waldport Fine Sand	<1	0.3%
Waldport Fine Sand	54	32.8%
*Water	29	NA
Dune Land	22	13.4%
Udorthents, level (57)	<1	0.2%
Subtotal	**195**	**100.0%**

[37] See Coast & Harbor Engineering, 9 March 2011, Volume 2 – Jordan Cove Energy Project and Pacific Connector Pipeline Coastal Engineering Modeling and Analysis, filed as Appendix H.2 in Resource Report 2 of Jordan Cove's May 2013 application to the FERC.

TABLE 4.3.1.2-1

Acres of Impacts at the Jordan Cove LNG Terminal, by Soil Type

Soil Type	Acres a/	Percent
Non-Jurisdictional Project Area		
Waldport-Heceta Fine Sand	61	93.2%
Waldport Fine Sand	5	6.8%
Subtotal	**66**	**100.0%**
Temporary Construction Areas		
Dune Land	23	16.9%
Waldport Fine Sand	39	28.5%
Heceta Fine Sand	21	15.4%
Waldport-Heceta Fine Sand	5	3.7%
Udorthents, level (57)	48	35.5%
Subtotal c/	**136**	**100.0%**
Totals by Soil Type (entire terminal project)		
Heceta-Waldport Fine Sand	<1	0.1%
Dune Land	45	12.3%
Waldport Fine Sand	98	26.6%
Waldport-Heceta Fine Sand	119	32.5%
Heceta Fine Sand	56	15.2%
Water b/	29	NA
Udorthents	49	13.3%
Project Total	**397**	**100.0%**

a/ Column may not add correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
b/ Although it is acknowledged that water is not a soil, water is included because it is included in the soils mapping categories. Water is not included in percentage calculations and is denoted as "NA" for not applicable.
c/ The North Point Workforce Housing Complex adds an additional 2 acres to the temporary construction areas subtotal and project total that is not reflected in the table (see chapter 2). Soils in the housing project area are primarily Udorthents. This modification does not change the overall conclusions regarding soils impacts.

Waldport Fine Sand comprises approximately 27 percent of the project area. The Waldport Fine Sand is a deep, excessively drained soil, located on stabilized sand dunes. It is formed in aeolian deposits. Permeability of the Waldport soil is very rapid, but runoff is slow. This soil is susceptible to wind and water erosion and has the potential for severe erosion hazard.

Heceta Fine Sand comprises 15 percent of the project area. This is a deep, poorly drained soil found in deflation basins and depression areas between dunes. It is formed on aeolian materials. Permeability of this soil is rapid, and runoff is ponded. It only has a slight potential for water erosion.

Waldport-Heceta Fine Sands comprise approximately 33 percent of the project area. The soil is composed of 50 percent Waldport Fine Sand and 50 percent Heceta Fine Sand (both described above). This soil is characterized for its susceptibility to erosion and past erosion damage.

Dune Land soil makes up 12 percent of the project area. It consists of fine and medium textured sands on hills and ridges, formed in eolian deposits. Permeability is very rapid and runoff is slow. This soil type is susceptible to slight water and severe wind erosion.

Udorthents soils comprise 13 percent of the project area. They occur on floodplains, marshes, and tidal flats and in areas that have been filled and leveled for commercial and industrial uses. Areas on floodplains are made up of sandy, silty, or clayey material; and areas on marsh and tidal flats are made up of dredging spoil, dune sand, and wood chips. Soils at the proposed LNG terminal and the planned South Dunes Power Plant site have been previously disturbed by the operations of the Menasha and Weyerhaeuser companies and from the placement of fill material. At the Ingram Yard, the fill material, derived from COE dredging of the Coos Bay navigation channel in the 1970s, is more than 10 feet deep in some areas and mantles much of the terminal site. More recent testing and grading in the area of the Ingram Yard revealed the presence of ash-amended soils from 6 to 12 inches.[38]

The surficial fill materials present on portions of the terminal site are predominantly sand with some small percentage of silt. The material is typically characterized as loose to medium dense, brown sand. The material is fine grained and contains scattered shell fragments to a depth of 10 feet and a trace of silt. While not classified by the NRCS, it was assumed that these materials have similar properties and characteristics to adjacent soil types. Permeability of the fill materials is rapid. Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderate to severe. GRI performed geotechnical investigations in the area of the LNG storage tanks and process area of the proposed LNG terminal, including 11 deep borings.[39] The subsurface data revealed that generally the area was mantled by relatively clean, fine-grained sand, with traces of silt that is underlain by weathered sandstone. The sand layer extended from the surface to a depth of at least 124 feet.

Another geotechnical investigation was performed by GRI in April 2012 (GRI 2012) in the area where the planned South Dunes Power Plant (or "mill site") would be located, which included 12 deep borings. Typically, the upper 10 to 20 feet of the mill site is mantled with fill. The majority of the fill consists of reworked dune sand. The subsurface data revealed that generally underlying the fill was a relatively clean, fine-grained sand, with traces of silt, underlain by weathered siltstone.

GRI geotechnical explorations at the proposed Kentuck Slough wetland mitigation site indicate that the site consists of interbedded layers of sand and silt that extend from beneath an approximately 1- to 2-foot-thick surface layer of fill to a depth of about 35 feet, followed by silt to depths of about 70 to 100 feet. High moisture contents measured in the soil suggest the silt and sand may have a high organic content.

Sampling of the area to be dredged for the terminal access channel and marine slip was conducted during October 2006. A comprehensive sediment sampling and analysis program (SAP) protocol was prepared and submitted on August 17, 2006, for review by the COE. Results indicate that most of the materials consisted of sand. Grain size distribution analysis completed on 20 samples indicated the average percentage of sand was greater than 99 percent. No rock was encountered in the explorations for the SAP.

4.3.1.3 Soil Limitations

Prime Farmland

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion as determined by the U.S. Department of Agriculture (NRCS 2012b). Prime farmland can include land that possesses these characteristics but is being used currently to produce livestock and timber. Urbanized land and

[38] SHN, 2015, Letter to Robert Braddock, Jordan Cove Energy Project, regarding the Ingram Yard Test Pile and Ground Improvement Project, Chronology of Events, filed with FERC on February 3, 2015.
[39] GRI, 23 April 2013, Task Order No. 5, Geotechnical Investigation Proposed Jordan Cove LNG Facility Coos County, Oregon, attached as Appendix A.6 in Resource Report 6 of Jordan Cove's May 2013 application to the FERC.

open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, is not excessively erodible or saturated with water for long periods, and is not subject to frequent, prolonged flooding during the growing season. Soils that do not meet the above criteria may be considered prime farmland if the limiting factor is mitigated (e.g., using artificial drainage or irrigation).

Heceta Fine Sand does not meet the criteria for prime or unique farmland, but is considered to be farmland of statewide importance. This classification includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods (see section 4.3.2.1 for additional discussion of the "farmland of statewide importance" designation). However, no areas associated with the Jordan Cove Project are currently being used for cropland. The Ingram Yard and former mill site have been previously modified by industrial activities and the placement of fill. No prime farmland soils would be taken out of production by construction and operation of the Jordan Cove LNG terminal and related facilities.

Hydric Soils

Hydric soils are defined as "soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register 1994). Soils that are artificially drained or protected from flooding (e.g., by levees) are still considered hydric if the soil in its undisturbed state would meet the definition of a hydric soil. These soils are typically associated with jurisdictional wetlands, which must meet three required criteria: hydric soils, wetland hydrology, and hydrophytic vegetation, except in "atypical wetland situations" where not all criteria are evident. These situations are defined in the regional interim supplements to the COE's Wetland Delineation Manual (Environmental Laboratory 1987).

The Heceta Fine Sand soils are characterized as predominantly hydric and have mostly been covered with dredged material at the Jordan Cove Project site. These soils are located on the western edge of the terminal site, between Henderson Marsh and the forested dune, and on the northwestern corner of the area for the proposed marine slip. The Waldport-Heceta Fine Sands are partially hydric. The remaining site soils are non-hydric or predominantly non-hydric.

Jordan Cove has conducted wetland delineations of the site (see section 4.4 for a discussion of wetland delineations), which included evaluation of hydric soils. Construction of the Project would temporarily impact 21 acres of Heceta Fine Sand and 5 acres of Waldport-Heceta Fine Sand soils; and would impact 35 acres of Heceta Fine Sand and 53 acres of Waldport-Heceta Fine Sand soils that are located in the jurisdictional project area (NRCS 2012a).

Impacts on hydric soils would be reduced by Jordan Cove following the measures outlined in its *Plan* and *Procedures*. In addition, Jordan Cove proposed a *Compensatory Wetland Mitigation Plan* to mitigate impacts on wetlands. See section 4.4 for additional details regarding wetlands.

Erosion Potential

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles but highly influenced by wind intensity.

The potential for soil erosion at the proposed Jordan Cove LNG terminal varies based on the erosion mechanism and the soil characteristics. The soils at the terminal site occur within an area of high wind intensity and are in wind erodibility groups 1 (extreme) and 2 (high), which are the most susceptible to wind erosion. For the 98 acres of Waldport Fine Sand, the potential for water erosion is moderate to severe and the potential for wind erosion is extreme to severe when winds are strong.

The 56 acres of the Heceta Fine Sand and 45 acres of the Dune Land soils that would be impacted both have a slight potential for water erosion and high to severe potential for wind erosion, with the Dune Lands considered severe. The utility corridor would be constructed in the Dune Land soil. Runoff from the approximately 119 acres of Waldport-Heceta Fine Sand and 49 acres of Udorthents soils that would be impacted is slow, and the hazard of water erosion is slight to moderate, and the hazard to wind erosion is moderate to severe.

The erosion potential of soils at the terminal site is severe in some areas unless properly stabilized by the erosion and sedimentation BMPs to be implemented during construction. Temporary ditches, sediment fences and silt traps would be installed as necessary to minimize soil loss during construction and operation of the facility. Individual excavations would be made for equipment foundations. Following completion of foundations, the site would be filled, compacted, and brought up to final grade. Final grading and landscaping would consist of gravel-surfaced areas, asphalt-surfaced areas, concrete-paved surfaces, and grass areas. Areas disturbed by construction activities that would not be permanently covered with hard surface would be grassed using a seed mixture specified by the NRCS as being capable of surviving in highly permeable, xeric regimes, binding loose sand, and withstanding burial and deflation from aeolian process. Native species would be used and, if any non-native species are required for specific problem in extreme cases areas, species would be selected that would not become nuisance species to the surrounding areas.

Jordan Cove would adopt the provisions of the FERC's *Plan* and Jordan Cove's *Plan* to ensure that potential effects on soils due to construction are minimal. To minimize potential for soil loss due to erosion, all temporary erosion controls would be installed and maintained in accordance with Jordan Cove's *Plan*. In addition to temporary erosion controls, long-term erosion and sedimentation would be minimized by using county and state BMPs such as removing temporary sediment barriers and installing permanent erosion control measures as necessary. Permanent erosion control measures may include vegetation, vegetated swales, infiltration or settling basins, stormwater runoff diversion and control through ditches, check dams, or other velocity dissipaters.

For portions of the storm surge/tsunami barrier and terminal areas above +25 feet in elevation, which are not expected to normally be subjected to severe wind or water conditions, alternative erosion control would be used. The slope areas would be protected from potential tsunami runups using either concrete cellular mattresses, grout injected geotextile fabric mattresses, or other suitable means as determined during detailed design. The design of the slope protection against waves would be developed through consultation with DOGAMI. The erosion control measures would be designed in accordance with the ODOT Erosion Control Manual. By implementing the above-mentioned erosion control measures, construction of the LNG terminal and slip would not result in significant soil erosion by water or wind.

Erosion of the engineered slopes within the marine slip is not anticipated under normal conditions due to hydraulic mechanisms. The erosion control methods would be designed to withstand expected rainfall runoff and would be in accordance with the ODOT Erosion Control Manual. The east side of the slip would contain the LNG berth, and the north side would have the tug berth. The marine slip would be protected from LNG vessel and tugboat propeller scour with shore armor extending from the toe of the slope to above the water line where it would be tied into other slope stabilization techniques (concrete cellular mattresses, grout injected geotextile fabric mattresses, and/or geotextile reinforced vegetative planting). Additional discussion and description of the LNG terminal and slip design is included in sections 2.1.1 and 2.4.1 of this EIS.

Compaction Potential

Soil compaction is the process by which soil pore air space is reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates of the soil. Physical resistance to root growth can occur with high soil bulk densities. Soil compaction changes the soil structure by reducing the porosity and increasing the bearing strength of the soil. As a result, the ability to receive water is reduced, leading to an overall reduction in the moisture-holding capacity of the soil. The degree of compaction depends on the moisture content at the time of compaction and soil texture. Compaction decreases infiltration and thus increases runoff and the hazard of water erosion. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Sandy loam, loam, and sandy clay loam soils compact more easily than silt, silt loam, silty clay loam, silty clay, or clay soils (NRCS 2012b).

Construction equipment traveling over wet soils could further disrupt soil structure, reduce pore space, increase runoff potential, and cause rutting. Further compaction and rutting of impacted areas would be more likely to occur when soils were moist or saturated. However, based on previous activities at the Roseburg tract, and when Weyerhaeuser owned the terminal parcel, including dredge and fill activities, the soils at the terminal site are considered to be compacted. During most dredge and fill operations, material placed onto the land surface is compacted using heavy machinery. Jordan Cove would test subsoil for compaction at regular intervals in areas disturbed by construction activities.

The proposed cut and fill is largely balanced for the movements of the materials from the marine slip, the leveling of the LNG terminal site and the filling of the South Dunes Power Plant site. Approximately 60,000 cy of sand materials would be transported via trucks from the LNG terminal site to be used on the Kentuck Slough site for creation of the estuarine mitigation site. This fill is necessary to establish the appropriate vertical profile to establish tidelands influenced habitat. For additional information regarding the mitigation site, see discussions and information provided in sections 2.1.1.12 and 4.4.3 of this EIS.

Potentially Contaminated Upland Soils

Jordan Cove conducted multiple Phase I and Phase II ESAs at the terminal tract to determine if it contains contaminated soils. Phase I protocols consist of record searches, inventories, site visits, and other methods, but are not intrusive. Phase II protocols consist of intrusive sampling. Phase II ESAs were conducted to address the findings of the Phase I ESAs (CH2M Hill 1996; Thiel Engineering 2004; GRI 2005; PES Environmental 2006; GRI 2007c; GSI Water Solutions 2012). The ESAs are provided in Jordan Cove's Resource Report 7, Appendices C through F, dated May 21, 2013.

The site of the LNG terminal, referred to as the Ingram Yard, was the location of a livestock ranch until 1958. After it was acquired as part of the mill complex, the tract was occasionally used for log sorting activities. In 1972-1973, the COE spread materials dredged during maintenance of the Coos Bay navigation channel on the site. From the late 1970s through the early 1980s sand, boiler ash, and wood debris from milling operations were placed on the property. Weyerhaeuser, which acquired the mill in 1981, spread decant solids from its wastewater treatment facility at the Ingram Yard between 1985 and 1994.

In 1996, Weyerhaeuser had CH2M Hill conduct Phase II ESA investigations that found, with the exception of one sample, potential contaminants in the fill at the Ingram Yard were below levels that would necessitate cleanup work (CH2M Hill 1996). Polychlorinated biphenyl (PCB) concentrations in one sample were above the residential cleanup level but below the industrial level. Concentrations of arsenic were within natural background levels.

Additional Phase II ESA investigations were conducted by PES Environmental, Inc. (PES) in 2006. Eight composite samples were taken, at depths up to 18 inches, from the northern portion of the Ingram Yard. Trace amounts of barium, chromium, lead, and mercury were detected, but below screening levels. Low levels of dioxins, furans, and butyltin compounds were also detected in soil samples from the site. The amount of these contaminants were found to be below the EPA screening levels that represent a risk to human health for either residential or industrial land use (PES 2006).

A third Phase II ESA investigation was done at the LNG terminal site by GRI in October 2006 (GRI 2007c). Twelve test pits between 4 to 9 feet deep were excavated at the Ingram Yard, and two additional pits were located along the proposed eastern access road to the LNG terminal on the Roseburg property. Samples collected in areas where the black ashy mill waste was deposited typically had higher concentrations of contaminants than those taken at locations consisting only of sand. Volatile organic compounds (VOCs) and tributyltin were not detected. Detected levels of polynuclear aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons were below state and federal guidelines. Dioxins and furans were detected throughout the site at levels below the preliminary remedial goals for individual compounds. The toxic equivalent value for one sample collected at a depth of 2 feet was above federal guidelines for a dioxin/furan compound (2,3,7,8TCDD), but the statistical level for the site as a whole is below state requirements. Chromium and arsenic values for one sample were above naturally occurring levels, but that was likely caused by decaying treated wood waste. GRI recommended that when Jordan Cove conducts excavations for the marine slip the former mill waste should be separated, placed in the center of the bermed disposal areas at the South Dunes Power Plant area, and managed according to ODEQ standards and regulations (GRI 2007c).

GRI performed a Phase II ESA investigation of the Roseburg property in 2005 (GRI 2005). The Roseburg property includes northeastern portions of the LNG terminal area and a portion of the slip area. Roseburg has been using the property for wood processing activities since 1968. Geoprobe explorations were advanced to a maximum depth of 16 feet below the ground surface. Contaminants were detected in several locations throughout the area that would be used for temporary construction facilities. Detected levels of barium, chromium, and lead are within normal background levels for soils in Oregon. Soil samples from around an old burn pile (located to the east of the former shipping building) indicated contamination from VOCs. The detected compounds were petroleum hydrocarbons constituents found only in soils samples and not in groundwater samples. The detected concentrations were below the ODEQ Risk-Based Concentrations (RBCs) for residential soils (ODEQ 2012g). Contaminated areas were also found in the two existing buildings. Petroleum hydrocarbon constituents were found in the soil within the former sawmill building. Groundwater analysis indicated solvent constituents in the former sawmill building and petroleum hydrocarbon constituents in the former shipping building. Measured concentrations of the petroleum hydrocarbons, benzene, ethylbenzene, naphthalene, 1,2,4-trimethylbenezene and total xylenes are all within the ODEQ RBCs for residential soils and groundwater (ODEQ 2012g).

The Phase I ESA literature review that covered the South Dunes Power Plant area indicated that there were previous reports of spills of contaminated or hazardous waste. The site was originally developed as a sulfite pulp and paper mill by the Menasha Wood Ware Corporation in 1961. It was acquired by Weyerhaeuser in 1981, and converted to a recycle paper mill in 1995. The mill was closed in 2003. Between 1981 and 1992, Weyerhaeuser leased the southern portion of the property adjacent to the geographic Jordan Cove portion of Coos Bay to a fish hatchery operation. The buildings for both the mill and the fish hatchery have been removed. The Weyerhaeuser mill is included in the ODEQ's Environmental Cleanup Site Information (ECSI) database and in the Oregon Emergency Response Information System for a release of hydraulic oil to the ground surface in 1995. The fish hatchery has a separate entry in the ECSI database, identified as a level II area of concern, from a release of diesel fuel.

PES conducted Phase II testing in portions of the South Dunes Power Plant area. Concentrations of contaminants, including VOCs, PAHs, PCBs, dioxins and furans, and metals detected in soil and groundwater samples were below screening levels that would represent a risk to public health (PES 2006). The ODEQ issued Weyerhaeuser a "partial no further action" determination for the Ingram Yard and mill site, and included conditions that certain wastes be managed appropriately if they are disturbed (SHN 2015).

ODEQ approved the *Revised Work Plan for Joint Regulatory Closure Settling Basins, Petroleum-Contaminated Soil, Asbestos Waste, and Mill Waste Former `Weyerhaeuser Mill Site and Ingram Yard Properties* on July 22, 2013. The plan describes redevelopment of the South Dunes Power Plant site that would involve increasing existing site grades a minimum of 3 feet with clean structural fill consisting of sand from the new slip to be excavated on the Ingram Yard property. Development over the existing mill wastewater system settling basins would require over-excavation of geotechnically unsuitable (highly organic) sludge in the basins and replacement with clean, compacted structural fill. A qualified contractor familiar with handling potentially contaminated materials would be mobilized, and a dredge would be used to remove the basin sludge to a dewatering system. Potentially contaminated material would be transported off-site to an approved ODEQ-regulated facility that would be identified prior to construction.

The landfill Cell #3 located at the former Weyerhaeuser linerboard mill property is approximately 5.8 acres in extent. Jordan Cove plans to relocate the materials from this landfill to a qualified landfill site at the Columbia Ridge Landfill in Arlington, Oregon, managed by Waste Management (approximately all but 2 acres of the site will be filled in). This would be a benefit to the Jordan Cove Project and the overall site arrangement and would further protect the area and groundwater from this historically installed landfill. The landfill materials would be loaded in railcars and transported to the Columbia Ridge licensed existing landfill and properly disposed. This removal would be done in conjunction with the overall *Mill Site Closure Plan* that was approved by the ODEQ on July 22, 2013.

Jordan Cove filed supplemental information with the FERC on February 3, 2015, concerning Jordan Cove's Ingram Yard Test Pile and Ground Improvement Project. It comprises a February 2, 2015, letter to Jordan Cove from its contractor, SHN Consulting Engineers & Geologists, Inc. (SHN), and 12 attachments. The letter summarizes the chronology of activities for the test project, in particular as related to contaminated soils and a buried septic tank. During the final grading of the test pile staging area, a loader encountered a buried concrete tank on the southeast corner of Ingram Yard near the sheet pile staging area. The tank lid was punctured by the loader and liquids within the tank were observable. Inspection of the tank revealed no discernible odors or visual clues to suggest that the tank had petroleum residuals or volatile compounds, or signs of contamination in the soils around the top of the tank. Instead, the liquids in the tank were determined to be indicative of an old septic/holding tank. In early June 2014, after the test pile and ground improvement program was completed, tank liquids were tested and determined to be suitable for disposal as sewage. Once the tank contents were removed and properly disposed of, the tank was decommissioned by breaking the concrete into rubble and backfilling the void with clean sand.

On February 3, 2015, Jordan Cove filed the results of its 2014 geotechnical testing program at the Ingram Yard with the FERC. Grading for the north access road and the ground improvement test site required excavating between 12 inches to 60 inches of clean and low-level contaminated soils from a 2-acre area. Ash-amended soils were encountered during the site-grading activities occurring April 7 through April 15, 2014, with a total of 5,600 cubic yards of ash/soil mixture excavated and stockpiled on-site in berms as indicated in the 1200C permit.

During the grading of the site, an OSHA site inspection was performed and did not find exposure levels of concern among individuals working around the ash/soil mixture. While monitoring results indicated no worker exposure from the low-level contaminants in the soil, the OSHA site visit did initiate development of a site-specific health and safety plan for Ingram Yard (Attachment 7 of the supplemental filing with the FERC) was prepared by an industrial hygienist using past Phase 2 waste characterization studies. Based upon potential for inhalation exposure from the contaminants of concern, the health and safety plan identified that control of air born particulates (dust) would be beneficial for protecting workers from low-level contaminants in the ash/soil mix; and an air monitoring plan was also prepared (Attachment 9 of the supplemental filing with the FERC) and implemented during the ground improvement program. Real-time air monitoring of dust during the ground improvement project proved effective, and at no time did dust levels exceed job site threshold levels set for protection of workers.

On May 8, 2014, ODEQ conducted an on-site investigation of Ingram Yard activities. Based on ODEQ's site visit, it was determined that the low-level contaminated soils had been excavated and stockpiled on-site. These actions, while not prohibited, required a solid waste letter of authorization before commencement of grading activities. Because the work had already been initiated prior to being notified, ODEQ issued a "Warning Letter with Opportunity to Correct" (Attachment 10 of the supplemental filing with the FERC). The correction required Jordan Cove to obtain a solid waste authorization letter. On July 16, 2014, a solid waste authorization letter was submitted to ODEQ (Attachment 11 of the supplemental filing with the FERC). Per guidance from ODEQ, Jordan Cove would provide prior notice to ODEQ should any grading or ground disturbance activities be planned to occur on Ingram Yard. Ultimately, provisions for long-term disposal of disturbed Ingram Yard soils and any other specific mitigation measures would be specified in detail in the final engineering design.

Jordan Cove has prepared an *Unanticipated Hazardous Waste Discovery Plan* that includes the following measures that would be implemented in the event that unanticipated soil contamination is discovered during construction of the LNG terminal facilities:

- contractor would stop work in the vicinity of the suspected contamination;
- contractor would cordon off or otherwise restrict access to the suspected area;
- contractor would immediately notify Jordan Cove's on-site EI; and
- Jordan Cove's on-site EI would immediately notify the Environmental, Health and Safety Division of Jordan Cove in the event that unanticipated soil contamination is discovered.

If Jordan Cove's Environmental, Health and Safety Division determines that additional action is necessary, Jordan Cove would implement the following measures:

- contact a qualified consultant and/or testing laboratory to assist with the determination of the extent and nature of the contamination;
- devise a plan for additional site-specific investigations as necessary;
- conduct the necessary level of site-specific testing and/or laboratory analysis to determine extent and nature of contamination;
- notify all applicable environmental authorities as required by law, including ODEQ;
- devise a site-specific plan depending on the nature and extent of the contamination encountered for continuation of construction. This step may involve evaluation avoidance options as necessary to support the construction of the proposed facilities;
- devise a strategy or plan for handling wastes in an appropriate manner including waste characterization, hauling, manifesting, and disposal necessary to support continuing construction;
- devise a plan for site stabilization and backfilling; and
- complete all required and necessary agency follow-ups and reporting.

Spills or leaks of fuels, lubricants, or coolant from construction equipment could contaminate soils. The effects of contamination would typically be minor because of the low frequency of spills and leaks. However, the soil and sand on the LNG terminal site have high permeabilities, shallow groundwater (10 feet or less), and rapid transmissivity. If a spill occurred, it would spread quickly (in three dimensions) before mitigation and/or remediation could begin. Jordan Cove would implement a water quality management plan that includes an SPCCP. These plans describe spill prevention practices, spill handling and emergency notification procedures, and training requirements and would be implemented during construction of the LNG terminal and pipeline. The SPCCP addresses the unique soil and subsurface conditions of the LNG terminal site, including the high permeability, shallow groundwater, and rapid transmissivity. With the design features and SPCCP, construction of the LNG terminal is not anticipated to spread existing contamination or cause additional soil contamination.

Potentially Contaminated Bay Sediments

The Port developed a SAP (SHN 2006b) that details the sediment collection and testing program conducted on the proposed dredged material. The SAP was developed based on procedures outlined in the Lower Columbia River Management Area Dredged Material Evaluation Framework (DMEF) (COE et al. 1998). The sediment sampling and analysis program followed the DMEF Tier IIB approach for physical and chemical evaluation of the proposed dredged material. Four horizontally delineated areas were selected within the proposed dredging footprint to characterize the proposed slip access channel sediments (figure 4.3-1). Areas 1 and 2 were closest to the shoreline, whereas areas 3 and 4 were offshore, parallel to the Coos Bay navigation channel. Generally, two core locations were designated within each area in locations with the thickest deposits of proposed dredged materials (dredge prism). A total of eight sediment core borings were completed using direct-push methodology.

Dredged Material Management Units (DMMUs) were designated as "moderate" based on the DMEF ranking protocol with a maximum volume frequency of 40,000 cy for homogenous sediments. Two sediment bore locations were completed within each DMMU. Each sediment bore location was continuously cored in 4-foot intervals. Core intervals for each sediment bore were designated alphabetically, beginning with "A" representing the surface layer interval, and proceeding downward from the top in 4-foot increments. Each 4-foot DMMU depth interval was represented by one sample. The DMMU sample submitted for chemical analyses comprised core sections within the same sediment depth interval and with similar characteristics. Sample compositing was completed by the analytical laboratory. Four DMMUs were positioned on the proposed dredge area sediment surface that contained material from the depth interval 0 to 4 feet. This pattern was repeated for each subsequent depth interval of 4 feet, until the final designated characterization depth of -48 feet MLLW was attained or refusal was encountered. A total of 21 DMMUs representing the full dredge prism were characterized. Several sediment borings encountered refusal at deeper depths (25 to 35 feet below the sediment surface) and the deepest sediment sample collected at these locations was considered acceptable as a Z-sample. Z-samples represent the newly exposed sediment surface after dredging occurs.

During October 2006, direct-push boring samples were collected at eight locations specified in the revised SAP. The sediment core sections were segmented and sealed with Teflon tape and plastic end caps. The sediment core sections were transported by overnight courier to the analytical test laboratory for compositing. Collected samples were stored in iced coolers, or kept in a secured refrigeration unit at 39.2ºF.

Grain size analysis was immediately performed on all 21 DMMU composite samples following COE approved methods (COE et al. 1998). The results of the grain size distribution indicated the average percent of sand present in sediment samples was approximately 99.85 percent. The results of the total volatile solids (TVS) analysis indicated that the average percent TVS present in dredge prism sediments was approximately 0.71 percent.

Based on the results of the sediment sample analyses for grain size and TVS, and the DMEF guidelines for the Tiered Evaluation Process, no further analytical testing of sediment samples was completed. Specifically, DMEF Tier IIA states, "If the results of grain size analysis are at least 80 percent sand and TVS is less than 5 percent, the proposed dredging material qualifies for unconfined, aquatic disposal based on exclusionary status." The Port's report concluded that no areas of contaminated sediments were observed.

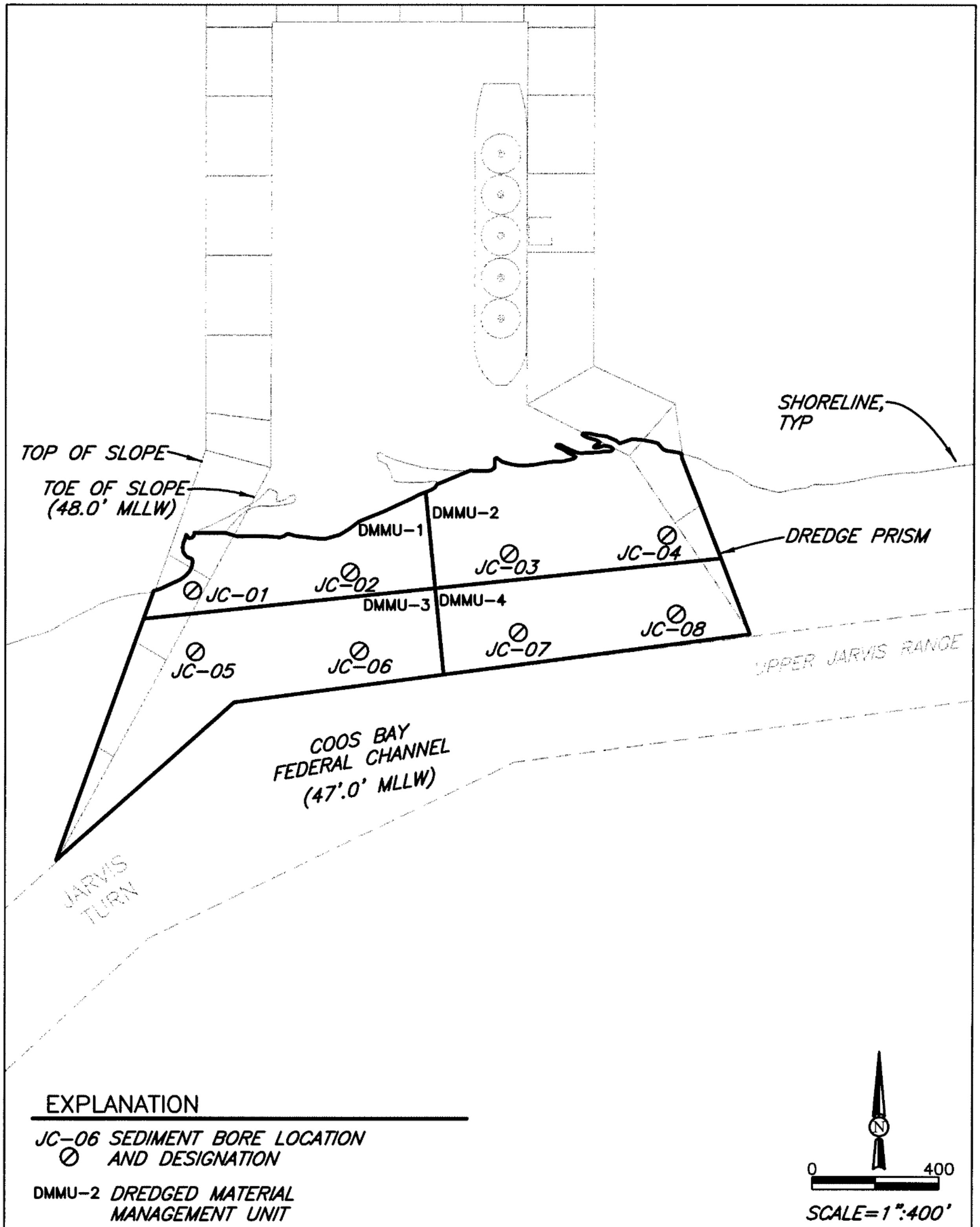


Figure 4.3-1

Dredged Material Management Units and Bore Locations

Extensive investigations regarding soil contaminants have been performed in close coordination with the COE at the Kentuck Slough mitigation site beginning in 2010. GRI has submitted four sampling and analysis plans and three sediment characterization reports for the site to the COE from September 2010 to November 2014. These studies document that chemical analysis of samples did not detect any contaminants above applicable screening levels and that the material is suitable for its intended use in the wetland mitigation site without restriction, with one exception. According to the sampling results documented in the November 13, 2014 Sediment Characterization Report, mercury is present at levels above Clean Fill screening criteria in sediments contained in the golf course irrigation pond. Oil-range hydrocarbons are also present at this location. Jordan Cove therefore plans to remove these sediments to an off-site disposal facility. COE approval of the reports is pending. In addition, no contaminants were detected that might be indicative of the previous existence of a methamphetamine lab on the property.

4.3.2 Pacific Connector Pipeline and Associated Facilities

Soils along the proposed pipeline route were identified using NRCS surveys for Coos, Douglas, Jackson, and Klamath Counties (NRCS 2004; SCS 1985, 1989, 1993); and NRCS State Soil Geographic Database (STATSGO) and Soil Survey Geographic Database (SSURGO) soil classifications (NRCS 2012a). The Forest Service soil resource inventories of the Umpqua, Rogue River, and Winema National Forests were used to assess soil resources in the National Forests (Forest Service 1976, 1977, and 1979). Information in the Forest Service surveys was supplemented by STATSGO and SSURGO data where available.

Regional maps from NRCS county soil surveys, coupled with SSURGO data, were used to provide descriptions of the soil associations that would be crossed by the pipeline and aboveground facility sites, including storage yards, rock sources, permanent disposal sites, proposed access roads, and proposed aboveground facilities. Generally, these associations are composed of two or three soil series. Each of the soil associations is a unique natural landscape with a distinctive pattern of soils, relief and drainage.

According to the NRCS Land Resource Regions and Major Land Resource Areas (MLRAs) (NRCS 2006b), the pipeline route would cross five MLRAs:

- the Sitka Spruce Belt including the Pacific Coast and Coos Bay area in Coos County;
- the North Pacific Coast Range, Foothills, and Valleys including Coos County and portions of Douglas County;
- the Siskiyou-Trinity Area including portions of Douglas and Jackson Counties, the Umpqua National Forest, and portions of the Rogue River National Forest; and
- the Klamath and Shasta Valleys and Basins in the southern part of Klamath County.

Soil associations crossed by the pipeline are shown in table 4.3.2-1 by MP, including the mileage percentage of the entire pipeline length. The Medco-McNull-McMullun and Vermisa-Vannoy-Josephine-Beekman soil associations are crossed by 15.5 and 14.2 percent of the pipeline length, respectively. The remaining soil associations are crossed by less than 9 percent of the pipeline length.

TABLE 4.3.2-1

Soil Associations Crossed by the Pacific Connector Pipeline

From	To	County	Soil Association (STATSGO)	Total Crossing Length (miles) a/	Percent of Project Mileage
MLRA 4A – Sitka Spruce Belt – MPs 1.47R to 19.22					
1.47R	1.78R	Coos	Nehalem-	2.8	1.2%
10.88R	9.11		Duneland	0	
10.6	11.34		Bullards	0	
			(s6398)	0	
1.74R	4.12R	Coos	Coos Bay Estuary	2.4	1.0%
4.12R 9.11 11.34	10.88R 10.6 19.22	Coos	Tolovana- Templeton- Salander- Reedsport' Fendall (s6399)	16.1	6.9%
			Total miles	**21.3**	
MLRA 1 – Northern Pacific Coast Range, Foothills, and Valleys – MPs 19.22 to 47.16					
19.22	22.4	Coos	Peavine-Olyic-Melby-	10.5	4.4%
23.36	27.79		Honeygrove-	0	
28.92	29.48		Blachly	0	
30.34	32.42		(s6396)	0	
22.4	23.36	Coos	Nekoma-Meda-	1.8	0.8%
29.48	30.31		Kirkendall-	0	
			Eilertsen	0	
			(s6402)	0	
27.79	28.93	Coos	Preacher-	14.5	6.9%
32.42	47.26	Douglas	Bohannon	1.6	
			(s6395)	0	
			Total miles	**28.0**	
MLRA5 – Siskiyou-Trinity Area – MPs 47.16 to 168.0					
47.26	48.05	Douglas	Windygap-	3.9	1.7%
52.5	55.14		Larmine-Bellpine-	0	
57.57	58.07		Bateman-Atring	0	
			(s6410)	0	
48.05	52.5	Douglas	Wapato-Waldo-	4.5	1.9%
			McAlpin-Cove-	0	
			Bashaw	0	
			(s6408)	0	
55.14	57.57	Douglas	Otwin-Oatman	3.3	1.4%
60.59	61.48		(s6397)	0	
58.07	60.59	Douglas	Vermisa-Vannoy-	32.9	14.2%
61.48	70.89		Josephine-	0	
71.72	89.37		Beekman	0	
91.88	95.23		(s6360)	0	
70.89	71.72	Douglas	Ruch-Medford	0.8	0.4%
			(s6385)	0	
73.19	75.22	Douglas	Lettia-Kanid-	7.4	3.2%
89.37	91.90		Atring-Acker	0	
95.23	96.52		(s6382)	0	
104.87	105.70			0	
109.38	110.10				
75.22	76.36	Douglas	Rock outcrop-	1.1	0.5%
			Pearsoll-	0	
			Dubakella-	0	
			Comutt	0	
			(s6377)	0	
96.52	104.87	Douglas	Tethrick-	8.4	3.6%
			Tallowbox-	0	
			Siskiyou-Shefflein	0	
			(s6383)	0	
105.7	109.38	Douglas	Thistleburn-	3.7	2.3%
110.1	111.77	Jackson	Telemon-	1.3	
			Scaredman-	0	
			Mellowmoon-	0	
			Lempira-Illahee14	0	

TABLE 4.3.2-1

Soil Associations Crossed by the Pacific Connector Pipeline

From	To	County	Soil Association (STATSGO)	Total Crossing Length (miles) a/	Percent of Project Mileage
			(s6390)	0	
111.77	117.75	Jackson	Straight-Geppert-	6.0	2.6%
			Freezener-	0	
			Dumont	0	
			(s6381)	0	
117.75	146.38	Jackson	Medco-McNull-McMullun	36.1	15.5%
146.86	152.42		(s6380 & S6386)	0	
153.07	155.02			0	
146.38	146.86	Jackson	Ruch-Medford	0.5	0.2%
			(s6385)	0	
152.42	153.07	Jackson/	Tatouche-	0.7	5.9%
155.04	168	Klamath	Pinehurst-Farva-	13.0	
			Bybee	0	
			(s6384)13	0	
			Total miles	**123.9**	
MLRA 21 – Klamath and Shasta Valleys and Basins MPs 168.0 to 228.13*					
168	174.69	Klamath	Oatman-Otwin	6.7	2.9%
			(s6387)13	0	
174.69	180.2	Klamath	Woodcok-Royst-	5.5	2.4%
			Pokegema	0	
			(s6388)	0	
180.2	189.9	Klamath	Sheld-Pinehurst-	9.7	4.2%
			Greystoke-Bly	0	
			(s656)	0	
189.9	190.83	Klamath	Lorella-Deven-	2.1	0.9%
197.86	198.59		Bieber-Adinot	0	
225.34	225.67		(s542)	0	
227.99	228.11				
190.72	193.6	Klamath	Tulebasin-Malin-	7.0	3.0%
194.43	197.86		Lather-Capjac	0	
198.59	199.27		(s1150)	0	
199.27	202.09	Klamath	Poe-Pit-Malin-	2.8	1.2%
			Laki-Henley	0	
			(s6357)	0	
202.09	214.7	Klamath	Fordney-Calimus	20.5	8.8%
215.9	216.25		(s6356)	0	
217.22	218.8			0	
221.75	225.34			0	
225.67	227.99			0	
228.11	228.19			0	
214.7	215.9	Klamath	Stukel-Salisbury-	5.1	2.2%
216.25	217.22		Lorella-Fiddler-	0	
218.8	221.78		Dehlinger-	0	
			Capona	0	
			(s6355)	0	
			Total miles	**59.5**	
			Project Total (miles)	**231.7 b/**	

a/ Mileages are rounded to the nearest tenth of a mile; therefore, column may not sum correctly.
b/ In an effort to maintain milepost continuity while adjusting the pipeline route, milepost equations have been incorporated into the alignment. This allows the mileposts, for the most part, to remain unchanged. However, the ending milepost no longer reflects the actual length of the proposed pipeline.
c/ Although alignment modifications made since the DEIS change the numerical information in this table, such changes would be slight and would not affect the evaluation of effects to soils. In addition, the alignment modifications were made to improve stream crossings and to minimize sidehill construction and grading and cut/fill requirements. Thus, overall impacts to soils and soil constraints would be reduced.

The dominant soil mapping units crossed by the pipeline in the McNull-Medco-McMullin soil association are the Medco-McMullin complex, 12 to 50 percent slopes; McMullin-Rock Outcrop, 3 to 35 percent slopes; McMullin-McNull gravelly loams, 35 to 60 percent slopes; Mcmullin-Medco Complex, 15-50 percent slopes; McNull loam, 12 to 35 percent north slopes; and McNull-

Medco complex, 12 to 50 percent slopes. Thirty-four other map units are crossed within this association. Each of the dominant soil map units has steep slopes, is susceptible to soil compaction, and has reclamation sensitivity potential. In addition, a few soils contain large stones, areas of shallow bedrock, and seasonal high water tables. One soil in this association is designated farmland of statewide importance.

The dominant soil mapping units for the Vermisa-Vannoy-Josephine-Beekman soil association crossed by the pipeline route are the Speaker-Beekman-Josephine complex, 60 to 90 percent north slopes; Josephine-Speaker complex, 30 to 60 percent north slopes; Speaker-Nonpareil complex, 30 to 60 percent slopes; Debenger-Brader complex, 12 to 30 percent slopes; Oakland-Nonpareil-Sutherlin complex, 30 to 60 percent slopes; and Speaker loam, 30 to 60 percent south slopes. Twenty-seven other soil map units are crossed by this association. All of the dominant soil map units are susceptible to soil compaction and have a reclamation sensitivity rating.

Much of these soils have steep slopes and water erosion potential and some have shallow bedrock. One soil has a shallow, seasonal water table, and one soil is listed as prime farmland (farmland of statewide importance).

Detailed descriptions of all soil associations crossed by the Project and their characteristics are provided in appendix G of this EIS. The remainder of this discussion focuses on the sensitive soils characteristics present along the pipeline route as shown in table 4.3.2-2.

To provide the highest level of detail in quantifying the soil properties and impacts, analysis was based on the characteristics of the individual soil mapping units crossed within each soil association. Major soil characteristics and limitations for the pipeline and aboveground facilities are discussed below. Table 4.3.2-2 provides a summary of soil limitations that could be encountered by the pipeline route, and table 4.3.2-3 provides a summary of the soil limitations associated with the aboveground facilities. These tables include footnotes to indicate where slight route changes were made and where four aboveground facilities were relocated. The soil parameter calculations were not revised because effects to soils in these areas are considered minor, and the slight route changes and facility relocations generally result in an overall improvement in terms of overall acreage and potential effects to soils.

TABLE 4.3.2-2

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline

Milepost		Total Crossing Length		Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/										
				Erosion From								High		
From	To	Length (miles)	County	Water b/	Wind c/	Steep Slopes d/	Large Stones e/	Restrictive Layer f/	Saline/ Sodic g/	Soil Compaction h/	Reclamation Sensitivity i/	Water Table j/	Hydric Soils k/	Prime farmland l/
1.47R 10.88R 10.60	1.78R 9.11 11.34	2.8	Coos	0.5 (11)	0.2 (17)	0.5 (8)	0.0	0.7 (12)	0	2.8 (64)	0.6 (24)	2 (54)	1.8 (51)	1.8 (37)
1.78R	4.12R	2.5	Coos	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.12R 9.11 11.34	10.88R 10.60 19.22	16.5	Coos	9.7 (140)	0.0	9.7 (140)	0.0 (<0.1)	12.7 (194)	0.0	16.5 (256)	9.5 (137)	1.1 (23)	1.1 (23)	4.6 (84)
19.22 23.36 28.92 30.34	22.40 27.79 29.48 32.42	10.5	Coos	6.3 (110)	0.0	6.0 (106)	0.2 (5.5)	0.7 (16)	0.0	10.5 (172)	6.3 (112)	0.1 (2)	<0.1 (<1)	0.1 (2)
22.40 29.48	23.36 30.34	2.0	Coos	0.2 (4)	0.0	0.2 (3)	0.0	0.0	0.0	2.0 (34)	0.2 (3)	1.3 (19)	0.5 (7)	1.6 (27)
27.79 32.42	28.92 47.26	14.5 1.6	Coos Douglas	9.6 (153)	0.0	8.9 (140)	6.1 (101)	11.0 (210)	0.0	15.9 (263)	11.5 (183)	0.0	0.3 (3)	<0.1 (1)
47.26 52.50 57.57	48.05 55.14 58.07	4.2	Douglas	1.9 (27)	0.0	1.3 (19)	0.3 (4)	3.4 (46)	0.0	4.2 (59)	3.7 (52)	0.7 (9)	<0.1 (<1)	2.7 (38)
48.05	52.50	4.6	Douglas	0.7 (4)	0.0	0.7 (9)	0.0	2.9 (47)	0.0	4.6 (68)	4.6 (67)	1.2 (18)	0.5 (6)	3.4 (52)
55.14 60.59	54.55 61.48	3.3	Douglas	1.4 (23)	0.0	1.4 (23)	<0.1 (3)	1.7 (28)	0.0	3.3 (51)	3.1 (49)	1.5 (23)	0.7 (10)	1.8 (27)
58.07 61.48 71.72 91.88	60.59 70.89 89.37 95.23	30.5	Douglas	19.1 (274)	0.0 (<1)	19.1 (274)	2.3 (67)	20.4 (317)	0.0	30.2 (502)	27.5 (451)	6.2 (98)	1.0 (16)	10.4 (218)
70.89	71.72	0.8	Douglas	0.5 (7)	0.0	0.5 (7)	0.3 (5)	1.1 (16)	0.0	1.3 (19)	0.9 (7)	0.7 (9)	0.3 (9)	0.8 (11)
73.19 89.37 95.23 104.87	75.81 91.88 96.51 110.10	8.0	Douglas	4.3 (63)	0.8 (11)	5.0 (73)	3.2 (45)	5.4 (75)	0.00	7.0 (107)	6.5 (100)	0.9 (11)	0.3 (4)	2.4 (41)
75.81	76.36	1.2	Douglas	1.1 (19)	0.0	1.1 (19)	1.0 (17)	1.2 (20)	0.0	1.0 (18)	1.2 (20)	0.0	0.0	<0.1 (1)
96.51	104.87	8.4	Douglas	8.2 (119)	4.4 (61)	8.2 (119)	2.9 (41)	8.0 (121)	0.0	4.3 (64)	8.4 (121)	2.4 (35)	0.0	0.1 (2)
105.70 110.10	109.38 111.77	3.7 1.3	Douglas Jackson	3.2 (44)	3.2 (44)	5.0 (85)	4.8 (82)	4.8 (82)	0.0	0.4 (6)	4.8 (82)	0.0 (3)	0.0	0.0
111.77	117.75	6.0	Jackson	1.9 (26)	0.0	6.0 (87)	4.1 (59)	5.4 (78)	0.0	4.2 (60)	6.0 (87)	0.5 (7)	0.6 (9)	0.6 (8)
117.75 146.86 153.07	146.38 152.42 155.04	35.9	Jackson	16.1 (257)	0.0	29 (448)	26.4 (409)	32.8 (511)	0.0	33.4 (552)	35.3 (548)	17.9 (274)	0.2 (6)	4.9 (77)
146.38	146.86	0.5	Jackson	<0.1 (1)	0.0	<0.1 (1)	<0.1 (1)	0.5 (6)	0.0	0.5 (6)	0.5 (6)	0.5 (6)	0.0	0.4 (5)
152.42 155.04	153.07 168.00	12.1 1.6	Jackson/ Klamath	0.6 (7)	0.0 (<1)	3.9 (83)	5.1 (95)	5.0 (79)	0.0	1.8 (29)	3.7 (98)	0.1 (22)	0.4 (6)	0.7 (12)

TABLE 4.3.2-2

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline

Milepost		Total Crossing		Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/										
				Erosion From								High		
From	To	Length (miles)	County	Water b/	Wind c/	Steep Slopes d/	Large Stones e/	Restrictive Layer f/	Saline/ Sodic g/	Soil Compaction h/	Reclamation Sensitivity i/	Water Table j/	Hydric Soils k/	Prime farmland l/
168.00	174.69	6.8	Klamath	0.0	0.0	0.2 (3)	3 (40)	0.0	0.0	2.9 (40)	0.2 (3)	0.8 (12)	0.0	0.0
174.69	180.20	5.5	Klamath	1.9 (27)	0.0	1.9 (27)	0.5 (6)	2.5 (32)	0.0	0.0	4.4 (59)	0.0	0.0	0.7 (8)
180.2	189.90	9.7	Klamath	1.0 (13)	0.0	3.0 (37)	1.3 (17)	3.3 (41)	0.0	0.6 (7)	3.9 (49)	0.0	0.0 (0.6)	3.0 (40)
189.90 197.86 225.34 227.99	190.72 198.59 225.67 228.11	2.0	Klamath	0.5 (10)	0.4 (19)	0.9 (12)	0.9 (12)	1.1 (27)	0.3 (11)	1.6 (60)	1.0 (16)	0.3 (11)	0.2 (7)	1.4 (56)
190.72 194.43 198.59	193.60 197.86 199.27	7.1	Klamath	0.3 (8)	0.0	0.0 (<1)	0.0 (<1)	4.3 (91)	4.6 (99)	6.6 (137)	4.6 (99)	4.9 (106)	1.8 (42)	6.6 (137)
199.27	202.09	2.8	Klamath	0.0	0.2 (6)	0.0	0.0	1.4 (24)	2.0 (38)	2.6 (49)	2.0 (7)	2.3 (44)	0.4 (8)	2.6 (49)
202.09 215.90 217.22 221.75 225.67 228.11	214.70 216.25 218.80 225.34 227.99 228.13	20.5	Klamath	1.2 (17)	7.0 (121)	1.1 (16)	1.1 (16)	9.0 (157)	1.3 (24)	20.5 (340)	9.0 (157)	1.8 (35)	0.0	19.3 (342)
214.7 216.25 218.80	215.90 217.22 221.75	5.1	Klamath	4.0 (60)	0.0 (1)	4.0 (60)	4.0 (60)	4.0 (60)	0.0	5.1 (71)	4.3 (66)	0.0	0.0	1.4 (22)
	Project Total	**231.8** m/	**All**	**94.3 (1,428)**	**16.2 (279)**	**117.6 (1,798)**	**67.6 (1,083)**	**143.3 (2,294)**	**8.2 (172)**	**183.6 (3,045)**	**163.5 (2,457)**	**47.2 (821)**	**10.3 (210)**	**71.5 (1,297)**
			Percentage	**40.7%**	**7.0%**	**50.8%**	**29.2%**	**61.8%**	**3.5%**	**79.2%**	**70.6%**	**20.4%**	**4.4%**	**30.9%**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").

a/ Numerical values shown are miles crossed by construction, including construction right-of-way and TEWAs. Acres affected shown in parenthesis. Soil data from NRCS 2004; SCS (1985, 1989, 1993); Forest Service 1976, 1977, and 1979. NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2012a).
b/ Soils with NRCS wind erodibility groups 1 and 2.
c/ Soils with NRCS rating of high or severe.
d/ Soils with slopes greater than 30 percent.
e/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.
f/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.
g/ Soils with an electrical conductivity of 8 mmhos/cm or greater and/or a Sodium Adsorption Ratio (SAR) of 13 or greater.
h/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.
i/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. The Reclamation/Sensitivity type does not include data related to the revegetation sensitivity studies on federally-managed lands (NSR 2015).
j/ Soils saturated within 60 inches of the surface in most years.
k/ Soils with at least one major named map unit included on the county hydric soil list.
l/ Soils with dominant map unit included on either the state or county list of farmland of importance.
m/ In an effort to maintain milepost continuity while adjusting the pipeline route, milepost equations have been incorporated into the alignment. This allows the mileposts, for the most part, to remain unchanged. However, the ending milepost no longer reflects the actual length of the proposed pipeline.

TABLE 4.3.2-3

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	Saline/ Sodic f/	High Compaction Potential g/	Poor Revegetation Potential h/	High Water Table i/	Hydric Soil j/	Prime Farmland k/
Jordan Cove Receipt MS, BVA #1, Receiver Site	<1	S6398 (61D)	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/	N/A l/
BVA #2 (Boone Creek Road) m/	<1	S6399 (54F)	No	No	No	Yes	No	No	No	No	No	Yes
BVA #3 (Myrtle Point Sitkum Rd)	<1	S6402 (47B)	No	No	No	No	No	Yes	No	Yes	Yes	Yes
BVA #4 (Deep Creek Rd)	<1	S6408 (52G)	Water	Yes	No	Yes	No	Yes	Yes	No	No	No
BVA #5 (S. of Ollala Creek)	<1	S6360 (14C)	No	No	No	No	No	Yes	No	Yes	No	Yes
Clarks Branch MS, BVA #6 Launcher/ Receiver & CT	<1	S6385 (189F)	Water	Yes	Yes	Yes	No	No	Yes	No	No	No
BVA #7 (Pack Saddle Rd)	<1	S6360 (270F)	Water	Yes	No	No	No	Yes	Yes	No	No	No
BVA #8 (Hwy 227)	<1	S6360 (183B)	No	No	No	No	No	Yes	Yes	No	No	Yes
BVA #9 (BLM Rd 33-2-12) n/	<1	S6381 (222)	No	Yes	Yes	Yes	No	No	Yes	No	No	No
BVA #10 (Shady Cove)	<1	S6380 (122E)	Water	Yes	Yes	Yes	No	Yes	Yes	No	No	No
BVA #11 (Butte Falls & Launcher/Receiver Site) o/	<1	S6380 (125F)	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No
BVA #12 (Heppsie Mtn Quarry)	<1	S6380 (111G)	Wind	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
BVA #13 (Clover Creek Rd)	<1	S6387 (R6)	No	No	No	No	No	Yes	No	No	No	No
BVA #14 & Launcher/ Receiver Site	<1	S656 (129B)	No	No	Yes	Yes	No	No	Yes	No	No	No
BVA #15 Klamath River p/	<1	S1150 (40)	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes
BVA #16 (Hill Road)	<1	S6356 (7B)	No	No	No	No	No	Yes	No	No	No	Yes
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, BVA #17, Launcher/Receiver & CT	31	S542 (19C)	Wind	No	No	No	No	Yes	No	No	No	Yes
Blue Ridge Communication Site	<1	S6396 (4D)	Water	No	No	No	No	Yes	Yes	No	No	No
Signal Tree Communication Site	<1	S6395 (50D)	No	No	Yes	Yes	No	Yes	Yes	No	No	No
Flounce Rock Communication Site	<1	S6380 (113G)	Water	Yes	No	Yes	No	Yes	Yes	No	No	No

TABLE 4.3.2-3

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	Saline/ Sodic f/	High Compaction Potential g/	Poor Revegetation Potential h/	High Water Table i/	Hydric Soil j/	Prime Farmland k/
Robinson Butte	<1	S6388 (0038)	No	Yes	Yes	No	No	No	No	No	No	No
Stukel Mountain Communication Site	<1	S6388 (16E)	No	Yes	Yes	No	No	No	Yes	No	No	No

MS = meter station, BVA = block valve, CT = communication tower. Soil data from NRCS (2004); SCS (1985, 1989, 1993); Forest Service (1976, 1977, and 1979). NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2012a).
a/ Area of construction and operation disturbance. Construction disturbance is included within the pipeline construction right-of-way. Acreages rounded to nearest whole acre; values less than 1 are reported as <1.
b/ Soils with NRCS rating of high or severe.
c/ Soils with slopes greater than 30 percent.
d/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.
e/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.
f/ Soils with an electrical conductivity of 8 mmhos/cm or greater and/or a SAR of 13 or greater.
g/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.
h/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop.
i/ Soils saturated within 60 inches of the surface in most years.
j/ Soils with at least one major named map unit included on the county hydric soil list.
k/ Soils with dominant map unit included on either the state or county list of farmland of importance.
l/ These aboveground facilities would be located entirely within the proposed Jordan Cove LNG terminal. This soil association has been previously disturbed and would be graded and built up during construction of the Jordan Cove LNG terminal prior to construction of the Pacific Connector pipeline.
m/ Relocated to avoid steep slope.
n/ Relocated to avoid NFS land.
o/ Relocated to improve access, minimize agricultural impacts, and reduce site acreage
p/ Relocated to improve spacing

4.3.2.1 Project-Specific Soil Limitations

Prime Farmland

The pipeline alignment crosses approximately 72 miles (31 percent of the pipeline) of soils where the dominant map unit in the MLRA is classified on either the NRCS state or county list of prime farmland or “farmland of statewide importance.” Not all of these soils are currently in agricultural production. In some areas, land that does not meet the criteria for prime or unique farmland is considered to be “farmland of statewide importance” for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate state agencies. Generally, this land includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some areas may produce as high a yield as prime farmland if conditions are favorable. Farmland of statewide importance may include tracts of land that have been designated for agriculture by state law (NRCS 2006b).

Impacts on prime farmland or farmland of statewide importance soils would include less crop or no crop production for a short term during the construction phase, which, depending on the crop being produced, could physically interrupt farming practices for one to two years. Following construction, the pipeline right-of-way could continue to be used for farming practices, with the exception of aboveground structures or long-term crops such as tree or fruit orchards or vineyards. Pacific Connector would implement mitigation measures to minimize impacts to prime farmland and crop yields, such as topsoil salvaging, scarification, and subsequent testing to ensure that potential compaction was removed. Topsoil salvaging and segregation would occur in areas mapped as prime farmland or active crops to minimize potential impacts to soil and agricultural productivity. Areas where topsoil salvaging and segregation would occur are shown by MP in table 4.3.2.1-1.

TABLE 4.3.2.1-1

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)
Coos County		
Wetlands/Pasture	6.22R	6.31R
Wetlands/Pasture	6.34R	6.46R
Pasture	8.31R	8.48R
Pasture	10.96R	11.06R
Wetland/Pasture	11.19R	12.39R
Wetland/Pasture	8.58	8.67
Wetland/Pasture	10.05	10.40
Wetland/Pasture	10.81	11.08
Wetland/Pasture	11.14	11.39
Residential	14.24	14.29
Wetland/Pasture	15.70	15.78
Pasture/Hayfield	22.59	23.04
Pasture/Hayfield	29.49	29.83
Pasture/Hayfield	29.87	30.14
Douglas County		
Croplands/Pasture	49.50	50.25
Croplands/Pasture	50.30	50.55
Pasture/Residential	50.72	50.82
Pasture	51.31	51.55
Pasture	51.58	51.78
Pasture/Wetlands/Residential	55.83	56.56
Pasture/Wetlands/Residential	56.77	57.10

TABLE 4.3.2.1-1

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)
Pasture/Wetlands/Residential	57.12	57.59
Wetlands/Pasture/Hayfield	57.61	57.83
Wetlands/Pasture/Hayfield	57.85	58.20
Wetlands/Pasture/Hayfield	58.21	58.53
Wetlands/Pasture/Hayfield	58.65	58.73
Wetlands/Pasture/Hayfield	58.79	59.60
Wetlands/Pasture/Hayfield	59.66	60.08
Pasture Pasture/Hayfield	60.15	60.24
Pasture Pasture/Hayfield	60.45	60.57
Pasture/Hayfield	60.58	60.66
Pasture/Hayfield	65.58	65.73
Pasture	66.88	66.94
Pasture	66.97	67.08
Pasture	69.22	69.49
Pasture	71.36	71.54
Pasture	76.41	76.47
Pasture	77.82	78.05
Pasture	79.00	79.03
Hayfield/Pasture	81.20	81.65
Pasture	88.29	88.50
Pasture	88.53	88.57
Pasture	88.61	88.70
Pasture/Wetlands	94.35	94.56
Pasture/Wetlands	94.87	95.07
Jackson County		
Pasture	118.84	118.91
Pasture	120.70	120.82
Pasture/Residential	120.84	120.90
Pasture/Hayfield	121.90	122.20
Pasture/Wetlands	128.47	128.69
Pasture	131.76	132.00
Pasture/Wetlands	132.12	132.68
Pasture/Wetlands	142.26	142.56
Pasture/Wetlands	142.58	142.66
Pasture Pasture/Wetlands	144.31	144.78
Pasture Pasture/Wetlands	145.05	145.95
Pasture	146.12	146.87
Klamath County		
Pasture/Hayfield/Wetlands	190.63	197.61
Pasture/Hayfield/Wetlands	197.74	198.21
Pasture/Croplands/Wetlands	199.60	214.67
Croplands	217.30	217.54
Pasture/Croplands	217.55	217.92
Pasture/Croplands	221.31	221.85
Pasture/Croplands	221.99	223.17
Pasture/Croplands	223.21	224.54
Pasture/Croplands	225.15	227.00
Pasture/Croplands/Residential	227.01	227.84

Note: For a description of topsoil segregation and effects to wetlands, see section 4.4. (Up to the top 12 inches of topsoil will be segregated from the area disturbed by trenching in wetlands, except in areas where standing water or saturated soils are present.)

Construction in the Klamath Basin would occur in the winter, outside of the typical agricultural period, to minimize impacts to agricultural activities. The winter construction schedule in the basin also would allow the irrigation canals to be crossed when they were mostly dry and out of operation. The *Winter Construction Plan for the Klamath Basin* is included in Appendix 1E of Pacific Connector's June 2013 FERC Application. The only permanent impacts on prime farmland soils from the proposed pipeline would be associated with the aboveground facilities located on prime farmland soils discussed in section 4.3.2.2 below.

Hydric Soils

Construction activities have the potential to result in structural damage to wet soils and soils with poor drainage. The Pacific Connector Pipeline Project would cross about 10 miles (4.4 percent of the Project length) of hydric soils. Some MLRAs contain at least one major soil unit that is classified as a hydric soil. Hydric soils are one of the three criteria that are used to designate jurisdictional wetlands.

Mitigation measures described in section 4.4 of this EIS and Pacific Connector's ECRP would be used during pipeline construction to minimize potential impacts to wetlands and hydric soils. With these measures, such as segregating topsoil, leaving root systems intact during vegetation removal, using low ground-weight equipment or prefabricated equipment mats, installing permanent and temporary erosion control near waterbodies, using trench breakers or sealing trench bottoms to maintain wetland hydrology, constructing during drier seasons, and monitoring, adverse impacts are not anticipated to hydric soils.

High Water Table

Soils that have a high water table have a saturated zone in the soil profile within 60 inches of the surface in most years. A saturated zone that lasts for less than a month is not considered a water table (NRCS 2012b). The pipeline alignment would cross 47.2 miles (20.4 percent of the pipeline length) in this sensitive soil group. Soils that are wet or poorly drained can experience structural damage from construction equipment.

Depending on the specific time of construction, trench dewatering may be required in some areas during excavation, pipe construction, and backfilling of the trench. All water from trench dewatering would be pumped into a filter structure in an upland area, and would not be directly discharged into wetlands or waterbodies.

Pacific Connector would reduce the potential for structural damage on wet soils by employing BMPs such as the use of low-ground-weight construction equipment, or operating normal equipment on timber riprap, prefabricated equipment mats, or terra mats. In addition, Pacific Connector would not conduct construction activities during extremely wet weather conditions. Wet or poorly drained soils are also generally identified as hydric soils, as discussed above. Pacific Connector would minimize impacts on wet soils by following the wetland crossing techniques outlined in the FERC's *Procedures*.

Erosion Potential

Accelerated erosion leads to the direct soil loss of plant nutrients. Erosion can also deposit sediments into waterbodies, which degrades water quality and stream conditions, and can adversely affect aquatic habitats and wildlife. Although sediment and wood debris inputs are part of a natural process, accelerated erosion can result in stream scouring, which degrades stream conditions, riparian zones, and fishery habitat.

The pipeline route would cross about 94.3 miles (40.7 percent of pipeline length) of soils with a high or severe water erosion potential. Soils that are susceptible to wind erosion are included in NRCS wind erodibility groups 1 and 2. Soil textures primarily range from very fine to coarse sand to silt loam soils with 5 percent or less clay and 25 percent or less of very fine sand. The proposed pipeline alignment crosses a total of 16.2 miles (7.0 percent of the pipeline length) of soils in this group.

Impacts on soils from erosion would be minimized by Pacific Connector following the FERC's *Plan* and *Procedures* and its project-specific ECRP. Pacific Connector would implement specific water erosion prevention measures such as covering temporary storage piles; covering, seeding and mulching of waste piles; and installation of sediment barriers, interceptor ditches or berms, or other measures where necessary, so that water is filtered or flows away from sensitive areas. With these measures, significant water erosion is not anticipated. Pacific Connector would implement reseeding efforts, apply mulch, and water for dust control to minimize potential erosion by wind on the disturbed soils during construction.

Pacific Connector would minimize impacts from erosion-and-sedimentation-producing actions and ensure the stability of the proposed pipeline alignment during the design phase by routing the pipeline along stable landscapes (such as ridgelines) and away from side slopes as much as practicable. In addition, as described in section 4.2 of this EIS, an extensive geotechnical review was conducted to ensure that the route avoided known or potential areas of mass soil movement. This effort required minor reroutes in numerous areas along the proposed alignment to ensure the safety and integrity of the pipeline.

Temporary erosion control measures would be installed immediately after clearing and prior to grading (initial soil disturbance). Near waterbodies and wetlands, the EIs would determine in the field if it is necessary to install temporary erosion control measures (i.e., sediment barriers) prior to clearing activities to minimize the potential for runoff to enter a wetland or waterbody. All erosion control devices would be routinely inspected and any damaged or temporarily removed structures would be replaced at the end of each working day. Temporary erosion control measures would be maintained until successful revegetation has been achieved.

Sediment barriers would be used to confine sediment to the construction right-of-way and would be constructed of either silt fence or straw bales. Generally, silt fence would be used where sediment barriers are required parallel to the right-of-way. Straw bales would generally be used in locations where sediment barriers are required to cross the construction right-of-way along the travel lane such as at waterbody and wetland crossings. Occasionally, silt fence is used across the construction right-of-way travel lane based on an evaluation of site-specific conditions. Sediment barriers would generally be placed as follows:

- at the base of slopes adjacent to road, wetland and waterbody crossings where sediment could flow from the construction right-of-way onto the road surface or into the wetland or waterbody;
- adjacent to wetland and waterbody crossings, as necessary, to prevent sediment flow in the wetland consistent with the requirements of the FERC's *Procedures*; and
- on the downslope side of the right-of-way where it traverses steep side slopes.

Pacific Connector would install temporary slope breakers to reduce runoff velocity, concentrated flow and to divert water off the construction right-of-way to avoid excessive erosion. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked straw bales, straw wattles, or sand bags. If it becomes necessary to delay final cleanup, including final grading and installation of permanent erosion control measures, beyond 20 days (10 days in residential areas) after the trench is backfilled in a specific area, Pacific Connector would apply mulch on all disturbed slopes before seeding.

Trench breakers would be installed in the trench and keyed into trench walls on slopes prior to backfilling to slow the flow of subsurface water along the trench to prevent erosion of trench backfill materials. A permanent slope breaker and a trench breaker would be installed at the base of slopes near the boundary between the wetland and adjacent upland areas.

After backfilling, the pipeline would be hydrostatically tested in accordance with DOT regulations to ensure that the system is capable of operating at the maximum operating pressure. Permission to discharge the hydrostatic test water would be applied for concurrently with the request for coverage under the ODEQ General Stormwater Discharge Permit and permitted through a separate letter of approval. Hydrostatic test water would be discharged into erosion control devices in upland settings (where feasible), to minimize the potential for scour, erosion, and sedimentation into nearby wetlands and waterbodies, in accordance with Pacific Connector's ECRP. Straw bale barriers and silt fence would typically be used to retain sediment and reduce velocity. Discharge rates would range from several hundred gallons per minute to several thousand gallons per minute, depending on the length of the test section, profile, topography, vegetation cover, and soil type, as reviewed by the contractor and the EI. See additional discussion of hydrostatic testing in section 4.4 of this EIS.

Waterbody crossings would be stabilized and temporary sediment barriers installed within 24 hours of completion of backfilling in accordance with Section V.C.2 of the FERC's *Procedures*. Pacific Connector would install erosion control fabric (such as jute or excelsior) on streambanks at the time of recontouring. The fabric would be anchored using staples or other appropriate devices. The erosion control fabric to be used on streambanks and steep slopes would be designed for the proposed use and would be approved by the EI, and authorized agency representative on federal lands.

Permanent slope breakers (waterbars) would be installed across the right-of-way on slopes. The purpose of these structures is to minimize erosion by reducing runoff velocities, by shortening slope lengths, preventing concentrated flow, and by diverting water off the construction right-of-way. Slope breakers are also intended to prevent sediment deposition into sensitive resources.

Water associated with trench dewatering would be pumped to a discharge structure that is appropriately designed to accommodate the discharge volume, and to discharge the water in a manner that would not cause erosion.

Revegetation Potential

The pipeline alignment would cross a total of 163.5 miles (70.6 percent of the pipeline length) of soils that are rated as having poor revegetation potential according to information provided by the applicant prior to consideration of efforts specific to federal lands (NSR 2014). These soils may have a combination of characteristics that could require additional measures or BMPs to reduce erosion and sedimentation potential. Restoration of these soils in most cases requires adaptive seed mixtures and implementation of revegetation practices (i.e., fertilization, mulching, monitoring) to enhance revegetation success.

Section 10.0 of Pacific Connector's ECRP includes a detailed description of soil restoration procedures and requirements. Pacific Connector would implement revegetation procedures, such as topsoil segregation, recontouring, scarification, soil replacement, seedbed preparation, fertilization, seed mixtures, seeding timing, seeding methods, and supplemental plantings to ensure revegetation success. Information contained in the BLM/Forest Service *Technical Memorandum Soil Risk and Sensitivity Assessment on BLM and National Forest System Lands* (NSR 2015a) will be used to identify and treat areas on BLM and Forest Service lands where specific and focused soils remediation measures may be required to minimize potential erosion and accomplish vegetation objectives. It is BLM and Forest Service's intent that FERC will use the assessment to supplement the ECRP, and the applicant would append this to the POD.

As previously discussed, topsoil segregation would be performed in croplands, hayfields, pastures, wetlands, and residential areas. Pacific Connector would stockpile topsoil separately from subsoil, and replace the horizons in the proper order during backfilling and final grading.

Pacific Connector would work with individual landowners to address restoration of active agricultural and residential landscaping, if affected by pipeline construction. In active agricultural areas, Pacific Connector would encourage the landowner to complete final restoration efforts in these areas and would compensate the landowner for these efforts. In residential areas, Pacific Connector would use contractors familiar with local horticultural and lawn establishment procedures for reclamation work or would compensate the landowner to restore these areas.

Seedbed preparation would be conducted, where necessary, immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to eliminate weeds which may have developed between initial reclamation and seeding. A seedbed would be prepared in disturbed areas, where necessary, to a depth of up to four inches using appropriate equipment to provide a seedbed that is firm, yet rough. A rough seedbed is conducive to capturing or lodging seed when broadcasted or hydroseeded, and it reduces runoff and erosion potential. The rough seedbed would retain soil moisture for seedling germination and establishment.

In most areas, final right-of-way cleanup procedures are sufficient because they leave a surface smooth enough to accommodate a drill seeder pulled by a farm tractor and rough enough to catch broadcasted seed and trap moisture and runoff. Where residential and cropland areas are disturbed, more intensive ground and seedbed preparations may be required including rock collection, grading, and soil preparation/amending. The EI would be responsible for determining where seedbed preparation measures are required prior to seeding. Pacific Connector would use a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer on all disturbed areas to be reseeded. This fertilizer application rate would apply 32 pounds per acre each of elemental nitrogen, phosphorous, and potassium. The NRCS did not recommend the addition of lime or other soil pH modifiers. Fertilizers would not be applied in wetlands, unless required in writing by the appropriate land management or state agency pursuant to the FERC's *Procedures*, and would not be applied within at least 100 feet of streams. Application of fertilizers would be avoided during heavy rain (0.3 inch/hour or greater) or when wind speed (25 mph or greater) could cause drift.

As required by the FERC's *Plan*, Pacific Connector has consulted with the NRCS and land management agencies regarding recommended seed mixtures for the project area. The seed mixtures developed for the Pacific Connector Pipeline Project are based on these agency recommendations and are provided in the ECRP. During right-of-way negotiations, private landowners may also request other seed mixtures than those proposed in the ECRP. These specific landowner requested/specified seed mixtures would be documented in landowner right-of-way agreements.

Pacific Connector would acquire the seed through commercial source where available and would contract with vendors to collect native species where these species are not commercially available. Native seed would be collected during the two years prior to construction as well as during the two years of construction to ensure that an adequate quantity of seed is available for reseeding efforts. Seed collected in the years prior to construction would be dried, stored in labeled, sealed bags and appropriately stored to preserve viability. It is anticipated that adequate seed would be collected to allow for direct re-seeding without the need for farm-increasing; however, some vendors may choose to grow out a quantity of the seed they have collected for project use to minimize collection efforts and to ensure appropriate quantities of seed are available for restoration of the areas disturbed by pipeline construction.

Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting, and if final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding, consistent with the FERC's *Plan*. Seeding would proceed in accordance with the ECRP.

Straw mulch would be certified weed-free by the appropriate state certification program. In non-forested areas, straw mulch would be uniformly applied at a rate of 2 tons/acre to cover the ground surface (except on slopes within 100 feet of waterbodies and wetlands where application rates would be increased to 3 tons/acre). Mulching would occur immediately after seeding where broadcast or drill seeding occurs. Anchoring the mulch is not expected to be necessary because strong winds, which could dislodge the mulch, typically occur during the winter rainy season when the moist conditions would bind the straw to the soils.

Compaction Potential

Soil compaction and displacement reduces water infiltration and often diverts lateral movement of the water within the soil. These conditions not only lead to increased erosion and sedimentation potential but could contribute to higher stormwater runoff from normal peak flows. The movement of heavy construction equipment, soil mixing or displacement from grading/excavation activities, or rutting from equipment or vehicle traffic would result in soil compaction and damage to soil structure.

The proposed pipeline alignment would cross a total of 183.6 miles (79.2 percent of the total pipeline length) of soils that are highly susceptible to compaction. Soils in this sensitive group were determined based on the NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting categories. Soils in this group are rated based on Unified soil texture classification, rock fragments on or below the surface depth to a restrictive layer, depth to a water table and slope. However, most soils are susceptible to compaction depending on the number of passes of heavy equipment and the moisture content of the soils at the time of construction. Unmitigated soil compaction can result in long-term reductions of soil productivity and increased erosion from increased surface runoff.

Pacific Connector would minimize soil compaction, rutting, and structural damage to wet soils and soils with poor drainage reduce the potential for structural damage on wet soils by employing BMPs such as the use of low-ground-weight construction equipment, or operating normal equipment on timber riprap, prefabricated equipment mats, or terra mats. In addition, Pacific Connector would not conduct construction activities during extremely wet weather conditions. During forest clearing activities, the potential for soil compaction would be minimized where cable and helicopter logging methods are used. Where log skidding occurs, several practices would be employed as described in Section 2.3 of Pacific Connector's *Right-of-Way Clearing Plan for Federal Lands* (Appendix U of the POD), where feasible, to minimize the potential for soil compaction.

The trench would be opened and backfilled after pipeline installation without a lot of machinery working over it. Therefore, there is a low potential for compaction of the material used to backfill the trench.

Regrading, recontouring, scarifying, and final cleanup activities after pipeline construction would mitigate potential soil compaction. However, these measures alone would not be sufficient to entirely address soil compaction, and additional measures including subsoil ripping and decompaction with hydraulic excavators would also be necessary to fully address soil compaction. Decompaction would be completed to achieve soil densities within 10 percent of adjacent bulk density.

Restrictive Layer

Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. The pipeline alignment would cross a total of about 143.3 miles (61.8 percent of the pipeline length) of soils with a restrictive layer. These soils have thin profiles, restrictive root zones and hold less available water for plant growth. Shallow and hard bedrock can also restrict trenching, requiring special equipment (rock hammers/saws) or blasting in some areas to efficiently excavate the trench to required design depths. Excavation of bedrock or cemented layers may require additional measures to provide suitable pipe bedding materials. Soils in this group are also included in the soils that have reclamation sensitivity. Section 4.2 of this EIS discusses shallow soils, rock lithology, potential blasting locations, rock removal, and disposal.

Steep Slopes

The pipeline alignment would cross a total of 117.6 miles (50.8 percent of the total pipeline length) of soils rated as has having slopes greater than 30 percent. This slope range was selected because the operation of rubber-tired equipment becomes hazardous when the slope approaches and exceeds 30 percent (NRCS 2004; Adams 1997; Garland 1997). Pacific Connector has routed the pipeline to ensure safety and integrity of the pipeline and has identified adequate work areas to safely construct. Mitigation for soil erosion would be required on soils with slopes less than 30 percent, but additional BMPs would typically be required when the slope approached or exceeded 30 percent; therefore, Pacific Connector would (see section 2.4.2.2 for more details):

- use appropriate construction techniques to minimize disturbance and to provide a safe working plane during construction;
- use temporary cribbing to store material on the slope;
- optimize construction during the dry season;
- use slope breakers/waterbars during construction;
- install trench breakers in the pipeline trench to minimize groundwater flow down the trench;
- backfill the trench according to Pacific Connector's construction specifications;

- restore the right-of-way promptly to approximate original contours or to stable contours after pipe installation and backfilling;
- install properly designed and spaced permanent waterbars;
- revegetate the slope with appropriate native, local source seed mixtures;
- provide effective ground cover from redistributing slash materials, mulching, or installing erosion control fabric on slopes; and
- monitor and maintain the right-of-way to ensure stability.

Large Stones

Soils with more than 25 percent cobbles and stones in the soil profile can present significant problems with surface reclamation because they hold less available water for plant growth and generally require broadcast seeding methods. Further, the introduction of stones or rocks from subsoils to surface soil layers during trenching or blasting can adversely affect agricultural productivity and agricultural equipment operation.

The pipeline route would cross a total of 67.6 miles (29.2 percent of the pipeline length) of soils containing cobbles and stones. Pacific Connector has developed measures that would reduce impacts on restoration and revegetation caused by rocks, cobbles, and stones near the soil surface. In agricultural and residential areas, topsoil would be segregated. A rock picker would be used to remove large fragments.

Rocks excavated from the trench would be kept separate from topsoil during construction and during surface preparation as part of restoration. Pacific Connector has identified rock disposal sites. These sites are listed in table 4.2.2.4-1 of section 4.2.2.4 of this EIS. Large rocks and boulders would also be used as OHV barriers along the right-of-way and at road crossings to control unauthorized OHV access to the right-of-way. Additionally, large rocks and boulders would be piled in upland areas along the right-of-way to create habitat diversity features where approved by the EI or Pacific Connector's authorized representative and the landowner or land management agency.

Saline/Sodic Soils

Sensitive soils in this group include soils that have an electrical conductivity of 8 millimhos (a scale used to measure salt levels) per centimeter (mmhos/cm) or greater, or a SAR of 13 or greater. Saline/sodic soils can be difficult to revegetate and generally require special seed mixes. The pipeline route would cross a total of 8.2 miles (3.5 percent of the pipeline length) of soils in this group, all in the Klamath Basin. Pacific Connector would revegetate saline/sodic soils using saline-tolerant seed mixes, listed in its ECRP.

Contaminated Soils

Federal and state databases were reviewed for documentation of National Priorities List sites, state hazardous waste sites, or landfills located within one-quarter mile of the proposed pipeline route. No known contaminated sites would be crossed by the pipeline; therefore, contact with contaminated soils during pipeline construction is not anticipated. One contractor yard would overlap a listed site. Use of the yard would not require excavation or ground disturbance; however, prior to using that yard Pacific Connector would further investigate the status of this site with the ODEQ. Implementation of Pacific Connector's SPCCP would prevent contamination from pipeline activities. Pacific Connector has developed a *Contaminated Substances Discovery Plan*[40] that specifies the measures that would be implemented if unanticipated contaminated soils are encountered. Some of the measures outlined in that plan include that all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted; that all construction, oversight, and observing personnel would be evacuated to a road or other accessible up-wind location until the types and levels of potential contamination can be verified, and that if an immediate or imminent threat to human health or the environment exists, one of Pacific Connector's emergency response contractors identified in the SPCCP or the National Response Team would be notified and mobilized.

4.3.2.2 Aboveground Facilities

Pacific Connector's aboveground facilities would be located within or immediately adjacent to the pipeline construction right-of-way. Each facility would be fenced and graveled immediately after construction.

Permanent impacts on soils would occur at aboveground facilities that would be graded and graveled or where facilities would be constructed. Soil limiting characteristics at aboveground facilities are listed on table 4.3.2-3. Soils at specific aboveground facilities are described below. Section 10.0 of Pacific Connector's ECRP includes a detailed description of erosion control and soil reclamation procedures and requirements.

Jordan Cove Meter Station

The Jordan Cove Meter Station (MP 1.5R) would be located adjacent to the planned South Dunes Power Plant, on the North Spit, in Coos County. This area was formerly the location of the Menasha-Weyerhaeuser mill (operated between 1961 and 2003), now dismantled. The meter station would occupy approximately almost 1 acre on the Bullards-Nehalem-Dune Land soil association. There are no known soil limitations that would affect the construction and use of this parcel for a meter station. The meter station site would be graded and its elevation built up by Jordan Cove from soils excavated and dredged from the LNG terminal access channel and marine slip. Those soils are described in appendix G. The Jordan Cove Meter Station would also contain MLV#1, a receiver, and a communication tower, within a fenced, graveled yard.

Clarks Branch Delivery Meter Station

The Clarks Branch Delivery Meter Station would be located at MP 71.5 in Douglas County. This station would be located on about 1 acre of the Philomath-Dixonville complex mapping unit within the Ruch-Medford soil association (see appendix G for soil descriptions). This mapping unit has few limitations, other than being cobbly. Although the area is currently used as a rangeland pasture, the mapping unit is not classified as prime farmland soil or farmland of statewide importance. The soil does not have a high water table and is not subject to flooding. However, some soil inclusions within this soil mapping unit may be hydric. The Clarks Branch Meter Station would also contain MLV#6, a launcher/receiver, and a communication tower within a graveled, fenced yard.

---

[40] The *Contaminated Substances Discovery Plan* was included in Pacific Connector's application to the FERC as Appendix E to the POD.

Klamath Compressor Station

The Klamath Compressor Station would be located at MP 228.1 in Klamath County. The site would also include the Klamath-Beaver and Klamath-Eagle meter stations, MLV #17, a launcher/receiver, and a communication tower. The compressor station would occupy a 31-acre site within the Fordney-Calimus Poman soil association. The two dominant soil mapping units at the site include the Fordney loamy fine sand and Calimus loam. These soil mapping units, which compose about 30 acres of the site, are considered prime farmland if irrigated; however, the site is not irrigated. The site supports rangeland vegetation and has a few scattered juniper trees. The Fordney soil comprises 77 percent of the site area and has a high wind erosion hazard due to its coarse loam sand texture. During construction clearing and grading activities, periodic watering would likely be necessary to minimize fugitive dust until the site has been stabilized with gravel.

Gas Control Communication Towers

Pacific Connector would install a series communication towers for gas control and system monitoring at 11 locations. As discussed above, three new communication towers would be erected within two meter stations and the compressor station. Pacific Connector would like to co-locate new communication facilities on existing towers at five locations: Blue Ridge, Signal Tree, Winston, Harness Mountain, and Starveout Creek. No soils would be disturbed where an existing tower would be utilized. Pacific Connector expects to erect new communication towers adjacent to existing facilities at three locations: Flounce Rock, Robinson Butte, and Stukel Mountain. Construction of the new towers would disturb about 0.2 acre at each location. Information on the soil characteristics for the new tower locations is provided in table 4.3.2-3. Soil limitations at Flounce Rock include the potential for water erosion, potential for compaction, presence of a restrictive layer, and poor revegetation potential. Robinson Butte is rocky. Soil limitations at Stukel Mountain includes stones and poor revegetation potential. Pacific Connector would minimize erosion by following its ECRP. Because the communication towers are industrial facilities, the presence of stones, restrictive layers, and poor revegetation potential would not be environmentally adverse factors in the construction and operation of the towers.

Launchers/Receivers and Mainline Block Valves

Seventeen MLVs would be located along the pipeline according to DOT spacing requirements (49 CFR Part 192 Section 192.179). Potential impacts from the MLVs are accounted for within the proposed pipeline because these facilities would be located entirely within the construction right-of-way. However, because these small (less than a tenth of an acre) sites would contain aboveground facilities, they would permanently affect soils. Six of the MLV locations would be located on soils designated as prime farmland, with five of these locations (MLVs 5, 8, 15, 16, and 17) located within existing cropland/pastures rangeland. Construction and operation of the launchers/receivers and MLVs would take a total of about one-third of an acre out of agricultural production, excluding acres that were already discussed under the meter stations. Loss of agricultural production would be a factor considered in compensation to landowners negotiated by Pacific Connector while obtaining easement agreements.

4.3.2.3 Temporary Storage Yards

Pacific Connector has identified 34 privately owned contractor and pipe storage yards in the general area of the pipeline that could be used temporarily during construction. Most (28) of the yards are located in existing industrial areas or sites that have been previously disturbed by filling, grading, and gravelling activities, and therefore the soils resources at these locations have been significantly altered. Of the remaining storage yards, another two have been partially disturbed (Riddle Pasture and Rogue Aggregates). Only seven storage yards have not been disturbed previously. These include four storage yards that are currently used for agriculture (Days Creek Yard, Highway 99/Hayfield Yard, Klamath Falls North of Cross Road East, and Klamath Falls North of Cross Road West). The remaining undisturbed storage yards (Klamath Amuchastegui Building, and Klamath Falls Industrial Oil) are undeveloped land in industrial parks.

All the storage yards located in Coos County are in the Sitka Spruce Belt MLRA. Sitka Spruce Belt soils generally are shallow to very deep and well drained. However, soils in terrace and floodplain area of the MLRA can be poorly drained in areas. Soils in the storage yards in Douglas County are generally moderately deep to very deep, and can vary greatly from poorly drained to well drained, and from clayey to loamy textures. All six storage yards located in Jackson County are in the Siskiyou-Trinity Area MLRA. The Siskiyou-Trinity Area MLRA includes soils that generally are moderately deep or deep, well drained, and loamy. All eight storage yards located in Klamath County are in the Klamath and Shasta Valleys and Basins MLRA. These soils generally are well drained, but they may be poorly drained or very poorly drained in the basins. They generally are loamy, clayey, or sandy and are shallow to very deep (see table 4.3.2-1 and 4.3.2.3-1).

Soil associations, mapping units, and sensitive soil characteristics are listed for each of the storage yards in table 4.3.2.3-1. Hydric soils are not indicated for any of the yards, while one (Klamath Amuchastegui Building) is noted as having a seasonal high water table. Most of the yards are listed as being prime farmland or farmland of statewide importance. Poorly drained soils are noted at Days Creek Yard. Yards noted with soil compaction concern are Riddle Pasture and Highway 99 Hayfield Yard. Shallow bedrock is noted at the following yard sites: Klamath Falls Industrial Oil, Klamath Falls North of Cross Road East, and Klamath Falls North of Cross Road West.

TABLE 4.3.2.3-1

Contractor and Pipe Storage Yards with Sensitive Soil Characteristics (Pastures, Fields and Vacant Lots)

Name	County	Section, Township, Range	Acres a/	Description	Soil Association – Soil Mapping Units and Sensitive Soil Characteristics b/
Days Creek Yard	Douglas	Section 18, T. 30 S., R. 4 W.	177	Existing cropland, hayfield or pasture	Soil Association: Ruch-Medford-Takilma (OR058) Soil Mapping Units (Douglas County): 37A, 44A, 224B, 184A 81A, 81C & 164A Sensitive Soil Characteristics: 1, 2,
Riddle Pasture	Douglas	Section 45, T. 30 S., R. 6 W.	23	Industrial/cropland pasture being converted to industrial use	Soil Association: Ruch-Medford-Takilma (OR058) Soil Mapping Units (Douglas County): 14A &14C Sensitive Soil Characteristics: 1, 3
Highway 99 Hayfield Yard	Douglas	Section 7, T. 30 S., R.5 W.	96	Existing cropland, hayfield or pasture	Soil Association: Ruch-Medford-Takilma (OR058) Soil Mapping Units (Douglas County): 214A, 224B, 37A & 165A Sensitive Soil Characteristics: 1, 3,
Rogue Aggregates	Jackson	Section 20, T. 36 S., R. 2 W.	111	Existing gravel quarry/ and existing Cropland/Pasture	Soil Association: Ruch-Medford-Takilma (OR059) Soil Mapping Units (Jackson County): 10B, 31A, 55A, 133A Sensitive Soil Characteristics: 1,
Klamath Amuchastegui Building	Klamath	Section 10, T. 39 S., R. 9 E.	25	Vacant lot	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 19A, 90 Sensitive Soil Characteristics:19A – 1; 90 – 1, 6 & 6
Klamath Falls Industrial Oil	Klamath	Sections 8, 9 & 10, T.39 S., R. 9 E.	39	Industrial Lot	Soil Association: Malin-Laki-Henley (OR008) Soil Mapping Units (Klamath): 7C, 18A, 74D Sensitive Soil Characteristic: 1, 4

TABLE 4.3.2.3-1

Contractor and Pipe Storage Yards with Sensitive Soil Characteristics (Pastures, Fields and Vacant Lots)

Name	County	Section, Township, Range	Acres a/	Description	Soil Association – Soil Mapping Units and Sensitive Soil Characteristics b/
Klamath Falls North of Cross Road East	Klamath	Section 1, T. 40 S., R.9 E.	31	Agricultural Field	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 4
Klamath Falls North of Cross Road West	Klamath	Section 1, T. 40 S., R.9 E.	37	Agricultural Field	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 4

a Acreages are rounded to nearest whole acre.
b/ Sensitive Soil Characteristics
1 – All soils within this mapping unit (based on SSURGO geographic databases) are considered prime farmland soil or farmland of statewide importance.
2 – These soils are positioned on floodplains and stream terraces and have soil components within the mapping unit that may be poorly drained and have either seasonal high water tables at or near the surface and have surface soils that are susceptible to compaction impacts and some that are susceptible to occasional or rare flooding.
3 – These soils have low strength and are susceptible to compaction especially if wet.
4 – Shallow to bedrock or duripan
5 – Hydric
6 – Seasonal high water table

Pacific Connector would use appropriate erosion control measures to minimize potential impacts at the yards. After the pipeline is constructed, the temporary yards would be restored back to their previous condition and use.

Potentially Contaminated Groundwater Sites

A review of ODEQ's ECSI database (ODEQ 2013b) revealed that the Pacific Connector Pipeline Project would impact nine sites investigated by the ODEQ for the release of hazardous substances into the site's environment. Based on the latest Project design, two of the sites would no longer be used. Of the remaining seven sites, an online review of site notes shows that ODEQ has determined that four require no further action. The remaining three sites, as shown in table 4.3.2.3-2, potentially contain hazardous substances. Two of those sites are proposed as contractor/pipe storage yards; the third site on Jordan Point would contain the Jordan Cove Meter Station, the pipeline from MP1.5R-1.64R, a TEWA, and a pipeyard.

TABLE 4.3.2.3-2

Identified Cleanup Sites Along the Pacific Connector Pipeline

Milepost Range (Nearest MP)	Project Site Name	Site ID	County	Hazardous Substances/Waste Types	Media Contaminated	Potential Impact Notes	Investigative Status of Site a/
MP 1.5R - 1.6R Jordan Cover Meter Station TEWA 01.46 Weyerhaeuser Cove Yard	Weyerhaeuser – Jordan Cove (54.1 acres)	1083	Coos	Fuel oil, diesel, hydraulic oil, waste oil, mineral spirits, asbestos	Groundwater, Soil	Areas of Residual Contamination in Fill Area on Jordan Point Main Mill Complex	Partial No Further Action September 15, 2006
Near MP 18.9	Coquille Yard (21.8 acres)	1255	Coos	Heavy oils, polychlorinated biphenyl, benzene, xylenes, polyaromatic hydrocarbons, asbestos	Surface water, groundwater, soil	Asbestos present in on-site debris piles related to inadequate abatement and characterization. May present an air quality problem if disturbed.	No Further State Action Required February 19, 1998
Near MP 128.7	Eugene F. Burrill Lumber (64.1 acres)	597	Jackson	Petroleum	Soil	Insufficient information available. Further investigation needed.	Site Screening recommended (EV)

a/ No Further State Action Required: ODEQ has determined that a site poses no unacceptable risk to human health or the environment. A No Further Action (NFA) decision may follow remedial actions, or (if baseline risks are acceptable), may be issued in the absence of remedial action.
No Further Action (Conditional): ODEQ's NFA determination depends on long-term Operation & Maintenance, or ongoing application of Engineering or Institutional Controls. State law requires such sites to remain on ODEQ's Confirmed Release List and Inventory.
Partial No Further Action: ODEQ's NFA determination applies to only a specified geographic portion of a site, or to one media only (e.g., soil, but not groundwater).
State Expanded Preliminary Assessment recommended (XPA): An Expanded Preliminary Assessment, or XPA, adds limited sampling to sites where a PA has been completed
Site Screening recommended (EV): Site Screening recommended means that DEQ has not yet reviewed the site.
Source: ODEQ (2013b); Supplemental Filing (Docket Nos. CP13-483-000 and CP13-492-000) February 13, 2015.

While Pacific Connector has prepared a *Contaminated Substances Discovery Plan* that outlines practices to protect human health and worker safety as well as measures that would be taken to prevent further contamination, the plan is meant to be implemented in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction. According to the ECSI database, these known sites contain hazardous substances that have contaminated soil, water, and groundwater, with some affecting air quality if disturbed. Information filed by Pacific Connector with the FERC on February 13, 2015, includes specific plans detailing how contaminants at the three ECSI sites would either be avoided or removed.

The Jordan Cove Meter Station location and pipeline alignment are located in the general area of potential debris/fill; however, the TEWA usage has been reduced in size, and the debris/fill material would be avoided because the TEWA usage is strictly surface use for staging equipment or materials. To protect human health and ensure worker safety, Pacific Connector or qualified contractor personnel would collect representative samples of the debris/fill in the excavation zone for the meter station and pipeline alignment and surrounding materials for laboratory analysis. If contaminated materials are identified in laboratory analysis, the contaminated material would be removed and properly disposed of in accordance with appropriate federal and state regulations pertaining to asbestos containing waste. Pacific Connector would utilize an environmental contractor with experience and expertise in contaminated media to characterize the excavation area. If necessary, the excavation area would be prepared and excavated by a firm appropriately credentialed for the handling and management of asbestos-containing material. Where the removed fill must be stockpiled pending characterization or regulatory approval, Pacific Connector would take precautions to isolate the substances (e.g., appropriate liner for storage area, berms).

In addition, Pacific Connector would ensure workers are trained in the hazard control measures that will be used at the site (e.g., respirators, protective clothing, decontamination techniques) as required by pertinent worker safety regulations. If contaminated fill is encountered that requires off-site disposal at a licensed disposal site, the material would be handled, containerized and transported appropriately. Clean backfill would be utilized to backfill excavations. This approach is consistent with ODEQ recommendations for this general area (ODEQ - No Further Action Determination Letter, Former Weyerhaeuser Containerboard Mill North Bend, Coos County, Oregon Tax Lots #25S-13W-4-100, 25S-13W-3-200, and the Ingram Yard portion of 25S-13W-0-200 ECSI Site ID No. 1083). Lastly, Pacific Connector would include pipeline contractor training regarding this site's status and history and that site excavation and disturbance is to be limited. No excavation would be allowed without Pacific Connector's knowledge and approval.

The Coquille Yard is identified as a TEWA intended for use as a contractor yard for staging pipe, equipment, or other construction supplies and materials. Based on historical information provided in the filing with the FERC on February 13, 2015, contaminated soil at the site was removed and treated in a soil treatment area and the site was encapsulated with fill dirt from ODOT in 1995. In 1998, the ODEQ recommended No Further Action for the site. Pacific Connector has identified this yard for staging of pipe, equipment or other construction supplies and materials and the use would be surface use only. Minor surface grading would be limited to pushing berms as needed to support pipe joints. This limited use of the site is not expected to result in affects to the encapsulated area or in a potential effects to human health, worker safety or the environment. However, Pacific Connector would consult with ODEQ prior to use of the site to confirm that the intended use is consistent with the protections required for this property. In addition, Pacific Connector would include pipeline contractor training regarding this site's status and history and that site excavation and disturbance is to be limited. No excavation would be allowed without Pacific Connector's knowledge and approval.

The Eugene F. Burrill Lumber site is identified as a contractor yard intended for staging pipe, equipment, or other construction supplies and materials. Supplemental information filed by Pacific Connector with the FERC indicates that this ECSI site represents the White City Plywood property that is not located in the specific area of the proposed Eugene F. Burrill Lumber (Burrill) Yard. Therefore, this site is not in an area of identified or suspected contamination, and avoidance or removal measures are not required.

4.3.2.4 Rock Disposal Areas

Pacific Connector has identified 42 potential rock source and permanent disposal sites that total 174.82 acres along the pipeline route. These sites are listed in table 4.2.2.4-1 of section 4.2.2.4 of this EIS. Most of these sites are located entirely or primarily within previously disturbed areas including numerous quarries; gravel pits; clearcut and regenerating forest land; transportation, utility, and communication corridors; cropland and pasture; and commercial areas. Therefore, soils at these sites are expected to have been disturbed to a large extent in quarries and gravel pits, and to lesser extent where there have been other land uses.

Pacific Connector would use appropriate erosion control measures to minimize potential impacts in the rock source and disposal areas.

4.3.2.5 Access Roads

Most access roads for the pipeline would be existing federal (BLM and Forest Service), state, county, and private roads that intersect the proposed pipeline alignment. Egress and ingress points from existing roads would be sufficient along most of the proposed pipeline to allow for safe, efficient construction and movement of equipment and materials. Where needed, Pacific Connector proposes to modify existing roads and construct new roads to ensure construction and operation access. Approximately 5 acres of soils would be affected to construct 13 TARs, and approximately 2 acres of soils would be affected to construct or reconstruct 17 PARs to provide permanent access to some of the aboveground facilities (i.e., MLVs, meter stations, and the compression station). The TARs would be constructed using appropriate BMPs to minimize potential impacts and would be designed and constructed for their intended use. All TARs would be reclaimed (i.e., regraded, scarified, and replanted) upon completion of construction according to the landowner or agency requirements. The PARs would permanently remove soils to allow for operation of the Project. Soils along PARs would be permanently compacted and unvegetated.

4.3.3 Soils and Sediments Specific to Consistency with Federal Land Management Plans

4.3.3.1 Project Impacts on Soils on BLM and NFS Lands

Subsequent to issuance of the DEIS, an assessment of soil risk and sensitivity specific to federal lands was conducted by NSR at the direction of the BLM and Forest Service (NSR 2015a). The objective of this assessment was to identify the areas where additional soil decompaction, erosion control, or other types of site-specific and focused remediation measures may be required on BLM and NFS lands to minimize erosion potential and/or accomplish agency revegetation objectives. This analysis utilized two key elements: risk and sensitivity to determine the type and scale of potential remediation measures that may be required to address revegetation sensitivity related to both natural conditions and/or the level of disturbance related to the Pacific Connector Pipeline Project.

In the DEIS, table 4.3.3.1-1 provided a description of direct impacts on soil resources on federal lands by watershed and administrative unit. This section has been revised to incorporate the new information from the BLM and Forest Service on this topic.

Table 4.3.3.1-1 shows the structure of the site risk-sensitivity matrix developed and used to stratify BLM and NFS lands along the proposed Pacific Connector pipeline corridor.

TABLE 4.3.3.1-1

Location Risk-Sensitivity Matrix between Risk Class and Sensitivity to Disturbance, where Values range from 1 (very low), 2 (low), 3 (moderate), 4 (high), and 5 (very high)

		Sensitivity		
Risk	**Rating**	**0**	**1**	**2**
	1	1	2	3
	2	2	3	4
	3	3	4	5

Based on the current version of the ECRP, this stratification approach assumes that only the proposed Pacific Connector Pipeline Project construction corridor, including the TEWAs, requires revegetation. The "other" classifications and UCSAs are either not cleared or do not require revegetation. Table 4.3.3.1-2 summarizes the Risk and Sensitivity matrix rankings applied to the Pacific Connector project area.

TABLE 4.3.3.1-2

Summary of Risk and Sensitivity Ratings by Construction Feature (acres)

Soil Rank-Sensitivity Rating	Cleared Corridor	Cleared TEWA	Total Cleared	Percent of Area	Other	UCSA	Total
1–Very Low	193.1	74.06	267.16	25%	0.53	60.66	328.35
2 –Low	470.45	158.43	628.88	58%	1.45	187.41	817.74
3–Moderate	105.77	32.79	138.56	13%	0.48	43.78	182.82
4–High	39.12	10.84	49.96	5%	0.22	3.63	53.81
5–Very High	0.04	0	0.04	0%	0	0.02	0.06
Total	808.48	276.12	1084.6	100%	2.68	295.5	1382.78

Table 4.3.3.1-3 summarizes risk-sensitivity ratings by administrative unit and watershed.

TABLE 4.3.3.1-3

Risk/Sensitivity Ratings by Administrative Unit and Watershed (Acres)

		Risk-Sensitivity Rank				
Watershed	**Admin Unit**	**1–Very Low**	**2–Low**	**3–Moderate**	**4–High**	**5–Very High**
Coos Bay-Frontal Pacific Ocean	Coos Bay District BLM	0.68	1.63	0.44	0.44	
Coquille River	Coos Bay District BLM		0.62	0.71	0.04	
North Fork Coquille River	Coos Bay District BLM	4.61	22.12	8.2	7.63	
East Fork Coquille River	Coos Bay District BLM	12.73	26.31	4.49	2.30	
Middle Fork Coquille River	Coos Bay District BLM	8.52	57.54	5.91	9.00	0.02
Subtotal Coos Bay District BLM		**26.54**	**108.22**	**19.75**	**19.41**	**0.02**
Middle Fork Coquille River	Roseburg District BLM	5.76	17.07	3.4	0.16	
Olalla Creek-Lookingglass Creek	Roseburg District BLM	9.81	9.94	4.74		
Clark Branch-South Umpqua River	Roseburg District BLM	2.39	7.48	1.36		

TABLE 4.3.3.1-3

Risk/Sensitivity Ratings by Administrative Unit and Watershed (Acres)

Watershed	Admin Unit	Risk-Sensitivity Rank				
		1–Very Low	**2–Low**	**3–Moderate**	**4–High**	**5–Very High**
Myrtle Creek	Roseburg District BLM	1.68	64.68	23.92	0.72	
Days Creek-South Umpqua River	Roseburg District BLM	12.76	146.24	16.46	3.14	
Elk Creek	Roseburg District BLM	0.17	1.98	0.01	0.35	
	Subtotal Roseburg District BLM	**32.57**	**247.39**	**49.89**	**4.37**	**0**
Days Creek-South Umpqua River	Umpqua NF		40.04	14.75		
Upper Cow Creek	Umpqua NF	6.8	39.06	15.05	9.43	0.04
Elk Creek	Umpqua NF	0.31	30.71	0.52		
Trail Creek	Umpqua NF	14.89	23.87			
	Subtotal Umpqua NF	**22.00**	**133.68**	**30.32**	**9.43**	**0.04**
Trail Creek	Medford District BLM	27.93	40.97	5.32		
Shady Cove-Rogue River	Medford District BLM	9.94	49.15	13.05	3.4	
Big Butte Creek	Medford District BLM	3.05	0.48	1.2	6.96	
Little Butte Creek	Medford District BLM	35.21	62.51	12.04	3.07	
	Subtotal Medford District BLM	**76.13**	**153.11**	**31.61**	**13.43**	**0**
Little Butte Creek	Rogue River NF	157.51	119.28	13.98	2.85	
	Subtotal Rogue River NF	**157.51**	**119.28**	**13.98**	**2.85**	**0**
Spencer Creek	Lakeview District BLM	1.66	0.45	11.91	0.85	
	Subtotal Lakeview District BLM	**1.66**	**0.45**	**11.91**	**0.85**	**0**
Spencer Creek	Winema NF	11.86	52.11	25.37	3.48	
	Subtotal Winema NF	**11.86**	**52.11**	**25.37**	**3.48**	**0**

Soil compaction is defined on BLM and NFS lands as a greater than 15 percent increase in bulk density on non-pumice soils and a greater than 20 percent increase on ash/pumice soils over an undisturbed reference soil condition. Areas that receive more than three passes by low ground pressure equipment may exceed these thresholds. Fewer passes by other equipment may result in soil compaction. Therefore, for the purpose of this EIS, it is assumed that soils within the 65-foot working side travel lane would be compacted by construction equipment. Within the trench, soils would be displaced. After the pipeline is installed, the trench would be backfilled; which may result in some soil mixing. The trench area may be compacted during restoration. Construction equipment would not be operating on the 20-foot-wide portion of the right-of-way used to store soils removed from the working side or excavated from the trench prior to pipeline installation. However, after backfilling the trench, equipment may work over the storage area during recontouring and restoration, resulting in compaction. All areas where vegetation is removed and soils disturbed should be considered at a high risk for soil erosion.

Unless otherwise noted, topsoil would not be segregated on BLM and NFS lands because doing so would increase the corridor width and hence impacts on other resources. Soil remediation using soil amendments such as biosolids may be required in areas with reclamation sensitivity to mitigate for the loss of topsoil. Biosolid availability and application rates would be done in coordination with ODEQ.

Surface Erosion

All soils are subject to erosion when disturbed. High intensity fires and rainfall have been the primary natural disturbance processes that affect soil erosion on BLM and NFS lands in the Project area (Everest and Reeves 2007). When site disturbances, such as severe fire, produce hydrologic conditions that are poor (less than 10 percent of the ground surface covered with plants and litter), surface runoff can increase over 70 percent and erosion can increase by three orders of magnitude.

Sediment yields approaching 50 tons/acre have been documented following wildfire (Robichaud et al. 2000). With good hydrologic condition (greater than 75 percent of the ground covered with vegetation and litter), only about 2 percent or less of rainfall becomes surface runoff, and erosion is low (Bailey and Copeland 1961, cited in Robichaud et al. 2001). Therefore, maintenance of ground cover during the rainy season is essential to minimizing soil erosion losses.

Acres of soils by risk/sensitivity ratings on BLM and NFS lands are summarized in table 4.3.3.1-3. Based on the BLM/Forest Service assessment, these ratings vary within the construction right-of-way due to soil characteristics, landscape features, and the nature of the construction/remediation actions proposed. During clearing and construction, all vegetation within the right-of-way would be removed and soils would be disturbed during grading, trenching, backfilling, and restoration activities (see the ECRP). Surface erosion risk would be highest in the first winter following clearing for the project. Without application of erosion control measures, significant surface erosion within the construction corridor would likely occur. Possible impacts of uncontrolled erosion include loss of topsoil and soil productivity, rill and gulley formation, and excessive sediment transport and deposition to stream systems. Where stream intersections occur, or where overland flows could reach stream channels, eroded material could be deposited in stream channels and adversely affect aquatic habitats.

No combination of erosion control measures can achieve 100 percent control of all erosion, however it is possible to substantially reduce surface erosion and off-site sediment transport. Seeding, while an excellent erosion control method, has a low probability of reducing the first season erosion because most of the benefits of the seeded grass occurs after the initial early season events that may cause surface erosion (Robichaud et al. 2000). Conversely, erosion control structures should be considered only as temporary expedients to hold the soil in place until vegetation can become established and stabilize streambanks and disturbed surfaces permanently (Forest Service 2013a). Effective control of surface erosion would require a combination of mechanical erosion control methods, maintenance of effective ground cover and aggressive reestablishment of native vegetation.

To minimize potential soil erosion, Pacific Connector has prepared an ECRP with active participation and engagement from the BLM and Forest Service. The ECRP incorporated into the POD for federal lands will include the recommendations provided as described in NSR (2015a). Acres of soils by risk/sensitivity ratings on BLM and NFS lands are summarized in section 4.3.3.4 and table 4.3.3.4-1. Section 4.3.3.4 also includes more aggressive soil remediation measures that might be used in areas of high soil sensitivity.

The project administrators representing the BLM and the Forest Service, in coordination with FERC EIs, will use this assessment and associated GIS files to determine where and what type of additional soil erosion risk reduction and/or site-specific remediation with biosolids and other organic materials may be necessary.

Pacific Connector would utilize the rating information to identify locations that may require additional measures to ensure a minimum percent effective cover of 65 to 85 percent of the disturbed areas consistent with the ECRP (as modified). Table 10.15-1 of the ECRP provides typical effective ground cover requirements based on specific site conditions.

The ECRP (as modified) for the Pacific Connector Pipeline Project describes the typical erosion control measures that would be implemented during corridor clearing to minimize transport of sediment to adjacent and nearby aquatic habitats. The project administrators representing the BLM and the Forest Service, in coordination with EIs will use the BLM/Forest Service assessment and associated GIS files based on site-specific field conditions determined during or immediately after timber clearing, grading and rehabilitation activities to determine where, and what type of additional soil erosion risk reduction and / or site specific remediation with biosolids and other organic materials may be necessary. These measures may include the following.

- Leaving slash generated during timber clearing operations on the corridor to reduce erosion over the following winter. This minimizes raindrop impacts and overland flow.
- Scarifying compacted surfaces, where appropriate, to promote infiltration and reduce runoff.
- Using additional slash/brush piles and coarse woody debris (limbs to large logs) at appropriate locations to minimize offsite runoff and sedimentation. Coarse woody debris placed on contour has been shown to be an effective hillslope measure to reduce erosion (Robichaud et al. 2000).
- Installation of slope breakers (water bars) at appropriate locations and spacings to shorten slope lengths, prevent concentrated flow, and divert runoff to stabilized areas. Waterbars are a proven and effective method of reducing the erosive energy of overland flow, diverting overland flow and minimizing sediment transport.
- Installation of silt fences and straw bale sediment barriers to prevent transport of sediment to aquatic habitats. Pacific Connector has committed to install and maintain erosion control structures including silt fences at stream crossings until effective ground cover is reestablished. When installed and maintained, silt fences are 90 to 95 percent efficient at trapping sediment (Robichaud et al. 2000).
- Temporary seeding (using appropriate quick-germinating cover crops such as annual ryegrass or other appropriate cover species), where not precluded by federal restrictions on introduced species.
- Mulching of corridor areas that do not have sufficient cover. Geotextile fabric erosion control blankets may also be used to provide temporary ground cover. Mulching reduces raindrop impacts, and when in contact with the ground, limits overland flow and sediment transport.

Mulch materials specified in the ECRP include:

- slash from clearing;
- wood fiber mulch applied during hydroseeding as hydromulch at 2,000 pounds/acre;
- bonded fiber mix (BFM) on slopes greater than 2.5 to 1 (i.e., 40 percent). BFM is similar to wood fiber mulch, but it has properties that allow it to remain strong and insoluble after its initial drying. BFM reduces erosion by (1) absorbing the impact of rainfall while still allowing water to filter through, and (2) absorbing water like a sponge to prevent overland water flow and rilling. It creates a strong and durable mat of interlocking fiber strands held together by a bonding agent which is water resistant and which would withstand re-exposure to moisture without re-dissolving or losing its adhesive quality. Once dry, it forms a water-absorbent protective mat which is porous and breathable and secures soil and seed until vegetation is established. BFM is designed to mix and flow easily when wet

and yet remain strong and insoluble once dry, protecting the soil surface from repeated rains and sheet flows. BFM can be applied prior to a rainy season or late in the year as it is formulated to endure the harsh conditions of heavy rains and snow. In time, BFM biodegrades completely into natural organic compounds that are beneficial to plant life. It is safe to use in riparian zones and watersheds. Because BFM is sprayed on, the site remains relatively undisturbed, further reducing the risk of erosion; and

- straw mulch that is certified weed-free by the appropriate state certification program. In 2009, Oregon established a voluntary pilot Weed Free Forage Program, which certifies both grass and alfalfa hay and straw. The contractor would deliver weed-free certification documents from this program to the EI prior to applying any straw mulch. However, if the certification program is not in place at the time of construction, or if there are not sufficient quantities of certified weed free straw available for the Project, the contractor would request review/inspection of the straw by the local soil and water conservation district, county agent, or other appropriate official or authorized agency representative on federal lands. Any straw that is found to contain noxious weeds during application would be immediately removed from the Project right-of-way and properly disposed of in a public landfill. In non-forested areas, the mulch would be uniformly applied at a rate of 2 tons/acre to cover the ground surface (except on slopes within 100 feet of waterbodies and wetlands where application rates would be increased to 3 tons/acre). Mulching would occur immediately after seeding where broadcast or drill seeding occurs. Anchoring the mulch is not expected to be necessary because strong winds, which could dislodge the mulch, typically occur during the winter rainy season when the moist conditions would bind the straw to the soil. Liquid mulch binders are not expected to be utilized unless hydromulch is applied. Liquid binders would not be used in wetlands or waterbodies.

Erosion control following high-intensity fire provides a useful comparison for effectiveness of erosion control methods. It has been demonstrated that sediment transport in post-fire situations can be reduced by 80 to 95 percent and is most closely correlated with ground cover (Robichaud et al. 2000; Wagenbrenner et al. 2006). Effective erosion control requires a combination of actions. Effective ground cover prevents the mobilization of sediment by absorbing rain drop impacts and, when in contact with the ground, minimizing overland flow of water. Mulch has been shown to reduce sediment yield by 95 percent compared to control plots (Wagenbrenner et al. 2006). Waterbars minimize erosion by shortening the distance water can travel overland and diverting water off of disturbed slopes. Erosion control seeding provides temporary vegetation until permanent revegetation is accomplished. Maintained silt fences provide a backstop that is 90-95 percent effective at trapping sediment, including fine-grained silt (Robichaud et al. 2000). Weed-free straw bales placed as part of the installation behind silt fences reinforce the silt fence and create a resilient sediment barrier that requires little or no maintenance.

The combination of effective ground cover from mulch and coarse woody debris, waterbars to slow and divert water off of the construction area, installation and maintenance of silt fences and other sediment barriers, soil remediation with biosolids and woodchips where necessary, and aggressive grass seeding and fertilization followed by reestablishment of native vegetation is expected to reduce any off-site sediment movement by 80 to 95 percent from levels that would be experienced without application of these methods. Sediment contributions to streams from the pipeline corridor are expected to be at, or near background levels during dry summer months. During winter rains, some increase in sediment transport from the corridor may occur, but this is expected to be minor and undetectable against background levels and well within the range of natural variability given the fire and erosion history southwest Oregon. When compared to current watershed conditions in watersheds crossed by the project, sediment contributions from existing roads and past management activities, any sediment mobilized from the project corridor would likely be an inconsequential contribution to the overall sediment budget of the affected watersheds. It is highly unlikely that the project corridor would become a chronic source of fine sediments with the effective application of erosion control measures and successful re-establishment of vegetation specified in the ECRP, success the first time, or continued until BLM and/or Forest Service acknowledge success.

If implementation or post-project monitoring show evidence, as defined by the BLM or Forest Service, of unacceptable surface erosion or unacceptable off-site sediment movement, Pacific Connector would be required by the terms of the Right-of-Way Grant to take additional erosion control measures as needed, as directed by the BLM or Forest Service, to reduce sediment transport to background levels. Evidence of "unacceptable" levels of sediment transport would include silt fences or other sediment barriers that are not maintained, lack of effective ground cover, visible turbidity at channel crossings, visible evidence of sheet or gulley erosion where sediment is transported off-site or to aquatic systems or chronic deposition of fine sediments as evidenced by turbidity or sediment deposition downstream of crossings.

Compaction

For the purposes of this analysis, all of the project area on the working side (65 feet or about 70 percent of the corridor width) of the construction corridor and TEWAs would be subject to multiple passes of heavy equipment and truck traffic and, as a result, would likely have some degree of compaction. The spoil storage area may experience some degree of compaction depending on the rate and scope of heavy equipment passage. Soil texture, moisture content, and exposure (number of passes and type of equipment) would determine the severity of compaction that may occur. Acres of soils with high potential for soil compaction on BLM and NFS lands are summarized by watershed and administrative unit in table 4.3.3.1-1 of the DEIS. Soils in this sensitive group were determined based on the NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category. Soils in this group are rated based on Unified soil texture classification, rock fragments on or below the surface depth to a restrictive layer, depth to a water table, and slope. Unmitigated soil compaction would result in long-term impacts on soil productivity and increased erosion due to increased runoff.

On slopes less than 35 percent that do not have high rock content, most soil compaction can be effectively treated with a winged subsoil ripper attached to a cat or operated with a hydraulic shovel. It effectively breaks up compacted subsoils and topsoils at a depth of 16 to 20 inches. Decompaction of soils would be accomplished to meet agency standards where possible to do so. Detrimental soil compaction is defined as an increase in bulk density of more than 15 percent when compared to adjacent undisturbed areas. On NFS and BLM lands, compaction testing on areas that are treated would confirm that compaction does not exceed a bulk soil density of 15 percent or more over adjacent undisturbed soils. On NFS lands, within 100 feet of perennial or intermittent streams, compaction would not exceed 10 percent of the activity area as confirmed through compaction testing.

Decompaction is not feasible in all areas. Where slopes exceed 35 percent, or where soils have high rock or boulder content, subsoiling is not feasible and compaction may not be fully treatable. Subsoil ripping is also not possible over the pipeline for safety reasons, so soil compaction in the backfilled trench area would be not be treated. Overall, considering steeper areas, and areas with high boulder content, and the trench area, an estimated 30 to 70 percent of the project area is likely to remain in a compacted soil condition.

Displacement and Mixing

Soil displacement and mixing may create detrimental soil conditions by increasing cobble and stone content, mixing soil horizons and removing or mixing nutrient-bearing "O" and "A" soil horizons with less productive subsurface layers. Soil mixing and displacement would be high in the trenched area. Some degree of displacement and mixing would likely occur on the spoil side of the corridor where excavated material is stored before reburying the pipeline and on the construction side from grading operations.

Severe disturbances such as soil mixing or displacement would reduce long-term site productivity by displacing the duff layer and soil surface ("A" horizon), thus reducing the soil's ability to capture and retain water and nutrients. Applying fertilizers to a damaged soil could offer a short-term boost to establishing grass and brush, but fertilizer alone would not mitigate the nutrient and moisture holding capacity of the original soil displaced from surface soil displacement and soil mixing.

Topsoil would not be segregated on BLM or NFS lands because this would require additional storage space necessitating a widened corridor and would cause additional resource impacts. LWD and slash would be placed back on the corridor for both erosion control and long-term nutrient restoration. The following method has been used with success on the Umpqua National Forest to help accelerate the start of the soil rehabilitation process and is recommended for this project.

- Cover the soil surface to be treated with some form of organic soil amendment (e.g., biochar, weed free straw [2 tons/acre], biosolids [300-pound N equivalence], wood chips [3-inch depth]) before decompacting the soil.
- Using an excavator and winged subsoiler attachment, fracture the soil to a minimum depth of 20 inches or to a restrictive layer if rocky. Pull undisturbed surface soil in from outside the disturbance edges to help inoculate the affected site.
- Using the excavator, pull litter and slash over the restored site before moving on.

Summary of Soil Impacts on BLM and NFS Lands

Soil compaction is treatable by subsoil ripping; however, it is unrealistic to assume all compacted areas would be restored to a condition with less than 15 percent increase in bulk density. Soil mixing, displacement, and compaction would be impossible to avoid on the backfilled trench and the spoils side of the corridor. Steep slopes in some locations, and rocky soils would limit soil decompaction. As a result, an estimated 30 to 70 percent of the project area would likely have detrimental soil conditions from mixing, displacement, or compaction. Complete rehabilitation would also require recovery of the soil biology, which requires restoration of the soil organic matter and time. Some surface erosion is likely to occur; however, 85 to 95 percent of surface erosion can be prevented or trapped on-site by application of measures in the ECRP. Any surface erosion that does occur is expected to be minor, and within the range of natural variability for watersheds in southwest Oregon (see appendix J, section 2.1).

4.3.3.2 Road Sediment Reduction

The Project may cause sediment transport from construction clearing and use of roads by the project. As part of the Project mitigation, road sediment reduction projects are aimed at reducing the chronic contributions of fine-grained sediment from road surfaces and fill failures to stream systems. As described in chapter 2, table 2.1.4-1, mitigation activities include decommissioning of 85.2 miles (approximately 165 acres) of BLM and Forest Service roads. Proposed road decommissioning would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project occur. Sediment reduction would also include closure of about 6.0 miles (approximately 12 acres) of Forest Service and BLM roads, reducing fine-grained sediments by eliminating traffic impacts.

Mitigation also includes road surfacing and drainage improvement to about 60.9 miles (approximately 118 acres with the assumption of a typical 16-foot-wide roadway) of Forest Service and BLM roads. Road surfacing reduces sediment by capping existing fine textured sediments in the running surface of a gravel road with coarser rock or by paving. Paving all but eliminates traffic-generated sediments. Drainage repair reestablishes outsloping cross-drains and in some cases ditchlines to ditch-relief culverts. These actions have the effect of getting water off the road before it can enter stream courses. Storm-proofing of 13.8 miles (approximately 27 acres) of Forest Service and BLM roads would reduce sediment from roads by increasing the resistance of a road to failure during high-intensity rainfall events. Storm-proofing strategies include improving drainage, reducing diversion potential at culverts, outsloping road surfaces and replacing culverts with hardened low water fords. Road sediment reduction activities would result in approximately 322 total acres of long-term sediment mitigation on federal lands. This mitigation would offset the short-term impacts during Project construction to over 1,000 acres of federal lands.

Road stabilization and culvert replacement of five sites on NFS and BLM lands would reduce road-related sediment by stabilizing or removing failing cut and fill slopes. Culvert replacement reduces sediment by replacing undersized or failing culverts with culverts that are appropriate to pass debris at higher flows. This reduces the probability of fill failure associated with plugged culverts.

The specific locations of the road sediment reduction activities are listed in table 4.3.3.2-1. Activities on BLM lands include road surfacing near the Coquille River East, Middle, and North Forks (Coos Bay); road drainage–culvert replacement near the Clark Branch South Umpqua (Roseburg); road stormproofing near the South Umpqua Days Creek (Roseburg); road drainage and surface enhancement near Myrtle Creek (Roseburg); and road stabilization in the Olalla-Looking Glass watershed (Roseburg).

TABLE 4.3.3.2-1

Mitigation Projects to Address LMP Amendments on BLM and NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity	Unit
Coos Bay BLM	East Fork Coquille River	Road Sediment Reduction	Road Surfacing	Road Surfacing –Yankee Run Spurs	0.9	miles a/
	East Fork Coquille River	Road Sediment Reduction	Road Surfacing	Road Surfacing –South Fork Elk Creek	2.6	miles
	East Fork Coquille River	Road Sediment Reduction	Road Surfacing	Road Surfacing –Yankee Run Mainline	2.0	miles
	Middle Fork Coquille River	Road Sediment Reduction	Road Surfacing	Road Surfacing –Fall Creek System	0.9	miles
	Middle Fork Coquille River	Road Sediment Reduction	Road Surfacing	Bridge Approach paving –Sandy & Jones Creek Roads	2	ea.
	North Fork Coquille River	Road Sediment Reduction	Road Surfacing	Bridge Approach paving –Woodward & Alder Creek Roads	2	ea.
Roseburg BLM	Clark Branch South Umpqua	Road Sediment Reduction	Road Drainage – Culvert Replacement	East Fork Willis Creek Tributary Culvert Replacement	1	project
	Clark Branch South Umpqua	Road Sediment Reduction	Road Drainage – Culvert Replacement	Judd Creek Culvert Removal	1	project
	Days Creek - South Umpqua	Road Sediment Reduction	Road storm-proofing	31-4-3.2 Road Storm-proofing	1	project
	Days Creek South Umpqua	Road Sediment Reduction	Culvert Replacement	Corn Creek	1	project
	Days Creek - South Umpqua	Road Sediment Reduction	Road Drainage and Surface Enhancement	South Umpqua Road Drainage and Surface Enhancement	10.0	miles
	Middle Fork Coquille River	Road Sediment Reduction	Road Drainage and Surface Enhancement	Camas Mountain Road Drainage and Surface Enhancement	3.5	miles
	Middle Fork Coquille River	Road Sediment Reduction	Road Surfacing and Cross Drain Replacements	Dice, Boulder, and Twelvemile Creek	11.0	miles
	Myrtle Creek	Road Sediment Reduction	Road Drainage and Surface Enhancement	Slide Creek Road Drainage and Surface Enhancement	1.0	miles
	Myrtle Creek	Road Sediment Reduction	Road Stabilization	South Myrtle Hill Slide Repair	1	project
	Olalla-Looking Glass	Road Sediment Reduction	Road Stabilization	Olalla Tie Road Renovation	1	project
	Olalla-Looking Glass	Road Sediment Reduction	Culvert Replacement	Unnamed Tributary to Lower Olalla Creek	1	project
	South Umpqua River	Road Sediment Reduction	Culvert Replacement	Corn Creek	1	project
Medford BLM	Big Butte Creek	Road Sediment Reduction	Road storm-proofing	Big Butte Creek Road Storm-proofing	6.4	miles
	Little Butte Creek	Road Sediment Reduction	Road Drainage and Surface Enhancement	Little Butte Creek Road Improvement	3.5	miles
	Little Butte Creek	Road Sediment Reduction	Road Decommissioning	Little Butte Creek Road Decommissioning Butte Falls RA	2.4	miles
	Little Butte Creek	Road Sediment Reduction	Road Surfacing	Little Butte Cr. Road Resurfacing, Butte Falls Resource Area	9.4	miles
	Shady Cove RR	Road Sediment Reduction	Road Drainage and Surface Enhancement	Shady Cove Road Improvement	1.3	mile
	Shady Cove RR	Road Sediment Reduction	Road Surfacing	Shady Cove Road Resurface	1.5	miles
	Trail Creek	Road Sediment Reduction	Road storm-proofing	Trail Creek Road Storm-proofing	4.3	miles
	Trail Creek	Road Sediment Reduction	Road Surfacing	Trail Creek Road Resurface	16.3	miles

TABLE 4.3.3.2-1

Mitigation Projects to Address LMP Amendments on BLM and NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity	Unit
Lakeview BLM	Spencer Creek	Road Sediment Reduction	Road Drainage – Culvert Replacement	Keno Access Road Repair and Culvert Replacement	1	site
	Spencer Creek	Road Sediment Reduction	Road Drainage	Spencer Creek Drainage Improvements and Sediment Trap Removal	15	sites
	Spencer Creek	Road Sediment Reduction	Road Closure	Spencer Creek Repair Existing Road Closure	12	sites
Umpqua National Forest	Days Creek - South Umpqua	Road sediment reduction	Road Closure	Days Creek -South Umpqua Road Closure	0.5	miles
	Elk Creek - South Umpqua	Road sediment reduction	Road Storm-proofing	Elk Creek Road Storm-proofing	1.6	miles
	Elk Creek - South Umpqua	Road sediment reduction	Road Closure	Elk Creek Road Closure	2.8	miles
	Elk Creek - South Umpqua	Road sediment reduction	Road Decommissioning	Elk Creek Road Decommissioning	2.8	miles
	Trail Creek	Road sediment reduction	Road Decommissioning	Trail Creek Road Decommissioning	1.1	miles
	Trail Creek	Road sediment reduction	Road Storm-proofing	Trail Creek Storm-proofing	0.5	miles
	Upper Cow Creek	Road sediment reduction	Road Closure	Upper Cow Creek Road Closure	2.6	miles
	Upper Cow Creek	Road sediment reduction	Road Decommissioning	Upper Cow Creek Road Decommissioning	4.3	miles
Rogue River National Forest	Little Butte Creek	Road sediment reduction	Road Decommissioning	Little Butte Creek Road Decommissioning	53.2	miles
Winema National Forest	Spencer Creek	Road sediment reduction	Road Decommissioning	Spencer Creek Road Decommissioning	21.4	miles

a/ Mileages are rounded to nearest tenth of a mile.

4.3.3.3 National Forest Detrimental Soil Condition Thresholds

LRMPs for the Umpqua, Rogue River, and Winema National Forests have standards and guidelines that establish thresholds for detrimental soils conditions as shown in table 4.3.3.3-1.

TABLE 4.3.3.3-1

Thresholds for Detrimental Soil Conditions on NFS Lands

Watershed	Total Project Acres a/	Cleared Acres b/	Threshold Acres Allowed c/	Minimum Projected Acres in Detrimental Condition d/	Maximum Projected Acres in Detrimental Condition	Minimum Acres Over Threshold	Maximum Acres Over Threshold
Umpqua National Forest							
Days Creek- South Umpqua	53	21	11	6	15	-5	4
Elk Creek-South Umpqua	30	29	6	9	20		14
Upper Cow Creek	78	78	16	23	55	7	39
Trail Creek	62	53	12	16	37	4	25
Total Umpqua NF	***223***	***181***	***45***	***54***	***127***	***9***	***82***
Rogue River National Forest							
Little Butte Creek	276	206	28	62	144	34	116
Winema National Forest							
Spencer Creek, All Land Allocations other than Management Area 8	85	73	17	22	51	5	34
Spencer Creek Riparian Areas (Management Area 8)	7	7	1	2	5	<1	4

TABLE 4.3.3.3-1

Thresholds for Detrimental Soil Conditions on NFS Lands

Watershed	Total Project Acres a/	Cleared Acres b/	Threshold Acres Allowed c/	Minimum Projected Acres in Detrimental Condition d/	Maximum Projected Acres in Detrimental Condition	Minimum Acres Over Threshold	Maximum Acres Over Threshold
Total Winema NF	***92***	***80***	***18***	***24***	***56***	***5***	***38***
Total Cumulative Direct Effect, All NFS Lands	**591**	**467**	**91**	**140**	**327**	**48**	**236**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Total Project Acres is all acres within the right-of-way. This includes cleared and uncleared areas.
b/ Cleared Acres are the construction corridor and TEWAs.
c/ Threshold Acres Allowed is the threshold from the standards and guidelines times the Total Project Acres.
d/ Projected Acres in Detrimental Conditions is estimated at 30 percent (minimum) to 70 percent (maximum) of the Cleared Acres.

Detrimental soil conditions are measured upon completion of a project after restoration and rehabilitation work is completed. Detrimental soil conditions are defined in each national forest LRMP, but generally include:

- compaction, which is defined as an increase in bulk density of 15 percent when compared to adjacent undisturbed soils for all soils except volcanic ash or pumice. For volcanic ash soils, compaction is defined as a 20 percent increase in bulk density when compared to adjacent undisturbed soils;
- displacement or mixing, which is the horizontal removal by mechanical means of 50 percent or more of the topsoil or "A" horizons, or mixing of these layers with less fertile subsurface mineral layers such that the continuity of the horizons is lost; and
- detrimental puddling, which is the physical change to soil structure that results when traffic ruts and molds a soil to a depth of 6 inches or more.

Precise estimates of detrimental soil conditions likely to exist at completion of a project are impossible to make. For the purposes of this assessment, 30-70 percent of the pipeline project area may be in a detrimental soil condition upon completion of all soil restoration and rehabilitation efforts. Table 4.3.3.3-1 has been updated from the DEIS and provides an estimate of predicted detrimental soil conditions. Where projected acres exceed the threshold, an amendment of the affected LRMP is necessary to make provision for the Pacific Connector Pipeline Project.

The impacts of detrimental soil conditions include:

- a possible reduction in soil productivity from mixing or displacement of nutrient-bearing soil layers; and
- a potential increase in runoff and erosion from decreased infiltration of compacted soils.

See section 4.3.3.1 for measures that would be applied on federal lands to address these issues.

Amendments of Forest Plans Related to Thresholds for Detrimental Soil Conditions

Where detrimental soil conditions exceed the threshold established in an LRMP, an amendment of the LRMP is necessary for the Project to proceed. The following amendments of National Forest LRMPs are proposed to waive limitations on detrimental soil condition thresholds to make provision for the Project.

UNF-3. Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas

Forest-Wide Soils Standard and Guideline #1 (LRMP IV-67) states:

> *The combined total amount of unacceptable soil condition (detrimental compaction, displacement, puddling or severely burned) in an activity area (e.g., cutting unit, range allotment, site preparation area) should not exceed 20 percent. All roads and landings, unless rehabilitated to natural conditions, are considered to be in detrimental condition and are included as part of this 20 percent.*

For planning purposes, soil impacts are considered long term. Soil compaction and displacement would be confined to the project area, but predicting how much would be affected is an estimate based on professional judgment and the nature of corridor construction. See section 4.3.3.1 for a discussion of environmental consequences.

The Project would likely result in a detrimental soil condition on 30 to 70 percent of the project area on the Umpqua National Forest (223 acres) due to displacement and compaction. Approximately 8 to 20 of those acres would likely be in Riparian Reserves. Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the Project. Existing LRMP standards and guidelines allow up to 20 percent of the project corridor (about 45 acres of the corridor on the Umpqua National Forest) to be in a degraded soil condition upon completion of a project. The Pacific Connector Pipeline Project would exceed these thresholds by about 9 to 82 acres on the Umpqua National Forest. These impacts would be spread over four separate fifth-field watersheds. See section 4.1.3.5 and appendix J, Aquatic Conservation Strategy Assessment, for a watershed-specific evaluation. Amendment of the Umpqua National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of ACS objectives (section 4.1.3.5 and appendix J, sections 2.4.6, 2.4.7, 2.4.8, and 2.5.3). See section 4.1.3.4 for a discussion of significance of this amendment in the context of the Umpqua National Forest LRMP.

RRNF–6. Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas

Standards and guidelines in the Rogue River National Forest LRMP (pp. 4-41, 4-83, 4-97, 4-123, 4-177, 4-307) state:

> *No more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices including roads and landings. Permanent recreation facilities or other permanent facilities are exempt.*

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent of the pipeline right-of-way on NFS lands in the Rogue River National Forest (all in the Little Butte Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent or 28 acres of the pipeline corridor to be in a degraded soil condition on completion of a project. Thus, the pipeline project would likely exceed this threshold by about 34 to 116 additional acres or 0.07 to 0.2 percent of the 57,234 acres (NFS lands only) within the Little Butte Creek Watershed upon completion. About 2 to 5 acres of degraded soil conditions above LRMP thresholds may be in Riparian Reserves. See section 4.1.3.5 and appendix J, Aquatic Conservation Strategy Assessment, for a watershed-specific evaluation of consequences. Amendment of the Rogue River National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of ACS objectives (section 4.1.3.5 and appendix J, section 2.5.6). See section 4.1.3.4 for a discussion of this amendment in the context of the Rogue River National Forest LRMP.

<u>WNF-4 and WNF-5: Site-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas (WNF-4) and in Management Area 8 -Riparian Areas (WNF-5)</u>

These standards and guidelines of the Winema National Forest LRMP restrict the amount of an area that may be in a degraded soil condition as a result of a management activity. They are considered together here because the assessment is the same for both standards.

The forest wide general standard and guideline requires detrimental soil conditions not exceed 20 percent of the total acres within the activity area (Forest Plan page 4-73) and Management Area 8—Riparian Areas requires the cumulative total area of detrimental soil conditions in riparian areas shall not exceed 10 percent of the total riparian acreage within an activity area (Forest Plan page 4-137). Detrimental soil conditions occur when soil is compacted, puddled, displaced over an area greater than 100 square feet, or are severely burned.

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent project right-of-way on NFS lands in the Winema National Forest (all in the Spencer Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent (1.5 acres) of the project corridor in Management Area 8 Riparian Areas or 20 percent (17 acres) in the pipeline corridor outside of Management Area 8 to be in a degraded soil condition on completion of a project. Thus, the pipeline project would likely exceed this threshold by an estimated 5 to 38 additional acres or 0.03 to 0.16 percent of the 22,307 acres (NFS lands only) within the Spencer Creek watershed upon completion. See section 4.1.3.5 and appendix J, section 2.6.3, for a watershed-specific evaluation of consequences. Amendment of the Winema National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of ACS objectives (section 4.1.3.5 and appendix J, section 2.6.3). See section 4.1.3.4 for a discussion of the significance of this amendment in the context of the Winema National Forest LRMP.

<u>Cumulative Impacts, All Units</u>

Cumulatively, on the Umpqua, Rogue River, and Winema National Forests, detrimental soil conditions within the pipeline project area are expected to range between about 140 and 327 acres (table 4.3.3.3-1), or about 49 to 236 acres over the combined LRMP threshold for the pipeline project of 91 acres. Assuming an even distribution over the 30.6-mile NFS part of the pipeline project area, this equals about 2 to 8 acres of detrimental soil conditions above the LRMP thresholds for each mile of pipeline, spread over six separate fifth-field watersheds.

4.3.3.4 Soil Risk and Sensitivity Assessment

At the request of the BLM and Forest Service, Pacific Connector identified areas on BLM and NFS lands along the proposed Project where there is a low vegetation recovery potential. These soils included combined characteristics including high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. Certain types of disturbed soils where residual soil compaction exists in subsurface soil layers, topsoil has eroded, soil horizons have been mixed, and/or topsoil has been removed, can lead to conditions where revegetation can be very difficult, no matter what mitigation methods are employed.

In order to specifically identify areas of revegetation concern where more rigorous mitigation might be required, a Soil Risk and Sensitivity Assessment was performed for the BLM and Forest Service (NSR 2015a). The intent of the assessment was to identify the areas where additional soil decompaction, erosion control, or other types of site-specific and focused remediation measures may be required on BLM and NFS lands to minimize erosion potential and/or accomplish agency revegetation objectives. Soil risk and sensitivity factors were identified by a BLM/Forest Service team including four criteria in the assessment of the risk element; plant mortality, soil erosion, slope rating and aspect; and three levels of sensitivity, primarily based on qualitative values related to management objectives.

As depicted in table 4.3.3.4-1, approximately 83 percent of the Project area, or about 1,143 acres, is rated as Level 1 – very low or Level 2 – low for combined risk and sensitivity. These are locations where revegetation measures are expected to be successful with decompaction and other standard methods described in the ECRP. Approximately 18 percent of the Project area, or about 237 acres, is rated as Level 3 – moderate or Level 4 – high for combined risk and sensitivity where more aggressive erosion controls and/or soil remediation are likely to be needed.

TABLE 4.3.3.4-1

Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres)

Unit	Watershed	Risk Sensitivity Rank				
		1 (very low)	2 (low)	3 (moderate)	4 (high)	5 (very high)
Coos Bay BLM	East Fork Coquille River	13	26	4	32	0
	Coquille River	0	<1	<1	<1	0
	North Fork Coquille River	5	22	8	8	0
	Middle Fork Coquille River	9	58	6	9	<1
	Coos Bay-Frontal Pacific Ocean	<1	2	<1	<1	0
	Subtotal	**27**	**108**	**20**	**19**	**<1**
Roseburg BLM	Clark Branch South Umpqua	2	7	1	0	0
	Olalla-Looking Glass	10	10	5	0	0
	Days Creek -South Umpqua	13	146	16	3	0
	Middle Fork Coquille River	6	17	3	<1	0
	Myrtle Creek	2	65	24	<1	0
	Elk Creek	<1	2	<1	<1	0
	Subtotal	**33**	**247**	**50**	**4**	**0**
Medford BLM	Big Butte Creek	3	<1	1	7	0
	Little Butte Creek	35	63	12	3	0
	Shady Cove RR	10	49	13	3	0
	Trail Creek	28	41	5	0	0
	Subtotal	**76**	**153**	**32**	**13**	**0**
Lakeview BLM	Spencer Creek	**2**	**<1**	**12**	**<1**	**0**

TABLE 4.3.3.4-1

Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres)

Unit	Watershed	Risk Sensitivity Rank				
		1 (very low)	2 (low)	3 (moderate)	4 (high)	5 (very high)
Umpqua National Forest	Days Creek - South Umpqua	0	40	15	0	0
	Elk Creek - South Umpqua	<1	31	<1	0	0
	Trail Creek	15	24	0	0	0
	Upper Cow Creek	7	39	15	9	<1
	Subtotal	**22**	**134**	**30**	**9**	**<1**
Rogue River National Forest	Little Butte Creek	**158**	**119**	**14**	**3**	**0**
Winema National Forest	Spencer Creek	**12**	**52**	**25**	**3**	**0**
	Total	**328**	**814**	**183**	**54**	**<1**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

Areas rated as Level 3 – moderate (about 183 acres or 13 percent of the Project) had either high risk **or** high sensitivity but not both, or were ranked as moderate for both criteria. Areas that ranked as Level 4 – high (about 54 acres or 4 percent of the Project) had both high sensitivity and high risk and would be considered high priority areas for aggressive soil remediation. Less than one acre was ranked Level 5 – very high and considered to have a very high priority for aggressive restoration measures.

Areas ranked a Level 3 – moderate to 5 – very high (237 acres total) would be recommended for more site-specific validation of the risk criteria used in this assessment to confirm that specific locations merit consideration of the more aggressive soil remediation measures listed below:

- biochar to increase the nutrient and moisture holding capacity of the soil and/or adjust soil pH;
- a thin organic Class-A compost (biosolids, 300 to 400 lb/acre N equivalent) to increase the nutrient level of the soil in a slow release form;
- a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw;
- adaptive seed mixes and vegetation to better fit site conditions;
- deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance;
- more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.;
- more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.;
- more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles, etc.; and
- priority monitoring of results as needed to measure success or make future recommendations.

This page intentionally left blank.

4.4 WATER RESOURCES AND WETLANDS

4.4.1 Groundwater

4.4.1.1 Jordan Cove LNG Terminal

The Jordan Cove LNG terminal would be located on the North Spit of Coos Bay at the southern edge of the 19.5-square-mile (12,480-acre) Dune-Sand Aquifer, an unconsolidated-deposit aquifer. Unconsolidated-deposit aquifers consist of sand and gravel, but may contain variable quantities of silt and clay (USGS 2009b). The North Spit is primarily composed of sand dunes, dune forest, and marsh areas that are easily penetrated by water. The Dune-Sand Aquifer is generally 100 feet thick, ranging from a maximum of 200 feet to zero (USGS 1992). At the LNG terminal, the sand aquifer extends to a depth of -160 feet below sea level.[41] Surficial groundwater can be found approximately 8 to 10 feet bgs at the terminal and fluctuates with the Coos Bay tides.

A review of EPA's sole or principal source aquifer (SSA) mapping revealed that the closest SSA is approximately 40 miles north of the LNG terminal site.[42] Additionally, a review of ODEQ data showed that the LNG terminal does not overlie any Groundwater Management Areas where groundwater contamination from non-point source activities warrants state intervention. The potential for contaminated soils at the LNG terminal is discussed in section 4.3.1.3 of this EIS.

Data maintained by the OWRD indicate that there are four groundwater wells permitted for industrial use and fire protection to Roseburg Forest Products located just east of the LNG terminal site. Three of the wells are within the footprint of a proposed construction laydown area that Jordan Cove would lease from Roseburg Forest Products. The fourth well is approximately 550 feet south of the proposed temporary heavy equipment truck haul road that Jordan Cove would use across the Roseburg property. Jordan Cove has stated that activities within the temporary laydown area would not restrict access by Roseburg Forest Products to the wells or the water from the wells. Additionally, Jordan Cove has stated that following construction, the leased construction laydown area would revert to its pre-construction condition and use, and that operation of the LNG terminal would not restrict access to the wells. We note, however, that Jordan Cove has not stated how the wells within the construction laydown area would be protected from construction equipment or supplies being parked on top of the wellheads or from the inadvertent release of fuel or other hazardous liquids used to fuel and/or maintain construction equipment. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, a plan to protect the four groundwater wells located on Roseburg Forest Products property from physical damage during construction of the LNG terminal.**

---

[41] See Livesay, D., 2006, *Jordan Cove Energy Project, Groundwater Review*, Groundwater Solutions, Inc., Portland, attached as Appendix E.2 to Resource Report 2 filed with Jordan Cove's May 2013 application to the FERC.

[42] EPA defines an SSA area as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer from drinking water (EPA 2013a).

The CBNBWB has 18 groundwater wells located within the Oregon Dunes National Recreation Area (ODNRA) within the Siuslaw National Forest to the north of the LNG terminal. These wells, ranging in depth from 90 to 120 feet bgs, withdraw non-potable water from the Dune-Sand Aquifer. The CBNBWB's well field is capable of producing up to 4 mgd of water during normal precipitation years (CBNBWB 2012). The well field is managed though conditions outlined in the Forest Service Special Permit. Conditions in the permit are protective of aquatic and terrestrial ecosystems located in the ODNRA (CBNBWB 2009). The closest CBNBWB well is about 3,500 feet north of the terminal (see Appendix E.2 in Jordan Cove's Resource Report 2). Neither construction nor operation of the LNG terminal would have any direct impacts on the structure of the CBNBWB wells due to the distance of the wells from the Project.

As described in section 2.1.1.10, Jordan Cove would obtain both raw and potable water from the CBNBWB. The CBNBWB has one potable water line that runs along the Trans-Pacific Parkway, and two raw water lines that extend from its well fields. As shown in table 4.4.1.1-1, Jordan Cove estimates that it would need a total of approximately 1.7 billion gallons of water for construction. If calculating a five-day workweek over the 3.5-year construction period, construction of the LNG terminal site would require approximately 1.9 mgd, which is within the amount CBNBWB stated it could provide.

TABLE 4.4.1.1-1

Water Usage from CBNBWB Sources for Jordan Cove Facilities

Activity	**Amount of Water**
Construction	**Million Gallons—Total**
Construction activities (concrete washouts, tire washes, offices etc.)	100
Concrete Operations	100
Site Work	1,500
South Dunes Power Plant	23
Hydrostatic testing –LNG storage tanks	28
Hydrostatic testing of process lines on the South Dunes site	1
Initial fill of firewater ponds	5.3
Hydrostatic testing usage – South Dunes	8.4
TOTAL	**1,765.7**
Operation	**Million Gallons—Annual**
LNG Terminal	184 a/
Make-up to the firewater ponds due to evaporation water loss	3.1 b/
South Dunes Power Plant	295 a/
LNG Terminal/South Dunes Power Plant Workers	0.57 c/
TOTAL	**482.8**

a/ The operational water usage is the average consumption rate on an annual basis (based on a 310 MW plant output, relevant to the terminal and power plant).
b/ Western Regional Climate Center (2013).
c/ Assumes 145 workers using 15 gallons per day for 260 working days per year (CSG Network 2014).

Currently the wells in the ODNRA are not being used due to the closure of the Weyerhaeuser mill; therefore, use of water from the CBNBWB wells for project construction and operation may temporarily lower groundwater levels in the wells. However, the water need of 1.9 mgd is within the capacity of the well field (which has an average capacity of 4 mgd), while still protecting aquatic resources such as surficial lakes and wetlands (CBNBWB 2009).

During operation of the Jordan Cove Project, water from the CBNBWB potable line on the North Spit would provide the potable water requirements for the various buildings, staff needs, the supplementary filling of the fire water pond from evaporation loss, and supplemental water in the event of an emergency. Operational water usage is estimated to be approximately 1.3 mgd. This amount is within the limit of 1.5 mgd of potable water that the CBNBWB has stated it could provide.

Construction and operation of the LNG terminal has the potential to affect groundwater resources, because of the shallow depth to surface groundwater and the permeability of the sand and gravel soils across the site. Construction impacts could result from excavation of the upland portion of the terminal marine slip, driving of piles for the LNG vessel berth and the tug boat berth, and installation of foundations for major structures. During both construction and operation of the terminal, spills or leaks of hazardous liquids, such as lubricating oil, gasoline, and diesel fuel used for equipment and facilities, may affect groundwater. In addition, there is the potential for a spill or leak of LNG during plant operations.

To create the marine slip, Jordan Cove would excavate and dredge to a depth of -45 feet NAVD88, removing about 4.3 mcy of material. Since the bottom of the marine slip would be below the surface water level, excavation and dredging may cause local groundwater elevations to drop. Water levels at the CBNBWB well that is closest to the LNG terminal (Well 46 located 3,500 feet north) may drop as much as 0.5 feet (see Appendix E.2 in Jordan Cove's Resource Report 2). After construction of the slip is completed, we expect that groundwater levels would fluctuate somewhat with the tides (GRI 2013b). As a result of the tidal influence on the local groundwater, the change of 0.5 foot in the vicinity of the terminal is not considered substantial.

There is also the potential for seawater intrusion caused by the construction of the marine slip. A study conducted for Jordan Cove[43] estimated that introduction of seawater into the slip would move the current seawater/saltwater interface northward about 1,650 feet. This should have no impacts on the CBNBWB well field on the North Spit. The water table would remain at an elevation of about +10 feet above mean sea level at the northern boundary of the terminal property.

Jordan Cove would drive approximately 210 piles into the slip during construction to support the LNG berth, loading platform, and tug berth. Depending on the location and type, piles could potentially be conduits for contaminants to impact groundwater if a spill of hazardous material occurs at the pile (Boutwell et al. 2004; IDEM 2011). Once subsurface materials have been disturbed, soils may be more permeable, and manmade preferential pathways can transmit contaminant away from the release point as pure produce, in a vapor phase, or dissolved in water, regardless of depth to groundwater (IDEM 2011). Non-displacement piles (steel "H") form conduits, but displacement-type piles (wood, steel, and probably concrete) do not form conduits for contaminate migration (Boutwell et al. 2004). If a hazardous spill occurs and seeps into the groundwater, remediation of the spill would be necessary to clean up the contaminated soil and groundwater. Spill-related impacts are discussed below. Implementation of Jordan Cove's SPCCP would minimize the risk of a spill occurring.

No blasting is anticipated during construction of the terminal. Therefore, no adverse effects on groundwater flow due to blasting in the vicinity of the proposed terminal are expected.

---

[43] Livesay, D., 4 December 2006, *Jordan Cove Energy Project, Groundwater Review*, Groundwater Solutions, Inc., Portland. Attached as Appendix E.2 in Resource Report 2 included with Jordan Cove's May 2013 application to the FERC.

When groundwater is encountered during excavation, dewatering would be required. Methods for dewatering may include the use of wellpoints, which consist of a closely spaced series of small-diameter shallow wells connected to a common headermain and high-efficiency vacuum dewatering pump. The contractor would determine the most appropriate method for dewatering excavations and obtain appropriate permits prior to construction. All water associated with dewatering would be pumped to a discharge structure that is appropriately sized for the discharge volume. Water associated with construction dewatering would not be directly discharged to waterbodies until either filtered or directed to a settling pond before discharge. Technical memoranda were submitted in Jordan Cove's February 13, 2015, filing that summarize evaluations of the potential for dewatering activities during construction to impact groundwater, surface water, and wetland habitats near the terminal (DEA 2015; GSI Water Solutions Inc. 2015). Dewatering proposed for excavation of the LNG facilities would be temporary, and it is expected that groundwater movement would return to currently normal conditions following construction. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts to ground and surface waters. The details of the monitoring program would be developed in consultation with the Project's assessment of biological resources and design/construction teams.

To prevent or reduce impacts on groundwater from the accidental release of hazardous materials during construction, Jordan Cove has prepared a Spill Plan[44] that describes preventive measures that would be implemented to avoid spills and leaks, as well as the measures used to minimize potential effects should a spill or leak occur. The Spill Plan designates refueling procedures; spill response procedures, spill response materials, and training; countermeasures/contingency plan; and hazardous liquids storage, and disposal.

Spill-related impacts during operation of the LNG terminal would mainly be associated with fuel storage, facilities use, equipment refueling, and equipment maintenance, which would be prevented or minimized with the implementation of Jordan Cove's SPCCP. Jordan Cove included a Preliminary SPCCP as Appendix N.2 of Resource Report 2 in its May 2013 application to the FERC and submitted a final SPCCP in its February 12, 2015, response. The SPCCP includes detailed information such as the location and type of bulk storage containers and the type of potential spills.

The terminal would have a system of curbs, drains, and basins to collect and contain any spills of LNG during operation. In the unlikely event that LNG is spilled, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water and would completely vaporize shortly after being spilled, the LNG could not mix with or contaminate groundwater.

During operation, the jurisdictional LNG terminal and related facilities and the non-jurisdictional South Dunes Power Plant and SORSC combined would occupy a total of 251 acres, of which about 34 acres would be covered by impervious surface materials, such as asphalt and concrete. This surface cover would reduce the area available for groundwater recharge to the Dune-Sand Aquifer, and potentially cause a decrease in the shallow, water-bearing zone underlying the LNG terminal. However, in comparison to the total 12,480-acre area of the Dune-Sand Aquifer, this

[44] The preliminary draft Spill Plan was included in Jordan Cove's May 2013 application to the FERC as Appendix K.2 to Resource Report 2. The Final Spill Plan was submitted February 12, 2015.

0.03 percent area reduction would not likely result in an adverse effect on the level of groundwater in the area. Through use of the measures discussed above, we conclude that impacts on groundwater resources at the Jordan Cove LNG terminal would be minimized to the extent practicable and would not be significant.

4.4.1.2 Pacific Connector Pipeline

Groundwater depths would vary throughout the project area crossed by the Pacific Connector pipeline route, depending on the local topography as well as on the different underlying aquifers. As identified in table N-4 in appendix N of this EIS, approximately 46 miles (or 20 percent) of the pipeline route would cross areas of shallow groundwater where the water table ranges from zero to 6 feet bgs. Approximately 36 of those 46 pipeline miles would be located in areas that have seasonally high groundwater (fall through spring), 10 of those 46 pipeline miles, primarily in the Klamath Basin (MPs 191.3 to 214.0), would be located in areas with shallow groundwater year-round.

Aquifers

The pipeline and associated aboveground facilities would not overlie any EPA-designated SSAs. The nearest EPA-designated SSA, and the only one in Oregon, is the North Florence Dunal Aquifer (EPA 2013a), which is in Lane County, approximately 40 miles to the north of the pipeline.

There are four general aquifer types within the project area defined by their geologic and hydrologic characteristics: unconsolidated-deposit, pre-Miocene rock, volcanic and sedimentary rock, and Pliocene and younger basaltic rock. The following aquifer descriptions are taken from the USGS Groundwater Atlas (USGS 1994). Surface geology is discussed in section 4.2.2.1 of this EIS.

Unconsolidated-deposit Aquifers – The pipeline would overlie unconsolidated-deposit aquifers for approximately 7.6 miles in and around Coos Bay (between MPs 1.5R and 23.4), 3.1 miles in Douglas County between MPs 55.3 and 69.7, and 23.0 miles in the Klamath Basin between MPs 191.8 and 214.9. Many of the large lower-gradient streams in the area flow through unconsolidated deposits. These aquifers consist primarily of sand and gravel and are the most productive and widespread aquifers in Oregon. These unconsolidated-deposit aquifers typically provide freshwater for most public-supply, domestic, commercial, and industrial purposes (USGS 1994).

Pre-Miocene Rock Aquifers – The majority of the pipeline route between MPs 23.5 and 155.8 would overlie aquifers of pre-Miocene rocks. These aquifers consist of undifferentiated volcanic rocks, undifferentiated consolidated sedimentary rocks, and undifferentiated igneous and metamorphic rocks principally in the mountainous areas crossed by the pipeline. Within and west of the Cascade Range, the consolidated sedimentary rocks are of marine origin and commonly yield salt water. At depth, the salt water can contaminate overlying freshwater aquifers. Permeability of the aquifers varies greatly. Water from wells completed in these aquifers is used mostly for domestic and agricultural (livestock watering) supplies (USGS 1994).

Volcanic and Sedimentary Rock Aquifers – East of Medford, the pipeline route enters a groundwater area of volcanic and sedimentary rock aquifers for about 8.2 miles between MPs 134.2 and 156.9. These aquifers consist of a variety of volcanic and sedimentary rocks and are not as productive as the unconsolidated-deposit, Pliocene and younger basaltic-rock or Miocene basaltic-rock aquifers. Volcanic- and sedimentary-rock aquifers generally yield fresh water but locally yield salt water. About 30 percent of the fresh groundwater withdrawals are used for public supply, about 20 percent are used for domestic and commercial, and about 50 percent are used for agricultural (primarily irrigation) purposes (USGS 1994).

Pliocene and Younger Basaltic-rock Aquifers – In the Klamath Basin, between MPs 191.9 and 228.1, the pipeline route passes south of Brown Mountain through an area of Pliocene and younger basaltic-rock aquifers while passing in and out of unconsolidated deposit aquifers. Pliocene and younger basaltic-rock aquifers consist primarily of thin, basaltic lava flows and beds of basaltic ash, cinders, and sand and yield fresh water that is used mostly for agricultural (primarily irrigation) purposes (USGS 1994).

Water Supply Wells and Springs

Public Supply Wells – According to the ODEQ, groundwater is the only source of drinking water for about 95 percent of the rural areas in Oregon (2012a). The 1996 federal Safe Drinking Water Act (SDWA) requires Source Water Assessments for all public water systems that have at least 15 hookups, or serve more than 25 people year-round. The Oregon Health Authority and the ODEQ Drinking Water Protection Program jointly manage the SDWA assessment requirements. ODEQ maintains the Drinking Water Protection database, which includes public drinking water source areas for groundwater and surface water, as well as the locations of public water system intakes and public groundwater wells (ODEQ 2012b). According to the ODEQ database, there are no groundwater wells that supply public drinking water systems within 400 feet of the proposed route and associated facilities.

ODEQ has identified and established wellhead protection areas (WHPAs) to protect public drinking water sources. The SDWA defines a WHPA within the recharge area of a well as the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such a water well or well field. The pipeline would cross six WHPAs as shown in table 4.4.1.2-1 (ODEQ 2012b).

TABLE 4.4.1.2-1

Wellhead Protection Areas Crossed by the Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Public Groundwater Source Area	Public Drinking Water System ID
6.38R	6.74R	Coos	Kentuck Golf Course	4190858
195.09	196.29	Klamath	Production Metal Forming, Inc	4195058
197.35	197.77	Klamath	Timber Resource Services LLC	4193994
198.45	199.62	Klamath	Collins Products LLC	4193995
199.26	199.66	Klamath	Columbia Plywood Corp	4194403
200.54	201.12	Klamath	Crossroads Mobile Home Park	4100446

Private Wells –– As shown in table 4.4.1.2-2, eight private wells permitted for irrigation purposes are located within 150 feet of the construction work area (OWRD 2013). Two private wells were found within the construction work area: one in a temporary work space and another within the construction right-of-way.

TABLE 4.4.1.2-2

Private Wells in Klamath County Within 150 Feet of the Pacific Connector Construction Work Area

Milepost	Permit Number	Use	Distance to Construction Area (feet)
190.83	10354	Irrigation	99.73
203.75	15818	Irrigation	0.00 a/
201.08	15997	Supplemental Irrigation	116 c/
212.07	16733	Supplemental Irrigation	71.68
217.34	3957	Irrigation	61.68
223.44	15416	Supplemental Irrigation	0.00 b/
224.04	12433	Supplemental Irrigation	78.75
224.04	365	Irrigation	78.75

a/ Well located within temporary extra work space
b/ Well located within construction right-of-way
c/ Well located within 150 feet of a temporary extra work space

Other Groundwater Wells – There are several types of groundwater wells in Oregon that are exempt from obtaining any kind of permit, and are therefore not registered or identified in a state database. These include wells for single or group domestic purposes not exceeding 15,000 gallons per day.

Springs and Seeps – A spring is a concentrated discharge of groundwater appearing at the ground surface as a current of flowing water. Seeps, as distinguished from springs, are areas that indicate a slower movement of groundwater to the ground surface. Water seepage areas may pond and evaporate or flow, depending on the magnitude of the seepage, the climate, and the topography. Pacific Connector surveys have identified a number of springs and seeps as noted in appendix N of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with landowners.

Construction Impacts and Proposed Mitigation Measures

Construction of the pipeline would require trenching to depths between 6 and 11 feet bgs, depending on the site-specific conditions (see section 2.4.2.1). Construction activities such as trench excavations, grading, and filling of the excavated trench could cause minor fluctuations in shallow groundwater levels, increase turbidity within shallow groundwater adjacent to the construction activity, or alter the flow path of springs and seeps. When the pipeline is located in areas of shallow groundwater, Pacific Connector has stated that it would follow the FERC's *Procedures* requiring the use of trench breakers or installation of trench plugs in areas of shallow groundwater and on slopes. Trench breakers (or plugs) would prevent local shallow groundwater and recharge (via precipitation) from flowing along the pipeline trench. Trench plugs are installed after the pipeline is installed in the trench and prior to trench backfilling.

<u>Dewatering the Trench</u>

Approximately 65 miles of the pipeline route would cross areas where the groundwater is zero to 6 feet bgs. Pacific Connector has stated that in areas where the trench may be continually flooded and dewatering would not be feasible, it would float the pipeline into place and install it using the push-pull method (see section 2.4.2.2). While the installation of trench breakers and trench dewatering by pumps to an upland area may be feasible for small areas of seasonally high groundwater, we note that some of these shallow groundwater areas could extend over 4 miles (see table N-4 in appendix N), making the float and push-pull construction technique impracticable. For longer stretches of the pipeline route, trench dewatering through a well point pumping system with a groundwater treatment plan may be the best option depending on if the groundwater is emanating from a pressurized or non-pressurized source point.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers.

Potentially Contaminated Groundwater Sites

As discussed in section 4.3.2.3, of the nine sites investigated by the ODEQ for contaminants that the Pacific Connector Pipeline Project could affect, three potentially have groundwater contamination. As recommended, information filed by Pacific Connector with the FERC on February 13, 2015, includes specific plans detailing how contaminants at these three sites would either be avoided or removed.

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers. A spill could reach different aquifer layers in these areas. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases.

Pacific Connector's SPCCP[45] addresses the preventive and mitigative measures that would be implemented to avoid or minimize the potential effects of hazardous material spills during construction. These measures include, but are not limited to:

- regular inspection of containers and tanks for leaks;
- use of secondary containment of fuel storage tanks and hazardous materials containers 55-gallons or greater;

[45] The SPCCP was included in Pacific Connector's June 2013 application to the FERC as Appendix 2B to Resource Report 2. A revised SPCCP was submitted in the February 13, 2015, Supplement.

- implementation of emergency response procedures, including spill reporting procedures; and
- use of standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

Prior to construction, Pacific Connector would include in the SPCCP the types and quantities of hazardous materials that would be stored or used during construction. Project personnel would be trained and prepared to demonstrate their ability to implement the SPCCP to federal, state, or local inspectors. As discussed in section 2.5.1, Pacific Connector would employ EIs to ensure compliance with the SPCCP and other specifications during construction and restoration. In accordance with the FERC's *Plan*, the EIs would have the authority to stop work and order corrective actions for activities that violate the environmental conditions of our Certificate and other permit authorizations.

Pacific Connector developed a *Contaminated Substances Discovery Plan,* Appendix E to the POD, in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction. The plan outlines practices to protect human health and worker safety and measures that would be taken to prevent further contamination, including:

- all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted;
- all construction, oversight, and observing personnel would be evacuated to a road or other accessible upwind location until the types and levels of potential contamination can be verified;
- if an immediate or imminent threat to human health or the environment exists, one of Pacific Connector's emergency response contractors identified in the SPCCP or the National Response Team would be notified and mobilized; and
- the contaminated material would be removed and properly disposed of in accordance with appropriate regulations and ordinances and in accordance with the SPCCP.

In addition, the Forest Practices Act Division 620 for chemical and other petroleum product rules may be applicable. Certain requirements apply to the use of chemical and other petroleum products such as fuels and lubricants on any forest operation to protect soil, air, or waters of the state.

Blasting

Pacific Connector identified a number of locations along the proposed route where blasting may be required for pipeline installation (see section 4.2.2.5). Blasting could affect groundwater quality by temporarily changing groundwater levels and increasing groundwater turbidity near the construction right-of-way. Pacific Connector has developed a *Blasting Plan*[46] to minimize potential adverse impacts on the environment, nearby water sources, structures, or utilities. As stated in the *Blasting Plan*, licensed blasting contractors would conduct the blasting activities in accordance with all applicable federal, state, and local regulations. Pacific Connector would obtain all necessary permits if blasting is required.

[46] The *Blasting Plan* was included in Pacific Connector's June 2013 application to the FERC as Appendix C of the POD.

Pacific Connector's blasting contractor would prepare blasting plans specific to the area to avoid potential effects. The blasting plans would be reviewed and approved by appropriate agencies. The blasting contractor would conduct appropriate pre-construction investigations, as needed, and develop specific blasting operation and monitoring plans to address site variables (soil and rock types, etc.), which would incorporate locations of existing groundwater wells or springs and seeps. Limits would be set for blast peak particle velocity to a level that would protect water wells, springs, and other nearby structures from any structural damage. As noted in Pacific Connector's *Geologic Hazards and Mineral Report*,[47] potential effects, if any, are expected to be temporary and localized because of the small amount of blasting agents generally needed for trenching.

In its *Groundwater Supply Monitoring and Mitigation Plan,*[48] Pacific Connector states that should it be determined after construction that there has been an effect to groundwater supply (either yield or quality), Pacific Connector would provide a temporary supply of water, and if determined necessary, would replace the affected supply with a permanent water supply. Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs.

Drain Tiles

In a tile drainage system, a sort of "plumbing" is installed below the surface, effectively consisting of a network of below-ground tiles that allow subsurface water to move out from between soil particles, into the tile line, and ultimately into surface water points—lakes, streams, and rivers—located at a lower elevation than the source. In agricultural areas, drain tiles remove excess water from the soil subsurface as too much subsurface water can prevent root development, inhibiting the growth of crops.

Approximately 20 miles of the pipeline route through Klamath County would cross agricultural fields containing drain tiles. Pacific Connector has not identified the exact locations of the drain tiles but would identify the presence of drain tiles on individual properties during right-of-way easement acquisition.

Pacific Connector would ensure that any drain tiles cut or damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required from ODEQ under Section 401 of the CWA. All drain tiles crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test tiles for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drain tiles to the same condition that existed prior to construction.

Water Use and Quality

Trenching and dewatering could result in adverse effects to the water supply of wells, springs, and seeps if extensive pumping is needed in the immediate vicinity of those groundwater sources. Disruption to groundwater well supplies would likely be temporary and well recharge

[47] Stand-alone report attached to Pacific Connector's application to the FERC in June 2013.
[48] The *Groundwater Supply Monitoring and Mitigation Plan* was included in Pacific Connector's application to the FERC as Appendix 2F of Resource Report 2.

should occur when dewatering stops. Trench excavations, the use of trench plugs to remove groundwater from a trench, grading, and filling could alter the flow path of springs and seeps. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan.* Landowners would be supplied with documentation that explains the proposed pipeline construction methods, and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies for landowners within and adjacent to the proposed pipeline right-of-way.

The landowner would be provided with a point of contact with Pacific Connector to report potential problems with wells, springs, and seeps believed to be the result of construction. We note that neither the *Groundwater Supply Monitoring and Mitigation Plan* nor Pacific Connector's Resource Report 2 contain language regarding physical protection for groundwater supplies during construction. Groundwater wells should be fenced off to avoid being affected by construction equipment. Springs and seeps, along with their associated discharge areas, should be protected by a minimum of one row of silt fence.

All groundwater wells, springs, and seeps within 150 feet of the proposed right-of-way would be considered potentially susceptible to impacts from pipeline construction and would be included in the monitoring program. In order to determine the final number of wells, spring, or seeps potentially affected by the Project, and protect those wells or springs, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and approval by the Director of OEP, a revised *Groundwater Supply Monitoring and Mitigation Plan* that identifies the location by MP of all wells, springs, and seeps within 150 feet of the construction right-of-way, including direction and distance (in feet) from the pipeline centerline, and outlines measures that would be implemented to avoid or reduce impacts on those features.**

The following information would be documented for groundwater wells: date and time, location, weather (if outside), water level, flow rate (calculating gallons per minute), horsepower of existing pump and number of samples taken. Similar information would be documented for springs and seeps but would also include proximity to other sources, presence of barriers, and other pertinent information (i.e., fisheries significance).

If a groundwater supply (either yield or quality) has been affected by the Project, Pacific Connector would work with the landowner to provide a temporary supply of water; if determined necessary, Pacific Connector would provide a permanent water supply to replace affected groundwater supplies. Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs and be specific to each property. Pacific Connector has stated that within 30 days of placing the facilities in service, it would file a report with the

Secretary discussing whether any complaints were received concerning the water yield or water quality and how each was resolved.

The proposed compressor station, meter stations, MLVs, communication towers, access roads, TEWAs, and contractor yards would be in the same general vicinity as the pipeline. The measures Pacific Connector has proposed to minimize the potential effect of the pipeline on groundwater (e.g., adherence to the measures included in Pacific Connector's ECRP, SPCCP, and our *Plan* and *Procedures*) would apply to these areas as well. Additionally, although some clearing and grading activities may be associated with the TEWAs, contractor yards, and access roads, trenching and drilling would not take place in these areas, thereby reducing the potential for impact. If groundwater is encountered during construction, Pacific Connector would follow the same dewatering techniques as described above.

The depth of excavation necessary for construction of the Klamath Compressor Station is dependent on soil conditions at the site. We note that the compressor station would be located in an area of high blast potential (see section 4.2.2.5). If blasting is required, it would be conducted in accordance with the *Blasting Plan* as described above. Blasting could temporarily affect shallow groundwater at the site and would not persist beyond the end of construction affecting the subsurface.

Operational Impacts of Aboveground Facilities and Proposed Mitigation Measures

The proposed piping associated with aboveground facilities would be fixed to belowground structures, coated in accordance with the DOT standards, and hydrostatically tested prior to the commencement of operation to avoid leaks. Pacific Connector would conduct monitoring in accordance with the DOT requirements during operations to minimize the potential of corrosion and leaks.

For the operation of its aboveground facilities, Pacific Connector is required to provide a SWPPP to the ODEQ in order to obtain an NPDES permit. The SWPPP would include a listing of hazardous materials associated with operation of the aboveground facilities and BMPs to avoid, minimize, and mitigate the spill of any hazardous substances that could affect shallow groundwater and/or unconsolidated aquifers. Pacific Connector has stated that its NPDES permit application would be submitted one year prior to scheduled pipeline construction.

Conclusions About the Potential Pipeline Project Effects on Groundwater Resources

No long-term effects to groundwater are anticipated from construction or operation of the pipeline and aboveground facilities because disturbances would be temporary, erosion controls would be implemented, natural ground contours would be returned as close to preconstruction conditions as possible, and the right-of-way revegetated. Implementation of Pacific Connector's ECRP and our *Plan* and *Procedures* would limit impacts from construction on groundwater resources. Our review indicates that potential effects to drinking water wells are unlikely and would be mitigated if they occur.

Temporary, minor, and localized effects could result during trenching activities in areas with shallow groundwater (depth less than 10 feet below the ground surface) crossed by the pipeline. The greatest threat posed to groundwater resources would be a hazardous material spill or leak into groundwater supplies. Pacific Connector developed an SPCCP to minimize impacts on ground water resources in the event of an inadvertent spill during construction. We do not anticipate any significant impacts on aquifers by the pipeline given the shallow depth of the trench. Because of the reasons cited above, we conclude that the construction or use of the aboveground facilities, access roads, TEWAs, and contractor yards would not significantly impact groundwater resources.

4.4.2 Surface Water

There are federal and state laws and regulations pertaining to impacts on waterbodies. Section 10 of the RHA prohibits the creation of any obstruction to the navigable capacity of any waters of the United States without specific approval of the COE. Under Section 404 of the CWA the COE regulates the discharge of dredged or fill material into waters of the United States. The limits of COE regulatory jurisdiction extend landward up to the mean high water mark in tidally influenced areas and to the ordinary high water mark in non-tidal, navigable waters. The term "waters of the United States" includes the territorial seas and tidally influenced waters. "Waters" also include all other waters that are part of a surface tributary system to and including navigable (non-tidal) waters of the United States. Wetlands adjacent to these waters are also "waters of the United States." On October 15, 2013, Jordan Cove and Pacific Connector submitted a single comprehensive JPA to the COE for the Project.[49]

There are seven RHA Section 10 navigable waterways as regulated by the COE located within the project limits. These waterways include:

- Rogue River (river mile [RM] 0 to RM 27.1);
- Umpqua/South Umpqua River (RM 0 to RM 122.2);
- Coos River (RM 0 to RM 15.6);
- Coquille River (RM 0 to RM 36.3);
- Catching Slough (RM 0 to RM 7.0);
- Haynes Inlet (RM 0 to RM 2.0); and
- The Pacific Ocean (territorial sea boundary/baseline to 3 miles offshore).

There is one CWA Section 404 navigable waterway located within the project limits:

- Rogue River (RM 27.1 to RM 157.5).

The EPA's CWA Section 404(b)(1) Guidelines (Guidelines) are binding regulations to the COE Regulatory Program and provide the substantive environmental standards by which all Section 404 permit applications are evaluated. COE's regulatory authority (under the RHA) is rooted in the navigable capacity of a river, and in the agency's responsibilities to maintain and restore the chemical, physical, and biological integrity of the nation's waters. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the applicant. The Guidelines outline a process whereby a proposed action is analyzed to assess and ensure the "Least Environmentally Damaging Practicable Alternative" is adopted. A project-scale and individual-impact scale Guidelines analysis would be required prior to obtaining applicable

[49] A copy of the single comprehensive JPA was filed with the FERC by Jordan Cove on November 6, 2013.

permits prior to construction. Jordan Cove prepared a "Supplemental Alternatives Analysis Report" in May 2015 that includes the alternatives analysis requested by the COE.

The Project would also need to comply with Section 401 of the CWA. The applicant would be required to obtain an individual Section 401 water quality certification demonstrating that the discharges associated with the project comply with federal and state water quality standards. The ODEQ is the state agency responsible for Section 401 water quality. For example, Section 401 would pertain to a stormwater management system to gather runoff from impervious surfaces at the LNG terminal.

Construction activities including clearing, grading, excavation, and stockpiling that would disturb 1 or more acres and may discharge to surface waters or conveyance systems leading to surface waters of the state would be regulated by the ODEQ under ORS 468B.050 and Section 402 of the CWA.

ODSL regulates removal or fill material in waters of the state under the Oregon Removal-Fill Law (ORS 196.795-990). The purpose of the law is to protect public navigation, fishery, and recreational uses of the waters of the state.

Through the notification process, provisions for surface water quality under the Forest Practices Act and rules will be addressed, if applicable. Details would be submitted in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act.

4.4.2.1 Jordan Cove LNG Terminal

The Jordan Cove LNG import terminal would be located on the bay side of the North Spit of Coos Bay, about 7.5 miles up the bay from its mouth. The planned South Dunes Power Plant and the proposed Jordan Cove natural gas processing plant would be located on the north side of geographic Jordan Cove, which is part of Coos Bay. On the east side of the power plant site is Haynes Inlet, which is also part of Coos Bay.

Coos Bay is an inland estuary. The surface area of the estuary covers about 12,380 acres measured at mean high water. Coos Bay is fed by about 30 tributaries, including the Coos River, Millicoma River, Catching Slough, Isthmus Slough, Pony Slough, South Slough, North Slough, Kentuck Slough, and Haynes Inlet. The estimated average annual discharge at the mouth of Coos Bay is 2.2 million acre-feet of fresh water (Roye 1979).

The estuary lies within the USGS-designated watershed, Coos Bay (USGS HUC: 17100304; EPA 2012). The watershed covers an area of approximately 739 square miles of Oregon's southern coastal range, and is included in the larger South Coast Watershed Basin (ODEQ 2012c).

There is an existing navigation channel in Coos Bay that would be used as part of the waterway for LNG vessels transiting to the Jordan Cove terminal. Between the existing navigation channel and the terminal marine slip, Jordan Cove would create a dredged new access channel in the bay. The Oregon Institute of Marine Biology (OIMB) sampled physical oceanographic data in Coos Bay, specifically in the area of the terminal access channel, from August 2009 through December 2010 (Shanks et al. 2010, 2011). The OIMB physical oceanographic data set included salinity, temperature, and Chlorophyll a. The data provide some insight into the effect of tidal flow and season on the characteristics of the water flowing past the terminal location. On those dates when the 24-hour sampling took place during the dry season (October 2009 and 2010, and July 2010), there is little variation exhibited in salinity during the tidal cycle, but slightly lower and higher salinities during low and high tides, respectively. In contrast, temperatures are markedly higher during low tides than high tides. In the rainy season (sampled in March 2010), the pattern reverses. There is little change in temperature over the tidal cycle, but large variations in salinity with low salinities during low tides and high salinities during high tides. May is a transition month. There is still enough flow from the Coos River to cause variation in salinity within the estuary and solar warming of the shallow waters up the estuary and cooling of the coastal waters due to upwelling caused variation in the temperature signal. During low tides, the waters passing the Project site area were warmer and less salty than during the rising tides. In effect, the results of the OIMB sampling program indicate that there is a great amount of variability in the physical oceanographic data of the waters of Coos Bay in the vicinity of the terminal.

Jordan Lake is an upland waterbody on the North Spit, located approximately 0.4 mile to the east of the LNG terminal site. Jordan Lake would potentially be affected by construction of the access/utility corridor bridge span.

Surface Water Quality

The ODEQ's Integrated Report identified Coos Bay on the Section 303(d) list (in CWA) for not meeting the criteria for shellfish growing since 2004, due to elevated fecal coliform measurements. Coos Bay is listed as Category 5, water quality limited, and a Total Maximum Daily Load (TMDL) is needed (ODEQ 2012d). Wastewater generated during construction and operation of the Jordan Cove terminal would be treated by the City of North Bend's wastewater treatment system via a new sewer line, and therefore the Project is not likely to add fecal coliform to Coos Bay.

Dredging the Access Channel

At the terminal marine slip, created from an existing upland, about 2 mcy would be dredged by Jordan Cove. While the marine slip is dredged, it would be separated from the bay by an earthen berm. Therefore, those activities would have no effect on the waters of the Coos Bay.

Project-related dredging in the bay, including removal of the berm, would result in temporary siltation and sedimentation impacts similar to those that currently occur during maintenance dredging activities by the COE for the existing navigation channel. On average, the COE removes approximately 900,000 cy of dredge material from Coos Bay every year. The COE indicated that average turbidity in Coos Bay ranges between 20 and 49 nephelometric turbidity units (NTU) and believes its maintenance dredging activities in the existing navigation channel below NCM 12 do not significantly increase ambient bay turbidity levels (Roye 1979).

Jordan Cove would dredge approximately 1.8 mcy in the bay during the removal of the berm and creation of the access channel. The duration of turbidity created would be temporary, lasting only as long as the dredging activities occurred in the bay. This would be between 4 to 6 months. All work in the bay would be done during the ODFW recommended in-water window between October 1 to February 15. Turbidity caused by dredging would be localized, dissipating to minor levels of suspended sediments within 200 feet, as discussed below.

Jordan Cove submitted its *Report on Turbidity Due to Dredging* (provided in Appendix F.2 to Resource Report 2 of its May 2013 application to the FERC) that included a modeling analysis of the turbidity that would be generated by the dredging operation at the access channel. The model was developed on the basis of a sediment analysis conducted at the site of the dredging and took into consideration wind, tidal currents, and seasonal flows. The ambient turbidity levels in the water (generated by flows, waves and ship traffic) create a background level of turbidity ranging by season from 3.7 to 18.1 NTUs or 5.7 to 45.7 milligrams per liter (mg/l) total suspended solids (TSS). The model indicated that the hydraulic cutterhead dredge to be used by Jordon Cove would generate TSS levels up to a maximum of 500 mg/l in the vicinity of the dredge. However, the turbidity would rapidly reduce to a maximum of 14 mg/l by a distance of 60 meters (200 feet) with a current of 1.0 meter per second (m/s).

Resuspension of sediments during dredging operations can be a significant source of turbidity. However, through proper operational controls and the potential use of physical barriers, this source can be controlled to minimize the concentration and dispersion of TSS in order to meet the water quality criteria required in the CWA Section 401 water quality certificate to be issued by the ODEQ. Operational controls include cessation of dredging, decreasing cutterhead speed, increasing suction flow rate and using a different size or type of dredge, lowering the crest elevation and/or avoiding stockpiling during peak ebb conditions. Physical barriers include silt curtains which are suspended vertically in the water with floats and are anchored, typically extending to within 2 feet of the bottom.

Jordan Cove has stated that because of the possible presence of buried woody debris in the near-shore area of the proposed access channel, clamshell dredging rather than hydraulic dredging may be required to construct some portions of the access channel. During clamshell dredging, sedimentation and turbidity may be higher than that predicted for a hydraulic dredging operation. Clamshell dredging is proposed for maintenance dredging of the slip and access channel, and potential effects are discussed below in the Maintenance Dredging and Disposal section.

Analysis of sediment transport modeling results indicated that, for all design conditions, no changes in existing patterns of shoreline erosion and rates of bottom depth changes in Coos Bay are expected because of the construction of the Jordan Cove access channel and terminal marine slip.[50] Creation of the access channel and marine slip would not cause large waves that would erode the shoreline of the bay, nor would construction of the access channel and marine slip result in the additional deposition of sediments that would greatly modify the depths of the bottom of the bay.

Modeling was conducted by CHE to determine the potential effects of slip excavation and the construction of the Pacific Connector pipeline through Haynes Inlet should these activities occur at the same time. The results of this modeling are presented in two volumes: CHE (2010b) and CHE (2011b, provided as Appendix H.2 of Jordan Cove's Resource Report 2). Construction of the slip and the dredging of the access channel would produce no or negligible impacts on tidal flow circulation near Jordan Cove and Haynes Inlet. As expected, the result of the tidal flow circulation modeling and analysis has shown that there would be a localized reduction of

[50] See Coast & Harbor Engineering, March 9, 2011, *Technical Report – Draft – Volume 2 – Jordan Cove Energy Project and Pacific Connector Gas Pipeline Coastal Engineering Modeling and Analysis*, attached as Appendix H.2 to Resource Report 2 included with Jordan Cove's May 2013 application to the FERC.

velocities at the Project site and a small localized increase of velocities downstream and upstream of the Project site. As there are small localized changes in tidal velocities and sediment transport predicted by the model, water quality would not be affected, and no water quality and geomorphic changes cascading up and down the bay or into the tributaries would occur based on model analysis (CHE 2010b).

Maintenance Dredging and Disposal

The volume of spoil dredged from the slip and access channel for routine maintenance would be approximately 360,000 cy during the first 10 years of the operation of the terminal, and approximately 330,000 cy during the second 10 years. Future maintenance dredging of the slip and access channel would likely be conducted using a mechanical clamshell dredge, which consists of a close-lipped bucket operated from a floating barge. A close-lipped bucket is specifically designed to reduce sediment resuspension into the overlying water column by forming a seal when the bucket surfaces. The material removed by clamshell dredging would be placed on either a flat-deck barge with watertight sideboards, or a bin-barge with one or multiple cells. The material would be transported to the offshore Site F for disposal.

Maintenance dredged material would be deposited at Site F, in the Pacific Ocean, about 1.75 miles north-northwest of the north jetty at the mouth of Coos Bay. This is an existing EPA-designated and managed offshore placement site, used by the COE since 1986 to dispose of materials dredged during maintenance of the Coos Bay navigation channel, in accordance with Section 103 of the MPRSA. The site was expanded in 1989, 1995, and 2006, so that it now encompasses about 3,075 acres, with water depths ranging from 20 to 160 feet. Jordan Cove included a *Slip and Access Channel Excavated and Dredged Material Management Plan* with its COE Permit Application (Appendix H.7 of Jordan Cove's Resource Report 7). This plan outlines procedures for the disposal of materials resulting from maintenance dredging of the LNG terminal access channel and slip at Site F, to ensure that the site capacity is not significantly inhibited. It considers the needs and characteristics of Site F defined by the COE and EPA, addresses the types and volumes of materials to be deposited, methods of disposal, and location.

Maintenance dredging and spoil disposal would occur during in-water work windows established by the ODFW and NMFS. No dewatering of dredge material would occur in Coos Bay.

Based on the turbidity modeling conducted for this maintenance dredging (Appendix F.2 in Jordan Cove's Resource Report 2), the effects are predicted to be localized and relatively short term. During maintenance dredging activities, the dredged material is presumed to comprise primarily fine particles (mud, clay silt). According to the DREDGE model, the use of an open "clamshell" dredge for maintenance dredging would result in the maximum TSS concentrations of about 830 mg/l in the vicinity of the dredge, decreasing to 125 mg/l at 660 feet away.

According to the Mike21 simulations, maintenance dredging may result in a turbidity plume for up to 1.9 miles from the dredging location at highest ebb or flood currents. However, the duration of high tides and currents may not last more than a 2-hour period, and time-averaged TSS concentrations would not exceed natural ambient concentrations (10 to 30 mg/l) outside the dredging area. As a result of the modeling of fine materials, we do not expect the turbidity plume to contain TSS in excess of 50 mg/l.

Terminal Water Supply and Discharges

Water to be used for both construction and operation of the Jordan Cove terminal would come from the existing CBNBWB lines. CBNBWB obtains water from groundwater wells located on the North Spit and two reservoirs. Jordan Cove proposes to use the existing industrial wastewater line to discharge water used to hydrostatically test the LNG storage tanks during construction of the terminal. Jordan Cove would not use surface water sources during construction or operation of the terminal, and all waters discharged from the site would be treated prior to release. Permits would be obtained for all wastewater discharges as required by ODEQ.

Volumes of wastewater generated by the Project are included in table 4.4.2.1-1.

There are no process water discharges from the liquefaction process. There would be some wastewater discharges from the oily water separators that would be directed to the industrial wastewater pipeline. There are no anticipated changes to water temperature, salinity, and current/hydrology in Coos Bay channel from the release of wastewater from the LNG terminal.

TABLE 4.4.2.1-1

Wastewater Generated from Construction Areas and Operational Facilities

Location	Volume of Wastewater
Construction	**Million Gallons - Total**
South Dunes Power Plant	5.35 a/
Operation	**Gallons per day**
LNG Terminal	144,000
South Dunes Power Plant	238,400
North Point Workforce Housing	68,400 b/

a/ Value is for system flushing and chemical cleaning for steam blows
b/ Value is based on an average workforce of 792 using 87 gallons per day each.

Stormwater Runoff

During construction of the LNG terminal facilities, stormwater runoff could erode disturbed soils, creating sediment in nearby surface waters. To minimize potential impacts, construction activities would be conducted in compliance with the NPDES permit (1200-C) for stormwater discharges during construction activities. Stormwater runoff from the disturbed portions of the site would be managed in accordance with a site-specific ESCP, which incorporates stormwater pollution prevention. A draft of the site-specific Preliminary ESCP is provided as Appendix I.2 of Jordan Cove's Resource Report 2. Jordan Cove would install all necessary erosion and sedimentation control structures in compliance with the ESCP. Following appropriate treatment such as electro-coagulation, chemical flocculation, or filtration, if needed, all construction stormwater from the proposed LNG terminal site would be directed towards the slip. An on-site concrete batch plant would be used in the construction of the LNG storage tanks. To minimize the potential for accidental discharges during construction, Jordan Cove would implement its SWPCP for the concrete batch plant. Jordan Cove has filed a preliminary plan in accordance with the ODEQ and DOGAMI Storm Water Discharge Permit for Concrete Batch Plant (General Permit Number 1200-A). Jordan Cove would finalize the plan prior to construction and provide a copy to ODEQ with the general permit application. A copy of the Preliminary SWPCP is included in Appendix J.2 of Jordan Cove's Resource Report 2.

Jordan Cove would design and construct a stormwater management system, to gather runoff from impervious surfaces within the terminal and direct the flow to designated areas for disposal. Stormwater drainage and collection would be accomplished by a system of ditches and swales. Stormwater collected in areas that have no potential for contamination would be allowed to flow or be pumped to ditches that ultimately drain to the slip. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water collection sumps. Collected stormwater from these sumps would flow to the oily water separator packages before discharging to the industrial wastewater pipeline. Jordan Cove would apply for a new NPDES permit for this discharge. No untreated stormwater collected in areas that are potentially contaminated with oil or grease would be allowed to enter federal or state waters.

The NPWHC would incorporate percolation for treatment and disposal of stormwater. Parking surfaces would be constructed with permeable asphaltic pavement to let stormwater percolate through the surface into a gravel base and then into a sandy substrate. Surfacing for the bus depot area would include a more durable but less permeable surface treatment. Consequently, the bus depot area would be equipped with a storm system designed to capture run-off and treat flow before being discharged to the environment by incorporating oil-water separators in catch basins and a stormwater detention pond to capture and retain up to a two-year rainfall event. Larger storm events would be detained and slowly released via percolation and overflow to the existing north point bioswale/drainage system. With the exception of the bus depot, all other roadways for the NPWHC would be constructed to accommodate large trucks using an open graded durable rock surfacing, which would allow incipient rainfall to infiltrate into the sandy substrate. Housing units would use "on-site infiltration sumps" installed alongside each housing unit to percolate downspout drainage. Sump installation would follow local standards of practice and would accommodate a 10-year storm event before allowing localized ponding during peak flows. All NPWHC on-site improvements would be 50 feet or more from the estuary, with a vegetated buffer for any surface water runoff not captured by on-site stormwater facilities.

Accidental Spills or Leaks of Hazardous Materials at the Terminal

Spills, leaks, or other releases of hazardous materials during construction of the LNG terminal could also adversely affect water quality. Hazardous materials entering Coos Bay resulting from material spills being flushed into waterbodies with stormwater runoff or entering Coos Bay directly from leaks or spills at the LNG unloading berth could have an adverse impact on water quality.

Because of the design of the terminal, it is highly unlikely that there would be a spill or release of LNG. Within the terminal would be a system of curbs, drains, and basin that would collect LNG if any spilled or leaked. Jordan Cove prepared a draft ERP (included as Appendix P.2 in Resource Report 13) for the operational phase of the terminal to minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization, containment, remediation, and reporting of any releases that might occur. If LNG spilled or leaked, it would turn to vapor when exposed to the warmer atmosphere, and these vapors would rise as lighter than air. LNG is not soluble, would not mix with water, and would not contaminate surface water.

The most likely source of hazardous liquids that may spill or leak during construction and operation of the terminal, with the potential to contaminate surface water, would include oils and gasoline from equipment. Spill-related impacts from the construction of the LNG terminal facilities are mainly associated with fuel storage, equipment refueling, and equipment maintenance. These potential impacts can be avoided or greatly reduced by regulating storage and refueling activities, and by requiring immediate cleanup should a spill or leak occur. Jordan Cove prepared a site-specific *Preliminary Draft Spill Plan* (Appendix K.2 in Jordan Cove Resource Report 2) for the construction phase of the Project to minimize the potential for accidental releases of hazardous materials and to establish proper protocol concerning minimization of, containment of, remediation of, and reporting of any releases that might occur. In addition, Jordan Cove prepared a Preliminary SPCCP for the design, construction, and operation of the Project (Appendix N.2 in Jordan Cove's Resource Report 2) to describe the preventive measures that would be implemented to avoid spills and leaks, as well as the mitigation measures utilized to minimize potential effects should a spill or leak occur. Jordan Cove's proposed measures to reduce the risk of hazardous material spills and minimize impacts should a spill occur include, but are not limited to:

- all employees handling fuels and other hazardous substances would be properly trained;
- hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary;
- all equipment would be parked overnight and fueled at least 150 feet from a waterbody or in an upland area at least 150 feet from a wetland boundary;
- secondary containment or diversionary devices would be required for all containers 55 gallons or larger. Discharge prevention measures include dikes, retaining walls, curbing, weirs, booms, diversion ponds, retention ponds, and absorbent materials. The secondary containment systems would be adequate to contain the content of the largest container plus sufficient freeboard for precipitation (i.e., 110 percent); and
- all drainage of accumulated stormwater from containment systems would be inspected to ensure no visible sheen is present and the condition documented prior to discharge.

Upon finalization, the SPCCP would designate refueling areas; spill response procedures, materials, and training; mitigative measures/response; and hazardous liquids quantities, storage, and disposal. Should a spill occur, Jordan Cove would implement containment actions identified in the SPCCP and notify the appropriate agencies based on the type, volume, and location of the spill. While a hazardous material spill has the potential for significant adverse environmental impacts, adherence to the SPCCP would greatly reduce the likelihood of such impacts, as well minimize the resulting impacts should a spill occur. As such, significant adverse impacts to surface water due to contamination from hazardous material spills or releases are unlikely.

Vessel Propeller Wash and Waves

Propeller wash from LNG vessels and tug boat propellers associated with the Project, as well as ship wakes (waves) breaking on shore, could cause increased erosion along the shoreline and resuspend the loose sediment along shallow shoreline area, resulting in a temporary increase in turbidity in the bay. Resuspension of bottom sediments and resulting increases in turbidity are considered temporary short-term impacts. Use of shallow draft tugs to assist LNG vessels throughout the mooring and departure operations may result in some resuspension of bottom sediments and increase turbidity over the short term until the bottom sediments become stabilized.

The possible magnitude and effects of the Project on shoreline erosion were approximated by Jordan Cove through model studies by Moffat & Nichol (2008) and by CHE (2011b).[51] Details of the model parameters and results are discussed in section 4.6. The Moffat & Nichol (2008) report indicated that along most of the route (approximately from NCM 1 to the new facility entrance) sediment resuspension caused by propellers would be slight within the navigation channel as the increased velocity would be similar to maximum tidal currents. The CHE (2011b) report also modeled likely bottom disturbance from existing deep-draft cargo ship (assumed 106 trips annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG vessels (projected 113 trips annually). Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current-induced suspension.

The CHE (2011b) report modeled velocities and likely effects on sediment scour at the terminal slip from the tugboat pushing of vessels to the dock. The modeled estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 ft/sec, which would be unlikely to erode the bank. Furthermore, the slip would be armored to minimize erosion. Near the bottom, maximum velocity in the access channel and slip would be about 2.16 ft/sec. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about 2 inches over a limited bottom area (approximately 100 by 50 feet) in the channel. Some bottom disturbance would likely occur during docking, but in most cases is likely to be much less than estimated because of the conservative assumptions used for this model. Therefore, turbidity increases near the bottom may occur at the terminal slip from the tugboat propeller. The turbidity increase would be local and settle once the propellers stopped.

The CHE (2011b) report indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG vessels through Coos Bay. However, the overall effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay.

Release of Hazardous Materials from LNG Vessels

Spills, leaks, or other accidental releases of hazardous materials during operation from the LNG vessel and escorts during transit in the waterway could adversely affect water quality of the bay. These vessels contain LNG, fuel, and oil. LNG would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water it could not mix with or contaminate water. It is unlikely that LNG would spill from a vessel in transit in the waterway because of the hull design and containment structures on board.

A spill or leak of fuel or oil into Coos Bay during LNG vessel transit is also unlikely because of vessel design and on-board spill kits. The International Maritime Organizations Marine Environmental Protection Committee published Shipboard Oil Pollution Emergency Plan requirements in 2000 (78 FR 60099). These include mitigating activities that are also included in the Coast Guard requirements. Resource requirement are based on the vessel's fuel oil capacity

[51] Appendix H.2 in Resource Report 2 attached to Jordan Cove's May 2013 application to the FERC.

(33 CFR 151). Spills of fuel or other oils are more likely to be released into surface waters during fueling or bunkering at the dock when the hazardous materials are being transferred onto the vessel. To reduce the risk of spills during fuel transfer, procedures should be followed by the chief engineer familiar with the system to be involved in operations (78 FR 60099). With the implementation each vessel's shipboard oil pollution emergency plan, impacts resulting from the spill of fuel, or oil, or other hazardous liquids would be minimized.

Water Releases from LNG Vessels at the Terminal Berth

LNG vessels at the Jordan Cove terminal berth would release ballast water and engine cooling water into the marine slip. No wastewater would be discharged from the LNG vessels into the slip. The LNG vessels may arrange with licensed private entities for refueling, provisioning, and collection of sanitary and other waste waters contained within the vessel. The licensed private entities would transport the waste to a permitted treatment facility. Discharges from vessels are subject to regulation by EPA. EPA currently regulates discharges incidental to the normal operation of vessels operating in a capacity as a means of transportation with the Vessel General Permit. This general permit became effective December 2013 and includes general effluent limits applicable to all discharges; general effluent limits applicable to 26 specific discharge streams; narrative water-quality based effluent limits; inspection, monitoring, recordkeeping, and reporting requirements; and additional requirements applicable to certain vessel types. Vessels of 300 gross tons or more or that have the ability to hold or discharge more than 8 cubic meters of ballast must submit a notice of intent in order to receive permit coverage. Jordan Cove would provide permitting requirements to the LNG vessels calling on the Project.

Ballast Water

The Coast Guard mandates a ballast water exchange (BWE) process for vessels arriving at U.S. ports. The BWE process includes complete exchange of ballast water in the open sea at least 200 miles from U.S. waters. Therefore, the ballast water discharged by LNG vessels at the Jordan Cove terminal would have originated in the open sea rather than a foreign port.

LNG vessels at the terminal slip would discharge ballast concurrently with the LNG cargo loading. The amount of ballast water discharged must, at a minimum, be adequate to maintain the LNG ship in a positive stability condition and with an adequate operating draft while the LNG cargo is loaded. Jordan Cove expects its terminal to be visited by 90 LNG vessels per year. Each LNG vessel would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded.[52]

The LNG loading rate is designed to be 10,000 m^3/hr (with a peak capacity of 12,000 m^3/hr), or 4,600 metric tons per hour (t/hr) (5,520 t/hr peak), consequently the ballast water discharge rate would be approximately 20,250 gpm. Typical LNG vessels have three ballast water pumps, each capable of 3,000 m^3/hr (13,210 gpm) rated capacity. The typical LNG vessel has an upper and a lower ballast water discharge on each side of the hull, referred to as sea chests. The lower unit is just above the keel, approximately 10 meters (33 feet) below the water line. The typical ballast

[52] One cubic meter of LNG is 0.46 metric tons (t), which for the maximum size of LNG vessel authorized to call on the LNG terminal (148,000 m^3) would be 68,080 t of LNG per ship. Assuming 1 t of seawater is 1.027 m^3, the amount of seawater ballast discharged (50 percent of the weight of the LNG loaded) would be approximately 34,959 m^3 (approximately 9.2 million gallons).

water discharge port or sea chest is approximately 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 20 to 25 mm.

A potentially notable difference that may be observed in water quality could be salinity. Coos Bay is an estuary where freshwater runoff from upland rives meets seawater. According to Roye (1979), the zone of change in salinity in Coos Bay occurs at about NCM 8. The findings of the sampling conducted by OIMB (Shanks et al. 2010, 2011) in the bay near the LNG terminal indicated a wide range in salinity between seasons and tidal cycles. Salinity ranged from approximately 16 practical salinity units (psu) at low tide in winter to approximately 33 psu during high tide between May and September. On average, seawater in the world's oceans has a salinity of about 35 psu. Shanks et al. (2010, 2011) estimated the volume of water passing through Coos Bay in the vicinity of the Jordan Cove terminal during lower tidal levels to be 106 million m^3. Therefore, any increase in salinity from the 9.2 million gallons (34,825 m^3) of ballast water discharge would be approximately 0.3 percent of the water passing by the terminal. Consequently, virtually no change in salinity would occur in Coos Bay.

Another physio-chemical water quality parameter that may be influenced by the introduction of ballast water is the dissolved oxygen level. Dissolved oxygen levels are a critical component for the respiration of aquatic organisms. Among many other factors, dissolved oxygen levels in water can be influenced by water temperature, water depth, phytoplankton, wind, and current. Typical water column profiles indicate a decrease in dissolved oxygen with an increase in depth. Some factors that often influence this stratification include sunlight attenuation for photosynthetic organisms that can produce oxygen, wind, wave, and current that results in mixing. ODEQ records indicate that dissolved oxygen is rarely below the 6 mg/l standard below NCM 13 in Coos Bay (Roye 1979).

Water that is collected within the ballast tanks of a ship would lack many of these important influences and could suppress dissolved oxygen levels. However, ballast water that is discharged is not expected to be anoxic (i.e., lacking all oxygen), just lower than what levels would likely be at the surface. In addition, ballast water would be discharged near the bottom of the slip where dissolved oxygen levels may already be lower. Therefore, no significant impacts are likely to occur as a result of discharging ocean water with potentially suppressed dissolved oxygen levels.

Water temperatures and pH in Coos Bay are not likely to be significantly altered as a result of the release of ballast water by LNG vessels in the Jordan Cove marine slip. The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F. In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F in September at NCM 8 (Roye 1979). Since ballast water is stored in the ship’s hull below the waterline, water temperatures are not expected to deviate much from ambient temperatures of the surrounding bay water. The pH of the ballast water (reflective of open ocean conditions) may be slightly higher as compared to that of freshwater estuaries. However, this slight variation is not expected to have any impacts on existing marine organisms.

LNG Vessel Engine Cooling Water

The LNG vessels would also re-circulate water for engine cooling while loading LNG at the berth. No chemicals would be added to the cooling water. The amount of cooling water to be re-circulated is a function of the propulsion system of the LNG vessel. For purposes of this analysis, typical cooling water flow rates were used. Cooling water flows while at the berth are approximately 1,300 m^3/hr (343,421 gallons per hour or 5,723 gpm). For a 148,000 m^3 vessel, this would total approximately 6.1 million gallons while at berth (for 17.5 hours). The intake port for this engine cooling water is approximately the same size and at the same location as the ballast water intake port, 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 25 mm and approximately 32 feet below the water line, or 5.6 feet from the keel of the LNG vessel. The velocity across this port is approximately 0.28 ft/sec with a temperature differential of 3°C.

The effects of engine cooling water discharged by an LNG vessel at the terminal berth on the temperature of the water in the marine slip were evaluated (CHE 2011b). The engines would be running to provide power for standard hotelling activities as well as running the ballast water pumps. The activities that would require LNG vessel power and the assumptions used to develop the engine cooling water flow requirements are as follows:

- hotelling operations require the generation of 1.9 MW of power during the entire time that the LNG vessel remains in the slip. The vessel is anticipated to be within the slip for a total of 17.5 hours; and
- a typical auxiliary power unit for an LNG vessel is the Wartsila 34DF. This is a dual-fuel (liquid and natural gas) unit that is a complete primary driver/generator package capable of being sized upwards to 6.9 MW output. Fuel to power conversion is 7,700 kilojoules per kilowatt-hour (kJ/kWh) (7,305 British thermal units per kWh [Btu/kWh]). This system has an overall fuel to power efficiency of 46.7 percent, thereby resulting in the rejection of 3,893 Btu of heat into the cooling water for each kWh of power generated.

All calculations that follow are based upon the transfer of 148,000 m^3 of LNG from the LNG storage tanks to the LNG vessel. The 148,000 m^3 vessel is set as the basis because it represents the largest vessel authorized by the Coast Guard to call on the LNG terminal.

The total gross waste heat discharged into the slip from the cooling water stream would be due primarily to the hotelling operations (including the power required to run the ballast water discharge pumps) because the shore-side LNG pumps would be used to transfer the LNG from the LNG storage tanks to the LNG vessel. The hotelling operations were assumed to be as follows:

- hotelling operations – 17.5 total hours x 1,900 kW x 3,983 Btu/kWh = 132.5 MMBtu; and
- the total amount of heat discharged into the slip during each vessel call is approximately 132.5 MMBtu.

Two models (the 3-D UM3 model and the DKHW model) were used to study possible slip temperature changes resulting from the discharge of engine cooling water by an LNG vessel at the Jordan Cove berth. The models simulate hydrodynamic mixing processes of submerged discharges and predict temperature fields and dispersion of non-conserved substances in ambient waterbodies. Cooling water numerical modeling requires input of steady-state flow velocity in the modeling domain. The results of tidal flowing modeling using the SELFE model showed that ambient current velocities inside the slip vary, depending on tidal stage. Peak current speeds in the berth only exceed approximately 0.32 fps less than 2 percent of the time. Therefore, for cooling water modeling, two steady state ambient flow velocities were assumed and used further in the analysis: high velocity = 0.32 fps and typical velocity = 0.16 fps.

The modeling assumptions are conservative in that a steam-powered ship was used. Steam-powered ships tend to be older than the newer more modern dual-fuel diesel electric ships that require lower quantities of cooling water.

Results of the modeling showed that for typical ambient flow conditions at a distance of 50 feet from the discharge point (LNG vessel sea chest), temperatures would not exceed 0.3ºC (0.54ºF) above the ambient temperature (CHE 2011b). This temperature difference would decrease with distance from the point of discharge. Considering the volume of water in the Jordan Cove marine slip (an estimated 4.8 cy), and tidal mixing in Coos Bay, the release of heated water from LNG vessel engine cooling operations would not substantially increase water temperatures.

Also ameliorating the impact of the release of warm engine cooling water from an LNG vessel at the Jordan Cove berth would be the decrease in temperature of the surrounding slip water due to the cooling effect that would occur from the addition of LNG cargo to the vessel. The cold LNG cargo could moderate effects on slip water temperature. Because of the extreme differential of the temperature of the cargo in the LNG vessel (-260°F) and that of the surrounding bay water (nominally 50°F) there is a constant uptake of heat by the LNG vessel. This heat uptake is manifested by the amount of LNG cargo that changes state from liquid to vapor on a daily basis. The typical LNG vessel sees 0.25 percent of its liquid cargo converted to the gaseous state each 24 hours because of this warming. In this process, 219 Btu of heat is absorbed for each pound of LNG converted to vapor. This results in a total of 53 MMBtu absorbed by a typical 148,000 m^3 LNG vessel during the 17.5 hours it is within the slip. It is reasonable to assume that 50 percent or more of the heat uptake by the vessel is extracted from the water.[53]

In addition, ballast water discharged from the LNG vessel would also comprise some portion of the water withdrawn for cooling and affected by its discharge. As the greatest predicted temperature increase from the release of engine cooling water is only about 0.5°F and that increase would be reduced further in proximity to the LNG vessel, we conclude that the thermal effect of LNG vessel operations at the berth would have very minimal impact on background water temperatures.

4.4.2.2 Pacific Connector Pipeline

The Pacific Connector pipeline would cross six subbasins including the Coos, Coquille, South Umpqua, Upper Rogue, Upper Klamath, and Lost River. Within the six subbasins, 19

[53] This assumption is further reinforced by the fact that the heat transfer coefficient between water and steel is significantly higher than the heat transfer coefficient between air and steel. Therefore, it is estimated that 26.5 MMBtu would be removed from the water in the slip by the LNG vessel during its stay. Thus, a portion of the 132.5 MMBtu of thermal energy discharged into the slip from the cooling water is offset by the uptake of 26 MMBtu by the LNG vessel itself, resulting in a net heat input to the slip of 106.5 MMBtu per 148,000 m^3 LNG vessel call.

hydrologic units at the HUC 10 level, otherwise referred to as a fifth-field watershed, would be crossed by the pipeline as listed in table 4.4.2.2-1.

TABLE 4.4.2.2-1

Subbasins and Fifth-Field Watershed Crossed by Proposed Pacific Connector Pipeline

Subbasin	Fifth-Field Watershed Name	HUC	Miles Crossed a/
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	20.6
Coquille	Coquille (Middle Main) River	1710030505	2.0
	North Fork Coquille River	1710030504	8.3
	East Fork Coquille River	1710030503	9.7
	Middle Fork Coquille River	1710030501	15.8
South Umpqua	Olalla Creek-Lookingglass Creek	1710030212	8.8
	Clark Branch - South Umpqua River	1710030211	13.5
	Myrtle Creek	1710030210	8.7
	Days Creek - South Umpqua River	1710030205	19.8
	Elk Creek	1710030204	3.3
	Upper Cow Creek	1710030206	5.3
Upper Rogue	Trail Creek	1710030706	10.7
	Shady Cove - Rogue River	1710030707	8.1
	Big Butte Creek	1710030704	5.1
	Little Butte Creek	1710030708	32.9
Upper Klamath	Spencer Creek	1801020601	15.1
	John C. Boyle Reservoir - Klamath River-	1801020602 b/	5.4
Lost River	Lake Ewauna-Upper Klamath River	1801020412	16.1
	Mills Creek - Lost River	1801020409	22.6
		Total	**231.8**

a/ Mileages are rounded to nearest tenth of a mile.
b/ There are no waterbodies crossed in the Klamath River-John C. Boyle Reservoir Fifth-Field Watershed.

The following section provides additional information on applicable regulations, affected waterbodies, and on the potential impacts associated with the construction and operation of the Project.

Oregon Water Quality Regulations and Standards

Section 303(c) of the CWA requires states to establish, review, and revise water quality standards for all surface waters. To comply with these standards, the ODEQ has developed its own unique classification system to describe the highest beneficial use(s) and associated minimum water quality standards of identified surface waterbodies within the state. The Oregon Water Quality Standards include beneficial use(s), fish use designations, narrative and numeric criteria to support the beneficial use(s), and anti-degradation policies. The purpose of the Anti-degradation Policy is to guide decisions that affect water quality such that unnecessary further degradation from new or increased point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to ensure the full protection of all existing beneficial uses (Oregon Secretary of State 2012).

The state-designated beneficial use classifications for the basins crossed by the proposed Pacific Connector pipeline are shown in table 4.4.2.2-2.

TABLE 4.4.2.2-2

Designated Beneficial Uses for Basins Crossed by the Proposed Pacific Connector Pipeline

	South Coast		Umpqua		Rogue			Klamath	
Beneficial Use	**Estuaries and Adjacent Maine Waters**	**All Streams and Tributaries Thereto**	**South Umpqua River Main Stem**	**All Other Tributaries to Umpqua, North and South Umpqua Rivers**	**Rogue River Main Stem From Estuary to Lost Creek Dam**	**Rogue River Main Stem above Lost Dam and Tributaries**	**All Other Tributaries to Rogue River and Bear Creek**	**Klamath River from Klamath Lake to Keno Dam**	**Lost River and Lost River Diversion Channel**
Public Domestic Water Supply		X	X	X	X	X	X	X	X
Private Domestic Water Supply		X	X	X	X	X	X	X	X
Industrial Water Supply	X	X	X	X	X	X	X	X	X
Irrigation		X	X	X	X	X	X	X	X
Livestock Watering		X	X	X	X	X	X	X	X
Wildlife and Hunting	X	X	X	X	X	X	X	X	X
Fishing	X	X	X	X	X	X	X	X	X
Boating	X	X	X	X	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X	X	X	X	X
Aesthetic Quality	X	X	X	X	X	X	X	X	X
Hydro Power		X	X	X		X	X	X	
Commercial Navigation and Transportation	X				X			X	
Fish and Aquatic Life a/	X	X	X	X	X	X	X	X	X

Source: ODEQ (2006a)
a/ See additional discussion in section 4.6.2 of this EIS.

Studies requested by ODEQ are part of a broad evaluation of potential water quality, stream channel stability, and riparian impacts resulting from pipeline construction and maintenance. GeoEngineers have conducted studies including a stream crossing risk analysis, hyporheic exchange impacts analysis, and a study on the impact to turbidity, nutrients, and metals along the streams crossed by the pipeline (GeoEngineers 2013c, d, and b, and 2015). The intent of the evaluations is to focus resources on those waterbody pipeline crossings that present the greatest risk of impacts to beneficial uses. ODEQ's regulatory authority under the CWA and OAR is provided to maintain beneficial uses through enforcement of water quality standards.

Through the notification process, provisions for surface water quality under the Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODEQ in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act.

Water Quality Limited Waters

Each state is required, under Section 305(b) of the CWA, to submit a report to the EPA describing the status of surface waters in the state biennially. Waterbodies are assessed to determine if their use is "fully supported," "fully supported but threatened," "partially supported," or "not supported" in accordance with the water quality standards. A use is said to be "impaired" when it is not supported or only partially supported. A list of waters that are impaired is required by Section 303(b) of the CWA and included in the 305(b) report. To restore a waterbody to its use classification, a state may elect to impose restrictions more stringent than those normally required by the NPDES or other permitting programs, or even deny a permit for activities that adversely affect an "impaired" waterbody.

States are also required to develop TMDLs for the impaired waterbodies. TMDLs describe the amount of each pollutant a waterbody can receive and not violate water quality standards. To comply with EPA requirements, the State of Oregon recently produced a combined report entitled Oregon's 2010 Integrated Report on Water Quality (Integrated Report). The report includes an assessment database containing information on the water quality status of waters in Oregon, the assessment methodology used to evaluate data, the 2010 303(d) list, and a schedule for developing TMDLs for waters on the Section 303(d) list (ODEQ 2012e, 2012d). EPA approved the report on March 15, 2012.

The Integrated Report designates waterbodies according to five Water Quality Assessment Categories, which are:

1. All standards are met (this category is not used).
2. Attaining - some of the pollutant standards are met.
3. Insufficient data to determine whether a standard is met.
   - 3a. Potential concern: Some data indicate non-attainment of a criterion, but data are insufficient to assign another category.
4. Water quality is limited but a TMDL is not needed. This includes:
   - 4a. TMDL approved: TMDLs needed to attain applicable water quality standards have been approved.
   - 4b. Other pollution control requirements are expected to address all pollutants and will attain water quality standards.
   - 4c. Impairment is not caused by a pollutant (e.g., flow or lack of flow is not considered a pollutant).
5. Water quality is limited (303d list) and a TMDL is required.

To address water quality concerns in the Umpqua and Rogue River Basins, the ODEQ issued TMDLs in 2006 and 2008, respectively. For nonpoint sources (which includes near stream vegetation disturbance), heat allocations are translated into effective shade surrogate measures (stream side vegetation objectives) to provide site-specific targets for land managers. Attainment of these measures ensures compliance with the nonpoint source allocations (ODEQ 2006b, 2008b). Compliance with Oregon water quality standards and applicable TMDLs would be addressed during the CWA Section 401 water quality certification processes prior to construction.

The GIS coverage for the 2010 Integrated Report was reviewed to determine the locations of the water quality limited waters for both Water Quality Assessment Categories 4 and 5 to determine if they are in the vicinity of Project components. Based on the ODEQ 2010 Integrated Report GIS coverage, 35 Category 4 and 5 water quality impaired waterbodies would be crossed by the pipeline and are listed in table 4.4.2.2-3 (ODEQ 2012d). TMDLs for the South Umpqua subbasin were completed in October 2006. TMDLs for the Upper Rogue subbasin were completed in December 2008. TMDLs for the Upper Klamath River, and Lost River subbasins were approved in December 2010. TMDLs for the Coos and Coquille Subbasins are in progress. Pacific Connector proposes to cross 29 of these impaired waterbodies using dry/diverted open-cut crossing techniques. Conventional boring, DP, or HDD methods would be used to cross 5 of the impaired waterbodies. Only Haynes Inlet in the Coos Bay estuary would be crossed using wet open-cut trenching.

All stream crossings would be completed under the terms of a COE CWA Section 404 permit, the NPDES Construction Stormwater Permit (CWA Section 402), and CWA Section 401 water quality certification requirements. Construction would be carried out under a Construction General Permit (NPDES permit 1200-C) for stormwater discharges during construction activities. Stormwater runoff from the disturbed portions of the site would be managed in accordance with a site-specific ESCP, which incorporates stormwater pollution prevention and includes the development of BMPs to protect surface water from stormwater runoff.

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs, and Pacific Connector would be identified as a new nonpoint source. The source specific implementation plan would be reviewed and approved by ODEQ.

BMPs to minimize sedimentation during construction would be employed on all streams. However, for water quality impaired streams, additional BMPs should be installed for additional protection. For temperature-impaired streams, additional buffers should be utilized to avoid removal of woody riparian vegetation where possible. Riparian vegetation would have to be removed in the right-of-way for all pipeline crossings. Further discussion on temperature changes in streams is discussed below. Overall, the small reduction in shade is not likely to change stream temperatures substantially downstream of the pipeline crossing. However, removal of vegetation that once shaded the stream may cause local and temporary (daily) increases in temperature during the hot summer months. This may or may not exceed the TMDL on temperature-impaired streams. Assessment of individual stream crossings for temperature-impaired streams may be needed to identify the risk of exceeding the TMDL for temperature if woody riparian vegetation will be removed. Pipeline crossings may also affect streams impaired due to habitat modification. Mitigation for habitat fragmentation or modification of habitat may require off-site mitigation to offset loss of habitat at the crossing. Site-specific assessments for water quality impaired streams should identify appropriate mitigation for each TMDL that is at risk.

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Coast Range Ecoregion, Coos Subbasin Coos Bay-Frontal Pacific Ocean Fifth-field Watershed, Coos County				
Coos Bay	Wet Open-Cut	Major	Estuary	Fecal Coliform/Year-Round - 5
Kentuck Slough	Conventional Bore	Intermediate	Perennial	Fecal Coliform/Year-Round – 5; Dissolved Oxygen/Year-Round – 5 Habitat Modification – 4C
Willanch Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5
Echo Creek	Dry Open-Cut	Intermediate	Intermittent	Fecal Coliform/Year-Round - 5
Coos River	HDD	Major	Perennial	Fecal Coliform/Year-Round - 5
Stock Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5
Catching Slough	Conventional	Major	Perennial	Fecal Coliform/Year-Round - 5

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
	Bore			
Ross Slough	Dry Open-Cut	Minor	Perennial	Temperature/Year-Round - 5
Catching Creek	Dry Open-Cut	Minor	Perennial	Fecal Coliform/Year-Round - 5
Coast Range Ecoregion, Coquille Subbasin, Coquille River Fifth-field Watershed, Coos County				
Cunningham Creek	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year Round - 5; Dissolved Oxygen/Year Round – 5; Habitat Modification – 4C; Flow Modification – 4C
Coast Range Ecoregion, Coquille Subbasin, North Fork Coquille River Fifth-field Watershed, Coos County				
North Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Biological Criteria/Year-Round – 5 Dissolved Oxygen/Year-Round (ns) – 5 Temperature/Year-Round (ns) - 5 Habitat Modification – 4C
Middle Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) - 5
Coast Range Ecoregion, Coquille Subbasin, East Fork Coquille River Fifth field Watershed, Coos County				
East Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer - 5 Habitat Modification – 4C
Elk Creek	Dry Open-Cut	Minor	Perennial	Temperature/Year-Round (ns) -5
Coast Range Ecoregion, Coquille Subbasin, Middle Fork Coquille River Fifth field Watershed, Coos County				
Upper Rock Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer (ns) – 5 Habitat Modification – 4C
Klamath Mountains Ecoregion, Coquille Subbasin, Middle Fork Coquille River Fifth field Watershed, Douglas County				
Middle Fork Coquille River	Dry Open-Cut	Intermediate	Perennial	Dissolved Oxygen/Year-Round – 5 E. Coli/Year Round – 5 Temperature/Summer (ns) – 5 Habitat Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Olalla Creek-Lookingglass Creek Fifth field Watershed, Douglas County				
Olalla Creek	Dry Open-Cut	Intermediate	Perennial	Biological Criteria - 5; Temperature/Year-Round – 4A; Iron/Year-Round - 5 Flow Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Clark Branch-South Umpqua River Fifth field Watershed, Douglas County				
Kent Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C Habitat Modification – 4C
Rice Creek	Dry Open-Cut	Major	Perennial	Temperature/Summer (ns) -4A Habitat Modification – 4C Flood Modification – 4C E. Coli/Summer – 4A
Willis Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C
South Umpqua River	Direct Pipe Level 2	Major	Perennial	Fecal Coliform/Summer - 5; Biological Criteria - 5; Aquatic Weeds or Algae/Summer – 4A; Dissolved Oxygen/Year Round (ns) – 4A; Dissolved Oxygen/May 15-Oct 15 (s) – 5 Temperature/Year-Round (ns) - 5; Chlorophyll a/Summer – 4A; E Coli/Summer – 4A; pH/Summer – 4A Chlorine/Year-Round – 4B Flow Modification – 4C Habitat Modification – 4C

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Klamath Mountains Ecoregion, South Umpqua Subbasin, Myrtle Creek Fifth-field Watershed, Douglas County				
Bilger Creek	Dry Open-Cut	Minor	Perennial	E. Coli/Year-Round – 5 Dissolved Oxygen/Year-Round - 5
North Myrtle Creek	Dry Open-Cut	Intermediate	Perennial	Biological Criteria/Year-Round – 5 Dissolved Oxygen/Oct. 15-May 15 - 5 Temperature/Year-Round (ns) – 4A; E Coli/Summer – 4A Habitat Modification – 4C Flow Modification – 4C
South Myrtle Creek	Dry Open-Cut	Intermediate	Perennial	E. Coli/Summer – 5 Dissolved Oxygen/Oct. 15-May 15 - 5 Temperature/Year-Round (ns) – 4A Flow Modification – 4C
Klamath Mountains Ecoregion, South Umpqua Subbasin, Days Creek – South Umpqua River Fifth field Watershed, Douglas County				
Fate Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) – 4A
Days Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Year-Round (ns) – 4A Habitat Modification – 4C Flow Modification – 4C
Cascades Ecoregion, South Umpqua Subbasin, Days Creek – South Umpqua River Fifth field Watershed, Douglas County				
Saint John Creek	Dry Open-Cut	Intermediate	Perennial	Flow Modification – 4C
South Umpqua River	Diverted Open-Cut	Major	Perennial	Dissolved Oxygen/Oct 15-May 15; - 5; Temperature/Year-Round (ns) – 4A; pH/Summer – 4A Flow Modification – 4C Habitat Modification – 4C
Cascades Ecoregion, Upper Rogue Subbasin, Trail Creek Fifth field Watershed, Jackson County				
West Fork Trail Creek	Dry Open-Cut	Intermediate	Perennial	Dissolved Oxygen/Summer – 5 Flow Modification – 4C
Cascades Ecoregion, Upper Rogue Sub-basin, Shady Cove-Rogue River Fifth field Watershed, Jackson County				
Rogue River	HDD	Major	Perennial	pH/Summer - 5
Cascades Ecoregion, Upper Rogue Subbasin, Little Butte Creek Fifth field Watershed, Jackson County				
Lick Creek	Dry Open-Cut	Intermediate	Intermittent	Dissolved Oxygen/Summer - 5; Biological Criteria/Year Round - 5 E Coli/Summer - 4A
Salt Creek	Dry Open-Cut	Intermediate	Perennial	E Coli/Year-Round - 4A
North Fork Little Butte Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer – 4A; E Coli/Year Round – 4A pH/Summer - 5
Eastern Slopes Ecoregion, Upper Rogue Subbasin, Little Butte Creek Fifth field Watershed, Jackson County				
South Fork Little Butte Creek	Dry Open-Cut	Intermediate	Perennial	Temperature/Summer -4A b/; E Coli/Summer – 4A b/; Sedimentation – 5 b/ Habitat Modification – 4C b/ Flow Modification – 4C b/
Eastern Slopes Ecoregion, Upper Klamath River Subbasin, Spencer Creek Fifth field Watershed, Klamath County				
Spencer Creek	Dry Open-Cut	Minor	Intermittent	Biological Criteria - 5; Sedimentation - 5; Temperature/Year-Round - 5 Habitat Modification – 4C Flow Modification – 4C
Clover Creek	Dry Open-Cut	Minor	Intermittent	Sedimentation – 5 Habitat Modification – 4C

TABLE 4.4.2.2-3

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Eastern Slopes Ecoregion, Lost River Subbasin, Lake Ewauna-Klamath River Fifth field Watershed, Klamath County				
Klamath River	HDD	Major	Perennial	Dissolved Oxygen/Year-Round (ns) - 5; Ammonia/Year-Round - 5; Chlorophyll a/Summer - 5; pH/Summer - 5 Habitat Modification – 4C Flow Modification – 4C
Eastern Slopes Ecoregion, Lost River Subbasin, Mills Creek – Lost River Fifth field Watershed, Klamath County				
Lost River	Dry Open-Cut	Major	Perennial	Dissolved Oxygen/Year-Round (ns) - 5; Ammonia/Year-Round - 5; Chlorophyll a/Summer – 5 E. Coli/Summer – 5 Temperature/Year-Round – 5 Habitat Modification – 4C Flow Modification – 4C

a/ Minor waterbody includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction; intermediate waterbody includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction; and major waterbody includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.
b/ Water quality limited within one mile of crossing, not at point of crossing.
ns – non-spawning

A potential new nonpoint source of nutrients and/or oxygen demanding pollutants would be the use of fertilizer for revegetation of disturbed areas. Any monitoring required for nutrients at locations where fertilizer is likely to contribute to run-off to waterbodies will be addressed in the state permit process and be included in a source-specific implementation plan as required by OAR 340-042-0080.

Contaminated Surface Water or Sediments

A review of ODEQ's ECSI database (ODEQ 2013b) revealed that the Pacific Connector Pipeline Project would impact nine sites investigated by the ODEQ for the release of hazardous substances into the site's environment. Of those nine sites, an online review of site notes shows that ODEQ has determined that four of those sites require no further action. The remaining five sites, as shown in table 4.3.2.3-2, potentially contain hazardous substances. Four of those sites are proposed as contractor/pipe storage yards; the fifth site on Jordan Point would contain the Jordan Cove Meter Station, the pipeline from MP1.5R-1.64R, a TEWA, and a pipeyard. See section 4.3.2.3.

However, the chance for unanticipated discovery of contaminated sediments remains. In rural areas, potential sources for contamination of sediments in waterbodies are agricultural fields containing fertilizers and pesticides, and leachate from feed lots and sanitary fields. In urban areas, contaminated stormwater runoff, wastewater discharges, erosion or leachate from industrial sites such as mineral processing or mining, petroleum refining, treatment plants, or landfills may contribute to the sediment contamination in waterbodies.

A records search has not indicated any known hazardous waste sites in Coos Bay that would be crossed by the pipeline, so toxic effects from resuspended sediment should not occur. However development, including boat painting with toxic compounds (e.g., lead, tributyltin), has occurred in Coos Bay in the past. There are records of elevated levels of tributyltin in the sediment of

Catching Slough (Elgethun et al. 2000), which the pipeline would cross under using a bore at about MP 11.1. The sediment characterization assessment for the proposed alignment across Haynes Inlet (GeoEngineers 2010) concluded that contaminants of concern have not been identified near the project area within Coos Bay at concentrations greater than Sediment Evaluation Framework screening levels and, therefore, it is unlikely that the project activities would present unacceptable risks to the receptors of concern identified in the Conceptual Site Model.

Pacific Connector, in consultation with the BLM and Forest Service, developed a *Contaminated Substances Discovery Plan*. This plan outlines practices to protect human health and worker safety and to prevent further contamination in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction of the pipeline.

Drinking Water Source Areas

The pipeline route would cross or be adjacent to 12 surface water public drinking water source areas (DWSAs; ODEQ 2012e). Table 4.4.2.2-4 lists the locations where the pipeline route would cross source areas. In some locations, the pipeline route is within a particular source area for several miles, but in other locations the route travels along ridgelines meandering in and out of source areas. Where the pipeline route meanders in and out of source areas, two source areas are shown in table 4.4.2.2-4 for that length of the pipeline route.

TABLE 4.4.2.2-4

Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Drinking Water Source Area a/	Public Drinking Water System ID	Source Water
19.86	35.81	Coos	City of Myrtle Point	4100551	N. F. Coquille River
35.81	38.42	Coos	City of Coquille	4100213	Coquille River
38.42	42.48	Coos	City of Myrtle Point	4100551	N.F. Coquille River
			City of Coquille	4100213	Coquille River
42.48	53.21	Coos	City of Coquille	4100213	Coquille River
53.21	64.71	Douglas	Winston-Dillard Water District	4100957	S. Umpqua River
64.71	70.52	Douglas	Roseburg Forest Products-Dillard	4194300	S. Umpqua River
70.52	74.86	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
			Roseburg Forest Products-Dillard	4194300	
74.86	82.74	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
82.45	86.38	Douglas	Tri-City Water District	4100549	S. Umpqua River
			Clarks Branch Water Association	4100548	
86.38	95.42	Douglas	Tri-City Water District	4100549	S. Umpqua River
95.42	101.78	Douglas	Milo Academy	4100250	S. Umpqua River
			Tri-City Water District	4100549	
101.78	102.74	Douglas	Tiller Elementary SD #15	4192139	S. Umpqua River
			Tri-City Water Distract	4100549	
102.74	108.	Douglas	City of Glendale	4100323	Cow Creek
	97		Tiller Elementary SD #15	4192139	S. Umpqua River
108.97	111.111	Douglas	City of Glendale	4192139	S. Umpqua River
111.11	124.61	Jackson	Country View Mountain Home Estates	4100808	Rogue River
124.61	135.04	Jackson	Anglers Cover /SCHWC	4100808	Rogue River
			Country View Mountain Home Estates	4100513	
135.04	168.01	Jackson	Medford Water Commission	4100513	Rogue River

a/ The proposed route meanders in and out of Surface Water DWSAs where there are two DWSAs listed.

Public Drinking Water Intakes

Table 4.4.2.2-5 lists the public water systems that have surface water intakes within 3 miles downstream of waterbodies that would be crossed by the pipeline (ODEQ 2013a). The downstream distance from the waterbody crossing to the intake is also provided in table 4.4.2.2-5 in addition to the source water. The surface water intake for Roseburg Forest Products in Dillard on the South Umpqua River is 0.8 mile downstream of the crossing of Rice Creek at MP 65.76 and 1.8 miles downstream of the crossing of Willis Creek at MP 66.95. Pacific Connector would provide written notification to the authorities of the surface water supply intakes in table 4.4.2.2-5 at least one week before beginning in-water work or as otherwise specified by the appropriate authorities.

TABLE 4.4.2.2-5

Public Surface Water Drinking Water Intakes within 3 Miles Downstream of Proposed Waterbody Crossings for the Pacific Connector Pipeline

Intake	Public Water System	Source Water for Intake	Waterbody Crossing	Distance Downstream	County
4194300	Roseburg Forest Products –Dillard	S. Umpqua River	Rice Creek – MP 65.76 Tributary to S. Umpqua River	0.8 mile	Douglas
4194300	Roseburg Forest Products –Dillard	S. Umpqua River	Willis Creek MP 66.95 Tributary to S. Umpqua River	1.8 miles	Douglas
4100808	Country View Mountain Home Estates	Rogue River	Rogue River MP 122.65	1.4 miles	Jackson
4101483	Anglers Cove Subdivision	Rogue River	Rogue River 122.65	Approx. 3 miles	Jackson

There are 10 rock source and disposal sites, 26 contractor and pipe storage yards, 9 TARs, 10 PARs, and 9 aboveground facilities located within surface water public DWSAs. In the event of an inadvertent spill, or a disruption of flow and sediments are introduced into these waters, Pacific Connector would notify potable water intake users of the conditions so that necessary precautions could be implemented. Prior to construction, Pacific Connector would consult with all surface water intake operators listed in table 4.4.2.2-5 with active intakes located within 3 miles downstream from a stream crossing location and establish a process for advanced notification of instream work. A summary of the consultations would be filed with FERC prior to construction of the pipeline.

Points of Diversion

There are locations along the Project route where surface water is diverted (point of diversion) for uses such as irrigation. A total of 57 point of diversion locations are within 150 feet of the construction work area. These are listed in table 4.4.2.2-6. Of these 57 points of diversion, 16 are located within the construction work area. The State of Oregon uses 4 in Douglas County for irrigation, and the other 12 are private and used for industrial/manufacturing uses, fire protection, livestock watering, irrigation, or domestic uses. A total of 12 of the points of diversion are located within pipe yards or TEWAs. A total of 4 of the 16 points of diversion are located within the construction right-of way. Pacific Connector would consult with the landowner if the point of diversion could not be avoided and identify an alternate location for the diversion prior to construction. Should it be determined that there has been an impact on the water supply, Pacific Connector would work with the landowner to ensure a temporary supply of water, and if determined necessary, Pacific Connector would replace the affected water supply with a permanent water supply. Mitigation measures would be specific to each property, and would be determined during landowner negotiations. Points of diversion (both public and private) beyond 150 feet of the construction work areas are not expected to be affected by the pipeline.

TABLE 4.4.2.2-6

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion	Number of Water Rights
Storage	Private	Douglas	60.73	44288	Stream	Perron Creek	Livestock	35.90	-	1
			65.35	T 6708	Stream	South Umpqua River/Reservoir 1	Industrial/manufacturing uses	0.00	Pipe Yards	1
			67.12	R 14589	Stream	Unnamed Stream	Multiple purpose	108.39	-	2
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Fire protection	0.00	Construction Right-of-Way	1
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Livestock	0.00	Construction Right-of-Way	1
			75.49	17241	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
			75.49	30362	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
									Storage Total	***8***
Surface Water	Private	Coos	12.07	53679	Stream	Unnamed Stream	Domestic including Lawn and Garden	79.83	-	1
			13.80	36042	Spring	A spring	Domestic	0.00	Construction Right-of-Way	1
			29.48	S 44450	Stream	Stemmler Creek	Domestic including Lawn and Garden	134.81	-	1
			29.48	S 44450	Stream	Stemmler Creek	Livestock	134.81	-	1
			29.86	60877	Stream	East Fork Coquille River	Irrigation	56.92	-	1
			30.00	39940	Stream	East Fork Coquille River	Irrigation	0.00	Construction Right-of-Way	1
		Douglas	49.53	44065	Stream	Lang Creek	Irrigation	109.26	-	1
			58.64	S 54735	Stream	Olalla Creek	Domestic Expanded	117.96	-	1
			67.19	15423	Stream	South Umpqua River	Irrigation	132.51	-	1
			67.19	22390	Stream	South Umpqua River	Irrigation	67.80	-	1
			67.19	23826	Stream	South Umpqua River	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			70.36	29340	Stream	South Umpqua River	Irrigation	120.06	-	1
			70.36	65231	Stream	South Umpqua River	Irrigation	64.53	-	1
			70.36	68634	Stream	South Umpqua River	Irrigation	64.53	-	1
			75.49	15598	Stream	Sutherlin Creek	Industrial/Manufacturing Uses	0.00	Pipe Yards	2
			75.49	17292	Stream	Camas Swale/Log Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			75.49	30363	Stream	Sutherlin Cr/Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			81.23	55163	Stream	South Myrtle Creek	Irrigation	67.96	-	1
			82.27	80544	Stream	South Umpqua River	Irrigation	0.00	Pipe Yards	1
			88.16	43561	Stream	Fate Creek	Irrigation	90.46	-	1
			88.16	52977	Stream	Fate Creek	Irrigation	90.46	-	1
			88.52	56872	Stream	Fate Creek	Irrigation	147.03	-	1
		Jackson	122.67	34473	Stream	Rogue River	Irrigation	132.95	-	1
			122.83	65482	Stream	Rogue River	Irrigation	22.39	-	1
			145.77	2170	Stream	Little Butte Creek	Irrigation	100.10	-	1

TABLE 4.4.2.2-6

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion	Number of Water Rights
			145.77	2470	Stream	Little Butte Creek	Irrigation	129.80	-	1
			145.77	57753	Stream	North Fork Little Butte Creek	Irrigation	129.80	-	1
			145.82	17215	Stream	North Fork Little Butte Creek	Irrigation	103.16	-	1
		Klamath	199.96	67512	Stream	Klamath River	Fire Protection	23.69	-	1
	State	Coos	22.30	9712	Spring	A spring	Domestic	119.11	-	1
			27.20	60812	Stream	Middle Creek	Irrigation	127.86	-	1
		Douglas	67.19	S 51632	Stream	South Umpqua River/Con 18714	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			67.30	S 51924	Reservoir	South Umpqua/Galesville	Supplemental Irrigation	0.00	Pipe Yards	1
			70.36	S 52930	Stream	South Umpqua River	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			71.31	S 51924	Stream	South Umpqua River	Irrigation	0.00	Temporary Extra Work Space	1
		Jackson	128.61	73043	Stream	Indian Creek	Anadromous and Resident Fish Rearing	9.87	-	12
			135.65	41308	Reservoir	Reservoir	Wildlife	100.42	-	1
									Surface Water Total	***49***
									Grand Total	**57**

Nationwide Rivers Inventory

The Nationwide Rivers Inventory is a listing of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. Under a 1979 Presidential directive, and related CEQ procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more Nationwide Rivers Inventory segments.

Three rivers crossed by the pipeline are listed on the Nationwide Rivers Inventory (NPS 2013):

- The North Fork of the Coquille River from its headwaters in Section 16, T.26S., R.10W. to the confluence with the South Fork Coquille River in Section 5, T.29S., R.12W. It was listed in 1993 for outstandingly remarkable fish, wildlife, and cultural (prehistoric Indian sites) values. The Pacific Connector pipeline would cross this section of river at MP 23.1. Pacific Connector developed a site-specific crossing plan for the North Fork Coquille River using a dry open-cut method to contain disturbed sediments.
- The East Fork of the Coquille River from its headwaters in Section 18, T.28S., R.8W. to the confluence with the North Fork of the Coquille River in Section 36, T.28S., R.12W. It was listed in 1993 for outstandingly remarkable fish, wildlife, boating and fishing. The proposed Pacific Connector pipeline alignment crosses this section of river at MP 29.9. Pacific Connector developed a site-specific crossing plan for the East Fork Coquille River using a dry open-cut method to contain disturbed sediments.
- The South Umpqua River from Tiller (Section 33, T.30S., R.2W.) to the confluence with the North Umpqua River at River Forks (Sections 31 and 32, T.26S., R.6W.). It was listed in 1993 for outstanding and remarkable fish and historical values. It supports outstanding fishery-related recreation. The pipeline would cross this section of river twice: at MP 71.3 and MP 94.7. Pacific Connector developed a site-specific crossing plan for the western South Umpqua River crossing using a DP to eliminate an open-cut and minimize impacts by drilling under the river and I-5 in a single operation. Pacific Connector developed a site-specific crossing plan for the eastern South Umpqua River crossing using a diverted open-cut to limit water quality impacts by creating a "dry" working area.

Floodplains

EO 11988 (10 CFR 1022) requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Potential effects of the project located within a floodplain should be evaluated and project design should consider flood hazards and floodplain management. It is reasonable to assume that all watercourses that convey natural flows, whether mapped as floodplains, flood hazard areas, or not, present some level of flood hazard. The flood hazard is not limited to inundation; bank erosion and bed scour (a lowering or destabilization of the channel bed during a flow event) are also hazards that can occur due to flooding.

Some of the streams that would be crossed by the Pacific Connector Pipeline Project have delineated 100-year floodplains designated by FEMA. The 100-year floodplain is the area that would be inundated by a flood with a recurrence interval of once in 100 years, on average.

Approximately 7.5 miles of the pipeline is located within an area inundated by 100-year flooding and approximately 0.1 mile is located in an area characterized as inundated by 500-year flooding, or 100-year flooding with average depths of less than 1 foot, or an area protected by levees from 100-year flooding. These areas are identified in table 4.4.2.2-7.

TABLE 4.4.2.2-7

Floodplain Areas Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	Fifth-Field Watershed	Zone a/	Miles of Pipeline b/
1.7 R	4.2 R	Coos Bay-Frontal Pacific Ocean	A	2.5
6.2 R	6.5 R	Coos Bay-Frontal Pacific Ocean	A	0.3
8.3 R	8.5 R	Coos Bay-Frontal Pacific Ocean	A	0.2
11 R	11.1 R	Coos Bay-Frontal Pacific Ocean	A	<0.1
11.1 R	8.8	Coos Bay-Frontal Pacific Ocean	A	1.5
10.1	10.4	Coos Bay-Frontal Pacific Ocean	A	0.3
10.4	10.4	Coos Bay-Frontal Pacific Ocean	A	<0.1
11	11.4	Coos Bay-Frontal Pacific Ocean	A	0.4
11.8	11.9	Coos Bay-Frontal Pacific Ocean	A	<0.1
15.7	15.7	Coos Bay-Frontal Pacific Ocean	A	<0.1
22.8	23.1	North Fork Coquille River	A	0.3
27	27.1	North Fork Coquille River	A	<0.1
29.7	29.9	East Fork Coquille River	A	0.2
58	58.8	Olalla Creek-Lookingglass Creek	A	0.8
65.7	65.8	Clark Branch-South Umpqua River	A	<0.1
66.9	67	Clark Branch-South Umpqua River	A	<0.1
71.2	71.4	Clark Branch-South Umpqua River	A	0.1
71.4	71.4	Clark Branch-South Umpqua River	X500	<0.1
94.7	94.8	Days Creek-South Umpqua River	A	0.1
122.6	122.8	Shady Cove-Rogue River	A	0.2
122.8	122.9	Shady Cove-Rogue River	X500	0.1
145.7	145.8	Little Butte Creek	A	0.1
		Total		**7.6**

a/ Zone A: An area inundated by 100-year flooding, for which no Base Flood Elevations have been determined.
Zone X500 - An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.
b/ Mileages are rounded to the nearest tenth of a mile; values less than 0.1 mile are noted as <0.1. Column may not sum correctly due to rounding.

Building is permitted in flood-prone areas with certain restrictions. For instance, buildings are to be elevated such that the lowest floor is above the 100-year flood level, and an area of the watercourse is typically set aside for flow conveyance (the floodway). Encroachment of a Project structure into a flood path could result in flooding of or erosion damage to the encroaching structure, diversion of flows and increased flood risk for adjacent property, or increased erosion on adjacent property.

The pipeline within a flood hazard area subject to scour or lateral movement of a stream channel would be buried beneath the 50-year scour depth. Since the pipeline would be buried, a majority of the project footprint that would affect floodplains would be permanent facilities and PARs. To minimize effects to the floodplain and effects from flooding that would require floodplain management, permanent Project facilities and PARs should be located outside of the floodplain as much as practicable. If it is not possible to avoid placing permanent structures within the floodplain, permanent structures would be designed to manage flood watercourses and designed to withstand effects from flooding. The Project is not likely to substantially impact flood flows in each watershed as a result of the small footprint of the Project within each watershed floodplain.

Surface Waterbody Crossings

Because of the pipeline's linear nature, it is not possible to avoid crossing waterbodies and riparian areas. However, the number of stream crossings required for the pipeline was minimized by Pacific Connector's identification of a pipeline route that follows ridgelines and watershed boundaries to ensure the long-term safety, stability and integrity of the pipeline as it crosses the Coast and Cascade mountain ranges.

The pipeline route would cross 19 fifth-field watersheds, with proposed access roads crossing an additional 5 watersheds. The construction of the pipeline would affect waterbodies at 265 locations; 35 of these locations are not crossed by the pipeline but are located within the right-of-way or workspaces. Of the 265 locations where waterbodies would be affected, 106 are perennial, 151 are intermittent, 5 are ponds (including stock ponds), plus 1 industrial pond and 1 excavated pond, and 1 is an estuary (Haynes Inlet in Coos Bay). [54]

In Coos County, the project would affect 59 perennial and 41 intermittent waterbodies, 1 stock pond, and the estuary. In Douglas County, the project would affect 31 perennial and 36 intermittent waterbodies. In Jackson County, the pipeline would affect 13 perennial and 55 intermittent waterbodies, and 3 ponds. In Klamath County, the pipeline would affect 3 perennial and 19 intermittent waterbodies, and 1 pond, plus 1 industrial pond, and 1 excavated pond. A table of crossings with the proposed crossing method is included in appendix N (table N-3).

This section describes proposed waterbody crossing methods. Pacific Connector would follow its consultant's *Stream Crossing Risk Analysis* (GeoEngineers 2013c),[55] and the *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2015)[56] which identified design guidance, contingency measures, and monitoring protocol specific to each crossing. All waterbodies would be crossed in accordance with the FERC's *Procedures*, as well as according to the COE, ODSL, ODEQ, Forest Service, BLM, Reclamation, and ODFW approvals.

GeoEngineers (2015) applied the FWS's Pipeline Screening Matrix to all stream crossings that display fluvial characteristics and streams that are of special concern to the BLM and Forest Service. The analysis identified 131 sites needing pre-construction surveys. Surveys were completed for 60 stream crossings sites that were accessible between May and August 2014 to observe current site conditions, ground-truth date from the 2013 desktop study, and to provide a basis for developing site-specific approaches for restoration planning. Sites not accessible during the 2014 surveys would be surveyed by Pacific Connector prior to construction following approval of access agreements of the landowners.

As described in GeoEngineers (2013c), once the Project is approved and all permits and route access obtained, all stream crossings would have a pre-construction survey to confirm and clarify conditions developed in the risk analysis. This survey would be done by a team of professionals qualified to

[54] The values reported here for waterbody crossings differs from those reported in section 4.6, because that section does not analyze ditches.
[55] Attached as a stand-alone report in Pacific Connector's June 2013 application to the FERC.
[56] Provided as Attachment 23 in Pacific Connector's February 13, 2015, submittal in response to recommendations in the DEIS.

assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to pipeline construction across stream channels and ditches. Following these surveys, if significant changes occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If a change in a waterbody crossing were deemed to be necessary based on the survey, Pacific Connector would file a variance with the FERC and contact other relevant regulatory agencies prior to construction. With all regulatory approvals, Project construction would then move forward.

As a follow-up measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector would conduct on-the-ground monitoring of all stream crossings, regardless of risk, quarterly for 2 years after construction. Any adverse issues found during the monitoring with channel stability or habitat would be remediated. Additional monitoring would occur periodically over a 10-year period with implementation of remediation as needed.

Non-Flowing Streams and Ditches

Pacific Connector proposes to use several different methods to install the pipeline across waterbodies depending on site-specific conditions. Many of the waterbodies crossed by the pipeline are minor intermittent streams or ditches that are expected to be dry or nonflowing at the time of construction. For all intermittent waterbodies without flow at the time of construction, Pacific Connector would utilize standard upland, cross-country construction methods identified in Pacific Connector's ECRP. At these crossings, the depth of cover would be 5 feet (from the top of pipe to the bottom of streambed). In instances where the pipeline is below scour depth in bedrock, the top of pipe may be at any elevation below scour depth.

Flowing Streams and Waterbodies

For perennial waterbodies and intermittent waterbodies that are flowing at the time of construction, Pacific Connector has proposed the following crossing methods. These construction methods, along with FERC's *Procedures*, are designed to maintain water flow and minimize changes in waterbody flow characteristics.

Temporary Bridges at Stream Crossings

On most waterbodies, a temporary bridge would be installed prior to construction of the crossing to allow equipment and personnel to cross the waterbody. These temporary bridges would be removed when construction and restoration are completed for the project. If water is present in streambeds at the time of construction, Pacific Connector would utilize temporary construction bridges during all phases of construction to cross the waterbodies. In general, equipment/temporary bridges would not be installed on intermittent waterbodies which are dry at the time of construction; however, if a storm occurs that results in water in the streambed of the otherwise intermittent waterbody, no equipment would cross the waterbody until the streambed is dry or until a bridge is installed. Any proposed culverts and temporary bridges on federal lands would require design, review and approval by a Professional Engineer licensed in Oregon. Designs, including drawings, specifications, and other relevant materials, shall be approved by the agency of jurisdiction prior to installation of any temporary bridges. Site restoration details shall also be submitted for approval by the agencies as part of any temporary bridge or major culvert crossing plans on federal lands.

Soil would not be used to stabilize bridges, and the bridges would be constructed to span the entire OHWM of the waterbody. If it is not possible to span the OHWM with the bridges, a temporary culvert or pier may be required. The temporary crossings may be constructed of:

- equipment mats and culvert(s);
- equipment mats or railroad car bridges without culverts;
- clean rock fill and culverts; or
- flexi-float or portable bridges.

Minor or Intermediate Waterbody Crossings

We define minor crossings as waterbodies less than 10 feet across, while intermittent streams are between 10 and 100 feet wide. Virtually all minor or intermittent waterbodies (91 of the 97 perennial streams) would be crossed using dry open-cut methods as discussed below.

Dry Open-Cut Crossing Methods

Flume. The flume method typically is used to cross small to intermediate flowing waterbodies that are either fish-bearing or non-fish-bearing streams. The flume technique involves diversion of stream flow into a carefully positioned steel pipe of suitable diameter to convey the maximum flow of the stream across the work area, and ensures that stream flow rate is not interrupted.

Dam-and-Pump. With the dam-and-pump method, stream flow is diverted around the work area by pumping water through hoses over or around the construction work area. The goal of this technique is to create a relatively "dry" work area to avoid or minimize the transportation of heavy sediment loads and turbidity downstream of the crossing. This crossing method may be used on all waterbodies where stream flow can be diverted by pumping around the work area.

It is anticipated that most Reclamation facilities, including drains and laterals, would be dry or contain relatively little water at the time of construction. These crossings would generally be completed using a dry open cut crossing method (typically flume or dam and pump), but may be crossed using trenchless conventional bore methodology depending on actual conditions at the time of construction. Reclamation canal crossings would be completed using conventional bore methodology.

Major Waterbody Crossings

We define major waterbodies as being more than 100 feet wide. These waterbodies include, from west to east along the pipeline route, Coos Bay, Kentuck Slough, Coos River, Catching Slough, South Umpqua River, Rogue River, and Klamath River. The methods for crossing these major waterbodies are discussed below. Coos Bay is the only waterbody that would be crossed using a wet open-cut method. Kentuck Slough and Catching Slough would be crossed using conventional bores. The Coos River, Rogue River, and Klamath River would be crossed using an HDD. The South Umpqua River would be crossed using DP technology for the western crossing, and a diverted open-cut for the eastern crossing.

Wet Open-Cut Crossing Method

The wet open-cut method involves trench excavation, pipeline installation, and backfilling through a waterbody without controlling or diverting streamflow (i.e., the stream flows through the work area throughout the construction period). The pipeline across the Haynes Inlet portion of Coos Bay, between about MPs 1.7R and 4.1R, would be constructed as a wet open-cut. The proposed route mostly avoids eelgrass beds and commercial oyster-growing colonies. This portion of Coos Bay has water depths between 10 and 3 feet; however, it becomes dry mudflats during low tides. A shallow water lay barge would be used to install the pipeline using "pipe push" methods. During the pipe push, the lay barge would remain stationary and the pipe joints would be floated out into the pre-dug trench. The pipe joints, which would be concrete coated, would be welded on the barge. The trench would be mostly be dug by marsh excavators with tracks around pontoons. Where deeper water allows, a bucket dredge would be used for trenching. The pipeline would be buried 5 feet deep; which would be below anticipated scour depth. Pipeline construction in Coos Bay would be limited to the ODFW recommended in-water work window between October 1 and February 15, when tides are lowest. Pacific Connector estimated it would take the duration of the fish window to install the pipeline across Haynes Inlet due to logistics of tidal fluctuations, potential mechanical issues affecting production, materials and supply and operation access to lay barges, and accommodation of other boat traffic. Work would be done in accordance with the *Report on Preliminary Pipeline Study Haynes Inlet Water Route*. That plan included the following BMPs:

- the contractor would develop a turbidity monitoring and management plan;
- where water depths allow, the dredge bucket would be kept below the water surface while placing excavated spoil along the trench in order to minimize turbidity;
- the trench would be backfilled quickly after the pipeline is lowered in to minimize the spreading of excavated spoil from tidal influence;
- turbidity curtains may be deployed, as practicable, in certain areas to protect sensitive resources such as oyster and eel grass beds;
- turbidity would be monitored, and not allowed to exceed the levels established in the CWA Section 401 water quality certification issued by the ODEQ;
- fueling of equipment would be done more than 150 feet way from open water, where practicable; and
- biological monitoring would be conducted in accordance with state and federal permit requirements.

If the water quality criterion is exceeded, ODEQ would ask for work to cease and BMPs to be adapted to ensure that the criterion would no longer be exceeded.

Diverted Open-Cut Crossing

The diverted open-cut crossing method would require an instream tie-in, but it would be made in the dry behind the diversion structure. During the crossing, initial trenching would first occur on the dry side of the river; however, depending on the water levels during the season, it may be necessary to install a diversion to push or divert the flow to at least the middle of the river. Pacific Connector is proposing a diverted open-cut at the eastern crossing of the South Umpqua River at MP 94.7 because the river is too wide to utilize other dry crossing methods (flume or dam-and-pump).

The South Umpqua River channel is sufficiently flat, wide, and shallow to divert all of the river flow to one side or bank of the river while work is proceeding in the dry on the opposite bank.

The eastern crossing of the South Umpqua River would require TEWAs to be located in the river and would require equipment to work in the river to place the diversion structures or dams to divert the river flow from one side of the river and then to the other. The diversion could be constructed using portadams, aqua dams, steel plates, plastic sheeting, and/or sand bags to divert the river's flow temporarily away from the work area in order to minimize contact between streamflow and the excavation and backfill activities. This would require Pacific Connector to place equipment within the stream to install, maintain, and ultimately remove the diversion structures. Pacific Connector estimates the crossing would take a minimum of 14 days to complete, including 3 to 4 days of instream work to install, rearrange, and remove the diversion structures.

Once the construction right-of-way has been isolated by the diversions and/or sediment control devices, trenching would proceed to approximately the middle of the river. Trench spoil would be stored within the stream channel below the diversion or sediment control structures to ensure that sedimentation from saturated materials does not flow back into the river. After the trench has been completed, a section of pipe would be placed in the trench. Trench boxes or another marker form would be placed at the end of the pipe section in the middle of the riverbed for the tie-in. The trench would be backfilled and the streambed restored to the original contour configuration, except for the immediate area around the tie-in.

The diversion structure would then be removed and rearranged to divert the flow temporarily to the other side or dry side of the river in order to minimize contact between streamflow and the excavation and backfill activities. This would again require Pacific Connector to place equipment within the stream in order to rearrange the diversion structures. Once the diversion structures have been properly reconfigured and extended beyond the tie-in location and the river flow diverted to the opposite side of the river, excavation for the other section of pipe would begin. Trenching would proceed across the river bed to the tie-in point in the middle of the river where it would be uncovered. Once the excavation is complete, the second pipe section would be carried in and tied into the first section. After the tie-in has been made, the streambed would be restored to its original contours and configuration and the diversions structures would be removed. Streambanks would be re-established and stabilized.

During the diverted open-cut at the eastern crossing of the South Umpqua River, multiple discharge pumps would be required to keep the tie-in area dry while the welds are being made and to control any flow seepage in the work areas. The discharge from this activity would occur to a straw bale discharge structure located in an upland area as far away from the river as possible to prevent any silt-laden water from flowing into the river.

The eastern crossing of the South Umpqua River was given a turbidity score of 4 – moderate. The evaluation concluded that turbidity generated during construction may exceed the Oregon water quality standard for short distances and short durations downstream from each crossing, either coinciding with construction across perennial waterbodies or in intermittent streams coincidental with autumn precipitation. There would be short-term turbidity increases for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing of the South Umpqua River.

Direct Pipe Techniques

DP installation is a developing trenchless technology that can overcome problematic issues associated with the HDD crossing method because it provides a continuously supported hole during the excavation process; reduces pressure of drilling mud; and eliminates the borehole reaming and pullback requirements of an HDD. Pacific Connector proposes to go under I-5, the western crossing of the South Umpqua River (MP 71.3), Dole Road, and a railroad using a single DP operation. The DP at this location would be about 2,000 feet long and would be about 40 feet below the surface of the river. Being so deep under the river, the DP technique should avoid direct impacts on the aquatic environment.

DP techniques combine microtunnelling and HDD. An articulated, steerable microtunnel boring machine mounted on the leading end of the product pipe or casing would be jacked into position using a pipe thrusting machine mounted at or near the ground surface. To reduce the frictional resistance between the pipe and surround soil, over cutting would be employed (typically 1 to 2 inches). A slurry of bentonite clay would be used between the pipe and soil to reduce the frictional resistance as well as reducing the risk of collapse of the annulus around the pipe. Feasibility studies were conducted to verify that the DP installation would work at this location. Through proper design, inadvertent returns of the bentonite slurry would be reduced. Further geotechnical subsurface analysis would be conducted to refine the design prior to construction. Construction procedures would be implemented to prevent inadvertent returns of the bentonite slurry which include monitoring and maintaining the volumes, slurry fluid properties, and penetration rates.

Because the DP technology would install the pipeline deep beneath the river, there would be no direct effects to surface water. Work areas at entry and exit points may require grading during construction. As with all work areas near waterbodies, BMPs would be implemented to minimize effects to surface water. To contain and control inadvertent returns of the bentonite slurry at the entry and exit work zones, a berm would be built that may include hay bales or silt screen. Inadvertent returns would be cleaned and hauled or pumped to one of the drilling mud storage pits at the closest drilling site. In the event that slurry is detected in the river, appropriate resource agencies would be notified, and approved containment methods implemented to minimize impacts.

Conventional Borings

Boring is frequently utilized at road and railroad crossings. Conventional bores are proposed at Kentuck Slough (MP 6.3R), Catching Slough (MP 11.1), and the Medford Aqueduct (MP 133.4). The specific type of bore (i.e., jack and bore, slick bore, hammer, etc.) that would be utilized would be determined during a subsequent (refining) design phase of the Project and depends on construction characteristics, the type of soils present and the contractor's familiarity with the method. A successful bore under a waterbody would avoid impacts.

During a standard boring operation a bore pit is excavated on either side of the feature to be crossed at a depth sufficient to provide the desired depth of cover between the top of the pipeline and bottom of the feature to be crossed. A boring machine excavates the bore hole, spoil material is passed into the bore pit, and trackhoes then remove this spoil from the bore pit. Pipe is welded up and eventually pulled through the bore hole. Each section of the pipe is joined using full-penetration welding procedures and 100 percent of the welds are inspected using non-destructive testing procedures (x-ray) to form a continuous pipeline segment. Because conventional boring does not limit water migrating into the bore, an important factor in the design of launching and receiving pits is groundwater control. Dewatering systems using deep wells or well points installed around the bore holes are frequently used. Trench boxes or sheet piling are often used to support the pit walls and to cut off groundwater inflows. Because bore pits on either side of the crossing would be required, there is some risk that high water tables may cause groundwater to infiltrate the bore pit walls, or create pressure from the exterior of the pit walls and cave in the bore pits. Shoring would be used as required to prevent bore pit cave in, and pit dewatering would be conducted as required. Water pumped from the pit would be discharged to an upland location designed to prevent turbid waters from reaching a waterbody. Erosion control measures would be implemented to prevent surface erosion at the pump discharge point.

Horizontal Directional Drills

The HDD method involves drilling under a feature and pulling the pipeline into place through the drillhole that has been reamed to accommodate the diameter of the pipeline. This procedure involves three main phases, pilot hole drilling, subsequent reaming passes, and pipe pullback. Pacific Connector is proposing to use the HDD method for the crossing of the Coos River (MP 11.1R), the Rogue River (MP 122.7), and the Klamath River (MP 199.4). By drilling deeply under a river, an HDD can avoid impacts. However, to deal with the potential for HDD failure or the possible release of drilling mud during an HDD, Pacific Connector developed two separate plans: *Failure Mode Procedures for the HDD Pipeline Installation Method* and *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[57]

Pacific Connector developed site-specific waterbody crossing plans.[58] The plan for the HDD under the Coos River showed it would be about 1,700 feet long, with a maximum depth of -80 feet under the river. The HDD under the Rogue River would be about 3,050 feet long, with the pipeline reaching a maximum depth of about -80 feet below the river. The HDD under the Klamath River would be about 2,300 feet long, with a maximum depth of about -80 feet under the river.

The HDD method has the potential for inadvertent releases of drilling mud into the waterbody. If a fault or crack in the overburden is encountered, the drilling mud can escape to the surface. This is referred to as a "frac-out." Drilling mud typically comprises bentonite clay and water, and can include additional additives specific to each drilling operation and would therefore be considered a pollutant. Pacific Connector would approve any additive compounds prior to use by the drilling contractor to ensure compliance with all applicable environmental and safety regulations. Toxic additives would not be used in the bentonite drilling mud for the Pacific Connector HDDs.

If an inadvertent return occurs, the HDD operation would be stopped temporarily to determine an appropriate response plan. Pacific Connector would attempt to determine the cause of the hydraulic fracture and inadvertent return and would implement procedures to correct or mitigate the situation. Those procedures may include:

- increasing the drill fluid viscosity;

[57] These plans were included in Appendix 2H attached to Resource Report 2 filed with Pacific Connector's June 2013 application to the FERC.
[58] These plans were included in Appendix 2E attached to Resource Report 2 filed with Pacific Connector's June 2013 application to the FERC.

- introduction of lost circulation materials back into the hole;
- installation of steel casings; or
- use of a grout mixture.

Any inadvertent release of drilling mud into a river would be monitored, and the appropriate agencies would be contacted, and approved corrective measures would be implemented.

GeoEngineers (2013h)[59] indicated that an HDD of the Coos, Rogue, and Klamath Rivers could be successfully implemented at the proposed crossing locations. However, Pacific Connector considered procedures to be implemented in the event of a failure. If the pilot hole collapsed, material falls into the hole, pipe becomes lodged in the hole, or there is a mechanical breakdown of the rig, the contractor would remove the pipe, and the HDD would be reattempted at the same location, or slightly offset. Pacific Connector would provide a technical consultant on-site during the HDD process to keep adequate documentation describing the events leading up to the failure. Pacific Connector would then submit this documentation to the necessary agencies for review and approval that the drill has failed at the present alignment. If the hole has to be abandoned, the contractor would grout the top 5 vertical feet of the hole on both the entry and exit side of the crossing with a cement type grout and the top 12 inches of the hole would be filled with native material or in accordance with the permit requirements.

Upon successful HDD completion, impacts on aquatic species and water quality would be avoided. The segment of the Rogue River at the pipeline crossing is not designated as a Wild and Scenic river segment. The Forest Service reviewed the crossing and determined that there would be no impact or effect to the Wild and Scenic River resources. Specifically, as the HDD crossing of the Rogue River would be underground, there is no potential to affect free-flow, scenery, recreation, fish, or wildlife values present in the river corridor, and therefore a Section 7 determination is not required (Macwhorter 2014).

General Pipeline Construction Impacts on Waterbodies and Proposed Mitigation Measures

Construction of the pipeline could result in minor, short-term impacts to waterbodies. These impacts could occur because of instream construction activities, use of access roads, or construction on slopes and riparian areas adjacent to stream channels. Clearing and grading of streambanks, removal of riparian vegetation, instream trenching, trench dewatering, and backfilling could result in the following potential effects:

- streambank modification;
- channel simplification;
- change in channel cross-sectional shape due to a decrease in natural bank stability;
- lateral channel migration resulting from decreased bank stability and loss of riparian vegetation;
- increased vertical streambed variability due to localized scour and fill in the area of disturbed streambed material, potentially resulting in disconnection with the floodplain possibly exposing the pipeline, thus resulting in additional in-channel work;

[59] The *HDD Feasibility Study* was attached as Appendix 2G of Resource Report 2 included with Pacific Connector's June 2013 application to the FERC.

- floodplain disturbance and riparian impacts resulting from both the initial construction work, which will require vegetation removal, and future impacts due to the management of woody vegetation in the vicinity of the pipeline;
- removal of spawning gravel from the streambed;
- temporary or permanent blockage of fish access due to physical changes of the stream channel;
- increased sedimentation;
- turbidity;
- increase in temperature, decreased dissolved oxygen concentrations;
- releases of chemical and nutrient pollutants from sediments; and
- introduction of chemical contaminants such as fuel and lubricants.

An increase in soil compaction and vegetation clearing could potentially increase runoff and subsequent streamflow or peak flows. Surface waters could be affected due to alteration of groundwater flow where the pipeline intersects waterbodies. To minimize potential adverse impacts along the construction right-of-way and at waterbody crossings, Pacific Connector would implement its ECRP during construction, restoration, and operation of its proposed facilities. Pacific Connector's ECRP is mostly compatible with the FERC's *Plan* and *Procedures*. Alternative measures requested by Pacific Connector are identified and reviewed in appendix I. For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) would be used as directed by BLM and Forest Service monitors in conjunction with the FERC's EIs.

Construction activities at waterbody crossings would be conducted in accordance with all federal and state regulations and permit requirements. Pipeline installation at waterbodies would be conducted during low-flow periods whenever possible, and within the ODFW and NMFS recommended in-water construction windows. Construction during low flows would minimize sedimentation and turbidity, minimize streambank and bed disturbances, and limit the time it takes to complete instream construction. Specific impacts and proposed mitigation measures are discussed further below. Permits required for instream work may contain mitigation measures in addition to those discussed here. Pacific Connector would work with the COE and ODEQ to address impacts to water quality at stream crossings as part of the CWA Sections 401, 402, and 404 application process.

Turbidity

To minimize increases in turbidity and suspended sediment at waterbody crossings, Pacific Connector would utilize the dry crossing methods (i.e., flume and dam-and-pump) for most of the flowing waterbodies crossed by the pipeline (91 of the 97 perennial waterbodies). The remainder would be crossed by conventional bore, diverted open-cut, HDD, DP, and one instance of wet open-cut in the Coos Bay estuary. Turbidity and sedimentation impacts associated with dry open-cut methods are generally minor and temporary, lasting typically for only a few hours, and are associated with (1) installation and removal of the upstream and downstream dams used to isolate the construction area; (2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; (3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and (4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed. Both "dry" techniques produce much less sediment in the water than alternative "wet" open-cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004). Dry methods have been reported to produce one-seventh the suspended sediment in streams than "wet" methods (Reid et al. 2002). According to Pacific Connector, during construction of Williams Northwest Pipeline's Capacity Replacement Project in Washington State (completed in 2006), a total of 67 waterbodies were crossed using dry open-cut crossing methods (fluming and/or dam and pump). During these crossings, there was only one event where state water quality turbidity limits were exceeded. The exceedance occurred through a failure of the pumps during the night when a monitor was not on site to restart the pump.

Some turbidity would result during instream activities and when the water is diverted to the backfilled areas. GeoEngineers (2011) evaluated the potential risk of turbidity during construction across waterbodies. The qualitative evaluation was based on each affected waterbody's hydroperiod, presence of erodible clay and loam soils in streambanks, presence of clay in streambed (suspended clay contributes to turbidity), long-term stability of stream channels, and level/duration of construction effort and stabilization measures likely added at the time of construction. The turbidity risk was scored from 1 (low) to 5 (high). Of 420 waterbodies evaluated, 150 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period and 270 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench (GeoEngineers 2011).

Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings in North American streams. The study estimated that suspended sediment concentrations averaged 99 mg/l for flumed crossings and 23 mg/l at the dam-and-pump crossings. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. Pacific Connector estimated that suspended sediment concentrations produced during pipeline construction during summer low-flow conditions may be highest for the six waterbodies crossed within the Coquille River fifth-field watershed (see Table 3.2-21 in Pacific Connector's Resource Report 3). However, even for these streams, nearly all dry crossing estimates of TSS would be less than 100 mg/l within 10 meters downstream of the crossing site. For the other fifth-field watershed crossings where estimates could be made, the average suspended sediment concentrations produced during fluming and dam-and pump construction would be near background suspended sediment levels (about 2 mg/l). Nearly all estimates were less than 10 mg/l between 10 and 100 meters downstream from construction sites.

Potential effects from turbidity from construction across streams are expected to be temporary and minor for the following reasons:

- all but six crossings of perennial streams would be completed either using dry open-cut crossing methods or methods that avoid direct impacts altogether;
- crossings would be completed during ODFW and NMFS recommended in-water work periods when the flow volumes and velocities will be low;
- most dry open-cut crossings would be completed in less than 48 hours;
- headwater streams are typically dominated by gravel/cobble substrates reducing the potential to generate turbidity during crossings;

- crossings would be scheduled individually, several days apart, and not completed concurrently; and
- erosion control BMPs, as outlined in Pacific Connector's ECRP, would be implemented to minimize the potential for erosion and sedimentation.

The *Turbidity-Nutrients-Metals Water Quality Impact Analysis* (GeoEngineers 2011) concluded that turbidity may exceed Oregon numerical water quality standards for short distances and short durations downstream from each crossing, either during and shortly after construction (in perennial waterbodies) or after fall rains begin (for intermittent and ephemeral streams). Such exceedances are allowed as part of the narrative turbidity standard if recognized in a CWA Section 401 water quality certification as long as every practicable means to control turbidity has been used.

Trenching within Coos Bay would result in elevated levels of TSS for the short-term period during the pipeline installation. Modeling was conducted using the DREDGE model of TSS during dredged material placement using an open clamshell dredge at different locations along the pipeline in Haynes Inlet (CHE 2013b). Model results suggest that concentrations of TSS over 50 mg/l would be limited to a region within 100 feet from actual placement. Concentrations of TSS up to about 15 mg/l would be limited to likely less than 300 to 500 feet from actual trenching, which are normal ranges for turbidity in Coos Bay during the fall and winter (Moffat & Nichol 2006a). Model results also indicated that suspended sediment concentrations would not exceed ambient suspended sediment concentrations by more than 10 percent within 350 feet or less of actual trenching. Pacific Connector estimated that assuming 800 feet of trench excavation per day with approximately 1,600 feet of trench open at any given time, modeling results indicated that turbidity would not exceed regulatory requirements at the point of measurement. The raised levels of turbidity in the bay would occur over the construction period (October 1 through February 15) to traverse the 2.5 miles across Haynes Inlet.

Streambank Protection and Restoration

During pipeline construction, clearing and grading of vegetative cover could increase erosion adjacent to streambanks. Alteration of the natural drainage or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks and the transportation of sediment carried by runoff water into the waterbodies. The extent of the impact would depend on sediment loads, stream velocity, turbulence, streambank composition, streambank vegetation, stream type, scour depth, and sediment particle size. To minimize these impacts, equipment bridges and mats would be used, as necessary, to provide stable work areas and isolate equipment from direct impact on waterbodies. TEWAs for spoil storage and pipe staging would be set back from the bank as discussed in the following paragraph, and temporary sediment barriers would be installed around disturbed areas, where necessary, in accordance with Pacific Connector's ECRP.

To restore streambanks on non-federal lands, Pacific Connector would explore options such as tree revetments, stream barbs/flow deflectors, toe-rock, and vegetation riprap before using hard bank protection. Streambanks would be returned to their preconstruction contours or shaped to a stable angle. Erosion control fiber fabric or matting would be installed on slopes adjacent to streams. On some banks, depending on site-specific conditions, fiber rolls may also be installed to stabilize bank toes. The streambanks would be seeded and woody riparian vegetation planted for stabilization according to Pacific Connector's ECRP. Pacific Connector does not anticipate that riprap would be required for streambank stabilization, but if used would be limited to the areas where flow conditions preclude effective vegetation stabilization techniques. Bioengineering would be preferred, so riprap would be a last resort intended to limit damage.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans, included as a supplement to appendix J (NSR 2014), would be used as directed by BLM and Forest Service monitors in conjunction with the FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service LMPs.

Sedimentation Control

Pacific Connector would install temporary equipment bridges across perennial or intermittent waterbodies flowing at the time of construction to prevent sedimentation caused by construction and vehicular traffic. The ECRP outlines the erosion control procedures that Pacific Connector would utilize.

Trench spoil excavated from within the waterbody would be placed at least 10 feet from the water's edge or in a TEWA. In some waterbodies, native washed streambed boulders, cobbles, and gravels removed from the surface of the trench may be stored within the construction right-of-way in the streambed in areas isolated from streamflow (i.e., within the dammed area for flumes or dam-and-pump crossing). Storing this material in the streambed would minimize handling and help to ensure the material would be available for backfill and streambed restoration. However, those specific cases would require a modification from Section V.B.4.a. of the FERC's *Procedures* (which require spoil store more than 10 feet from the edge of waterbody). Staging areas and additional spoil storage areas would be located at least 50 feet away from waterbody boundaries, where topographic conditions and other site-specific conditions allow. Where topographic conditions do not allow a 50-foot setback, spoil storage areas would be located at least 10 feet from the water's edge. Sediment control devices, such as silt fences and straw bales, would be placed around the spoil piles to prevent spoil flow back into the waterbody.

Trench Dewatering

During construction, the open trench may accumulate water either from groundwater intrusion or precipitation. Intermittent streams and ditches that are dry on the surface may contain water below the surface. As such, the trench may require dewatering to allow for proper and safe construction. However, the construction schedule would generally coincide with the period when the soils in these areas are dry, thereby minimizing the amount of trench dewatering. During trench dewatering, water would be pumped from the trench into stable, vegetated areas through a straw bale structure or filter bag. Typically, dewatering activities are only necessary in localized high groundwater areas for short-term periods (a few days) to allow access to the trench, such as where tie-in welds are required. Therefore, potential effects from dewatering activities (i.e., erosion/sedimentation effects) are temporary. No vegetation clearing outside of the approved work spaces would be required. Trench dewatering structure locations would be selected in the field in response to actual conditions encountered. The rate of flow from dewatering pumps would be regulated to prevent erosion from runoff, and dewatering would be conducted in a manner designed to ensure that water is allowed to infiltrate into the ground rather than flow over the surface whenever possible. If trench dewatering does result in surface runoff, it would be conducted to ensure that turbid water does not reach a surface water of the state, and does not result in the deposition of sand, silt, and/or sediment. All materials used to filter water from the trench would be cleaned up and the site restored after dewatering is complete. The ECRP provides additional information regarding dewatering and the BMPs that would be implemented to minimize potential sedimentation.

Pacific Connector proposes a winter construction schedule for the Klamath Basin area between approximately MPs 188 and 228.13 to minimize impacts to agricultural activities and to minimize construction across areas of high groundwater due to irrigation activities that would increase the instances of trench dewatering. The *Winter Construction Plan for the Klamath Basin* is included in Appendix 1E of Pacific Connector's June 2013 FERC Application.

Potential sedimentation impacts would be reduced due to the dry climate of the area and the colder winter climate of the area would reduce runoff potential during frozen periods. Additionally, Pacific Connector would utilize BMPs as necessary as discussed in the ECRP to prevent sedimentation into waterbodies or wetlands. Mulch would also be used to apply effective ground cover to minimize erosion potential. Effective ground cover is considered to be the amount of cover necessary for maintaining a disturbed site in a low hazard category for erosion.

<u>Blasting</u>

Blasting may be required for pipeline construction in areas where hard, non-rippable bedrock occurs within the trench profile (see section 4.2.2.5). Blasting could alter the in-channel characteristics and hydrology of the stream, potentially decreasing flows due to increased infiltration where bedrock would be fractured. Where blasting is required in streambeds, Pacific Connector proposed to utilize the dam-and-pump crossing method so that blasting activities can be completed in the dry to avoid or minimize potential impacts to aquatic species during in-water blasting. State permits would be obtained for blasting in waters of the state in coordination with ODFW and ODEQ.

Pacific Connector developed a *Blasting Plan* in consultation with the BLM, Forest Service, and Reclamation. Blasting-related operations including obtaining, transporting, storing, handling, loading, detonating, and disposing of blasting material, drilling, and ground-motion monitoring would comply with applicable federal, state, and local regulations and permits. To reduce impacts, a site-specific blasting plan would be developed by the blasting contractor prior to work. The site-specific blasting plans would be reviewed and approved by appropriate agencies. A permit from the COE or ODEQ may be required for any in-water blasting. Additional discussion of potential blasting impacts and Pacific Connector's proposed measures to minimize impacts is included in section 4.6.2, where the effects of in-stream blasting on fish are discussed.

<u>Spills of Hazardous Materials</u>

Spills of hazardous materials could occur during equipment fueling and storage of oil, fuel, or other materials near waterbodies. Leaks from equipment and vehicles could cause potential impacts on surface water quality.

Hazardous materials, chemicals, fuels, and lubricating oils would be stored in accordance with Pacific Connector's ECRP and SPCCP. Pacific Connector has developed a general SPCCP that describes measures to be implemented by Pacific Connector's personnel and contractors to prevent and, if necessary, control any inadvertent spill of hazardous materials such as fuels, lubricants, and solvents that could affect water quality. This general SPCCP would be updated with site-specific information before construction. All Project employees would receive SPCCP training.

The SPCCP includes a measure to prohibit the storage of hazardous substances, chemicals, fuels, and lubricating oils within 150 feet of waterbody banks or wetlands. Restricted areas for storage of these materials would be clearly marked in the field. These activities would only occur closer if the EI finds, in advance, no reasonable alternative and the contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill and the procedures outlined in Pacific Connector's SPCCP are followed. Pacific Connector has proposed containment structures for pumps to prevent fuel spills from entering waterbodies. All hazardous materials would be handled in accordance with the SPCCP.

Channel Migration and Scour

Fluvial erosion represents a potential hazard to the pipeline where streams are capable of exposing the pipe as a result of channel migration, avulsion, widening, and/or streambed scour. Pacific Connector had a consultant conduct a study of stream migration and scour for the waterbodies crossed by the pipeline route.[60] Ten crossings were identified as Level 2 (listed below on table 4.4.2.2-8), which have large or complex channels with a high potential for migration, avulsion, or scour, and required site-specific additional analyses.

TABLE 4.4.2.2-8

Streams Crossed by the Pacific Connector Pipeline Route That Have a High Potential For Scour or Migration

Watershed	Stream Name	MP	Maximum Scour Depth	Other Hazards	Mitigation Measures
Coquille	Middle Park Creek	27.0	10.5 feet	Channel widening	Dry open-cut
Coquille	South Fork Elk Creek	34.5	6.0 feet	Channel widening	Bury in bedrock
S. Umpqua	Olalla Creek	58.8	7.5 feet	Migration	Bury in bedrock
S. Umpqua	Western Crossing of the South Fork Umpqua River	71.3	unknown	unknown	DP
S. Umpqua	North Myrtle Creek	79.1	6.5 feet	Migration	Bury in bedrock
S. Umpqua	South Myrtle Creek	81.2	unknown	Migration	Bury in bedrock
S. Umpqua	Eastern Crossing of the South Fork Umpqua River	94.7	8.7 feet	unknown	Diverted open-cut
Rogue	West Fork Trail Creek	118.9	unknown	unknown	Bury in bedrock
Rogue	Rogue River	122.7	6.9 feet	Migration	HDD
Rogue	North Fork Little Butte Creek	145.7	unknown	unknown	Dry open-cut

GeoEngineers (2013f) made the following recommendations to mitigate for scour or channel migration at the 10 waterbody crossings with high risk factors:

- bury the pipeline in bedrock, where feasible;

[60] GeoEngineers, Inc., 29 May 2013, *Channel Migration and Scour Analysis for the Pacific Connector Gas Pipeline Project in Southern Oregon*, prepared by E.T. Barnett, J.M. Ambrose, and T. Hoyles, filed with Pacific Connector's June 2013 application to the FERC as a stand-alone attachment to the copy of the JPA.

- where bedrock is not encountered, bury the pipeline below the estimated depth of streambed scour; and
- within floodplains adjacent to migrating streams, bury the pipeline below the 50-year channel projections.

We conclude that these measures should adequately mitigate the risk of stream scour on the pipeline.

Dust Control

While it is not possible to know how much water would be needed for dust suppression on the pipeline construction right-of-way, during dry seasons, Pacific Connector estimates that there would be approximately five 3,000-gallon water trucks per construction spread on a given day. Pacific Connector anticipates using five construction spreads, which would total 75,000 gallons for 25 water trucks per day. Watering trucks would spray only enough water to control the dust or to reach the optimum soil moisture content to create a surface crust. Runoff should not be generated during this operation. Water may be obtained through municipal sources or withdrawn from surface water or groundwater sources on non-federal lands. All appropriate permits/approvals would be obtained prior to withdrawal. Table 4.4.2.2-9 lists potential dust control water sources that have been identified by Pacific Connector.

TABLE 4.4.2.2-9

Potential Dust Control Water Sources for the Pacific Connector Pipeline

County	Approximate MP	Source
Coos	16.5	Aqueduct Lake
Coos	37.0	Brewster Lake (WI-602)
Douglas	50.2	Lang Creek Reservoir
Douglas	79.0	Big Lick Reservoir
Jackson	128.0	Indian Lake Reservoir
Jackson	133.4	Eagle Point Irrigation Canal Crossing
Jackson	141.0	Star Ranch Lake
Jackson	144.0	Unnamed Reservoir
Jackson	145.0	Gardener Reservoir
Klamath	228.5	High Line Canal
Klamath	228.7	Capek Reservoir
Klamath	229.4	Low Line Canal

Additionally, Pacific Connector has indicated it may utilize a synthetic product such as Dustlock®, in addition to water, for dust control. Dustlock is a naturally occurring byproduct of the vegetable oil refining process. Dustlock penetrates into the bed of the material and bonds to make a barrier that is naturally biodegradable, ensuring that the surrounding ground and water are not contaminated, and minimizing any potential effects to fish and wildlife. According to the product safety data sheet, there are no known health risks to fish and wildlife resources by the use of Dustlock. However, Pacific Connector would not use Dustlock within 150 feet of riparian areas. Pacific Connector developed a *Fugitive Dust Plan* in consultation with BLM and Forest Service.

Hydrostatic Testing

After backfilling, the pipeline would be hydrostatically tested in accordance with DOT regulations to ensure that the system is capable of operating at the maximum operating pressure. Pacific Connector estimates that approximately 62 million gallons of water would be required to test the pipeline.

Water for hydrostatic testing would be obtained from commercial or municipal sources, private supply wells, or from surface water right owners (see table 4.4.2.2-10). If water for hydrostatic testing would be acquired from any source other than a municipality, including surface water sources, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the ODWR, prior to use. As part of this process, ODWR would have the applications reviewed by ODEQ and ODFW to determine if there are concerns about the impact water withdrawals may have on water resources, (including concerns relating to the timing, seasonality, and method of withdrawal), as well as water quality and/or fish and wildlife species and the habitat, respectively. ODWR would provide public notice and opportunity to comment on the applications.

TABLE 4.4.2.2-10

Potential Hydrostatic Source Locations

County	MP	Source		Owner	Volume (gal)
Coos Bay Frontal Pacific Ocean (1710030403)					
Coos	1.47R	Coos Bay -North Bend Water Board		Coos Bay North Bend Water Board	14,204,643
Middle Fork Coquille River (1710030501)					
Douglas	50.20	Water Impoundment	Kinnan Lake	5-J Limited Partnership, Donald R. Johnson 29080601300	2,098,651
Olalla Creek-Lookingglass Creek (1710030212)					
Douglas	55.90	Water Impoundment	Ben Irving Reservoir	Douglas County Public Works/ Looking Glass Olalla Water District/ Winston-Dillard Water District	1,390,902
Douglas	58.75	Looking Glass Olalla Water District (Olalla Creek Crossing)		Looking Glass Olalla Water District	2,098,699
Clark Branch-South Umpqua River (1710030211)					
Douglas	71.30	S. Umpqua River Crossing #1		Oregon Department of Water Resources	5,572,843
Days Creek-South Umpqua River (1710030205)					
Jackson	94.73	S. Umpqua River Crossing #2		Oregon Department of Water Resources	6,695,648
Shady Cove-Rogue River (1710030707)					
Jackson	122.5	Rogue River Crossing		Oregon Department of Water Resources	8,770,257
Little Butte Creek (1710030708)					
Jackson Jackson	146.70	N. Fork Little Butte Creek Crossing		Medford Irrigation District/ Rogue River Valley Irrigation District	1,883,276
Jackson	161.40	Water Impoundment	Fish Lake	United States, Bureau of Reclamation	3,420,951
Fourmile Creek (1801020302)					
Klamath	168.90	Water Impoundment	Lake Of The Woods National Forest Lake	Oregon Department of Water Resources (Bureau of Reclamation)	4,102,136
John C Boyle Reservoir-Klamath River (1801020602)					
Klamath	184.30	Water Impoundment	John C. Boyle Reservoir	Oregon Department of Water Resources	2,282,231

TABLE 4.4.2.2-10

Potential Hydrostatic Source Locations

County	MP	Source		Owner	Volume (gal)
Lake Ewauna-Klamath River (1801020412)					
Klamath	189.00	Water Impoundment	Keno Reservoir	Oregon Department of Water Resources	3,359,703
Klamath	199.20	Klamath River			3,308,134
Mills Creek–Lost River (1801020409)					
Klamath	228.1	High Line Canal		Malin Irrigation District	2,923,230
				Total	**62,111,304 (190.61)**

The pipeline would be tested in approximately 75 sections, each with varying lengths and water volume requirements. During the test, it may be necessary to discharge water at each of the section breaks; however, discharges would be minimized and water would be conserved as much as practical by cascading water between test sections when feasible (pumping from one segment to the next). When discharged, the test water would be released adjacent to the construction right-of-way through an energy dissipating device and a straw bale filter or sediment bag. Test water would not be discharged directly into surface waters. Pacific Connector would apply for permission to discharge the hydrostatic test water with ODEQ. Hydrostatic discharge locations have been located in upland areas where feasible, and at an appropriate distance from wetlands and waterbodies to promote infiltration and to ensure that sedimentation of wetlands, waterbodies, or other sensitive areas do not occur (identified in table D-3 in appendix D). Pacific Connector's EIs would visually monitor the release of hydrostatic test water and trench dewatering activities to ensure that no erosion or sedimentation occurs. In addition, the EIs would ensure that turbid water is not discharged to waters of the state. If an EI determines that a discharge is occurring from trench dewatering, the receiving water would be visually monitored for turbidity. If a turbidity plume is observed, the trench dewatering operations would be immediately adjusted/reinstalled/ maintained to ensure that the discharge of sediment to surface water is stopped and water quality standards are not exceeded.

In addition to the 75 test header section breaks located within the construction right-of-way or TEWAs (identified in table D-3 in appendix D), Pacific Connector identified seven potential hydrostatic discharge locations outside of the construction right-of-way and TEWAs. In these seven locations, small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. A rubber-tired or track hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

Pacific Connector developed a *Draft Hydrostatic Testing Plan* in consultation with the BLM and Forest Service as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University). The plan includes measures to prevent the transfer of aquatic invasive species and pathogens from one watershed to another. Where possible, test water would be released within the same basin from which it was withdrawn. However, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same basin where the water was withdrawn in all cases. Pacific Connector originally proposed to test the water to be used for the absence of a potential invasive species or forest pathogen. However, the test results would only confirm the absence in the sample aliquot and would not confirm the potential presence of an invasive species within the entire waterbody source. Since it would be impractical to test the entire volume of hydrostatic test water required, it was concluded that Pacific Connector should assume that all non-municipal test water sources could contain a potential invasive species and that water treatment methods should be implemented to prevent the potential spread of aquatic invasive species or forest pathogens. Therefore, if hydrostatic test source water cannot be returned to the same water basin from where it was withdrawn, Pacific Connector would employ an effective and practical water treatment method (chlorination, filtration, or other appropriate method) to disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water would be treated after it is withdrawn and prior to hydrostatic testing. The hydrostatic test water treatment process would incorporate screening during water withdrawal that would meet NMFS and ODFW criteria to prevent the entrainment of small fish. Based on the various chlorine treatment methods for the various aquatic invasive species and pathogens that potentially may occur within identified water sources, Pacific Connector proposes to use a treatment of 2 mg/l free chlorine residual with a detention time of 30 minutes. Chlorinated water would be discharged upland at least 150 feet from wetlands and waterbodies and not directly to surface water features or wetlands. Water would be discharged according to ODEQ requirements for chlorinated water discharges as noted in the *Hydrostatic Test Plan*. All discharge locations would be monitored after construction for potential noxious weed establishment and treated if necessary.

Restoration of Streambeds

After the pipeline has been installed, the trench would be backfilled with the native material that was excavated from the trench. Backfill material would match the natural streambed material size, gradation, and composition as closely as possible. The streambed profile would be restored to pre-existing contours and grade conditions. Section V.C.1 of the FERC's *Procedures* requires that the upper 1 foot of the trench should be backfilled with clean gravel or native cobbles in all waterbodies that contain cold water fisheries. However, Pacific Connector has requested a modification, where the existing substrate is not gravel or cobbles and site access is limited, only native materials removed from the stream be used for backfill. We have recommended that Pacific Connector provide site-specific justifications from this modification to our *Procedures*. Any subsequent need to place fill within a stream would require a permit from COE under Section 404 of the CWA and ODSL under the ORS.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) would be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service land management plans.

Peak Flows

Vegetation management or clearing activities that create sizable canopy openings can increase water yields (Forest Service 2000). Compared to locations lacking large canopy openings, sizeable canopy openings can result in decreased evapotranspiration (due to decreased leaf area), decreased interception by the canopy, increased snow accumulation and melt rates, greater snow accumulation and more rapid snowmelt, resulting in increased peak flows (Forest Service 2008). Clearing can also reduce cloud water interception, having the opposite effect (Forest Service 2008). The pipeline would cross 15 fifth-field watersheds with portions located in the transient snow zone (2,000- to 5,000-foot elevation range), affecting a total of 2,121 acres within the transient snow zone. The portion affected within the transient snow zone represents about 0.16 percent of the total acreage of these 15 watersheds. Increases in peak flows generally diminish with decreasing intensity of percentage of watershed harvested and the magnitude of any effect diminishes with increasing basin size (Forest Service 2008). In other words, increased harvesting causes more extreme peak flows, and the larger the basin size, the lower the magnitude of effects if comparing from the same harvest acreage in a smaller basin. Only clearing that permanently alters canopy cover could affect long-term peak flows; disturbance in existing agricultural and rangeland areas, grasslands, and shrubs (where the restored vegetation would provide similar cover) would have no long-term effects. Therefore, when only considering forest clearing within these 15 watersheds, pipeline disturbance to forested vegetation types would represent only 0.07 percent of the total area of these watersheds.

The greatest forest clearing disturbance within the transient snow zone on a percentage basis would occur within the Spencer Creek watershed. The pipeline would disturb a total of about 126 acres of forest within the 21,913-acre transient snow zone within the 54,242-acre watershed. The pipeline would disturb 0.57 percent of the watershed that is within the transient snow zone. When considering forest vegetation disturbance within the transient snow zone, the pipeline would also have the highest percentage of forested disturbance within the Trail Creek Watershed, disturbing about 107 acres of forested vegetation types within the 30,107-acre transient snow zone in the 35,343-acre Trail Creek watershed, which represents 0.36 percent of the total watershed area in the transient snow zone (see Table 2A-11 in Pacific Connector's Resource Report 2).

The Little Butte Creek fifth-field watershed would have the largest area disturbed by the Project that is located within the transient snow zone with about 434 acres, including 298 acres of forested vegetation, 54 acres of grass-shrub-sapling or regenerating young forest, 33 acres of Oregon white oak forest, and 103 acres of grasslands or shrublands. Thirty-two acres of disturbance would occur within two minor land use types including industrial areas and roads. The forest clearing (about 298 acres) in the transient snow zone represents 0.19 percent of the total watershed area (see Table 2A-11 in Pacific Connector's Resource Report 2).

Because of the pipeline's linear nature, disturbance within the transient snow zone would occur across a broad number of watersheds and various vegetation types and affect a relatively small percentage of the watersheds and the total area of the watershed within the transient snow zone. Although permanent canopy removal in forested areas along the right-of-way would increase the potential for snow accumulation, it is not expected that forest clearing within any of the watersheds would have a measurable influence on peak flows. In addition, Pacific Connector's proposed design measures are intended to ensure that impacts would have an immeasurable effect on forest hydrology. These measures include:

1. Where feasible, the pipeline route has been primarily aligned along ridgelines and watershed boundaries where it would traverse the Coast and Cascade Mountain Ranges. This alignment would minimize clearing effects within any single watershed.
2. The size of construction work areas have been minimized to the extent practical to minimize clearing.

3. After construction, disturbed areas would be returned to a stable, approximate original contour configuration, to restore preconstruction drainage patterns.
4. BMPs would be used to minimize runoff and erosion and to promote infiltration. These BMPs include:
   - compactions mitigation, surface roughening, and use of waterbars on slopes to promote onsite infiltration and to minimize runoff;
   - applying slash or mulch on disturbed areas to ensure effective ground cover requirements are achieved; and
   - replanting cleared forested areas in temporary construction areas during restoration.

Stream Temperatures

During pipeline construction, removal of riparian vegetation along streambanks that serves as shade can increase the temperature of waterbodies. However, available information on the effects of linear pipeline crossings of streams on water temperature indicates there is little to no change. Typically pipeline rights-of-way are narrow, and water would flow quickly past the crossing locations, with greater volumes in larger streams. Therefore, streamwater exposure to the lack of shade at pipeline crossings would be temporary and limited. In addition, stream temperatures are influenced by the infusion of fresh water from springs, seeps, and other groundwater sources, in addition to surface tributary runoffs, both upstream and downstream of pipeline crossings.

Pacific Connector conducted its own research on the potential for its pipeline crossings to increase stream water temperatures. One study (NSR 2009) was conducted on six streams on NFS lands and is discussed later in this section (section 4.4.4.2). Another study (GeoEngineers 2013i)[61] examined 13 stream crossings on non-federal lands, listed on table 4.4.2.2-11.

TABLE 4.4.2.2-11

Predicted Temperature Modeling at Selected Stream Crossings Along the Pacific Connector Pipeline Route

MP	Watershed	Stream	Width	Ambient Water Temperature	Post-Construction Water Temperature
10.3	Coos	Stock Slough	16 feet	56.30 °F	56.32°F
17.5	Coos	Catching Slough	257 feet	56.30°F	56.30°F
23.1	Coquille	North Fork Coquille River	21 feet	74.30°F	74.23°F
29.2	Coquille	Tributary to East Fork Coquille River	6 feet	58.82°F	58.78°F
29.5	Coquille	Tributary to East Fork Coquille River	6 feet	59.72°F	59.72°F
29.9	Coquille	East Fork Coquille River	62 feet	64.22°F	64.24°F
32.4	Coquille	Elk Creek	8 feet	58.46°F	58.47°F
58.8	South Umpqua	Ollalla Creek	78 feet	58.46°F	58.48°F
73.2	South Umpqua	Richardson Creek	21 feet	58.46°F	58.59°F
84.2	South Umpqua	Wood Creek	8 feet	58.46°F	58.5°F
94.7	South Umpqua	Eastern Crossing South Fork Umpqua River	205 feet	58.46°F	58.49°F
132.8	Rogue	Quartz Creek	2 feet	58.64°F	58.94°F
212.1	Lost River	Lost Rover	118 feet	70.70°F	70.68°F

[61] GeoEngineers, Inc., 29 May 2013, *Thermal Impacts Assessment, Pacific Connector Gas Pipeline Project, Coos, Douglas, Jackson, and Klamath Counties, Oregon*, prepared by E.T. Barnett, J.M. Ambrose, and T. Hoyles, attached as a stand-alone document with the copy of the JPA included in Pacific Connector's June 2013 application to the FERC.

GeoEngineers (2013i) modeled thermal impacts at representative stream crossings where riparian shading vegetation would be removed within the construction corridor and where it would be affected within the 30-foot maintenance corridor over the long term. The maximum predicted water temperature increase was 0.3°F at one crossing location (Quartz Creek). However, this was the smallest creek crossing examined; only two feet wide. Modeling results indicate that within a short distance downstream from all crossings, instream water temperatures would return to ambient conditions. Based on the predictive modeling presented in the GeoEngineers (2013i) report, the short-term post-construction increase in thermal loading in the South Umpqua basin based on the combined Cow Creek, Olalla/Lookingglass Creeks, and South Umpqua River was estimated at 0.022 percent at the basin-wide scale. The longer term thermal loading (prior to mitigation) is predicted to be 0.004 percent increase for the basin. Additional analysis regarding stream temperature impacts associated with perennial stream crossings can be found in section 4.6 and appendix J.

To minimize the potential effects of pipeline construction on stream temperatures by the removal of riparian vegetation, Pacific Connector has incorporated the following mitigation measures into its project design:

- narrowing the construction right-of-way at waterbody crossings to 75 feet where feasible based on site-specific topographic conditions;
- locating TEWAs 50 feet back from waterbody crossings to minimize impacts to riparian vegetation, where feasible; and
- replanting the streambanks after construction to stabilize banks and to re-establish a riparian strip across the right-of-way for a minimum width of 25 feet back from the streambanks.

Based on these mitigation measures and the studies provided by Pacific Connector, we conclude that the construction and operation of the pipeline would have no discernible effect on stream temperature.

<u>Hyporheic Exchange</u>

The hyporheic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone is recognized to be important for surface water and groundwater interactions, as well as fish spawning, among other processes. Pacific Connector conducted a hyporheic exchange analysis on the waterbodies and ditches crossed by the pipeline (GeoEngineers 2013d). The assessment focused on determining if construction has the potential to affect the structure and function of the hyporheic zone, and if so, which stream crossing may be most sensitive to changes in hyporheic zone structure and organization. Historically, pipeline construction has not typically been considered as having a potential effect on hyporheic zone function, presumably because of the nature of the construction process having relatively limited, localized and temporary change to the subsurface conditions under streams and rivers. It is difficult to measure hyporheic exchange without detailed site-specific study, but qualitative observations of bed and bank material, stream gradient, location within a watershed, and morphological features can help indicate whether a stream has an active and functional hyporheic zone. GeoEngineers (2013d) developed weighting factors to assign criteria of high, moderate, and low sensitivity to the crossing locations. The analysis used these qualitative parameters to rank how sensitive a stream crossing may be to potential hyporheic zone alteration.

Thirteen stream crossings were categorized as having a high sensitivity to hyporheic zone alteration, which would suggest a high likelihood of a functioning hyporheic zone, mostly associated with larger waterbodies with greater floodplain widths and instream morphologic features. Two of the 'high' sensitivity crossings, including the Coos River crossing at MP 11.13R and the Rogue River crossing at MP 122.65, would be crossed by HDD rather than open trenching across the stream channel.

A "moderate" sensitivity indicates that the stream crossing displays some indicators that a hyporheic zone is active and functional. Approximately 118 crossings fit this category, most of them upper to middle watershed streams. A "low" sensitivity indicates that the stream crossing does not likely support either an extensive or functional hyporheic zone. Approximately 169 stream crossings fit into this category. Many of these low scoring stream crossings are bedrock-controlled, are dominated by finer-grained material, or are canals and ditches. Eleven stream crossings were not assigned any point values or ranking due to there being no channel or channel forming processes observed at the crossing location in the field.

Water quality parameters, including water temperature and intragravel dissolved oxygen, might potentially be affected at crossings where hyporheic exchange is extensive and active. Thus, streams with a "high" and "moderate" sensitivity would be the streams where water quality could potentially be compromised due to alteration of the hyporheic zone. Those crossings with a 'low' sensitivity indicate that little hyporheic exchange is currently operating in the stream, and thus would not likely impact water quality. Overall, the majority of the Pacific Connector pipeline crossings fall into a "low" sensitivity category, where water quality (including water temperature and intragravel dissolved oxygen) is unlikely to be significantly or measurably altered by pipeline construction.

The pipeline construction methods and BMPs described in the GeoEngineers (2013d) report, as well as the site-specific restoration plans for crossings of perennial stream on federal lands (NSR 2014) further reduce the potential for pipeline construction to adversely alter the hyporheic zone. Specifically, the BMPs which are of particular importance to reduce the potential impacts to the hyporheic zone, include the following:

- native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place in order to minimize potential changes to preconstruction permeability; and
- trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low at all stream crossings considering the proposed construction methods, Pacific Connector proposes these additional measures to further reduce the potential for even localized impacts to water quality from hyporheic exchange at the stream crossings identified as having high hyporheic sensitivity:

- Document streambed stratigraphy prior to construction to aid in site restoration. Such documentation would be conducted by staff trained in recognizing and observing river channel processes. If done during construction, this may be performed by the EI after receiving suitable training.
- As described in the *Stream Crossing Risk Analysis* (GeoEngineers 2013c) and the *Site-Specific Stream Crossing Prescriptions for Perennial Streams on BLM and National Forest System Lands* (NSR 2014), once the Project is approved and all permits and route access obtained, all stream crossing would have a pre-construction survey to confirm and clarify conditions developed in the risk analysis. This survey would be done by a team of professionals (including representatives from the BLM, Forest Service, and Reclamation as appropriate for sites on federal lands) qualified to assess terrestrial and aquatic habitat and the geotechnical and geomorphic conditions relative to pipeline construction across stream channels and ditches. Following these surveys if significant changes occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If a change in a waterbody crossing were deemed to be necessary based on the survey, Pacific Connector would file a variance with the FERC and contact other relevant regulatory agencies prior to construction. For crossings on federal lands, the BLM would require Pacific Connector to comply with all conditions of the Right-of-Way Grant prior to authorization to proceed. With all regulatory approvals, Project construction would then move forward.
- Segregate active streambed gravels and cobbles from underlying streambed materials (including fractured bedrock) to their natural depth and replace gravels/cobbles to this natural pre-construction depth.
- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

<u>Existing Access Roads</u>

Of existing roads that would be used as access for the Project, approximately 59 segments would be within riparian areas (i.e., within 100 feet of a stream). Of these segments, 23 would cross streams, with approximately 6 of these on perennial streams, the rest on intermittent or ephemeral channels. All stream crossings are currently planned to use the existing crossing facility (e.g., bridge, culvert, ford), but possibly 15 of these may either use a temporary crossing bridge (13) or replace an existing culvert (2). In most areas, no additional riparian clearing would occur, but a total of 7 locations are expected to have some riparian vegetation removed, generally consisting of understory brush with no or few trees removed. Four riparian cleared areas would be on intermittent and 3 on perennial streams. The cleared areas would be small as they result from slight road widening or formations of turn-outs. Roads are typically 10 to 20 feet wide with turn-outs of lesser widths. While the use and expansion of these roads may contribute sediment in the stream crossing areas from the installation of temporary bridges, sediment effects should be minor at the site-specific levels.

Where road improvements would be required, Pacific Connector would ensure that existing drainage features (culverts, ditches, dips, grade sags, etc.) continue to function properly or would employ suitable substitute measures to ensure that drainage is controlled to prevent off-site erosion or other resource damage. Road surfaces during the late fall and winter are generally more susceptible to rutting because of moisture conditions and freeze/thaw cycles and have a higher potential for increased erosion and sediment potential. To minimize potential resource damage, Pacific Connector would install appropriate erosion and sediment control BMPs along the access roads, as outlined in the ECRP, as determined necessary by Pacific Connector's EI. Paved roads would be kept free of mud and other debris that may be deposited by construction equipment.

New Temporary and Permanent Access Roads

Six of the 14 proposed new TARs would be located within 100 feet of a stream or ditch and there would be 6 new stream crossings (table 4.4.2.2-12).

TABLE 4.4.2.2-12

New Temporary and Permanent Access Roads Located within 100 feet of Waterbodies

TAR/PAR	Waterbody Name	Waterbody ID	Direction
TAR-29.88	East Fork Coquille River	BSP071	River is west of access road
TAR-81.37	Tributary to Myrtle Creek	BSP-259	Crossed
TAR-88.63	Days Creek	BSP-233	Crossed
TAR-88.67	Days Creek	BSP-233	Road is south of river
TAR-128.69	Tributary to Indian Creek	ASP-310	Crossed
TAR-212.50	Ditch	EDX054	Crossed
PAR-132.46	Ditch	AW243	Crossed
PAR 196.53	Ditch	ADX-31	Crossed

One permanent access road to MLV #12 (PAR-150.70) is located within the South Fork/North Fork Little Butte Creek Key Watershed within the Medford BLM District. This permanent access road would be installed within the permanent easement and is located adjacent to Heppsie Mountain Rock Quarry.

To minimize impact on waterbodies from construction of new temporary or PARs, Pacific Connector would install BMPs according to the ECRP. BMPs may include silt fence/straw bale sediment barriers or prefabricated construction mats to prevent rutting/compaction impacts. All TARs would be restored to preconstruction conditions following completion of construction.

Contractor and Pipe Storage Yards

Of the 31 surveyed yards, 12 yards contain drainage ditches or wetland features. Where drainage ditches occur at any of the proposed yard sites, Pacific Connector would avoid impacts to waterbodies by utilizing appropriate BMPs and working around them.

Conclusions about the Potential Pipeline Project Effects on Surface Water Resources

No substantial long-term effects to surface water are anticipated from construction or operation of the pipeline and aboveground facilities because disturbances would be temporary, erosion controls would be implemented, natural ground contours would be returned as close to preconstruction conditions as possible, and the right-of-way revegetated. Implementation of Pacific Connector's ECRP and our *Plan* and *Procedures* would limit impacts from construction on surface water resources.

Temporary, minor, and localized effects could result from clearing alongside streams in those areas of the pipeline corridor where there exists forested riparian vegetation. Turbidity increases due to stream crossings would be short term. Localized increases in turbidity would be minimized with the implementation of BMPs. Implementation of the ECRP with temporary and permanent erosion control measures and site specific mitigation measures for sensitive stream crossings would minimize effects. Based on the reasons cited above, we conclude that the construction or use of the aboveground facilities, access roads, TEWAs, and contractor yards would not significantly impact surface water resources.

Operation and Maintenance of the Pipeline

The operation of the new pipeline would not result in any adverse impacts to surface water use or quality. Associated pipeline facilities such as compressor stations and meter stations would be located outside of waterbodies to avoid impacts to surface waters. Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip of at least 25 feet, as measured from the waterbody's MHWM.

4.4.3 Wetlands

Wetlands are defined by the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands are considered to be ecologically important and can provide substantial biodiversity. They serve a variety of physical, biological, and chemical functions such as wildlife and fish habitat, flood flow moderation, groundwater recharge and discharge, water quality protection, and recreational opportunities.

Wetlands are regulated at the federal, state, and local level. At the federal level, wetlands may be deemed Waters of the United States (33 CFR 328.3) and may be subject to regulation through the CWA (i.e., the COE will determine which wetlands are regulated under the CWA). Sections 401 and 404 of the CWA were created specifically with the intent "to restore and maintain the chemical, physical, and biological integrity of our Nation's waters." The COE has authority under Section 404 of the CWA to review and issue permits for activities that would result in the discharge of dredged or fill material into wetlands or other jurisdictional waterbodies. Section 401 of the CWA requires that proposed dredge and fill activities under Section 404 be reviewed and certified by the designated state agency and that the Project meet state water quality standards. In this case, the ODEQ has been delegated this authority and is charged with verifying that the project meets state water quality standards.

In Oregon, wetlands are also regulated at the state level by the ODSL and at the local level by some city and county land-use ordinances. Most activities that affect more than 50 cy of material in wetlands are required to have a permit from ODSL, which administers Oregon's Removal-Fill Law (ORS 196.800) enacted in 1967 and 1971 to protect waterways and wetlands.

Through the State's notification process, provisions for wetlands under the ODF's Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODF in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act, including those related to wetlands.

On federally managed land, EO 11990 amended in 42 U.S.C. 4321 *et seq.*, requires the federal agencies "to avoid adverse impacts associated with the destruction or modification of wetlands wherever there is a practicable alternative" and to "include all practicable measures to minimize harm to wetlands." Further, the agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

The *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) provides the standards for determining wetlands. Wetland delineations for the Project were conducted in accordance with these federal regulations and methodologies. Wetlands at the LNG terminal and associated facilities are discussed in section 4.4.3.1, while wetlands crossed by the pipeline are discussed in section 4.4.3.2 below.

4.4.3.1 Jordan Cove LNG Terminal

Jordan Cove (through their consultant SHN Consulting Engineers and Geologists, Inc.) conducted wetland delineations within the LNG terminal site as well as the South Dunes Power Plant site, temporary North Point construction worker camp, and other associated sites using wetland classifications based on Cowardin et al. (1979).[62] The location of the wetlands delineated during surveys is shown in figure 4.4-1. The COE has reviewed Jordan Cove's wetland delineation and determinations, and provided a Preliminary Jurisdictional Determination on March 13, 2014. Wetlands identified in the area include estuarine, palustrine unconsolidated bottom, palustrine emergent, palustrine scrub-shrub, and palustrine forested wetlands.

Estuarine wetlands are characterized by sandy or rocky substrate that is regularly inundated by brackish water and influenced by tidal flux, resulting in cycles of saturation and exposure. Plant life is not typically abundant within these types of wetlands, though macro- and micro-algae and phytoplankton thrive here and create a rich intertidal habitat environment that supports numerous species of mollusks, crustaceans, and shorebirds. Estuarine intertidal wetlands occur along the shore of Coos Bay across the mouth of the slip.

Palustrine unconsolidated bottom wetlands are wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones. The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season. This wetland type occurs along the South Dunes Power Plant and the access/utility corridor.

[62] The wetland delineation reports can be found in Appendix D2 of Resource Report 2 included in Jordan Cove's May 2013 application to the FERC.

Figure 4.4-1
Wetland Delineation of the LNG Project Site

Palustrine emergent wetlands are freshwater wetlands dominated by erect, rooted, herbaceous wetland plants that generally persist for most of the growing season. Plant species found in emergent wetlands include slough sedge (*Carex obnupta*), Hooker's willow (*Salix hookeriana*), toad rush (*Juncus bufonius*), dagger-leaved rush (*Juncus ensifolius*), tinker's penny (*Hypericum anagalloides*), devil's beggartick (*Bidens frondosa*), knotgrass (*Paspalum distichum*), Yorkshire fog (*Holcus lanatus*), creeping bent-grass (*Agrostis stolonifera*), yellow pond lily (*Nuphar lutea* ssp. *polysepala*), and floating-leaved pondweed (*Potamogeton natans*). Emergent wetlands occur in the northern portion of the LNG terminal project area.

Palustrine scrub-shrub wetlands are freshwater wetlands that include areas dominated by woody vegetation less than 20 feet tall and are vegetated with true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Species found within scrub-shrub wetlands on the LNG terminal project area include Hooker's willow, Sitka willow (*S. sitchensis*), Douglas spiraea (*Spiraea douglasii*), twinberry (*Lonicera involucrata*), slough sedge, spreading rush (*Juncus effusus*), dagger-leaved rush, toad rush, western bent-grass (*Agrostis exarata*), creeping bent-grass, reed canary grass (*Phalaris arundinacea*), northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria elata*), and lowland cudweed (*Gnaphalium palustre*). Scrub-shrub wetlands occur in the northeast portion of the LNG terminal project area and in a small area near Jordan Lake. Henderson Marsh, which is located directly to the west of the site and would not be directly affected by the project (but which may be indirectly affected due to a minor reduction in water entering the marsh due to the construction of the tsunami berm on the west side of the slip), is composed partially of this wetland type.

Palustrine forested wetlands are freshwater wetlands that contain woody vegetation that is 20 feet or taller. Coniferous species found in the forested wetlands on the LNG terminal project area include shore pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and scattered Port-Orford cedar (*Chamaecyparis lawsoniana*). Shrubs within the forest wetland areas include scotch broom (*Cytisus scoparius*), coyote brush (*Baccharis pilularis*), hairy manzanita (*Arctostaphylos columbiana*), evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), wax myrtle (*Myrica californica*) and scattered rhododendron (*Rhododendron macrophyllum*). Herbaceous species include European beachgrass (*Ammophyla arenaria*), silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), sheep sorrel (*Rumex acetosella*), candy-stick (*Allotropa virgata*), and rattlesnake plantain (*Goodyera oblongifolia*). Forested wetlands occur in the northeast portion of the LNG terminal project area.

Table 4.4.3.1-1 lists all the wetlands identified within Jordan Cove's terminal and related facilities. Approximately 38.0 acres of wetlands would be affected by construction of the proposed LNG terminal and associated facilities (e.g., SORSC, South Dunes Power Plant, and North Point Construction Workers Camp), with approximately 35.6 acres of wetlands being permanently affected during operation of the Project (see table 4.4.3.1-1). The vast majority of impacts are associated with wetlands affected by construction of the access channel (which would impact 29.3 acres of wetlands).

TABLE 4.4.3.1-1

Wetlands Delineated on the LNG Project Site

Wetland Delineation	Wetland Type	Areas Affected By Construction (acres)	Areas Affected By Operation (acres)
Slip and Access Channel			
Eelgrass	Estuarine	2.5	2.5
Intertidal (MHHW)	Estuarine	8.1	8.1
Shallow Subtidal	Estuarine	3.3	3.3
Deep Subtidal a/	Estuarine	15.4 a/	15.4 a/
	Subtotal	**29.3**	**29.3**
Construction Dock			
Intertidal	Estuarine	1.9	1.4
Shallow Subtidal	Estuarine	0.2	<0.1
Eelgrass Habitat a/	Estuarine	0.3 a/	0.0 a/
	Subtotal	**2.4**	**1.5**
LNG Liquefaction Site			
2013-4	Palustrine Scrub-Shrub	0.3	0.3
2013-3	Palustrine Scrub-Shrub	0.1	0.1
	Subtotal	**0.4**	**0.4**
Access /Utility Corridor			
Wetland C	Palustrine Forested	0.2	0.2
Wetland E	Palustrine Aquatic Bed	1.0	0.2
2013-6	Palustrine Emergent	0.3	<0.1
2012-2	Palustrine Scrub-Shrub; Palustrine Emergent	0.2	0.0
2013-1	Palustrine Unconsolidated Bottom; Palustrine Scrub-Shrub; Palustrine Emergent	<0.1	<0.1
2013-2 a/	Palustrine Unconsolidated Bottom; Palustrine Scrub-Shrub; Palustrine Emergent	<0.1 a/	<0.1 a/
	Subtotal	**1.79**	**0.53**
Construction Worker Camp			
Wetland APC-A2	Estuarine	0.2	<0.1
Wetland APC-D	Palustrine Emergent	<0.1	<0.1
Coos Bay, below el. 746´ (MHHW)	Estuarine	<0.1	<0.1
	Subtotal	**0.3**	**<0.1**
South Dunes Power Plant			
Wetland F a/; b/	Palustrine Unconsolidated Bottom	0.9 a/; b/	0.9 a/; b/
Wetland G a/; b/	Palustrine Unconsolidated Bottom	0.9 a/; b/	0.9 a/; b/
Wetland H (East)	Palustrine Emergent	<0.1	<0.1
Wetland H (West)	Palustrine Emergent	<0.1	<0.1
Wetland I (North)	Palustrine Emergent	0.3	0.3
Wetland I (South)	Palustrine Emergent	<0.1	<0.1
Wetland J	Palustrine Emergent	<0.1	<0.1
Wetland L	Palustrine Emergent	0.1	0.1
Wetland M	Estuarine	0.2	0.2
2012-7	Palustrine Emergent	0.2	0.2
Coos Bay, below el. 746´ (MHHW)	Estuarine	0.5	0.5
	Subtotal	**3.2**	**3.2**
Rail Spur Bridge Relocation			
2012-4	Palustrine Emergent	<0.1	<0.1
	Subtotal	**<0.1**	**<0.1**
Southwest Oregon Regional Safety Center			
Wetland A	Palustrine Forested	0.2	0.2
Wetland B	Palustrine Forested	0.4	0.4
	Subtotal	**0.6**	**0.6**
Impact Summaries			
	Total Wetland Impacts	**38.0**	**35.6**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ These areas are not included in the mitigation requirements, and no mitigation for these areas has been proposed by Jordan Cove.

b/ These are jurisdictional wetlands but do not require mitigation as these former mill waste treatment areas are under an ODEQ NPDES permit.

Dewatering proposed for excavation of the LNG facilities could have temporary impacts to ground water, surface water, as well as wetlands (see sections 4.4.1 and 4.4.2). Technical memoranda were submitted in Jordan Cove's February 13, 2015, filing that summarize evaluations of the potential for dewatering activities during construction to impact groundwater, surface water, and wetland habitats near the terminal (DEA 2015; GSI Water Solutions Inc. 2015). Based on these assessments, it is expected that groundwater movement and levels would return to pre-disturbance conditions following construction. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts to ground and surface waters, as well as wetlands.

The spread or establishment of weeds can adversely affect wetlands. Weeds and the measures taken to avoid and minimize their spread or establishment are discussed in detail in section 4.5.

When unavoidable wetland impacts are proposed, the COE, EPA, and ODSL require that all practicable actions be taken to avoid, minimize, and then compensate for those impacts. The specific type and amount of compensatory mitigation that would be required to offset the loss of wetland acreage and functions that cannot be avoided or minimized would be determined by the COE as part of the CWA Section 404 permit process and by the ODSL as part of the state Removal-Fill permit process.

For activities involving CWA Section 404 discharges, a permit will be denied by the COE if the associated discharge does not comply with the EPA's 404(b) (1) Guidelines. The Guidelines are binding regulations and provide substantive environmental standards by which all Section 404 permit applications are evaluated. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the applicant.

The "overall project purpose," as determined by the COE, is used to structure the alternatives analysis. In other words, it determines the scope of alternatives that must be considered. The COE alternatives analysis must consider alternative sites and designs that would accommodate the overall project purpose. If a prospective permittee is not able to overcome the presumption of alternatives to their proposal that would avoid or minimize aquatic resource impacts, compensatory mitigation is required for any and all remaining impacts. The COE decision to issue a permit, issue a permit with conditions, or deny the permit application request is based upon an evaluation of the probable impacts of the project including cumulative impacts of the proposal and the proposal's intended use on the public interest.

Prior to COE authorization, the COE must ensure aquatic resource impact avoidance and minimization have been identified, outlined, and promulgated by an applicant. The COE uses a mitigation sequence to assess the need for aquatic resource impacts. This mitigation sequence contains a primary structure centered on avoidance of aquatic resource impacts, minimization of aquatic resource impacts, and compensation for the loss of aquatic resource impacts that could not be avoided. If, after outlining project aquatic resource avoidance and minimization to the degree practicable, an applicant may mitigate for subsequent aquatic resource impacts. Mitigation for aquatic resource impacts is carried out via the development of a compensatory mitigation plan. A compensatory mitigation plan must be developed to meet the requirements of the 2008 Compensatory Mitigation Rule as outlined in the Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (73 [70] FR 19594-19705 [April 10, 2008]) and in 33 CFR Part 232.4.

A compensatory mitigation plan must replace lost aquatic functions and values, and must contain the following required components:

- goals and objectives;
- site selection criteria;
- site protection instrument;
- baseline environmental information;
- determination of credit methodology;
- mitigation work plan;
- maintenance plan;
- performance standards;
- monitoring requirements;
- long-term management plan;
- adaptive management plan; and
- financial assurances.

Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts to wetlands.[63] Impacts on freshwater wetland resources would be mitigated via the West Bridge and West Jordan Cove Mitigation Sites for a total of approximately 4.5 acres of mitigation (i.e., area where mitigation would be conducted) with a mitigation credit of approximately 2.9 acres (i.e., offset of impacts; see Part A of Jordan Cove's *Compensatory Wetland Mitigation Plan*). Impacts to estuarine wetland resources would be mitigated via the Eelgrass Mitigation Site and Kentuck Slough Mitigation Site for total of approximately 50.8 acres of mitigation (i.e., area where mitigation would be conducted) with a mitigation credit of approximately 16.9 acres (i.e., offset of impacts; see Part B of Jordan Cove's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. As discussed above, approval of these mitigation plans by these agencies would be required prior to issuance of federal and state wetland permits.

Restoration effort at the Kentuck Slough and West Jordan Cove Wetland Mitigation Sites would result in some short-term impacts; however, they would be limited in scope and would only exist during the actual restoration process. Potential impacts include a temporary reduction in water quality due to an increase in sedimentation (e.g., resulting from grading/excavating at the West Jordan Cove site), temporary disturbances to adjacent wildlife, and a temporary impact on vegetation removed during restoration activities. However, these impacts would not be significant and would be part of an overall long-term enhancement of the wetland habitat. Because they would be limited in scope and temporary in duration, the dredged/excavated and eelgrass revegetation effort at the eelgrass mitigation site could result in temporary short-term impacts. Potential impacts include a temporary reduction in water quality due to an increase in

[63] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* filed with the FERC in April 2014, revising their original filing from the May 2013 application.

sedimentation during dredging activities and a temporary loss of benthic organisms. Benthic organisms could re-establish within the area once eelgrass revegetation was complete (see section 4.6 of this EIS).

The COE and ODSL have not approved the *Compensatory Wetland Mitigation Plan*, and have requested that the applicant provide more details regarding avoidance and minimization of aquatic (including wetland) impacts within the plan. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary its final *Wetland Mitigation Plan*, together with documentation that the plan was developed in consultations with the ODSL, ODEQ, ODFW, and COE.**

4.4.3.2 Pacific Connector Pipeline

Pacific Connector conducted wetland delineations for the pipeline right-of-way, staging areas, temporary extra work areas, and aboveground facilities.[64] On-site delineation was not possible in some areas because landowners denied Pacific Connector survey access. For these areas, Pacific Connector used USGS topographic maps, NRCS soil surveys, FWS NWI maps, and aerial photography to identify the approximate wetland type and boundaries.

The wetland types identified along the proposed route included palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, palustrine forested, riverine, and open water wetlands (e.g., estuarine or lakes). These classifications are based on Cowardin et al. (1979) and are summarized below.

Palustrine Unconsolidated Bottom and Aquatic Bed Wetlands: Unconsolidated bottom wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones (as described above). The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season.

Palustrine Emergent Wetlands*:* Most of the emergent wetlands identified are disturbed by agricultural activities, primarily grazing or haying. These disturbed emergent communities are dominated by hydrophytic pasture grasses such as meadow foxtail (*Alopecurus pratensis*), rough bluegrass (*Poa trivialis*), and various bentgrasses (*Agrostis* spp.). Soft rush (*Juncus effusus*) and white clover (*Trifolium repens*) are also commonly present in these disturbed wetlands. Within Douglas and Jackson Counties, pennyroyal (*Mentha pulegium*) is also a common dominant species in emergent wetlands. Native emergent wetlands are uncommon, but when they occur (primarily within swales and irrigation canals) they generally contain cattail (*Typha latifolia*), small-fruited bulrush (*Scirpus microcarpus*), hardstem bulrush (*S. acutus*), manna grass (*Glyceria elata*), American sloughgrass (*Beckmannia syzigachne*), and various sedges (*Carex* spp.).

Palustrine Scrub-Shrub Wetlands*:* The delineation identified disturbed scrub-shrub wetlands associated with grazing or development activities. Common species include Oregon ash

---

[64] The Pacific Connector *Wetland Delineation Report* was included as a stand-alone report in the June 6, 2013 application filed with the FERC. On August 6, 2014, the COE concurred with Pacific Connector's boundaries for the extent of waters of the U.S. as depicted in its wetland delineation report.

(*Fraxinus latifolia*), ponderosa pine (*Pinus ponderosa*), Pacific blackberry (*Rubus ursinus*), and Himalayan blackberry (*Rubus armeniacus*), as well as a mixture of Douglas' spirea, Pacific willow (*Salix lasiandra*), salmonberry (*Rubus spectabilis*), and Pacific ninebark (*Physocarpus capitatus*).

Palustrine Forested Wetlands*:* The majority of delineated forested wetlands contain Oregon ash (*Fraxinus latifolia*). Red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) are more common along the western part of the pipeline route in Coos and Douglas Counties. Western red-cedar (*Thuja plicata*) and Sitka spruce are common in the coast range forested wetlands. Skunk cabbage (*Lysichiton americanum*), salmonberry (*Rubus spectabilis*), lady fern (*Athyrium filix-femina*), and horsetails (*Equisetum* spp.) are often present in the understory. Forested wetlands are uncommon along the southeastern portions of the pipeline route, but are generally in swales or depressions. They are dominated by Oregon ash with an understory of Himalayan blackberry, slough sedge, and spreading rush.

Riverine Wetlands*:* Riverine wetlands are freshwater wetland habitats contained within a channel. The riverine wetlands along the pipeline construction route include species similar to those found in the palustrine emergent, scrub-shrub, and forested wetlands.

Estuarine and Open Water Wetlands*:* This includes estuaries, lakes, and other open water areas. Estuarine wetlands are discussed in detail within section 4.4.3.1.

The construction of a pipeline could have several effects on wetlands. Removal of vegetation could alter various wetland functions including their ability to provide fish and wildlife habitats, sediment and nutrient trapping, and other water quality functions. Soil disturbance and removal of vegetation could temporarily affect a wetland's capacity to moderate flood flow, control sediment, or facilitate surface water flow. Removal of vegetation could increase water and soil temperatures and alter species composition within forested and shrub wetlands to a more shade intolerant composition. Digging a trench through an impervious layer of soil in a wetland could alter hydrology of a perched water table leading to drier conditions and affect the re-establishment of wetland functions (including to wetlands located outside of the directly impacted area, but which may be hydrological connected to the affected area). Failure to segregate topsoil from the trench could result in altered biological and chemical functions in the wetland soil and could affect the re-establishment of vegetation, recruitment of native vegetation, or success of plantings. Improper operation of equipment or transport of pipe in wetlands could inadvertently rut or compact the soil and affect natural hydrologic patterns of the wetlands, and may lead to inhibited seed germination or increase the potential for siltation. Improper sediment controls could lead to sediment deposition in wetlands (including those wetlands located downslope or outside of the right-of-way or construction disturbance footprint), which could lead to the release of chemical and nutrient pollutants from sediments.

The scope of wetland impacts would vary depending on the type of wetland affected. In general, impacts on herbaceous wetlands would be short term, while impacts on scrub-shrub and forested wetlands would be long term. Also, some wetlands would be permanently affected as a result of maintenance of the of the pipeline's 10-foot-wide operational corridor, which would convert the affected wetland to a different wetland type (e.g., converting a forested wetland to an herbaceous wetland).

The Pacific Connector pipeline route would cross approximately 9.4 miles of wetlands. Construction of the pipeline would initially impact 195.9 acres of wetlands. Approximately 6.0 acres of wetlands would likely have long-term impacts (with about 1.6 acres of this resulting from wetlands that occur in the permeant maintained 10-foot operational corridor), although some of these wetlands would be allowed to restore to preconstruction conditions (i.e., about 4.4 acres of these long-term impacted wetlands would not be located within the permanent operational corridor), it could take many decades for conditions within these wetlands to restore to preconstruction conditions (see further discussion below). Tables N-1a and N-1b in appendix N of this EIS list the wetlands crossed by the pipeline by wetland type, ecoregion, subbasin, and fifth field watershed, and list the acres of impacts that would occur to each of these wetlands. Table 4.4.3.2-1 summarizes the acres of impacts that would occur to the general wetland types found along the pipeline.

TABLE 4.4.3.2-1

Summary of Wetland Impacts along the Pacific Connector Pipeline

Wetland Type	Total Construction Disturbance in Wetland (acres)	Wetland Vegetation Located Within Permanent Operational Corridor, or Requiring Long-Term Restoration a/, b/ (acres)
Palustrine unconsolidated bottom and aquatic beds	1.8	0.0
Palustrine emergent wetlands	97.3	0.0
Palustrine forested wetlands	5.2	5.2 (1.43)
Palustrine scrub-shrub wetlands	0.8	0.8 (0.12)
Riverine wetlands	14.5	0.0
Estuarine	76.3	0.0
Lake	<0.1	0.0
Total Wetland Impact	**195.9**	**6.0 (1.55)**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Includes wetlands that would be allowed to restore to preconstruction conditions (i.e., they would not be filled, nor would they be located within the permanent 10-foot-wide operational corridor); however, it could take many decades for conditions within these wetlands to restore to preconstruction conditions.

b/ The numbers in parentheses represent the permanent conversion of forested wetlands within the 30-foot maintenance corridor and scrub-shrub wetlands within the 10-foot maintenance corridor.

Scrub-shrub wetlands could take several years to reach functionality similar to pre-construction conditions, depending on the age and complexity of the system, indicating that impacts within these areas would be considered long-term impacts.

Within the 30-foot-wide pipeline operational easement subject to selective tree clearing, impacts on forested wetlands would be permanent, because most palustrine forested wetlands within the maintenance corridor would be converted to either scrub-shrub or emergent wetlands. Removing trees from the remaining construction right-of-way would result in a short-term loss in hydrologic and biogeochemical function that would begin to return as soon as the area was revegetated; however, the habitat functions provided by forested wetlands would require several decades to return. Measures to mitigate for impacts to wetlands would be determined during final permitting with the COE and ODSL in addition to the mitigation measures addressed later in the section.

While the pipeline would cross 19 watersheds identified as HUCs,[65] approximately 74 percent of the total wetland crossing length and 84 percent of the pipeline's total wetland impacts would occur in only two HUCs: Coos Bay Frontal and Lake Ewauna Upper Klamath River. Wetland impacts outside of these two HUCs during construction (i.e., about 31.2 acres) would occur primarily to numerous small palustrine emergent wetlands and intermittent drainages (see table N-1b in appendix N).

The majority of wetland impacts would occur within Coos County, in HUC 1710030403 (i.e., Coos Bay-Frontal Pacific Ocean), where approximately 4.6 miles of wetlands would be crossed resulting in 122.1 acres of construction impacts (see table N-1b in appendix N). The wetland crossings lengths within this HUC represents about 49 percent of the amount of wetlands crossed by the total pipeline length, while the acres that would be impacted represent approximately 62 percent of the total acres of wetlands affected by the pipeline.

The pipeline route within Klamath County, in the Lake Ewauna Upper Klamath River fifth field watershed (i.e., HUC 1801020412), would cross approximately 2.3 miles of wetlands, with construction resulting in about 43 acres of impacts to wetlands (see table N-1b in appendix N). The miles of wetland crossings within Lake Ewauna represents about 25 percent of the total wetland crossed by the pipeline, and the acres of wetland impact by construction represent about 22 percent of the total acreage of impacts. The impacts within the Lake Ewauna Upper Klamath River watershed would almost entirely occur to disturbed emergent agricultural pasture and hayfield wetlands, ditches, and canals.

To satisfy COE and state permitting Pacific Connected assessed the function and values of wetlands to determine which affected wetlands were high value wetlands. The criteria used to assess wetlands were their water quality and quantity, the value of their fish and wildlife habitat, their native plant communities and species diversity, and their value for recreation and educational purposes. Table N-2 in appendix N lists the impacts to high-value wetlands and the justification for their classification as high value wetlands. Construction of the pipeline would result in approximately 84.3 acres of impacts to high value wetlands, with the majority of these impacts (about 76.3 acres) occurring to the estuarine wetland located in Coos Bay (Wetland ID NE026). Of the 1.5 acres of permanent wetland impacts discussed above (for all wetland types and values), 0.6 acre would occur to high value wetlands.

Pacific Connector would implement the wetland construction and restoration measures contained in its ECRP. Section VI.A.3 of the FERC's *Procedures* requires that the construction right-of-way width be limited to 75 feet across wetlands, while Section VI.B.1.a requires that TEWAs be located at least 50 feet away from wetland boundaries. However, Pacific Connector has submitted modifications for these requirement associated with 96 areas where the applicant requested a 95-foot-wide construction right-of-way in a wetland or that TEWAs be located less than 50 feet away from a wetland. Their justifications for the modifications at specific locations vary, but include reasons such: necking-down the right-of-way in emergent wetland would require use of TEWAs that would be located 50 feet back from the waterbody, which could result in these work areas being located within forested or shrub wetlands that can have a higher

[65] A USGS classification system used to represent part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature.

function and value than the disturbed emergent wetland. FERC's review of Pacific Connector's proposed modifications to FERC's *Plan* and *Procedures* is provided in appendix P.

Based on our *Procedures* and its ECRP, Pacific Connector would implement the following measures to minimize impacts on wetlands:

- construction efforts would be scheduled for drier seasons;
- hazardous materials, fuels, and oils would not be stored in a wetland or within 150 feet of a wetland;
- the top 1 foot of topsoil would be segregated from the subsoil in the area disturbed by trenching, except where standing water is present or soils are saturated or frozen. Immediately after backfilling, the segregated soil would be restored to its original location;
- vegetation would be cut just above ground level to leave the existing root system in place. Tree stump removal and grading would occur directly over the trenchline. Stumps would not be removed from the rest of the right-of-way unless required for safety reasons;
- construction equipment operating in the wetland would be limited to that needed to clear vegetation, dig trenches, install the pipe, backfill, and restore the right-of-way. Other equipment would use upland access roads to the maximum extent possible. Travel would be restricted across wetlands where topsoil was restored;
- low ground-weight equipment would be used in saturated wetlands or the normal equipment would be operated on prefabricated equipment mats;
- slope breakers and sediment controls would be installed and maintained on slopes greater than 5 percent that are less than 50 feet from a wetland;
- erosion control devices would be installed and maintained as necessary to prevent sedimentation and runoff from entering wetlands;
- trench breakers would be installed, or the bottom of the trench would be sealed as necessary, to maintain the original wetland hydrology;
- appropriate weed-free live seed mixtures would be used for revegetation. No fertilizers would be used in wetlands;
- appropriate native trees and shrubs would be replanted during restoration of wetlands within riparian areas;
- wetlands would be monitored after revegetation for three years after construction or until the revegetation is successful. Revegetation would be considered successful when 80 percent of the type, density, and distribution of species are similar to that of adjacent unaltered wetlands. If revegetation is not successful at the end of three years, Pacific Connector would develop and implement a remedial revegetation plan to actively revegetate the wetland and would continue revegetation efforts until wetland revegetation is successful; and
- vegetation maintenance would not be conducted over the full width of the operational right-of-way within wetlands, but limited to a 10-foot-wide corridor.[66]

Pacific Connector would comply with conditions in the RHA Section 10 and CWA Section 404 permit obtained from the COE; the Removal/Fill permit from ODSL; and the CWA Section 401

[66] Additionally, trees may be selectively removed if they are within 15 feet of the pipeline that could compromise the pipeline coating integrity.

certification obtained from the ODEQ. These agencies would evaluate whether wetlands have been avoided or whether effects on wetlands have been minimized or rectified to the extent practicable.

The COE and ODSL may require additional mitigation (beyond what is required in this EIS) during their permitting process, which could include creating, restoring, or enhancing wetlands to replace the wetland functions and areas connectivity lost due to Project activities, or purchasing credits from a mitigation bank. ODSL administrative rules (OAR 141-085-136) include minimum ratios for acres required for compensation that varies by type of mitigation proposed (e.g., restoration is 1 acre for each acre lost, creation is 1.5 for 1, and enhancement is 3 for 1). Pacific Connector developed a *Compensatory Wetland Mitigation Plan.*[67] The plan proposed that the former Kentuck Golf Course in Coos County, which has been acquired by Jordan Cove, would be used to mitigate for the loss of wetlands associated with the pipeline project.

For approximately 2.4 miles (between MPs 1.7R and 4.1) the Pacific Connector pipeline would cross the Coos Bay estuary at Haynes Inlet, impacting approximately 5 acres of eelgrass beds, 35 acres of mud/sandflat, 1 acre of estuarine wetlands, and 33 acres of shallow subtidal habitats. To compensate for those impacts, Pacific Connector developed an *Estuarine Wetland/Open Water Mitigation Plan*.[68] The goal of the plan is to establish a one-to-one on-site restoration of all wetlands affected along the crossing of Coos Bay. The applicable standard of success is a return of each habitat to pre-construction conditions, or better, in order to ensure that the original functions and values of wetlands affected during the crossing are preserved.

The COE, ODEQ, and ODSL have received Pacific Connector's *Compensatory Wetland Mitigation Plan* and *Estuarine Wetland/Open Water Mitigation Plan*. They are currently reviewing the plan as part of their JPA review process.

4.4.4 Environmental Consequences for Water Resources on Federal Lands

4.4.4.1 Groundwater

Shallow Groundwater

As indicated in section 4.4.1.2, we note that the Pacific Connector Pipeline Project would cross areas where the groundwater is 0-6 feet bgs. Trench dewatering through a well point pumping system with a groundwater treatment plan may be the best option depending on if the groundwater is emanating from a pressurized or non-pressurized source point. We recommended in section 4.4.1.2 that Pacific Connector should file a *Shallow Groundwater Construction Plan* detailing how it would dewater the pipeline trench in areas of shallow groundwater where the push-pull method is not feasible. The plan should indicate dewatering methods and guidelines for discharging groundwater. On federal lands, dewatering activities would be coordinated with the BLM or Forest Service.

---

[67] Attached as Appendix 2K in Resource Report 2 included with Pacific Connector's June 2013 application to the FERC.
[68] Ellis Ecological Services, December 2013, *Estuarine Wetland/Open Water Mitigation Plan, Pacific Connector Gas Pipeline Project Coos Bay Estuary* was included as Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC on April 16, 2014.

Springs, Seeps, and Drains

Pacific Connector surveys have identified a number of springs and seeps, as noted in appendix N of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with the land manager. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

The BLM has disclosed that French drains, similar in function to drain tiles, were installed to stabilize Elk Creek Road, which the proposed route would cross six times between MPs 34.02 and 37.15. These crossings are all within BLM lands. Pacific Connector would ensure that any French drains damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required under Section 404 of the CWA. All French drains crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drains to the same condition that existed prior to construction. In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan.* Land managers would be supplied with documentation that explains the pipeline construction Project and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies within and adjacent to the pipeline right-of-way.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated (on non-federal lands) within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction would be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details).

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers. A spill could reach different aquifer layers in these areas. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases.

4.4.4.2 Surface Water

The Pacific Connector pipeline route would cross 19 fifth-field watersheds, and proposed access roads would cross an additional 5 watersheds. Of these, 16 watersheds include either BLM and/or NFS lands subject to the ACS.

Riparian Reserves and the ACS

The 1994 NWFP set forth detailed requirements that describe how land managers should treat the forest lands within the range of the northern spotted owl (through implementation of the Standards and Guidelines – Attachment A to the 1994 NWFP ROD [Forest Service and BLM 1994a]). Some standards and guidelines apply to all lands and others to a specific land allocation. The 1994 NWFP ROD described the ACS, which was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service within the range of the NSO.

To achieve ACS objectives in the 1994 NWFP ROD, the ACS included areas defined as Riparian Reserves and Key Watersheds, specified analytical procedures for evaluating watersheds, and defined a program for watershed restoration. While the ACS focus was primarily on the conservation of anadromous salmon and steelhead, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones in general to support invertebrate and vertebrate species dependent on those habitats.

The existing conditions of the fifth-field watersheds that would be crossed by the Pacific Connector pipeline are provided in the watershed analyses that were prepared by the various federal land management agencies having jurisdiction over the federal lands within the watersheds. Watershed assessments are a necessary component of a monitoring program in order to determine what degraded or impaired areas may exist in the watershed. These watershed analyses also provide a description of the range of natural variability of the important physical and biological components of the watershed. Table 4.4.4.2-1 lists the fifth-field watersheds that would be crossed by the proposed route. The table lists the federal land management agency jurisdiction, the date of completion of the watershed analysis, if available, and the total miles that would be crossed by the pipeline within each fifth-field watershed.

TABLE 4.4.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Federal Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
BLM – Coos Bay District	Coos Bay Frontal	0.3	2010
	Lower Coquille River (Middle Main)	<0.1	1997
	North Fork Coquille River	2.9	2001
	East Fork Coquille River	2.8	2000
	Middle Fork Coquille River	4.8	2007

TABLE 4.4.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Federal Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
BLM – Roseburg District	Middle Fork Coquille River	1.9	2007
	Olalla Creek-Lookingglass Creek	1.2	1999
	Clarks Branch- South Umpqua River	0.7	1999
	Myrtle Creek	2.5	2002
	Days Creek - South Umpqua River	6.7	2001
	Elk Creek	0.1	2004
BLM – Medford District	Trail Creek	4.0	1999
	Shady Cove-Rogue River	4.3	2011
	Big Butte Creek a/	0.8	1999
	Little Butte Creek	6.0	1997
BLM – Lakeview District	Spencer Creek	1.0	1995
	Mills Creek-Lost River	0.3	N/A b/
Forest Service – Umpqua National Forest (NF)	Days Creek-South Umpqua River c/	1.6	2001
	Elk Creek c/	2.7	1995 c/
	Upper Cow Creek c/	4.5	1995 c/
	Trail Creek c/	2.1	1995 c/
Forest Service – Rogue River NF	Little Butte Creek	13.7	1997
Forest Service –Winema NF	Spencer Creek	6.1	1995
Bureau of Reclamation	Lake Ewauna-Upper Klamath River	0.7	N/A b/
	Total Watersheds Crossed on Federal Lands	**71.6**	

Note that mileages may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1.
Source: BLM 2006; Forest Service 2006a
a/ The Lower Big Butte Creek Watershed Analysis encompasses the BLM lands within the Big Butte Creek Watershed that are crossed by the pipeline.
b/ Outside the range of the northern spotted owl.
c/ The Elk Creek Watershed Analysis (Forest Service 1996) and the Cow Creek Watershed Analysis (Forest Service 1995a) encompass the Umpqua National Forest lands crossed by the pipeline.

Riparian Reserves and the ACS defined Key Watersheds, the acres of impact that would occur to these areas/land-designations, as well as the mitigation measures that would be implemented to compensate for impacts to these areas are discussed within the following subsection. Riparian Reserves are lands along streams, wetlands, ponds, lakes, reservoirs and unstable and potentially unstable areas where special standards and guidelines direct land use on federally-managed lands.

The ACS includes two designations for Key Watersheds. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. While Tier 2 (other) Key Watersheds may not contain at-risk fish stocks, they are important sources of high-quality water.

Four watersheds that would be crossed by the Pacific Connector pipeline are designated as Key Watersheds: (1) South Umpqua River (Tier 1); (2) North and South Forks Little Butte Creek (Tier 1); (3) Spencer Creek (Tier 1); and (4) Clover Creek (Tier 2). North and South Forks Little Butte Creek is a Key Watershed within the Little Butte Creek fifth-field watershed. Key Watersheds that would be crossed by the Pacific Connector pipeline are listed in table 4.4.4.2-2. Key Watershed designations on BLM lands are also included in the table to show the ownership and management of the Key Watershed.

TABLE 4.4.4.2-2

Key Watersheds Crossed by the Proposed Pacific Connector Pipeline

Key Watershed	Jurisdiction	Approximate Miles Crossed	Approximate Construction Disturbance (acres) a/	Approximate Operational Easement (acres) b/
South Umpqua River (Tier 1) MP 82.75-108.97	BLM Roseburg District	6.6	115	24
	Umpqua National Forest	3.9	53	15
North and South Forks Little Butte Creek (Tier 1) MP 135.0-168.0	BLM Medford District	3.9	69	14
	Rogue River National Forest	13.7	208	50
Spencer Creek (Tier 1) MP 168.01-177.05 and MP 180.51-183.00	Winema National Forest	6.0	80	22
	BLM Lakeview District	0.9	13	3
Clover Creek (Tier 2) MP 177.1-180.5	BLM Lakeview District	0.2	2	<1
	Total	**35.2**	**540**	**128**

Note that values may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1. Acreages are rounded to the nearest whole acre; values less than 1 are noted as <1.
a/ Includes uncleared storage areas.
b/ Assumes 50-foot-wide permanent easement.

The pipeline would not cross any roadless areas and would not require any new roads to be constructed within Tier 1 Watersheds. Although the pipeline would cause temporary disturbance within Tier 1 watersheds, all disturbed areas associated with the pipeline would be restored after construction. No adverse, long-term effects are anticipated to the water resources. The 30-foot operational maintenance corridor along the pipeline centerline would create a permanent vegetation type conversion impact within forested vegetation types, but the vegetation conversion is not expected to measurably alter hydrologic functions. Restoration of all areas disturbed by the Pacific Connector pipeline would include shaping to the approximate original contour to restore drainage patterns, scarification to relieve compaction, and revegetation for stabilization and to restore habitats and land use functions. The compensatory mitigation measures outlined for LSRs and Riparian Reserves would benefit Key Watersheds if the mitigation projects such as road decommissioning occur within these watersheds.

On NFS and BLM lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be planted to ensure that the "maintain and restore" objectives of the ACS are accomplished for native riparian vegetation.

Impacts on Streams on Federal Lands and Mitigation

Temporary Equipment Crossings

For any temporary equipment crossings on any stream channel (whether intermittent or perennial, wet or dry) on federal lands, equipment crossings must be accomplished using (1) a bridge, (2) a temporary culvert with temporary road fill to be removed after work is completed, or (3) a low water ford with a rock mat. Although the FERC's *Procedures* allow clearing equipment and equipment necessary for installation of the temporary bridges to cross waterbodies prior to bridge installation, Pacific Connector would not allow clearing equipment to cross waterbodies prior to bridge placement. Furthermore, where feasible, Pacific Connector's contractor would attempt to lift, span, and set the bridges from the streambanks. Where it is not feasible to install or safely set the temporary bridges from the streambanks, only the equipment necessary to install the bridge or temporary support pier would cross the waterbody. Any equipment required to enter a waterbody to set a bridge would be inspected to ensure it is clean and free of dirt or hydrocarbons.

No waterbodies or riparian reserves on federal lands would be affected by temporary or permanent access roads.

Water Use During Pipeline Construction

Water withdrawals on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency that manages the specific water resources (federal or state). Water releases on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency of jurisdiction. We understand that site-specific approval by the authorized Forest Service officer on NFS lands, and similar authorizations by BLM and Reclamation would be coordinated through the development of the POD to support the Right-of-Way Grant. Withdrawals and releases of hydrostatic test water would be done in accordance with Pacific Connector's *Hydrostatic Test Plan*, included with the POD.

Potential Encounters with Contaminated Sediments

On federal land, hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary. As noted in the ECRP, any variance on federal lands would require prior approval by an authorized agency representative. In instances where it is not possible to maintain the 150-foot distance, the EI would request a variance that would require approval from the authorized agency representative. To reduce impacts from potential encounters with contaminated sediments, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan,* which was included as part of its POD.

East Fork Cow Creek Crossing

The Forest Service expressed concerns about the potential for naturally occurring mercury to reach the aquatic environment during construction of the pipeline near the historic Thomason claim group (near MP 109). To address this concern, Pacific Connector conducted a mine hazard evaluation and mercury testing study for the proposed 2007 route on the Umpqua National Forest at the crossing of East Fork Cow Creek, which crossed the Thomason claim group (GeoEngineers 2007c).[69] Soil samples were collected along the proposed alignment in an area believed to be outside the zone of mineralization where mercury deposits occur, in the stream system in the vicinity of the East Fork of Cow Creek, and from mine workings in

[69] GeoEngineers, Inc., 23 August 2007, *Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Groups, Jackson and Douglas Counties, Oregon*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.

proximity to the Pacific Connector right-of-way in 2007. The samples did not contain concentrations of mercury that exceeded human health risk screening criteria.

Subsequently, Pacific Connector moved its proposed route to the east to avoid a NSO nest site. GeoEngineers (2009b)[70] conducted an additional assessment of the relocated route, approximately 3,300 feet upstream and east of the original 2007 crossing to address the continued concerns of the Forest Service regarding the potential for naturally-occurring mercury within the East Fork Cow Creek drainage. That study concluded that the soils underlying the current proposed crossing of East Fork Cow Creek are unlikely to have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous 2007 crossing location and most likely will have lower levels than those reported in GeoEngineers' (2007c) mine evaluation.

In addition to the GeoEngineers (2009b) report, the Forest Service contracted with a geologist consultant (Broeker 2010b)[71] to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally occurring minerals along a 2,000-foot section of the proposed pipeline route between MP 109 and the East Fork Cow Creek. The Broeker study also concluded that construction activities along the revised pipeline route are not likely to encounter soils with elevated mercury concentrations.

In order to prevent this naturally occurring mercury from entering the aquatic environment during and after construction, additional erosion control measures and monitoring would be conducted along the pipeline route in the vicinity of the East Fork Cow Creek. If sediments containing high levels of mercury are encountered in the East Fork Cow Creek drainage during Project construction, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan*.[72]

<u>Hyporheic Exchange at South Fork Little Butte Creek</u>

The Forest Service has expressed concern that the crossing of South Fork Little Butte Creek would go through basalt and andesite bedrock, and therefore a site-specific crossing would need to address the potential for groundwater interception and flow at and near the crossing. A site-specific drawing for Little Butte Creek located on NFS land was included in Appendix 2E of Resource Report 2 with Pacific Connector's June 2013 application to the FERC. The crossing would need to address the potential for groundwater interception and flow at and near the crossing since it is a critical coho stream which flows through andesite and basalt. The *Stream Crossing Hyporheic Analysis* (GeoEngineers 2013d) determined that South Fork Little Butte Creek crossing had high hyporheic sensitivity. Therefore, BMPs would be implemented to mitigate for this possible effect.

Given the potential for disruption of hyporheic processes at crossings with a "high" sensitivity ranking, in addition to the pre-construction survey, a qualified geotechnical professional would

---

[70] GeoEngineers, Inc., 2 October 2009, *Addendum to Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Group,* prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.

[71] Broeker, L., 3 February 2010, *Potential for Natural-Occurring Mercury Mineralization to Enter the Aquatic Environment between MP 109 and East Fork Cow Creek Williams' Pacific Connector Pipeline Project*, filed as a stand-alone report with Pacific Connector's June 2013 application to the FERC.

[72] Appendix E of the POD filed as a stand-alone report in Pacific Connector's June 2013 application to the FERC.

be on-site to observe trenching/excavation associated with pipeline installation to document subsurface conditions, including the presence of fractured bedrock or the low probability of the presence of lava tubes. The geotechnical professional would make recommendations for backfill composition, including the use of trench plugs or other mitigation measures, to ensure that disruption to groundwater pathways are minimized. These recommendations would be pre-approved by an authorized Forest Service representative.

Stream Temperature Assessment

Project-specific temperature modeling was conducted on federal lands stream crossings. Temperature modeling, again using SSTEMP (Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek Deep Creek and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009 and again in 2013 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015b,c). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing stream's actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015b,c), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams.

Model analysis of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek and a small tributary to Big Creek (NSR 2014), with these limited temperature changes likely due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations(NSR 2015b). During the drought conditions of 2013, modeled 7-day maximum stream temperature just below in the multiple East Fork Cow Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015c). Measured stream volumes ranged from 0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) in small perennial channels in the East Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the drought conditions that occurred in 2013 and potential to overestimate of temperature in low-flow channels from the SSTEMP model as noted above. The 2014 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole et al. 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. The updated temperature assessment prepared for the Forest Service at this location (NSR 2014) incorporated field measurements of existing conditions on the Umpqua National Forest that showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015c). The presence of numerous small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. The 2014 assessment also supports the NSR (2009) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides significant shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the project, all LWD and boulders removed from the crossing area would be replaced during site restoration and low-growing brush would be retained where possible (NSR 2015). Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Where site-specific modeling on NFS perennial stream crossings suggests temperature increases over natural pre-project levels, a plan would be prepared to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the retention of existing shading brush on small channels, the placement of LWD, and the replanting of willows and other brush species, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009).

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs and Pacific Connector would be identified as a new nonpoint source. For perennial stream crossings on federal lands, this plan would incorporate the requirements of the site-specific restoration plans (NSR 2015b, c). The source-specific implementation plan would outline mitigation for predicted thermal impacts (GeoEngineers 2013i). This mitigation would have as its goal restoring shade along affected stream channels and nearby channels within the same fourth-field HUCs. Mitigation for construction-related impacts would occur to the extent allowed by landowners on the affected streambanks. This mitigation would incorporate riparian revegetation required by the Forest Service and/or the BLM for impacts to riparian reserves on federal lands. The length of channel banks planted by Pacific Connector would be determined prior to pipeline construction once a clear understanding of landowner wishes regarding streambank planting are known. Contiguous lengths of streambank planting would be preferred over planting on multiple small parcels, particularly for mitigation of permanent impacts. Mitigation ratios of 1:1 for construction-phase impacts or 2:1 for permanent impacts would be applied as outlined in ODEQ's September 2011 letter. Prior to construction, Pacific Connector would also provide the implementation plan to FERC.

Where TMDL thermal load allocations have not yet been established, ODEQ's 401 Water Quality Certification would require the development of a Water Protection Plan, consistent with the source specific implementation plan, and a mitigation plan to address project impacts on thermal loading.

On NFS lands, the Forest Service has requested that the riparian vegetation strip be extended up to 100 feet on either side of waterbodies in Riparian Reserves. Pacific Connector has agreed to implement this measure on both NFS lands and BLM lands. The riparian strip would generally be replanted with species such as willow cuttings and dogwood to provide a quick cover for shading and streambank stability. Quick cover plantings may be shorter in height than vegetation removed during constructions, thus providing less shade. Plantings/seeding would be done with native vegetation of a local source. The riparian strip would be maintained to allow an herbaceous cover 10 feet in width centered over the pipeline to facilitate corrosion and leak surveys. The remaining area of the construction right-of-way within the riparian strip would be replanted with trees that would provide greater height and stream shading over time.

Restoration

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final clean-up activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction will be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details). In response to a Forest Service request, Pacific Connector would stabilize intermittent stream crossings (whether flowing or not) on NFS lands with temporary sediment barriers and reseed as described for other waterbodies. Streambanks and stream beds would be revegetated with native species and "armored" as needed with LWD and boulders to ensure stability. Channel breakers would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench.

As discussed in section 4.4.2.2, Pacific Connector has requested a modification to the FERC's *Procedures* requirement that the upper 1 foot of the trench to be backfilled with clean gravel or native cobbles in all waterbodies that contain cold water fisheries. Pacific Connector has requested that for instances where the existing substrate is not gravel or cobbles, and site access is limited and would require unreasonable efforts to transport clean gravel to the waterbody, that only native materials removed from the stream be used for backfill.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix J (NSR 2014) will be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant BLM and Forest Service land management plans.

All disturbed areas on federal lands would be monitored following construction to verify successful revegetation and to implement corrective action. Pacific Connector would also adhere to its mitigation plan (developed to mitigate for impacts to all riparian and upland habitats), which would be followed in areas with severe to soil erosion potential. Throughout operation of the pipeline, Pacific Connector would continue to monitor and maintain the right-of-way. The Forest Service and BLM, in consultation with Pacific Connector, have prepared a list of mitigation actions to address unavoidable impacts on NFS and BLM lands.

4.4.4.3 Wetlands

The Pacific Connector pipeline would cross approximately 0.2 mile of wetlands on federally managed land, affecting a total of approximately 2.2 acres (see table N-1a in appendix N). Permanent wetland vegetation conversion on federally managed lands would occur in approximately 0.2 acre of wetlands as a result of vegetation management on the operational right-of-way. This 0.2 acre of permanent conversion would occur to three wetlands: palustrine forested wetland CW010 located on lands managed by the BLM Coos Bay District, palustrine forested wetland AW309 located on lands managed by the BLM Medford District, and palustrine scrub-shrub/emergent wetland GW-14/FS-HF-CWWW-111-001 (i.e., a tributary to East Fork Cow Creek) managed by the Forest Service (on the Umpqua National Forest). Compensatory mitigation measures for this long-term wetland impact on federally managed lands would be conducted as described above for the entire pipeline.

There would be no permanent wetland loss or wetland impacts on federally managed land due to the construction of aboveground facilities. Impacts resulting from use of existing roads would be minimized through the implementation of Pacific Connector's ECRP and the mitigation measures described above for the pipeline on all lands.

In order to prevent or limit the spread of invasive species and noxious weeds into wetlands on federally managed lands, Pacific Connector would inspect all construction equipment prior to transporting equipment to the construction right-of-way to ensure that it is clean and free of potential weed seed. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities, in addition to being cleaned at cleaning stations associated with any mapped infestation of noxious weed of priority A and T and selected B listed weeds within each National Forest. Because the BLM lands crossed by the pipeline are not contiguous but are instead spread out in a checkerboard pattern, Pacific Connector feels that is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposed that where

BLM lands are contiguous to NFS lands, the cleaning stations would be located to include the adjacent BLM lands. The location of any additional cleaning stations required in areas where BLM- or Reclamation-managed lands are not contiguous with NFS lands would be coordinated with the agency of jurisdiction. Additional measures to prevent the spread of invasive weed and wildlife species into wetlands and waterbodies are addressed within sections 4.5 and 4.6 of this EIS.

Measures to avoid or minimize impacts on wetlands that would be implemented on federally managed lands, in addition to those described above for the entire pipeline, include the following:

- Where straw is to be used on federally managed lands during seeding operations, the authorized officer for the agency of jurisdiction may inspect and approve straw material to verify that the straw is weed-free. Any gravel or rock used on federal lands would be from weed-free sources as well, and approved by the authorized representative for the agency of jurisdiction.
- Hazardous materials, fuels, and oils would not be stored in a wetland or within 150 feet of a wetland. Storage of hazardous materials on NFS lands would be in accordance with SPCCP - AGAR Regulations at Forest Service–approved sites.
- During revegetation efforts, specific mixtures specified by the agency with jurisdiction would be used on federally managed lands. No fertilizers would be used during the revegetation of wetlands.

Based on available information, with the implementation of appropriate plans, the use of additional BMPs, and mitigation, substantial effects to waterbodies on federal lands are not expected.

4.5 UPLAND VEGETATION AND TIMBER

4.5.1 Vegetation

4.5.1.1 Jordan Cove LNG Terminal

Botanical surveys have been conducted at the Jordan Cove LNG terminal site as well as the South Dunes Power Plant site, NPWHC, and the Kentuck Slough mitigation site[73] in order to determine the composition and extent of existing vegetation resources in the area. The Jordan Cove LNG terminal site was initially surveyed in 2005 and 2006 in support of the previous LNG import proposal (Docket No. CP07-444-000). Additional surveys were conducted in 2012 and 2013 to cover new areas identified for the current LNG export proposal.[74] Below we discuss the on-site vegetation associations documented during those botanical surveys, the impacts that construction and operation of the Jordan Cove Project would have on vegetation resources, as well as the measures that would be taken to reduce or mitigate for these impacts.

Vegetation Associations

The vegetation associations that may be affected by the Jordan Cove Project (i.e., the LNG terminal facility, South Dunes Power Plant, and NPWHC) are shown in figure 4.5-1. Vegetation cover within the project area includes forest, woodland, shrubland, and herbaceous plant associations (as described in Christy et al. 1998). In addition, the terminal tract and location for the South Dunes Power Plant contain disturbed areas resulting from former industrial activities (at the Weyerhaeuser linerboard mill site) and the placement of fill from historical dredging operations (at the Ingram Yard). Site-specific information relevant to these vegetation associations are discussed below.

<u>Forested Associations</u>

Forest associations are defined as areas where tree species comprise at least 60 percent of the vegetation cover. Forests on the Jordan Cove site are dominated by coniferous species with scattered hardwoods, generally along ridges and toe slopes, and vary in age and seral stages. The youngest forests are generally located along the perimeter of the site and adjacent to the Trans-Pacific Highway to the north. These young forests are associated with anthropogenic disturbance. More successionally mature forests are located in the interior portions of the site on stabilized dune ridges, troughs, and dry deflation basins.

The forests in this area are typically of dune forest types found on the North Spit of Coos Bay. Five different dune forests have been identified within the Jordan Cove Project site (i.e., Dune Forest A though Dune Forest E). Dune Forest A is located west of Jordan Lake and runs approximately 800 feet down from the utility corridor. Dune Forest B is the largest forest patch and is slated for removal to create the marine slip at the terminal. Dune Forest C is located north of Dune Forest B, immediately south of the Trans-Pacific Parkway. Dune Forest D is located on the northwestern tip of the overall site, immediately south of the Trans-Pacific Parkway. Dune Forest E is located in the western portion of the South Dunes Power Plant site, immediately east of Jordan Cove Road. The location of these dune forests are shown in figure 4.5-1.

---

[73] The Kentuck mitigation sites are related to wetland and wildlife mitigation efforts.

[74] Copies of the botanical survey reports found in Appendix B3 of Resource Report 3, which was included in Jordan Cove's application to the FERC in Docket No. CP13-483-000.

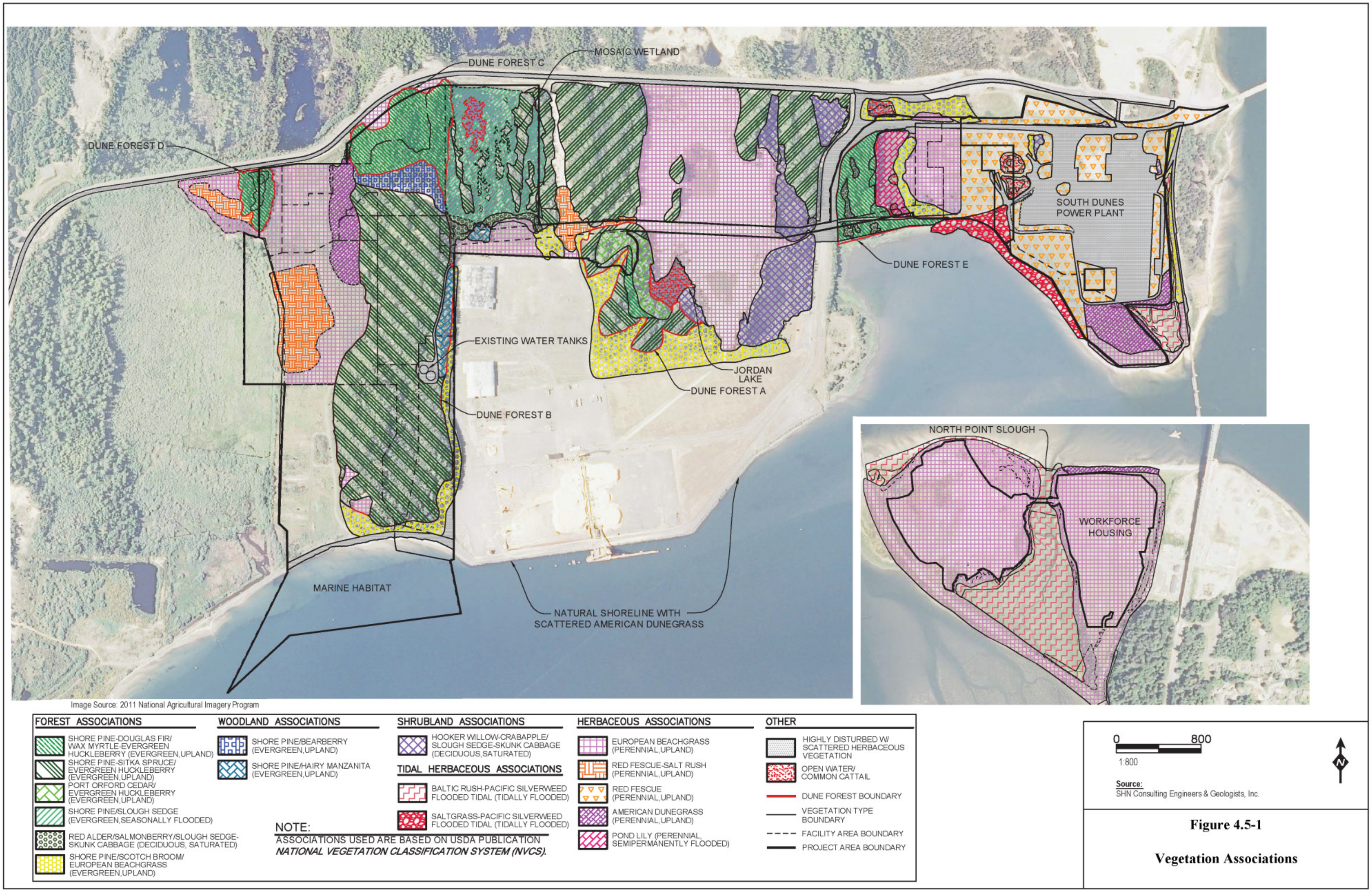


Figure 4.5-1

Vegetation Associations

Dune Forest A would be affected during construction of both the utility corridor and the control building/plant warehouse/maintenance building. Dune Forest B would be affected by the development of the slip, LNG loading berth, liquefaction process area, LNG storage tank area, refrigerant storage area, flare area, and laydown area. Dune Forest C would be affected by fill generated during construction. Dune Forest D would be affected by construction of the LNG terminal site access as well as the fill area. Dune Forest E would be affected by the construction of the utility corridor and the SORSC located just east of Jordan Cove Road. A total of approximately 90 acres of dune forest habitat would be cleared.

Several forest associations have been classified within the dune forest types found on the Jordan Cove site. These various forest associations are described in the following sub-sections. The location of each of these associations is shown in figure 4.5-1.

Shore Pine–Douglas-Fir/Wax Myrtle-Evergreen Huckleberry (Evergreen, Upland)

This association typically occurs near previously developed areas such as roads, fill sites, or industrial sites. It has been documented to occur most frequently on warm, dry ridges, and slopes on the dunes; primarily with south to west facing aspects (Christy et al. 1998). This association is characteristic of younger forest sites north of Jordan Cove. They occur in areas where dune stabilization has been achieved through rpg ecruitment of vegetation, most notably European beachgrass (*Ammophila arenaria*) and Scotch broom (*Cytisus scoparius*). The dominant tree species are shore-pine (*Pinus contorta*) and Douglas-fir (*Pseudotsuga menziesii*). This association has an open overstory dominated by shore pine with scattered Douglas-fir. The shrub layer is dominated by Scotch broom and coyote bush (*Baccharis pilularis*), with scattered hairy manzanita (*Arctostaphylos columbiana*), wax myrtle (*Myrica californica*), and evergreen huckleberry (*Vaccinium ovatum*). Dominant herbaceous species include European beachgrass, silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), and sheep sorrel (*Rumex acetosella*). This association can be found in portions of Dune Forests A, B, and C where adjacent landscapes have been altered by human or natural influences.

Shore Pine-Sitka Spruce/Evergreen-Huckleberry (Evergreen, Upland)

This association is common in successionally mature forests. Stands are generally dominated by shore pine and Douglas-fir, but also include Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and scattered Port-Orford-cedar (*Chamaecyparis lawsoniana*). The shrub understory layer ranges from dense to nearly impenetrable, and is dominated by evergreen huckleberry, salal (*Gaultheria shallon*), and wax myrtle, with scattered Pacific rhododendron (*Rhododendron macrophyllum*) also present. The shore pine–Douglas-fir association is differentiated from the shore pine-Sitka spruce association by the presence of western hemlock, which is more widespread in the shore pine–Douglas-fir/wax myrtle-evergreen huckleberry association. The herbaceous layer varies from being depauperate (diminished) to moderately covered with candy-stick (*Allotropa virgata*), rattlesnake plantain (*Goodyera oblongifolia*), and bracken fern along edges or gaps in the overstory. This association can be can be found in portions of Dune Forest B.

Port-Orford-Cedar/Evergreen-Huckleberry (Evergreen, Upland)

This association occurs in all aspects and slopes on narrow, dry stabilized dune ridges, troughs, and seasonally dry deflation basins at the southern end of the ODNRA immediately north of the Jordan Cove terminal site. The Port-Orford-cedar and evergreen huckleberry association is described by

Christy et al. (1998) as unique. The dominant tree species is Port-Orford-cedar. This forest association is unique because it is being decimated throughout its limited range by the Port-Orford-cedar root rot disease which is caused by the fungal root rot *Phytopthora lateralis* (Christy et al. 1998). A small component of a well-developed Port-Orford-cedar/evergreen huckleberry association is located upslope from the southwestern shore of Jordan Lake. Port-Orford-cedar observed at this location includes two trees upslope from the existing access trail that travels from the Roseburg Forest Products facility to Jordan Lake. Additionally, 23 Port-Orford-cedars were observed at sites located adjacent to Jordan Lake, in areas that would be preserved as part of the Jordan Cove Project. This association can be found in portions of Dune Forest A.

Shore Pine/Slough Sedge (Evergreen, Seasonally Flooded)

This wetland forest association occurs in depressions on deflation plains and on ancient marine terraces. The dominant tree species is shore pine. The understory is dominated by shrub species, including wax myrtle, salal, and evergreen huckleberry. Slough sedge is the single dominant herbaceous species, and was observed growing in depressions and open water habitats throughout the North Spit. This association has been detected in the north central wetland mosaic north of the Roseburg Forest Products property (along Dune Forest A).

Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage (Deciduous, Saturated)

The red alder/salmonberry/skunk cabbage forest association occurs in wetland habitats adjacent to upland forested habitats, and in low flat areas adjacent to inundated wetlands. In this association, the overstory consists entirely of red alder (*Alnus rubra*) located around wet areas, but transitions to shore pine in adjacent areas. Canopy cover varies from moderate to closed (i.e., more than 50 percent canopy cover). Scattered clusters of dense shrubs that include salmonberry (*Rubus spectabilis*) and Hooker willow (*Salix hookeriana*) are located in the understory. Herbaceous coverage is generally found in wet areas and consists almost entirely of slough sedge, with scattered skunk cabbage (*Lysichiton americanus*). This association has been documented in low spots in forests east of Jordan Cove Road (in Dune Forest E) and along the southern edge of the wetland mosaic located in the northwest part of the LNG terminal site (adjacent to Dune Forest B).

Shore Pine/Scotch Broom/European Beachgrass (Evergreen, Upland)

Although this association contains shore pine, it is sometimes described as a shrubland due to the high density of shrubby species, including Scotch broom, with only a limited distribution of shore pine. This association is relatively widespread throughout the LNG terminal site and is associated with roads and other disturbed areas. The overstory within this association is generally open, averaging less than 50 percent cover of shore pine in most areas. Scotch broom cover varies from moderately dense to very dense in areas that lack a substantial canopy cover. Dominant herbaceous species include European beachgrass, red fescue (*Festuca rubra*), tall fescue (*Festuca arundinaceae*), silver hairgrass, hairy cat's ear, and sheep sorrel. This association is early to mid-seral and is typically the first forest association to develop and replace European beachgrass dominated areas (Christy et al. 1998). This association occurs west of the South Dunes Power Plant, north of the Roseburg Forest Products property, along previous road cuts for the Trans-Pacific Parkway, and at the NPWHC.

Woodland Associations

Woodland associations are defined as open stands with tree cover varying from 25 percent to 60 percent. They occur on all aspects of dry, well drained, partially stabilized dune ridges, slopes, and flats between the sand and the forest edge (Christy et al. 1998). Two woodland associations occur within the Jordan Cove Project site, but neither is well represented (see figure 4.5-1).

Shore Pine/Bearberry Woodland Association

The shore pine/bearberry woodland association's overstory consists entirely of shore pine. The shrub layer is dominated by the low growing shrub bearberry (*Arctostaphylos uva-ursi*) with hairy manzanita in scattered patches. The understory is comprised almost entirely of moss and lichen species except for scattered little hairgrass, hairy cat's ear, and shrub starts. This association is unique due to its limited distribution, which is restricted to a thin band adjacent to the coastline, and the fact that it is easily damaged by human disturbances. The shore pine/bearberry association is scattered throughout the Jordan Cove terminal site, with the most substantial occurrence on the stabilized dune ridge northwest of the Roseburg Forest Products property between Dune Forests B and C.

Shore Pine/Hairy Manzanita Woodland Association

The shore pine/hairy manzanita woodland association's overstory is moderately open and is dominated by shore pine with scattered Douglas-fir trees. The shrub layer varies from moderately dense to dense in areas where the canopy is patchy. Hairy manzanita is the dominant shrub species with scattered evergreen huckleberry and bearberry along edges. The herbaceous layer varies from depauperate to moderately covered, with nonvascular plants and non-native herbs. The shore pine/hairy manzanita association successionally replaces the shore pine/bearberry association. A small area of this association can be found along the eastern boundary of Dune Forest B.

Shrubland Associations

Communities that consist of shrubs greater than 0.5 meter tall with generally greater than 25 percent cover and generally less than 25 percent tree cover are classified as shrubland associations. The density and distribution of the shrubland association is correlated to hydrology and topography. One of the major characteristics of the shrubland association is minor variation in topography, which affects the distribution of herbs and shrubs. The lowest lying areas are frequently inundated with water and, depending on the frequency and duration of inundation, they may be dominated with emergent hydrophyte species that generally grow partly or totally submerged in water. A single shrubland association was identified within the Jordan Cove project area (see figure 4.5-1).

Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage (Deciduous, Saturated)

The overstory within this association varies from patchy to dense, and is dominated by Hooker willow, Sitka willow, and Douglas spiraea, with scattered twinberry (*Lonicera involucrata*). Evergreen trees are mostly absent in this shrubland community, but may include scattered shore pine and Sitka spruce. Slough sedge is the most abundant herbaceous species. Other species include spreading rush (*Juncus effuses*), dagger-leaved rush (*Juncus ensifolius*), toad rush (*J. bufonius*), western bent-grass (*Agrostis exarata*), creeping bent-grass (*A. stolonifera*), reed canary grass (*Phalaris arundinacea),* northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria elata*), and lowland cudweed (*Gnaphalium palustre*). This association has been observed extensively throughout the wetland areas west of Jordan Cove Road, southwest of Jordan Lake, and at the southern tip of the South Dunes Power Plant.

Herbaceous Associations

Herbaceous associations and sand dunes are defined as communities with less than 25 percent shrub cover. Herbaceous associations are the most variable of all the vegetation associations located in the Jordan Cove project area. They range from being dominated by plants that are adapted for sand burial and desiccating winds, to species that are emergent or submergent hydrophytes. They are widespread throughout the site, including areas that have some active sand movement and/or anthropogenic disturbance. Five herbaceous associations have been identified within the site (see figure 4.5-1).

European Beachgrass Herbaceous Association

Dominant species within this association include European beachgrass, red fescue, silver burweed (*Ambrosia chamissonis*), sand pea (*Lathyrus japonicus*), seashore lupine (*Lupinus littoralis*), beach silvertop (*Glehnia littoralis*), and beach evening primrose (*Camissonia cheiranthifolia*). This association was observed in the western part of the LNG project area (also known as Ingram Yard) where the slip would be located, and at the NPWHC. It was also observed in patchy distribution throughout open dune lands located north of Jordan Lake where the access/utility corridor is proposed.

Red Fescue Herbaceous Association

The red fescue herbaceous association is generally located within sandy areas that are not dominated by European beachgrass and have limited sand movement. Red fescue (*Festuca rubra*) is the dominant grass; associate species are similar to the species found in the European beachgrass association, but also include bracken fern. European beachgrass is scattered in this association, but is not a dominant species because sand is partially stable. Scattered red fescue was observed west of the South Dunes Power Plant site (on fill) and north of the Roseburg Forest Products facility (on sand).

Red Fescue-Salt Rush Herbaceous Association

This association is similar to the red fescue association described above, except that it is dominated by salt rush (*Juncus lesuerii*) as well as red fescue. Red fescue-salt rush was also observed at sites where sand burial by wind driven forces limits species diversity, including in the Ingram Yard east of Henderson Marsh (western part of the LNG terminal site).

American Dunegrass Herbaceous Association

This association includes dune lands with the single dominant species: American dunegrass (*Leymus mollis*). It can be found on beaches and in foredunes, and to a lesser extent on open deflation plains and in upper estuaries. Continual sand burial and inputs of salt spray seem necessary for American dunegrass to thrive. Stands in most locations have been overrun by European beachgrass, but American dunegrass often persists in patches among the European beachgrass. Scattered American dunegrass was observed west of Dune Forest B, in the Ingram Yard grassland habitat east of Henderson Marsh on previous fill deposits.

Pond Lily (Perennial, Semi-permanently Flooded)

Dominant species in this association include yellow pond lily (*Nuphar lutea* ssp. *polysepala),* floating water-pennywort *(Hydrocotyle ranunculoides),* floating-leaved pondweed (*Potamogeton* *natans*), parrotfeather (*Myriophyllum aquaticum*), water shield (*Brasenia schreberi*), and common bladderwort (*Utricularia macrorhiza*). Pond lily habitat has been observed in deep freshwater wetlands located in the Jordan Cove Project site. This includes wetlands immediately west of Jordan Cove Road where the access/utility corridor is proposed (Wetlands 2012-2 and 2013-6) and in the southern portion of Wetland E.

Saltgrass-Pacific Silverweed Tidal Herbaceous Association

Dominant species found within this association include saltgrass (*Distichlis spicata*) and pickleweed (*Salicornia Virginia*). Himalayan blackberry (*Rubus discolor*) is the single dominant species along the upper shoreline above the ordinary high tide line and upper channel banks of this association, tapering to subdominant further inland. In the inland portion of the channel where freshwater prevails, common cattail (*Typha latifolia*) is the single dominant species. Subdominant species in this association include Hooker willow (*Salix hookeriana*) and giant horsetail (*Equisetum telmateia*) along the channel bank, reed canary grass (*Phalaris arundinaxxea*) and common rush (*Juncus effusus)* on the inland portions, and Lyngby sedge (*Carex lyngbeii*) above the high tide line on each side of the channel.

The saltgrass-Pacific silverweed tidal herbaceous association is one of the most salt-tolerant associations present on the North Spit, and also one of the most limited in distribution. It occurs at the South Dunes Power Plant site, adjacent to and including Wetland H (which includes a small freshwater channel to the shoreline of Coos Bay). The association occurs on sand or mud, usually cut with channels of tidal creeks. Occasional storm surges flood these areas with seawater, reworking sediments and importing large drift logs from beaches, as is the case with the Wetland H site.

Baltic Rush-Pacific Silverweed Tidal Herbaceous Association

Pickleweed and Lyngby sedge are the dominant species in this association, covering the majority of low marsh areas where this association is found. Subdominant species found include sea lavender (*Limonium californicum*), gumweed (*Grindelia squarrosa*), seaside arrowgrass (*Triglochin maritimum*), and salt rush (*Juncus lesueurii*).

This association is a component of "salt meadow" vegetation just above the intertidal zone in brackish marshes where limited freshwater is present. At the South Dunes Power Plant site, this association was found at the tip of Jordan Point where Wetland J occurs. Although there is a berm along the point, a culvert drains the inner marsh and opens up the area for tidal influence.

<u>Other Vegetation Associations</u>

Multiple disturbed areas are located within the LNG terminal site. Species composition within these disturbed areas consists of both native and non-native weedy herbaceous species with scattered shrubs. Forbs are more prevalent in areas that are heavily disturbed and compacted; grasses are widespread in areas that are moderately disturbed and are located along forest edges. Dominant species within the disturbed association include sweet vernal grass (*Anthoxanthum odoratum*), Queen Ann's lace (*Daucus carota*), hedgehog dogtail grass (*Cynosurus echinatus*), bird's foot trefoil (*Lotus corniculatus*), little hairgrass, silver hairgrass, hairy cat's ear, velvet grass (*Holcus lanatus*), English plantain (*Plantago lanceolata*), yarrow (*Achillea millefolium*), pearly everlasting (*Anaphalis margaritacea*), black mustard (*Brassica nigra*), small-head clover (*Trifolium microcephalum*), hop clover (*T. dubium*), white clover (*T. repens*), yellow parentucellia (*Parentucellia viscosa*), and wild radish (*Raphanus sativus*). In areas where this association has 50 percent cover or more of grasses, dominant species include tall fescue, wild oats (*Avena* spp.), orchard grass (*Dactylis glomerata*), bent grasses (*Agrostis stolonifera* and *A. exarata*), and brome grasses (*Bromus* spp.) with scattered Pacific reed grass (*Calamagrostis nutkaensis*) and a variety of herbs listed above.

Open water and areas dominated by common cattails can be found surrounding the existing sludge ponds at the South Dunes Power Plant site as well as around wetlands observed south of the Trans-Pacific Parkway in the eastern portion of the Jordan Cove terminal site. Species diversity in these areas is limited due to competition from the common cattail, which displaces other emergent vegetation.

General Impacts on Vegetation Associations

Table 4.5.1.1-1 lists the impacts on vegetation that would result from construction and operation of the LNG terminal and associated infrastructure (e.g., South Dunes Power Plant, temporary workers camp, SORSC). The areas affected by operation (as listed in table 4.5.1.1-1) would be considered a permanent impact, as these areas would remain cleared of vegetation for the life of the Jordan Cove Project. Areas that would be restored to pre-construction conditions following completion of construction would be considered temporary impacts (i.e., the difference between the values reported for construction impacts and the values reported for operation).

TABLE 4.5.1.1-1

Impact on Vegetation Type from the Proposed Jordan Cove Facilities

Vegetation Type	Land Cleared during Construction (acres) a/	Land Permanently Cleared due to Operations (acres) a/
FERC-Jurisdictional Project Facilities		
Forested Associations		
Port Orford Cedar/Evergreen Huckleberry	2	2
Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage	<1	<1
Shore Pine- Sitka Spruce/Evergreen Huckleberry	2	2
Shore Pine/Scotch Broom/Evergreen Beachgrass	5	5
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	8	8
Shore Pine-Sitka Spruce/Evergreen Huckleberry	42	42
Woodland Associations		
Shore Pine/Hairy Manzanita	2	2
Shrubland Associations		
Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage	<1	<1
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	8	8
Baltic Rush-Pacific Silverweed Flooded Tidal (Tidally Flooded)	<1	<1
Disturbed	19	9
Estuarine Habitat	31	31
European Beachgrass	51	51
Open Water/Common Cattail	<1	<1
Pond Lily	<1	<1
Red Fescue	10	10
Red Fescue-Salt Rush	10	10
Saltgrass-Pacific Silverweed Flooded Tidal (Tidally Flooded)	2	2
Total Impacts from Jurisdictional Project Facilities	***195***	***185***
Non-Jurisdictional Project Facilities		
Forested Associations		
Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage	<1	<1
Shore Pine/Scotch Broom/European Beachgrass	<1	<1
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	5	5
Shrubland Associations		

TABLE 4.5.1.1-1

Impact on Vegetation Type from the Proposed Jordan Cove Facilities

Vegetation Type	Land Cleared during Construction (acres) a/	Land Permanently Cleared due to Operations (acres) a/
Hooker Willow-Crabapple/Slough Sedge-Skunk Cabbage	<1	<1
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	1	1
Disturbed	***33***	***33***
European Beachgrass	<1	<1
Open Water/Common Cattail	1	1
Red Fescue	24	24
Total Impacts from Non-Jurisdictional Project Facilities	***66***	***66***
Temporary Construction Areas b/		
Forested Associations		
Shore Pine/Scotch Broom/European Beachgrass	3	0
Shore Pine-Douglas Fir/Wax Myrtle-Evergreen Huckleberry	12	0
Shore Pine-Sitka Spruce/Evergreen Huckleberry	13	0
Woodland Associations		
Shore Pine/Bearberry	4	0
Shore Pine/Hairy Manzanita	<1	0
Herbaceous, Disturbed, or Other Associations		
American Dunegrass	3	0
Disturbed	43	0
European Beachgrass	57	0
Total Impacts from Temporary Construction Areas	***136***	***0***
Grand Total for All Impacts		
Impact Grand Total	**397**	**251**

See table 2.3.1-1 in chapter 2 for the acreage of each individual Project component.
a/ Values may not sum exactly due to rounding of significant digits. Acreages are rounded to the nearest whole acre; acreages less than 1 acre are reported as <1.
b/ The values reported for Temporary Construction Area impacts exclude areas that overlap with permanent facility impacts.

Construction of the Jordan Cove facilities would result in a total of approximately 397 acres of clearing (about 195 acres of this would result from construction of FERC jurisdictional facilities). A total of approximately 251 acres of this impact would consist of permanent vegetation removal (i.e., areas that would remain affected throughout the life of the Jordan Cove Project and would occur under or within the footprint of Project-related facilities), with about 185 acres of this permanent impact resulting from FERC jurisdictional facilities. European beachgrass (with 109 acres of construction impacts or 27.4 percent of the total impact), currently disturbed habitats (with 95 acres of construction impacts or 23.0 percent), shore pine-Sitka spruce/evergreen huckleberry (with 55 acres of construction impact or 13.8 percent), and red fescue associations (with 34 acres of construction impacts or 8.6 percent) would be the most affected vegetation types.

The clearing of a dune forest habitat during construction would indirectly impact the vegetation at the newly exposed edge of the coniferous forest by changing the micro-climate factors (wind, light, salt spray, organisms that prefer edges). The vegetation found within the forest interior would be exposed to the environmental elements experienced by a forest edge, which could lead to a change in species composition.

After creation of the marine slip, all disturbed areas would be stabilized immediately with a dunegrass seed mixture compatible with applicable agency criteria as being capable of surviving in highly permeable substrates in order to withstand seasonal soil moisture changes, loose sand, and burial and deflation from aeolian (wind) processes.

To reduce the effects on vegetation within the construction area and improve the potential for revegetation, Jordan Cove would implement measures from its *Plan* and *Procedures* during construction and restoration. Areas that are disturbed by construction activities but are not affected by a facility component would be revegetated with native species of a local seed source, to achieve stabilization and prevent erosion of the disturbed areas. Restoration of areas disturbed by permanent facility components would be stabilized to prevent erosion by the planting of non-invasive species. Native species would be used if practical and, if any non-native species are required for specific problem areas, the species would be selected to ensure that it would not become a nuisance species to the surrounding areas. Environmental monitoring would be conducted in all of the areas disturbed, and would focus upon stabilization and prevention of erosion; monitoring would be an ongoing activity within the Jordan Cove facilities for the life of the Jordan Cove Project.

Noxious Weeds

For the purpose of this analysis, noxious weeds and invasive plant species are defined as non-native, undesirable native, or introduced species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground has been disturbed and can hinder restoration. The ODA Noxious Weed Control Program and the OSWB maintain the State Noxious Weed List. There are three classes of listed noxious weeds under the ODA Noxious Weed Control Classification System (i.e., Class A, Class B, and Class T weeds[75]). Species listed in the Noxious Weed Policy and Classification System and in the Oregon Aquatic Nuisance Species Management Plan that could potentially occur within the LNG terminal area are summarized in table 4.5.1.1-2.

TABLE 4.5.1.1-2

Potential for Species on the Coos County Noxious Weed List 2011-2012 to Occur at the Jordan Cove Project Site

Common Name	Scientific Name	LNG Export Terminal Facility	South Dunes Power Plant	Worker Camp
"A" Designated Weeds (i.e., weeds that occur in small enough infestations to make eradication or containment possible or is not known to occur in Oregon, but is present in neighboring states making occurrence in Oregon seem imminent)				
Dalmatian toadflax	*Linaria dalmatica*			
Diffuse knapweed	*Centaurea diffusa*			
False brome	*Brachypodium sylvaticum*			
Garlic mustard	*Alliaria petiolata*			
Giant hogweed	*Heracleum mantegazzianum*			
Portuguese broom	*Cytisus striatus*			
Spanish heath	*Erica lusitanica*			
Spotted knapweed	*Centaurea stoebe*			
Wooly distaff thistle	*Carthamus lanatus*			
Yellow Star thistle	*Centaurea solstitialis*			
"B" Designated Weeds (i.e., weeds that are regionally abundant, but may have limited distribution in some counties)				
Acacia	*Acacia* spp.			

[75] Class A – Weeds of known economic importance which occur in small enough infestations to make control or containment possible; or are not known to occur in Oregon, but are present in neighboring states making future occurrence in Oregon seem imminent.
Class B – Weeds of economic importance which are regionally abundant, but which may have limited distribution in some counties.
Class T – Priority noxious weeds designated as target species for which the ODA will develop and implement statewide management plans. Species selected from either the class "A" or "B" list.

TABLE 4.5.1.1-2

Potential for Species on the Coos County Noxious Weed List 2011-2012 to Occur at the Jordan Cove Project Site

Common Name	Scientific Name	LNG Export Terminal Facility	South Dunes Power Plant	Worker Camp
Biddy biddy	*Acaena novae-zelandiae*			
Bohemian knotweed	*Polygonum bohemica*			
Brazilian waterweed	*Egeria densa*			
Bull thistle	*Cirsium vulgare*	L	L	X
Butterfly bush	*Buddleia davidii*			
Canada thistle	*Cirsium arvense*	X	X	L
Cotoneaster	*Cotoneaster frigidus*			
English holly	*Ilex aquifolium*			
English ivy	*Hedera helix*	L	X	L
European beachgrass	*Ammophila arenaria*	X	X	X
Field bindweed (morning glory)	*Convolvulus arvensis*	L	L	L
French broom	*Cytisus monspessulanas*	X	L	L
Giant knotweed	*Polygonum sachalinesis*			
Gorse	*Ulex europaeus*	X	X	X
Herb robert	*Geranium robertianum*			
Himalayan blackberry	*Rubus discolor (R. armeniacus, R. procerus, R. fruticosa)*	X	X	X
Himalayan knotweed	*Polygonum olystachyum*			
Italian thistle	*Carduus pycnocephalus*	L	X	L
Japanese knotweed	*Polygonum cuspidatum*			
Meadow knapweed	*Centaurea moncktonii*			
Milk thistle	*Silybum marianum*			
Old man's beard	*Clematis vitalba*			
Pampas grass	*Cortaderia jubata*	L	X	X
Parrotfeather	*Myriophyllum aquaticum*	X	X	
Pennyroyal	*Mentha pulegium*	X	L	
Poison hemlock	*Conium maculatum*	X	X	
Purple loosestrife	*Lythrum salicaria*			
Scotch broom	*Cytisus scoparius*	X	X	X
Smooth cordgrass	*Spartina alterniflora*	L	L	
Sweet fennel	*Foeniculum vulgare*	X		
Tansy ragwort	*Senecio jacobaea*			
Yellow flag iris	*Iris psuedacorus*			
Yellow glandweed	*Parentucellia viscosa*	X	L	L
"T" Designated Weeds (i.e., weeds that are selected from the A or B lists and are designated as a target species)				
Bohemian knotweed	*Polygonum bohemica*			
Butterfly bush	*Buddleia davidii*			
Giant knotweed	*Polygonum sachalinesis*			
Gorse	*Ulex europaeus*	X	X	X
Himalayan knotweed	*Polygonum polystachyum*			
Japanese knotweed	*Polygonum cuspidatum*			
Meadow knapweed	*Centaurea moncktonii*			
Old man's beard	*Clematis vitalba*			
Parrotfeather	*Myriophyllum aquaticum*	X	X	
Purple loosestrife	*Lythrum salicaria*			
Yellow flag iris	*Iris psuedacorus*			

County list provided by the Oregon State University Extension Service.
"X" – indicates species has been documented at the project site
"L" – indicates species is likely to occur at the project area

Of the species listed in table 4.5.1.1-2, the following were encountered during field surveys conducted for the Jordan Cove Project: gorse (*Ulex europaeus*), parrotfeather (*Myriophyllum aquaticum*), Canada thistle (*Cirsium arvense*), English ivy (*Hedera helix*), European beachgrass, Himalayan blackberry (*Rubus armeniacus*), Italian thistle (*Carduus pycnocephalus*), Pennyroyal (*Mentha pulegium*), poison hemlock (*Conium maculatum*), scotch broom (*Cytisus scoparius*), sweet fennel (*Foeniculum vulgare*), and yellow glandweed (*Parentucellia viscosa*). Of these species, gorse and parrotfeather are classified as Class "T" weeds (i.e., weeds selected from the A or B lists that are targeted for eradication). The basic traits of these two Class "T" weeds are summarized below:

- Gorse readily invades areas of recent disturbance, such as pastures, agricultural lands, harvested timberlands, roadsides, trails, state parks and vacant lots, and can increase the risk of fire within affected areas due to an increase in flammable fuel loads. Gorse is intermixed within the forest and shrub associations in the project area, primarily near disturbed areas.
- Parrotfeather is a dominant species within yellow pond lily wetlands within the project area. Once parrotfeather becomes established in a natural waterbody, it can quickly grow into dense mats that shade out native plants and algae, while reducing fish habitat and recreational use.

Although botanical surveys were conducted at an appropriate time of year to identify weed species, the fact that only a subset of the weed species that could potentially occur in the area were actually identified in the areas does not mean that the other possible weed species (or any other invasive species) are not also present in the area (for example, additional weeds species may be present in the seedbank, and simply did not germinate during the survey window). Surveys were conducted to create a list of known infestations that could be mapped and controlled. If additional infestations or other invasive weed species are found, then these would be controlled and monitored as well. Measures aimed at preventing the spread of invasive weeds were designed to prevent the spread of all weeds species, not just those that were identified during surveys.

Construction of the LNG terminal has the potential to increase the risk of aquatic and terrestrial invasive plant species within and adjacent to the project area due to the amount of ground disturbance, heavy equipment use, and potential off-site vectors (i.e., equipment used in other locations). To avoid introducing or spreading invasive species, Jordan Cove would follow the recommendations outlined in the Oregon Aquatic Species Management Plan, the Oregon Noxious Weed Strategic Plan, BLM's multi-state EIS Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, and the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007). These documents focus on detection, containment, and/or reduction of invasive plant infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) as well as implementation of measures to avoid the introduction and spread of noxious weeds.

Jordan Cove would conduct a pre-construction survey of the site to identify noxious species listed by the ODA that persist despite recent and previous control efforts. Following the survey, Jordan Cove would employ standard removal practices (BLM 1985) for the weed species identified on the site. Methods for removal that would not aid in the dispersal of these species would be used and would include the use of integrated BMPs such as fire, mechanical or manual removal, and herbicide application, as appropriate. Treated areas would be restored by spreading native seeds and planting native plants.

Construction equipment used off the site would be cleaned to prevent the export and spread of noxious weed species and seeds. Jordan Cove would also use herbaceous and native dune seed mixes to limit germination of noxious weeds during the stabilization and restoration of the site during and following construction. Once the site is stabilized and in operation, Jordan Cove would check the site for noxious weed infestations and control measures would be implemented that are consistent with ODA, OISC, and BLM noxious weed control plans and policies, as applicable.

Vegetative Pathogens

Port-Orford-cedar root rot disease is caused by the fungus *Phytophthora lateralis*. The disease was first discovered in Port-Orford-cedar's natural range in 1952 and since has spread throughout the host's range. The fungus invades the roots of Port-Orford-cedar and eventually colonizes the entire root system until the tree eventually dies from girdling. Port-Orford-cedar root rot disease affects both seedlings and mature trees. Evidence of infected trees includes lighter colored foliage that eventually turns red to brown and dies and discolored inner bark. The spores live in the soil and are spread through contact with contaminated soil or via free water. The disease is primarily spread through soil disturbance and moving water. Spread of the disease over long distances occurs from contaminated equipment and livestock.

Surveys for Port-Orford-cedar root rot disease were not conducted at the Jordan Cove project area; however, based on what is known about the disease, it is likely to be present in the Coos Bay area, regardless of whether infected trees have been identified. Jordan Cove would take precautions during the construction to minimize the introduction or spread of Port-Orford-cedar root rot disease from contaminated earth moving equipment. Jordan Cove would conduct surveys prior to construction to identify whether the disease occurs on site, and if found, it would implement measures to decontaminate equipment before leaving the site and to prevent cross contamination between soil and water. In addition, all equipment would be decontaminated before beginning work on the site. If the disease is found during pre-construction surveys, maps with precise locations would be provided to all contractors and site construction personnel to help prevent the spread of the disease to off-site locations. To ensure adequate conservation measures to address Port-Orford-cedar root rot disease are in place and implemented, Jordan Cove would follow the measures and recommendations found in the Forest Service and BLM's Final Supplemental EIS regarding the management of Port-Orford-cedar in southwest Oregon (Forest Service and BLM 2004).

4.5.1.2 Pacific Connector Pipeline

The Pacific Connector pipeline route would cross ecologically diverse areas from Coos Bay to the Klamath Basin. It would pass through the wet, marine-influenced evergreen forests in the coastal region, coniferous forests of the Klamath Mountains and Cascades, and sagebrush steppe typical of the Basin and Range sub-ecoregions.

The pipeline lies within four ecoregions (see figure 4.5-2): (1) the Coast Range, which consists mainly of Douglas-fir plantations; (2) the Klamath Mountains, which supports a mosaic of northern California and Pacific Northwest conifers and hardwoods characteristic of areas with lengthy summer droughts; (3) the Cascades, which has a moist, temperate climate and contain an extensive and highly productive coniferous forest; and (4) the Eastern Cascades Slopes and Foothills, which supports shrub/grassland areas as well as open forests of ponderosa pine (*Pinus ponderosa*) and some shore pine (also known as lodgepole pine; *Pinus contorta*) that are adapted to the prevailing dry, continental climate and frequent fires found in this area (Bryce et al. 2003). Each ecoregion within Oregon has been divided into sub-ecoregions.

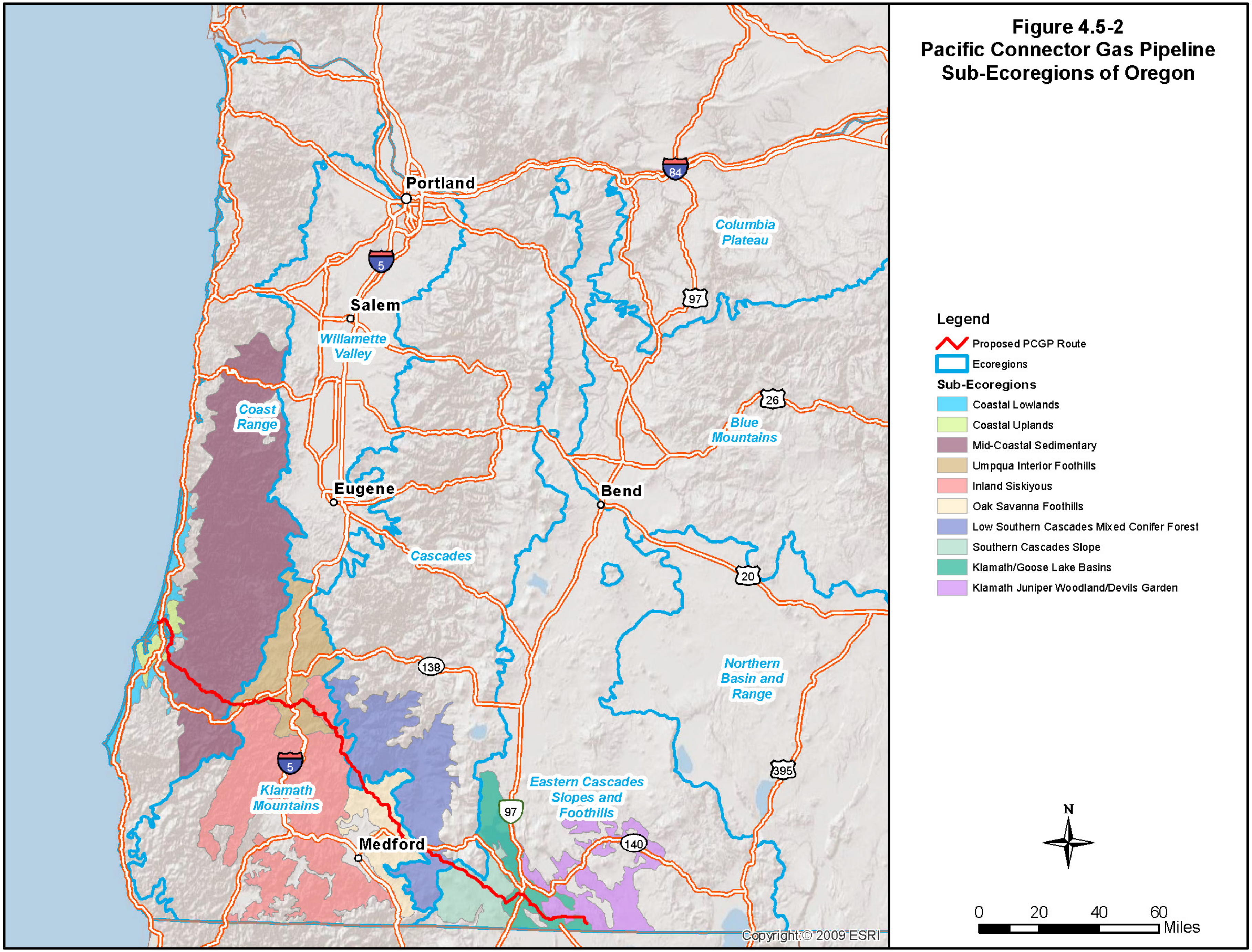


Figure 4.5-2
Pacific Connector Gas Pipeline
Sub-Ecoregions of Oregon

Within the Coast Range ecoregion there are three sub-ecoregions: the Coastal Lowlands, Coastal Uplands, and Mid-Coastal Sedimentary sub-ecoregions (Bryce et al. 2003). The Coastal Lowlands sub-ecoregion consists of beaches, dunes, and marine terraces (less than 400 feet) with wet forests, lakes, estuarine marshes, and tannic streams. Within this sub-ecoregion, many wetlands have been drained and converted to pastures. Residential, commercial, and recreational developments are currently expanding within this sub-ecoregion. The Coastal Uplands sub-ecoregion consists of headlands and low mountains. The Mid-Coastal Sedimentary sub-ecoregion consists of Douglas-fir forests, which lie outside the coastal fog zone and are intensively managed for timber production. Because this area is typically underlain by sandstone and siltstone, slope can become unstable when disturbed.

Within the Klamath Mountains ecoregion there are three sub-ecoregions, the Umpqua Interior Foothills, Inland Siskiyous, and Oak Savanna Foothills sub-ecoregions (Bryce et al. 2003). The Umpqua Interior Foothills sub-ecoregion consists of a complex of foothills and narrow valleys containing fluvial terraces, floodplains, and a xeric moisture regime. Dominant species present include Oregon white oak woodland, Douglas-fir, ponderosa pine, and Pacific madrone (*Arbutus menziesii)*, intermixed with pastureland, vineyards, orchards, and row crops. Within the Inland Siskiyous sub-ecoregion, forest cover is diverse, with a multi-layered mix of conifers, broadleaf evergreens, and deciduous trees. This area experiences a higher fire frequency with less annual precipitation and longer summer droughts than the coastal areas. It is more mountainous and at higher elevations than neighboring ecoregions. The Oak Savanna Foothills has two distinct components: (1) the driest area east of Medford that is dominated by oak woodlands, grassland-savanna, ponderosa pine, and Douglas-fir; and (2) the wetter foothills in the Illinois Valley that support Douglas-fir, Pacific madrone, and incense cedar (*Libocedrus decurrens*).

Only one sub-ecoregion (Southern Cascades) is crossed by the pipeline within the Cascades ecoregion (Bryce et al. 2003). Tree species present within the Southern Cascades sub-ecoregion are western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and Sierra Nevada species, such as incense cedar, white fir (*Abies concolor*), and Shasta red fir (*Abies magnifica* var. *shastensis*) that can tolerate prolonged summer drought. The Southern Cascades are low in elevation and lack steep slopes, which means river and stream discharge is low.

Within the Eastern Cascades Slopes and Foothills ecoregion there are three sub-ecoregions, the Southern Cascade Slope, Klamath/Goose Lake Basins, and Klamath Juniper Woodland sub-ecoregions (Bryce et al. 2003). The Southern Cascade Slope sub-ecoregion is considered a transition zone between the Cascades and the drier Eastern Cascades, this sub-ecoregion has a mix of forest types, including ponderosa pine, white fir, incense cedar, Shasta red fir, and Douglas-fir (at higher elevations). Historically, the Klamath/Goose Lake Basins consists of a variety of wildrye, bluegrass, and wheatgrass species; however, most of the wet meadows and wetlands have been drained and converted for agriculture. This sub-ecoregion consists of river floodplains, terraces, and lake basins. The Klamath Juniper Woodland is composed of hills, benches, and escarpments that are covered with a mosaic of rangeland and woodland, providing important habitat for wildlife. Western juniper (*Juniperus occidentalis*) grows on shallow, rocky soils with an understory of low sagebrush (*Artemisia arbuscula*), big sagebrush (*Artemisia tridentate*), bitterbrush (*Purshia tridentate*), and bunchgrasses. Other shrubland/grasslands include species uncommon in eastern Oregon, such as woolly wyethia (*Wyethia mollis*), Klamath plum (*Prunus subcordata*), and birchleaf mountain mahogany (*Cercocarpus montanus* var. *glaber*).

Existing vegetative resources within the pipeline's project area were determined and classified based on (1) botanical surveys conducted between 2007 and 2012 by Siskiyou BioSurvey LLC (SBS); (2) wetland delineation surveys conducted between 2006 and 2008 by Jones & Stokes Associates; (3) consultation with BLM and Forest Service experts; (4) aerial photography of the pipeline alignment; (5) BLM Forest Cover Operations Inventory digital GIS coverage; (6) digital GIS data coverage and vegetation categories described by the Oregon Gap Analysis Project (Oregon GAP; Kagan et al. 1999); and (7) current wildlife-habitat types described and delineated by the Northwest Habitat Institute in 1999 (Kiilsgaard and Garrett 1999). Additional details regarding the botanical and wetland surveys can be found in the botanical and wetland survey reports, which were included in Pacific Connector's June 2013 application to the FERC in Docket No. CP13-492-000.

Vegetation Associations

The following subsections describe the various vegetation associations found along the pipeline route. In general, these descriptions follow the categories developed by the Oregon GAP (Kagan et al. 1999); however, there are a few cover types present along the Pacific Connector pipeline route that were not described by the Oregon GAP. Therefore, descriptions found in the USGS Land Use and Land Cover Classification System, as well as Anderson et al. (1976), Johnson and O'Neil (2001), and Franklin and Dyrness (1988) were used for vegetation types delineated within the Pacific Connector pipeline area that were not included in the Oregon GAP.

<u>Forest and Woodland Vegetation Types</u>

Forests associations found along the Pacific Connector pipeline route were assigned an age class using available GIS data. Age class was also reviewed by BLM and Forest Service biologists on their respective lands with specific focus on verifying/classifying late seral forest stands, as well as by SBS. Age classes were categorized within five age ranges: clearcut (0-5 years), regenerating (5-40 years), mid-seral (40-80 years), late successional (80-175 years), and old growth (175+ years), based on Moeur et al. (2006).

- Clearcut includes areas that were recently harvested within the past five years but presently are non-stocked. This age class generally has a canopy cover of less than 10 percent.
- Regenerating forest or younger forest includes stands with average age of tree from 5 to 40 years. This age class generally includes seedlings and saplings with canopy cover greater than 10 percent and tree size less than 10 inches diameter at breast height (dbh). This category was further refined to identify early regenerating forest (harvested within the last 10 to 15 years) and regenerating forest for interior forest analyses described later in this section.
- Mid-seral forest includes stands within the current harvest rotation in Oregon, generally 40 to 80 years. This age class generally includes small single- and multi-storied trees with canopy cover greater than 10 percent and tree size between 10 and 20 inches dbh.
- Late successional forest includes forest stands between 80 and 175 years old. This age range is consistent with definitions used in the NWFP and as described in Moeur et al.

(2006). This age class generally includes medium and large single- or multi-storied trees with canopy cover greater than 10 percent and average tree size between 20 and 30 inches dbh.

- Old-growth forest includes forest stands greater than 175 years and dominated by coniferous forest. This correlates well with Moeur et al. (2006), Franklin et al. (1981, 1986), and Franklin and Spies (1991) descriptions that consider primary size and canopy structure characteristics of old-growth Douglas fir to develop between 175 and 250. This age class generally includes large, multi-storied stands with canopy cover greater than 10 percent and average tree dbh greater than 30 inches.

Douglas-fir–Western Hemlock–Western Redcedar Forest

Douglas-fir dominates multi-storied canopy, with western hemlock, western redcedar, and grand fir (*Abies grandis*) as co-dominants. In addition, Pacific yew (*Taxus brevifolia*) may be present in the subcanopy (Kagan et al. 1999). Port-Orford-cedar can also be a dominant tree species within Douglas-fir–Western hemlock–Western redcedar forest types within the pipeline project area (Johnson and O'Neil 2001). Within riparian areas, and non-conifer dominated stands, bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) are common. Large stature shrubs are frequently present, such as vine maple (*Acer circinatum*), Pacific rhododendron, and evergreen and red huckleberry (*Vaccinium ovatum* and *V. parvifolium*). Ferns dominate the rich and diverse herbaceous layer. This forest type is found low to mid elevations (Kagan et al. 1999). It is located in Coos and Douglas Counties along the pipeline route.

Douglas-Fir–Mixed Deciduous Forest

This forest type is a low to mid-elevation conifer and mixed deciduous forest found primarily in southwestern Oregon. The upper tree layer always contains Douglas-fir, with the sub-canopy consisting of a mix of shade tolerant conifers and deciduous trees including: tanoak, Pacific madrone, golden chinquapin, and Pacific dogwood. Indicative shrubs of this cover type include dwarf Oregon-grape, pacific blackberry, oceanspray, California hazelnut, and others (Kagan et al. 1999). This forest type is found within Douglas, Jackson, and Klamath Counties along the pipeline route.

Alder–Cottonwood

This forest type is found along the margin of flowing streams in the foothills and mountains throughout much of Oregon. It is prevalent along high gradient stream systems that flood frequently and deposit bed-load sand and gravel. Black cottonwood is always present in the overstory. West of the Cascade crest, other dominant species in the overstory include red alder and big leaf maple, and conifers could include Douglas-fir, western hemlock, Western redcedar, and Port-Orford-cedar. East of the Cascade crest, the other dominant species include white alder, with other deciduous trees present including mountain alder, Pacific willow, non-native black locust, and quaking aspen. Conifers associated east of the Cascades include ponderosa pine, Douglas-fir, Engelmann spruce, and lodgepole pine (Kagan et al. 1999). This forest type is found within all counties crossed by the pipeline route.

Mixed Conifer/Mixed Deciduous Forest

This forest type contains early successional (old clear-cut) generally composed of co-dominant conifer (Douglas-fir) and deciduous (red alder and/or bigleaf maple) trees in a single-layered canopy forest (Kagan et al. 1999). Port-Orford-cedar may also be the dominant tree species within this forest type (Johnson and O'Neil 2001). This forest type is found in low- to mid-elevations (Kagan et al. 1999). It is located in Coos County along the pipeline route.

Shasta Red Fir–Mountain Hemlock Forest

This mid-to-upper elevation conifer forest is mostly found above 4,000 feet. Overstory species generally include Shasta red fir, mountain hemlock, white fir, and lodgepole pine. It often is a closed, multi-story canopy with dense understory of shrubs, forbs, and ferns, including dwarf bramble, Oregon boxwood, pinemat manzanita, and saddler oak (Kagan et al. 1999). Along the pipeline route, this forest type is located in Jackson and Klamath Counties.

Douglas-fir–White Fir/Tanoak–Madrone Mixed Forest

Multi-layered forest of mixed conifer and mixed deciduous species make up this forest type. It always contains Douglas-fir, with other co-dominants (i.e., white fir, incense cedar, sugar pine [*Pinus lambertiana*] and western white pine). Subcanopy layers contain shade-tolerant trees, including tanoak (*Lithocarpus densiflorus*), Pacific madrone, chinquapin (*Chrysolepis hjelmquist*), Pacific dogwood (*Cornus nuttallii*), and California laurel (*Umbellularia californica*). Shrub and herb layers are generally well represented. This forest type is found at low to mid elevations (Kagan et al. 1999). It is located in Jackson County along the pipeline route.

Douglas-fir Dominant-Mixed Conifer Forest

Single-layer forest canopy is typical within this forest type, although stand structure can be diverse in undisturbed late seral stands. There is a wide range of canopy closure based on management practice, disturbance history, and microsite. Douglas-fir is dominant, with a variety of coniferous trees including, white fir, incense cedar, western white pine, ponderosa pine, and sugar pine. Understory vegetation is usually diverse and rich in species. This forest type is found at mid elevations (Kagan et al. 1999). It is located in Coos, Douglas, Jackson, and Klamath Counties along the pipeline route.

Ponderosa Pine/White Oak Forest and Woodland

Ponderosa pine is exclusively the overstory tree at low elevations within this forest type. White fir, grand fir, western larch (*Larix occidentalis*), incense cedar, Douglas-fir, subalpine fir, and Engelmann spruce (*Picea engelmannii*) dominate at higher elevations. Understory and regeneration layers reflect similar composition as overstory. Lower elevations have fewer shrubs, increasing in diversity and abundance with elevation and improved soil moisture conditions. This forest type is found at low to middle elevations (Kagan et al. 1999). It is found in Jackson and Klamath Counties along the pipeline route.

Ponderosa Pine Forest and Woodland

Ponderosa pine is exclusively the overstory tree at low elevations within this forest type. White fir, grand fir, western larch, incense cedar, Douglas-fir, subalpine fir, and Engelmann spruce are dominant at higher elevations. Understory and regeneration layers reflect similar composition as overstory. Lower elevations have fewer shrubs, increasing in diversity and abundance with elevation and improved soil moisture conditions. This forest type is found at low to middle elevations (Kagan et al. 1999). It is found in Jackson and Klamath Counties along the pipeline route.

Oregon White Oak Forest

This forest type contains deciduous woodland/forest dominated by Oregon white oak (*Quercus garryana*). Other canopy trees can be Douglas-fir and ponderosa pine in upland settings, and Oregon ash (*Fraxinus latifolia*), cottonwood (*Populus* spp.), and bigleaf maple on valley floors. The subcanopy often consists of California black oak (*Quercus velutina*). Understory typically contains tall deciduous shrubs and smaller stature deciduous trees. This forest type is a highly desirable wildlife habitat that has been decreasing as a result of fire suppression. It is found at low elevations (Kagan et al. 1999). This forest type can require more than 100 years to reach full productivity and function as wildlife habitat, and these types of habitats are limited within the region (see section 4.6). It can be found in Douglas and Jackson Counties along the pipeline route.

Western Juniper Woodland

This woodland type is dominated by western juniper and has an open canopy (less than 30 percent crown closure) and single story, short stature (6 to 20 feet tall) trees. Understory vegetation is dominated by sagebrush species, such as big sagebrush, rigid sagebrush (*Artemisia rigida*), and low sagebrush, as well as mountain mahogany, bitterbrush, and rabbitbrush (*Chrysothamnus* spp.). Grasses characterize the herbaceous layer. This woodland type is found at a wide range of elevations (Kagan et al. 1999). It can be found in Klamath County along the pipeline route.

Ponderosa Pine/Western Juniper and Woodland

This woodland type is typically found in the foothill margins bordering upland conifer types and sagebrush dominant lowlands. This forest type has a two-story canopy with widely spaced overstory ponderosa pine and a subcanopy of western juniper. Canopy cover is generally between 10 and 50 percent. The understory is dominated by a shrub layer, including big sagebrush, low sagebrush, rabbitbrush, mountain mahogany, and bitterbrush, and is interspersed with annual bunch grasses (Kagan et al. 1999). This woodland type is in Klamath County along the pipeline route.

Grass-shrub-sapling or Regenerating Young Forest

This forest type is characteristic of successional conditions following timber harvest, which can include ground scarification and slash/large woody debris, a variety of shrubs and forbs typical of the area, and then conifer saplings which form a continuous canopy above the shrub layer (Kagan et al. 1999). This forest type is located within all counties crossed by the pipeline route.

Grassland and Shrubland Vegetation Types

Sagebrush Steppe

This vegetation type is a mosaic of grasses (mostly introduced) and shrubs that include big sagebrush subspecies, such as Wyoming, basin, and mountain. Other shrubs include low, silver, and three-tip sage brush, and rabbitbrush. A variety of bunchgrasses are scattered with the shrubs, although overgrazing has limited their presence (Kagan et al. 1999). This vegetation type is found in Klamath County along the pipeline route.

Shrublands

This vegetation type consists of a mosaic of grasses and shrubs. It may include sagebrush, but is not dominated by this species. It typically occurs within revegetated utility corridors and transitional areas, such as reclaimed industrial sites. This vegetation type is within all counties crossed by the pipeline route.

Grasslands (west of Cascades)

This habitat contains less than 30 percent tree or shrub cover and is generally used for livestock grazing. Bunchgrasses dominate native-dominated sites, with mosses, lichens, and native forbs occurring throughout. It is found at lower elevations (Johnson and O'Neil 2001). It can be found in Coos, Douglas, and Jackson Counties along the pipeline route.

Grasslands (east of Cascades)/Forest-Grassland Mosaic

This vegetation type is a mosaic of bunchgrass grasses and conifer forest in the east Cascades. Ponderosa pine, Douglas-fir, white fir, and incense cedar are common conifers, with Idaho fescue generally the dominant grass. Other grasses that can form co-dominances include bluebunch wheatgrass (*Pseudoroegneria spicata*), junegrass (*Koeleria* spp.), Sandberg bluegrass (*Poa secunda*), and western needlegrass (*Achnatherum occidentale*). In heavily grazed stands, cheatgrass (*Bromus tectorum*) and bottlebrush squirreltail (*Elymus elymoides* ssp. *elymoides*) can be dominant. This vegetation type is found at low to middle elevations (Kagan et al. 1999). It is found in Klamath County along the pipeline route.

Riparian and Wetland Vegetation Types

Palustrine Forest

This vegetation type typically has a multi-storied canopy (trees greater than 18 feet tall). Deciduous trees generally dominate in eastern Oregon, including black cottonwood, white alder (*Alnus rhombifolia*), quaking aspen (*Populus tremuloides*), and peachleaf willow (*Salix amygdaloides*). In western Oregon, conifer trees tend to dominate the canopy: western redcedar, western hemlock, Douglas-fir, and grand fir. This vegetation type is located in narrow strips along riparian zones (Kagan et al. 1999). It is found within all counties crossed by the pipeline route.

Palustrine Shrubland

This vegetation type is dominated by dense, tall shrubs, typically willow species. Other shrubs found could include chokecherry (*Prunus virginiana*), bog birch (*Betula pumila*), bog blueberry (*Vaccinium uliginosum*), snowberry (*Symphoricarpos albus*), wax currant (*Ribes cereum*), and *Douglas spiraea*. This vegetation type is most prominent along low gradient streams in broad valleys and pluvial basins of eastern Oregon (Kagan et al. 1999). It can be found in Coos, Jackson, and Klamath Counties along the pipeline route.

Estuarine Emergent

This vegetation type consists of herbaceous wetlands that border coastal river mouths, bays, and estuaries. Vegetation composition consists of three plant communities: salt marsh, intermarsh, and transition zone (Kagan et al. 1999). Within the pipeline project area, this category is found in Coos County.

Palustrine Emergent

This vegetation type is made up of freshwater herbaceous wetlands that contain medium tall (2 to 4 feet) to tall (greater than 4 feet) grass or grass-like plants. Common herbaceous plants include cattails (*Typha* spp.), bulrush species, and burreed (*Sparganium* spp.). Grasses associated with this category are blue wildrye (*Elymus glaucus*), tufted hair grass (*Deschampsia cespitosa*), bluejoint weedgrass (*Calamagrostis canadensis*), reed canarygrass, American sloughgrass

(*Beckmannia syzigachne*), and northern mannagrass (*Glyceria borealis*) (Kagan et al. 1999). This vegetation type can be found within all counties crossed by the pipeline route.

<u>Agricultural Areas</u>

Agricultural areas include crop land, orchards, hay fields, and managed pastures. These areas consist of lands that have been cleared of native vegetation and modified for growing crops and/or animal husbandry (Kagan et al. 1999). Agricultural lands are found within all counties crossed by the pipeline route.

<u>Non-Vegetated Areas</u>

There are multiple non-vegetated areas crossed by the pipeline route, including developed lands (including roads), industrial lands, urban lands, residential lands, barren land, and open water (e.g., rivers, streams, ditches, canals, ponds, bays, and estuaries). These areas are not assessed in detail within this section of the EIS as they are not vegetated; however, they are included in impact tables as well as brief summary discussions to maintain consistency with total impact values presented in other sections of this EIS.

General Impacts on Vegetation Associations

The pipeline would cross approximately 231.8 miles, of which 211.5 miles would occur in areas considered to be vegetated (i.e., excluding developed, barren, and open water areas; see table 4.5.1.2-1). Construction of the pipeline would impact approximately 5,565 acres, of which 4,523 acres would occur in areas considered to be vegetated (see table 4.5.1.2-2). Operation of the pipeline project would impact approximately 877 acres, of which 802 acres would occur in areas considered to be vegetated (see table 4.5.1.2-3). The primary effects of pipeline construction would be the cutting, clearing, and/or removal of existing vegetation within the work areas. All areas except the UCSAs and portions of the hydrostatic test discharge sites would be cleared of vegetation during construction.

Impacts on areas where no permanent structures, aboveground facilities, or roads would occur are considered temporary, because these areas would be restored and revegetated. However, the duration of these impacts could be either short-term or long-term, depending on pre-disturbance vegetation cover. For example, the clearing and restoration of forested areas would be a long-term impact because of the extended length of time it takes trees to grow to maturity from seedlings or saplings planted as part of the revegetation process. However, the 30-foot-wide maintenance corridor within the operational pipeline easement that is kept clear of trees in formerly forested area would be considered a permanent impact.

TABLE 4.5.1.2-1

Vegetation Cover Types Crossed by the Pacific Connector Pipeline Project

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles d/	Percent of Total Vegetation Type
Forest-Woodland	Douglas-fir-W. Hemlock-W. Red-Cedar Forest	2.2	1.5	5.4	3.7	12.0	8.2	19.5	8.4
	Douglas-Fir-Mixed Deciduous Forest	6.4	4.4	12.9	8.8	7.8	5.3	27.1	11.7
	Alder-Cottonwood	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Mixed Conifer/Mixed Deciduous Forest	0.6	0.4	3.0	2.1	13.1	9.0	16.8	7.2
	Shasta Red Fir – Mountain Hemlock Forest	1.6	1.1	0.9	0.6	4.0	2.7	6.4	2.8
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	0.8	0.5	1.1	0.8	0.4	0.3	2.2	0.9
	Douglas-fir Dominant-Mixed Conifer Forest	23.6	16.2	8.6	5.9	13.9	9.5	46.1	19.9
	Ponderosa Pine/White Oak Forest and Woodland	2.7	1.9	2.0	1.4	2.5	1.7	7.3	3.1
	Ponderosa Pine Forest and Woodland	1.0	0.7	2.7	1.9	3.4	2.3	7.1	3.1
	Oregon White Oak Forest	2.5	1.7	2.4	1.6	0.0	0.0	4.9	2.1
	Western Juniper Woodland	0.0	0.0	3.3	2.3	0.0	0.0	3.3	1.4
	Ponderosa Pine/Western Juniper Woodland	0.0	0.0	1.0	0.7	3.8	2.6	4.8	2.1
	Subtotal	**41.3**	**28.3**	**43.6**	**29.9**	**60.9**	**41.7**	**145.9**	**62.9**
Grasslands-Shrubland	Sagebrush Steppe	0.0	0.0	0.0	0.0	0.0	0.0	4.9	2.1
	Shrublands	0.0	0.0	0.0	0.0	0.0	0.0	10.6	4.6
	Grasslands (West of Cascades)	0.0	0.0	0.0	0.0	0.0	0.0	10.2	4.4
	Grasslands (East of Cascades)/Forest-Grassland Mosaic	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.8
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**27.6**	**11.9**
Wetland / Riparian e/	Palustrine Shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Palustrine Emergent	0.0	0.0	0.0	0.0	0.0	0.0	5.6	2.4
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.7**	**2.5**
Agriculture	Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	32.1	13.8
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**32.1**	**13.8**
Developed / Barren	Urban	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.6
	Industrial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Beaches	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Roads	0.0	0.0	0.0	0.0	0.0	0.0	15.0	6.5
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**16.5**	**7.1**
Open Water	Rivers and Streams	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4
	Ditches and Canals	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	Palustrine Unconsolidated Bottom	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
	Bays and Estuaries	0.0	0.0	0.0	0.0	0.0	0.0	2.5	1.1
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.8**	**1.6**
	Project Total	**41.3**	**0.0**	**43.6**	**0.0**	**60.9**	**0.0**	**231.8**	**100.0**
	Percent of Project Total	**17.8**	**0.0**	**18.8**	**0.0**	**26.3**	**0.0**	**100.0**	

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
d/ Total miles crossed include the 0.9 mile of pipeline that would not disturb vegetation because of the HDD method and direct pipe method used to install pipeline below four waterbodies: Coos River, South Umpqua River, Rogue River, and Klamath River.
e/ Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of project impacts to wetlands.
General: Mileages may not sum correctly due to rounding. Mileages are rounded to nearest tenth of a mile; values less than 0.1 are shown as “<0.1”.).

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Pipeline Facilities: Construction Right-of-Way	Pipeline Facilities: Hydrostatic Discharge Sites d/	Pipeline Facilities: Temporary Extra Work Areas	Pipeline Facilities: Uncleared Storage Areas	Pipeline Facilities: Rock Source/ Disposal	Pipeline Facilities: Access Roads (TARs/PARs/ Improvements) e/	Pipeline Facilities: Pipe Yards	Pipeline Facilities: Aboveground Facilities - Klamath Compressor Station	Subtotals: Subtotal Late Successional – Old Growth	Subtotals: Subtotal Mid-Seral	Subtotals: Subtotal Clearcut or Regenerating	Subtotals: Subtotal by Habitat Type	Subtotals: *Percent of Vegetation Type*	Subtotals: *Percent of Total Vegetation Type*
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	25	0	1	5		<1	0	0						
		M-S	66	0	22	9	<1	<1	0	0	32	99	245	376	*13.0*	*6.8*
		C-R	138	0	78	23	5	<1	0	0						
	Douglas-fir – Mixed Deciduous Forest	L-O	73	0	20	102		<1	0	0						
		M-S	152	0	34	105	3	2	7	0	194	303	255	753	*26.1*	*13.5*
		C-R	92	<1	43	119		<1	<1	0						
	Alder-Cottonwood	L-O	0	0	0	0	0	0	0	0						
		M-S	<1	0	<1	0	0	<1	0	0	0	<1	33	34	*1.2*	*0.6*
		C-R	0	0	0	0	0	0	33	0						
	Mixed Conifer/Mixed Deciduous Forest	L-O	7	0	2	0	0	0	0	0						
		M-S	37	0	10	1	0	0	0	0	9	48	216	273	*9.5*	*4.9*
		C-R	155	0	56	5	0	<1	0	0						
	Shasta Red Fir – Mountain Hemlock Forest	L-O	18	0	1	7	0	0	0	0						
		M-S	9	0	<1	4	0	0	0	0	26	14	78	119	*4.1*	*2.1*
		C-R	45	0	17	16	0	<1	0	0						
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	9	0	3	6	0	0	0	0						
		M-S	13	0	3	6	0	2	0	0	17	23	6	46	*1.6*	*0.8*
		C-R	4	0	<1	1	0	<1	0	0						
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	273	0	50	112	2	1	0	0						
		M-S	100	0	29	41	0	<1	0	0	438	171	265	873	*30.3*	*15.7*
		C-R	157	0	45	61	<1	<1	0	0						
	Ponderosa Pine/White Oak Forest and Woodland	L-O	31	0	13	3	0	0	0	0						
		M-S	24	<1	7	<1	0	0	0	0	47	33	43	123	*4.3*	*2.2*
		C-R	29	0	8	7	0	0	0	0						
	Ponderosa Pine Forest and Woodland	L-O	11	0	2	0	0	0	0	0						
		M-S	33	0	2	0	0	<1	0	0	13	35	50	99	*3.4*	*1.8*
		C-R	39	0	9	0	<1	<1	0	0						
	Oregon White Oak Forest	L-O	30	0	10	5	0	<1	0	0						
		M-S	28	0	8	3	0	<1	0	0	45	39	0	84	*2.9*	*1.5*
		C-R	0	0	0	0	0	0	0	0						
	Western Juniper Woodland	L-O	0	0	0	0	0	0	0	0						
		M-S	34	0	7	0	<1	<1	0	0	0	42	0	42	*1.5*	*0.8*
		C-R	0	0	0	0	0	0	0	0						
	Ponderosa Pine/Western Juniper Woodland	L-O	0	0	0	0	0	0	0	0						
		M-S	12	0	1	0	0	0	0	0	0	13	48	61	*2.1*	*1.1*
		C-R	44	0	4	0	0	<1	0	0						

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

			Pipeline Facilities								Subtotals					
General Vegetation Type	**Mapped Vegetation Category Type**	**Forest Stand by Age a/,b/,c/**	**Construction Right-of-Way**	**Hydrostatic Discharge Sites d/**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal**	**Access Roads (TARs/PARs/ Improvements) e/**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal Late Successional – Old Growth**	**Subtotal Mid-Seral**	**Subtotal Clearcut or Regenerating**	**Subtotal by Habitat Type**	***Percent of Vegetation Type***	***Percent of Total Vegetation Type***
		L-O	***477***	***<1***	***101***	***240***	***2***	***2***	***0***	***0***					***28.5***	
Subtotal Forest-Woodland by Age Class		***M-S***	***508***	***<1***	***126***	***170***	***4***	***6***	***7***	***0***	***821***	***821***	***1,239***	***2,882***	***28.5***	***51.8***
		C-R	***705***	***<1***	***260***	***233***	***6***	***2***	***33***	***0***					***43.0***	
	Subtotal Forest-Woodland		**1,689**	**0**	**487**	**643**	**11**	**10**	**41**	**0**	**821**	**821**	**1,240**	**2,882**	***100.0***	
	Percent of All Forest-Woodland		***58.6***	***0.0***	***16.9***	***22.3***	***0.4***	***0.3***	***1.4***	***0.0***	***28.5***	***28.5***	***43.0***	***100.0***		
Grasslands-Shrubland	Sagebrush Steppe	n/a	62	0	14	0	7	<1	0	31	n/a	n/a	n/a	115	*21.3*	*2.1*
	Shrublands	n/a	120	<1	38	8	0	2	0	0	n/a	n/a	n/a	169	*25.1*	*3.0*
	Grasslands (West of Cascades)	n/a	116	<1	94	6	<1	2	21	0	n/a	n/a	n/a	239	*35.8*	*4.3*
	Grasslands (East of Cascades)	n/a	22	0	4	<1	1	<1	92	0	n/a	n/a	n/a	120	*17.8*	*2.2*
	Subtotal Grasslands-Shrubland		**320**	**<1**	**151**	**13**	**10**	**5**	**113**	**31**	n/a	n/a	n/a	**643**	**100.0**	**11.6**
Wetland / Riparian	Palustrine Forest	L-O	0	0	0	0	0	0	0	0						
		M-S	<1	0	<1	0	0	0	0	0	0	2	3	4	*4.0*	*0.1*
		C-R	2	0	<1	<1	0	0	0	0						
	Palustrine Shrub	n/a	<1	0	<1	0	0	0	0	0	n/a	n/a	n/a	<1	*0.9*	*0.0*
	Palustrine Emergent	n/a	65	0	34	<1	0	<1	0	0	n/a	n/a	n/a	98	*95.1*	*1.8*
	Subtotal Wetland / Riparian		**69**	**0**	**35**	**<1**	**0**	**<1**	**0**	**0**	**0**	**2**	**3**	**103**	***100.0***	***1.9***
Agriculture	Agriculture	n/a	364	<1	195	1	3	5	325	0	n/a	n/a	n/a	896	*100.0*	*16.1*
	Subtotal Agriculture		**364**	**<1**	**195**	**1**	**3**	**5**	**325**	**0**	n/a	n/a	n/a	**896**	***100.0***	***16.1***
Developed / Barren	Urban	n/a	17	0	34	<1	0	<1	11	<1	n/a	n/a	n/a	63	*6.7*	*1.1*
	Industrial	n/a	4	0	46	<1	61	<1	522	0	n/a	n/a	n/a	633	*66.8*	*11.4*
	Beaches	n/a	0	0	7	0	0	0	0	0	n/a	n/a	n/a	7	*0.7*	*0.1*
	Roads	n/a	144	0	68	17	2	<1	12	0	n/a	n/a	n/a	244	*25.8*	*4.4*
	Subtotal Developed / Barren		**166**	**0**	**155**	**17**	**63**	**<1**	**545**	**<1**	n/a	n/a	n/a	**947**	***100.0***	***17.0***
Open Water	Rivers and Streams	n/a	7	0	1	<1	<1	<1	0	0	n/a	n/a	n/a	9	*9.1*	*0.2*
	Ditches and Canals	n/a	4	0	3	0	0	<1	<1	0	n/a	n/a	n/a	7	*7.3*	*0.1*
	Palustrine Unconsolidated Bottom	n/a	<1	0	2	1	0	0	0	0	n/a	n/a	n/a	3	*3.3*	*0.1*
	Bays and Estuaries	n/a	74	0	2	0	0	0	0	0	n/a	n/a	n/a	76	*80.3*	*1.4*
	Subtotal Open Water		**86**	**0**	**7**	**2**	**<1**	**<1**	**<1**	**0**	n/a	n/a	n/a	**95**	***100.0***	***1.7***
	Subtotal Non-Forest		**1,005**	**<1**	**543**	**33**	**76**	**11**	**983**	**32**	**0**	**2**	**3**	**2,683**		***48.2***
	Percent of All Non-Forest		***37.5***	***0.0***	***20.2***	***1.2***	***2.8***	***0.4***	***36.6***	***1.2***	***0.0***	***0.1***	***0.1***	***100.0***		
Project Total		n/a	**2,694**	**1**	**1,030**	**676**	**87**	**21**	**1,024**	**32**	**821**	**822**	**1,242**	**5,565**		
Percent of Pipeline Facilities		n/a	***48.4***	***0.0***	***18.5***	***12.1***	***1.6***	***0.4***	***18.4***	***0.6***	***14.8***	***14.8***	***22.3***	***100.0***		

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

TABLE 4.5.1.2-2

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites d/	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements) e/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*

c/ The "Clearcut or Regenerating" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

d/ Small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. Minimal soil disturbance would occur. A rubber-tired hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

e/ Portions of some of the PARs are located within the construction right-of-way and there is some duplication in the acreage calculations. Impacts associated with existing access roads that would be improved (e.g., widening) would affect an additional 14 acres. Vegetation types affected by existing road improvement activity identify the vegetation type adjacent to the access road, although the majority of the 14 acres is assumed to be road surface or immediate roadside that has been previously disturbed.

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/)								Aboveground Facilities (acres a/)																		
			30-foot Maintenance Corridor	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	Total Operation Impacts by Vegetation Type f/
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	8	0					14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	17	0	8	17	43	68	29	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**72**
		C-R	43	0					72	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Douglas-fir – Mixed Deciduous Forest	L-O	23	<1					39	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0		
		M-S	47	<1	23	47	29	99	79	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	**99**
		C-R/	29	0					49	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Alder-Cottonwood	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	<1	0	0	<1	0	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Mixed Conifer/Mixed Deciduous Forest	L-O	11	0					18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	11	0	11	11	42	64	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	**61**
		C-R	42	<1					70	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Shasta Red Fir – Mountain Hemlock Forest	L-O	6	0					10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	3	0	6	3	15	24	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	**24**
		C-R	14	<1					24	<1	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0		
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	3	0					5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	4	0	3	4	1	8	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**
		C-R	1	0					2	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	86	0					143	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	31	0	86	31	50	167	52	<1	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1	**167**
		C-R	50	<1					84	<1	0	0	0	<1	0	0	0	0	<1	0	0	0	0	0	0	0	0		
	Ponderosa Pine/White Oak Forest and Woodland	L-O	10	0					17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	7	0	10	7	9	26	12	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**26**
		C-R	9	0					15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Ponderosa Pine Forest and Woodland	L-O	4	0					6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	10	0	4	10	12	26	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**26**
		C-R	12	0					20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Oregon White Oak Forest	L-O	9	0					15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	9	0	9	9	0	18	15	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**18**
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/): *30-foot Maintenance Corridor*	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Aboveground Facilities (acres a/): Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	Total Operation Impacts by Vegetation Type f/
	Western Juniper Woodland	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	11	0	0	11	0	11	19	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**11**
		C-R	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Ponderosa Pine/Western Juniper Woodland	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	4	0	0	4	14	18	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	**18**
		C-R	14	<1					23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0		
Subtotal Forest-Woodland by Age Class		***L-O***	158	<1					265	**2**	***0***	***0***	***0***	***0***	***0***	***0***	***<1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***<1***	***150***
		M-S	156	<1	158	156	215	530	260	**5**	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***<1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***<1***	***158***
		C-R	215	<1					360	**2**	***0***	***<1***	***0***	***<1***	***0***	***0***	***0***	***0***	***<1***	***0***	***0***	***0***	***<1***	***<1***	***0***	***0***	***0***	***<1***	***222***
Subtotal Forest-Woodland			**530**	**<1**	**158**	**156**	**215**	**530**	**885**	**9**	**0**	**<1**	**0**	**<1**	**0**	**0**	**<1**	**0**	**<1**	**0**	**0**	**0.0**	**<1**	**<1**	**0**	**0**	**0**	**<1**	**530**
Grassland-Shrubland	Sagebrush Steppe	n/a	19	<1	n/a	n/a	n/a	19	31	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	31	**49**
	Shrublands	n/a	38		n/a	n/a	n/a	39	64	2	0	0	0	0	0	0	0	0	0	0	0	<1	0	<1	0	0	0	<1	**39**
	Grasslands (West of the Cascades)	n/a	37	<1	n/a	n/a	n/a	38	62	1	0	0	0	0	0	<1	0	<1	0	<1	0	0	0	0	0	0	0	<1	**38**
	Grasslands (East of the Cascades)	n/a	7	<1	n/a	n/a	n/a	7	12	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**7**
Subtotal Grasslands-Shrubland			**101**	**<1**	n/a	n/a	n/a	102	***169***	**4**	**0**	**0**	**0**	**0**	**0**	**<1**	**0**	**<1**	**0**	**<1**	**0**	**<1**	**0**	**<1**	**0**	**0**	**31**	**31**	**132**
Wetland/ Riparian	Palustrine Forest	L-O	0	0					*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		M-S	<1	0	0	<1	<1	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
		C-R	<1	0					<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Palustrine Shrubland	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Palustrine Emergent	n/a	18	<1	n/a	n/a	n/a	18	30	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**20**
Subtotal Wetland/Riparian			**19**	**<1**	n/a	n/a	n/a	**19**	***32***	<1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**22**
Agriculture	Agriculture	n/a	116	<1	n/a	n/a	n/a	117	193	<1	0	0	<1	0	<1	<1	0	0	0	0	<1	0	0	0	<1	<1	0	1	**117**
Subtotal Agriculture			**116**	**<1**	n/a	n/a	n/a	**117**	***193***	<1	**0**	**0**	**<1**	**0**	**<1**	**<1**	**0**	**0**	**0**	**0**	**<1**	**0**	**0**	**0**	**<1**	**<1**	**0**	**1**	**117**
Developed / Barren	Urban	n/a	5	<1	n/a	n/a	n/a	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	**6**
	Industrial	n/a	1	0	n/a	n/a	n/a	1	2	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
	Beaches	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Roads	n/a	56	<1	n/a	n/a	n/a	56	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**54**
Subtotal Developed / Barren			**62**	**<1**	n/a	n/a	n/a	**63**	***101***	**0**	**<1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**<1**	**<1**	**61**

TABLE 4.5.1.2-3

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project

Mapped Vegetation Category	Type	Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/): 30-foot Maintenance Corridor	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Road Improvements	Aboveground Facilities (acres a/): Jordan Cove MS & BVA #1 e/	BVA #2	BVA #3	BVA #4	BVA #5	BVA #6, Clarks Branch Meter Station	BVA #7	BVA #8	BVA #9	BVA #10	BVA #11	BVA #12	BVA #13	BVA #14	BVA #15	BVA #16	Klamath CS, BVA #17, MS	Subtotal Aboveground Facilities	Total Operation Impacts by Vegetation Type f/
Open Water	Rivers and Streams	n/a	3	<1	n/a	n/a	n/a	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**
	Ditches and Canals	n/a	1	<1	n/a	n/a	n/a	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
	Palustrine Unconsolidated Bottom	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Bays and Estuaries	n/a	9	0	n/a	n/a	n/a	9	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**
Subtotal Open Water			**13**	**<1**	n/a	n/a	n/a	13	**22**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**14**
Subtotal Non-Forest			313	2	n/a	n/a	n/a	315	518	**5**	**0**	**0**	**<1**	**0**	**<1**	**<1**	**<1**	**<1**	**0**	**<1**	**<1**	**<1**	**0**	**<1**	**<1**	**<1**	**31**	**33**	**347**
Project Total			**843**	**2**	**158**	**156**	**215**	**845**	**1,404**	**14**	**0**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**<1**	**31**	**34**	**877**

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, 50-foot permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.
b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.
c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
d/ The "Clearcut or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years).
e/- CT = Communications tower
f/ Total by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves are located within the 30-foot maintenance corridor).
Columns and rows do not necessarily sum correctly due to rounding.
Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this EIS.
Shaded cells identify acres of vegetation type within the defined area but are not included in the overall Project total because: 1) only the 30-foot Maintenance Corridor included within the 50-foot Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the Project.

Short-Term Impacts

Impacts are considered short term if, after three growing seasons, the revegetated disturbed areas resemble adjacent undisturbed lands. Vegetated areas that have the potential for revegetation within three growing seasons include agricultural lands and areas dominated by grass and shrubs. For example, short-term revegetation in shrublands is possible because riparian shrubs removed during construction would be replaced by cuttings and sprigs of locally available shrub species during restoration/reclamation. Approximately 896 acres of agricultural lands and 643 acres of grassland-shrubland areas would experience short-term temporary impacts (see table 4.5.1.2-2).

Short-term impacts would also include areas within the UCSAs. UCSAs are work areas that would not be cleared of vegetation during construction. The UCSAs would be used to store forest slash, stumps, as well as dead and downed log materials that would be scattered across the right-way after construction. These areas may also be used to store spoil and park construction equipment and other vehicles. UCSAs would be located in mature forests and areas where the slopes of the soils would preclude the areas from being cleared (i.e., in order to minimize erosion risks) or along narrow ridgelines. In forests, these areas are characterized by trees that are sufficiently spaced to allow for storage of cleared right-of-way vegetation. EIs would rope off stands of mature trees and operators would be required to place and retrieve materials in such a manner as to minimize impacts such as soil compaction and bark damage. There would be approximately 676 acres of short-term impacts related to UCSAs (note that this value double counts some of the short-term impacts listed above, and includes impacts in forested and non-forested UCSA).

Within UCSAs located in forests and woodlands, some damage to understory vegetation and minor damage to trees would be expected. Trees that are damaged at the time of construction could die over time (in these cases, the impact would be long term; i.e., the death of a tree would be considered a long-term and permanent impact. See the discussion below for more details). Vegetation disturbance would generally depend on the site-specific vegetation characteristics, with younger revegetating forests being potentially more susceptible to damage such as limb breakage. UCSAs would impact approximately 643 acres of forest and woodland communities (see table 4.5.1.2-2). Of this, approximately 240 acres would occur to LSOG forests (i.e., forests areas where the majority of trees are over 80 years of age), 170 acres to mid-seral forests (i.e., forests where the majority of trees are over 40 years in age but under 80 years), and 233 acres of clearcut/grass-shrub-sapling or regenerating forests (i.e., clearcut consists of trees age 0 to 5 years in age while regeneration forest contain trees 5 to 40 years in age).

To protect trees within UCSAs, Pacific Connector would implement the measures outlined in its *Leave Tree Protection Plan*.[76] After construction, Pacific Connector would assess potential tree damage within the UCSAs and would appropriately compensate the landowner for damage. Appropriate restoration measures in areas were disturbance occurred would be applied as described in Pacific Connector's ECRP (e.g., scarification prior to seeding grasses and forbs; subsoiling prior to the replanting of deep-rooted trees and shrubs especially in areas where water infiltration is of prime importance, such as within riparian areas; etc.). Compacted soils would be scarified or subsoiled, depending on the vegetation to be restored, after use and prior to the

[76] This plan was included as Appendix P to Pacific Connector's POD, and filed as a stand-alone document with the June application to the FERC, as Appendix P (see table 2.1.4-1 in this EIS).

rainy season to promote revegetation and ensure that soil disturbance caused by pipeline construction would not permanently impact long-term site productivity. UCSAs and their utility to the Pacific Connector pipeline are discussed in more detail within section 2.3.2.1.

Short-term impacts would also include affected areas around hydrostatic test discharge sites. Pacific Connector has stated that portions of these sites may be cleared of small brush or trees either by mechanical means or by hand in order to position hay bales or filter bags. The six hydrostatic discharge sites, located outside of the construction right-of-way, would impact approximately 1 acre (less than a quarter acre of which would occur in forested areas) and would be revegetated as necessary following construction.

Long-Term Impacts (e.g., permanent impacts)

Long-term impacts would last longer than three growing seasons within the disturbed area and in some cases they would not resemble adjacent undisturbed lands for the life of the pipeline project (e.g., some long-term impacts would be permanent). For example, areas with trees and shrubs removed from coniferous, deciduous, and mixed forests would have long-term impacts. Particularly, mature trees would not regenerate during the life of the project, so their removal would be a long-term loss. The pipeline route would cross a total of about 145.9 miles of forest-woodlands areas (table 4.5.1.2-1). Construction of the Project would result in approximately 821 acres of impact to LSOG forests, 821 acres of impact to mid-seral forests, and 1,240 acres of impact to clearcut/regenerating forests (table 4.5.1.2-2); however, as discussed above, some of these impacts would occur as a result of UCSAs (which would not be cleared of vegetation, and would only result in long-term impacts if trees were damaged, resulting in loss of vigor or death of trees over time). Impacts to forested-woodlands areas, excluding UCSAs, would consist of 581 acres of LSOG, 651 acres of mid-seral forests, and 1,007 acres of clearcut/regenerating forests (table 4.5.1.2-2).

In addition, a portion of this initial construction impact would remain for the life of the Pacific Connector pipeline (i.e., would be a permanent impact), due to the permanent right-of-way maintenance, access roads, and aboveground facilities. Permanent impacts would occur at all aboveground facilities, within the operational footprint. At those locations, vegetation would be removed during construction, but not revegetated during restoration. Instead, structures would be installed at the aboveground facilities locations, and their yards would be covered by gravel during restoration. Permanent impacts to forested habitats would include approximately 150 acres LSOG forests, 158 acres of mid-seral forests, and 222 acres of clearcut/regenerating forests (table 4.5.1.2-3).

Operational right-of-way maintenance, access roads, and aboveground facilities would affect non-forested/woodland habitats as well. Permanent disturbance features (such as right-of-way maintenance, access roads, and aboveground facilities) would encompass approximately 347 acres of non-forested/woodland habitats, including 132 acres of grasslands/shrublands, 22 acres of wetlands, 117 acres of agricultural areas, 61 acres of barren/developed areas, and 14 acres of open water (table 4.5.1.2-3).

Additional long-term impacts would include the cutting of danger trees, which are defined as trees located outside approved construction areas that are at risk of falling on workers or vehicles and thus would need to be removed. The removal of these trees would result in an additional long-term impact to adjacent vegetation that cannot be quantified prior to construction. Landowners would be compensated for the removal of danger trees. Danger trees are discussed further in section 4.5.2.2.

Comments were received on the DEIS questioning how the cleared pipeline right-of-way may increase the chance for wind blowdowns. Wind is the major natural disturbance agent that affects forest dynamics. Trees can be blown down during high wind events (i.e., “windthrow”), resulting in the loss of some trees. The severity and frequency of wind disturbance is determined by many interrelated factors, including tree size and vitality, slope aspect, soil characteristics, stand composition, canopy structure, as well as the characteristics of the surrounding topography (i.e., as it affects wind flow). The Project’s proposed vegetation clearing in forested habitats has the potential to exacerbate the rate of windthrow in adjacent forest stands. Long-term forest stand degradation due to windthrow could potentially occur in local areas along the proposed right-of-way where the route is exposed to strong winds, especially where it runs perpendicular to the direction of the prevailing wind.

General Measures to be Implemented to Reduce or Mitigate Impacts on Vegetation

During construction and restoration, Pacific Connector would implement measures to minimize impacts on vegetation and ensure successful revegetation of disturbed areas. These measures include those found in the ECRP, *Leave Tree Protection Plan*, *Integrated Pest Management Plan*, and the SPCCP. These measures would be applied to all lands crossed by the pipeline route; however, federal land-managing agencies may impose additional measures on federal lands. Measures specific to federally managed lands are addressed below in section 4.5.1.3. General measures that would be implemented to minimize impacts on vegetation and ensure successful revegetation of disturbed areas include:

- UCSAs would be used in some places instead of TEWAs, with trees left in place.
  - No materials would be stored in aquatic areas such as streams or wetlands.
- In areas where the UCSAs may be used to store spoil, slash, stumps, logs, or to temporarily park equipment between the mature trees, these activities would not occur immediately adjacent to the tree to minimize impacts.
- The construction right-of-way would be limited to 75 feet based at stream and wetland crossings.
- TEWAs would be located 50 feet back from streams and wetlands, except where site-specific conditions would not allow (see table P-1 in appendix P).
- Topsoil would be segregated in agricultural and residential area, or where requested by landowners.
- The construction right-of-way would be graded to restore pre-construction contours and leave the soil in proper condition for seeding or planting.
- Damage to drain tiles or irrigation systems resulting from construction in active agricultural areas would be corrected and monitored until restoration is successful.
- Landscaped areas would be restored in accordance with the landowner’s request, or the landowner would be compensated (e.g., where mature trees are removed and can’t be replaced in kind).

- Restoration plans would include measures for re-establishing herbaceous or woody vegetation, controlling the establishment or spread of invasive species, weed control, and monitoring.
- Disturbed areas would be seeded in accordance with written recommendations for seed mixes, rates, and dates obtained from the local conservation authority or as requested by the landowner. Seed stock mixtures would be native seeds that are genetically and geographically adapted to local site conditions.
- Manufactured wood fiber mulch would be applied as hydromulch at 2,000 pounds per acre during hydroseeding. A tackifier or bonding agent recommended by the manufacturer would be used to bond the wood fiber mulch to the soil surface.
- Disturbed areas would be seeded within 6 working days of final grading, weather and soil conditions permitting.
- Fencing or other measures would be used to exclude cattle from entering sensitive reclamation areas in order to protect/enhance areas.
- A standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer (16:16:16 - nitrogen, potassium, and phosphorus) would be used on all disturbed areas to be reseeded.
- Seedbed preparation would be conducted, where necessary, immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to eliminate weeds which may have developed between initial reclamation and seeding.
- Pacific Connector would use certified weed-free straw for any mulch used during seeding. In addition, certified weed-free straw would be used for mulch and sediment barriers, dewatering structures, or other uses along the right-of-way. The EI or Pacific Connector's authorized representative would be responsible for ensuring that all straw hauled to the construction yards would be certified weed-free.
- All disturbed areas would be monitored each growing season until revegetation is considered successful, as compared to nearby undisturbed site vegetation of the same plant association. Any new locations of noxious weed infestations would be recorded and treated.
- Slash from timber clearing would be scattered across the right-of-way in order to return organic material to the soil and serve as erosion control.
- Revegetation in non-agricultural areas would be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands (not including landscaped areas). In agricultural areas, revegetation would be considered successful if crop yields are similar to adjacent undisturbed portions of the same field.
- All disturbed forests outside of the 30-foot maintenance corridor would be replanted. Approximately 1,800 acres would be replanted with native conifer species of the local seed source in forested areas outside of the 30-foot maintenance right-of-way, and 30 acres of hardwoods of the local seed source would be replanted within forested, shrub and riverine wetlands.

- In riparian areas on private lands, shrubs and trees would be replanted across the right-of-way for a width based on ODF's Riparian Management Area widths.
- Vegetation within the upland portion of the 30-foot maintenance corridor, centered over the pipeline, would be maintained in an herbaceous/shrub state of less than 6 feet in height. The remainder of the operational easement outside of 15 feet on each side of the pipeline centerline would be fully restored and revegetated in accordance with the ECRP, using native species.
  - The 30-foot maintenance corridor would be periodically maintained using mowing, cutting, and trimming either through mechanical methods or by hand. Maintenance activities are expected to occur approximately every three to five years depending on the vegetation's growth rate.
  - Routine vegetation maintenance clearing would not occur more frequently than every three years, except as necessary for the 10-foot-wide corridor centered over the pipeline that could be maintained annually if necessary.
  - Routine vegetation maintenance clearing would not occur during the principal portion of the growing season from April 15 to August 1.
  - Ground-based mechanized vegetation clearing/maintenance work would only be performed between August and October (outside of the principal rainy season).
  - Compaction of soils would be prevented through the implementation of the ECRP.
  - Outside of the 30-foot maintenance corridor, the permanent easement would not be maintained in order to allow mature trees to re-establish.
- Prior to construction or disturbance, areas of known noxious weeds may be pretreated with herbicides.
  - Mostly hand and mechanical methods (pulling, mowing, disking) would be used to remove weeds, with some spot use of herbicides. Herbicides would not be used within 100 feet of a waterbody or wetland. Boulders and other large rocks generated by construction activities would be used to block OHV access to the right-of-way.

Noxious Weeds

As discussed above for the LNG terminal site, noxious weeds and other invasive plant species are non-native species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground has been disturbed, and their presence can hinder restoration.

The ODA Noxious Weed Control Program and the OSWB maintain the State Noxious Weed List for the State of Oregon. Noxious weeds listed as Class "T" (i.e., target species) that have the potential of occurring in the area of the pipeline are listed in table 4.5.1.2-4.

TABLE 4.5.1.2-4

Oregon Target Weeds (Class T) (a/) Suspected within or Near the Proposed Pacific Connector Pipeline Work Area

Noxious Weed Common and Scientific Name	Known or Suspected Occurrences: County b/	Known or Suspected Occurrences: Forest Service Region 6 d/	Known or Suspected Occurrences: BLM Districts d/	Oregon DOA Class e/
Garlic mustard *Alliaria petiolata*	Jackson (L)			B
Plumeless thistle *Carduus acanthoides*	Klamath (L)			A
Woolly distaff thistle *Carthamus lanatus*	Douglas (L) Jackson c/		MD	A
Spotted knapweed *Centaurea stoebe*	Coos (L) Douglas (L) Jackson (L) Klamath (L)	Yes UMP	MD KF	B
Squarrose knapweed *Centaurea virgata*	Klamath c/		MD KF	A
Rush skeletonweed *Chondrilla juncea*	Douglas (W) Jackson (W)	UMP	MD KF	B
Field bindweed *Convolvulus arvensis*	Coos (W) Douglas (W) Jackson (W) Klamath (W)			B
Portuguese broom *Cytisus striatus*	Douglas (W)			B
Paterson's curse *Echium plantagineum*	Douglas (L)			A
Leafy spurge *Euphorbia esula*	Douglas (H) Jackson (W)		MD	B
Orange hawkweed *Hieracium aurantiacum*	Klamath (L)			A
Perennial pepperweed *Lepidium latifolium*	Klamath (W)			B
Dalmatian Toadflax *Linaria dalmatica* (*L. genista*)	Jackson (L) Klamath (W)	Yes	KF	B
Matgrass *Nardus stricta*	Klamath (L)			A
Taurian thistle *Onopordum tauricum*	Klamath (L)			A
Tansy ragwort *Senecio jacobaea*	Coos (W) Douglas (W) Jackson (L) Klamath (H)	Yes UMP	CB MD KF	B
Smooth cordgrass *Spartina alterniflora*	Coos (L)			A
Saltcedar *Tamarix ramosissima*	Klamath (L)			B
Gorse *Ulex europaeus*	Coos (W) Douglas (L) Jackson		CB	B

a/ Source: ODA 2012a; Forest Service 2005b
b/ Letter in parenthesis indicates distribution within the county, if provided (ODA 2012a). L = Limited, W = Widespread, and H = Historic. No letter indicates county not listed on the ODA (2012a) species fact sheet
c/ Medford BLM District indicated that this species is found in the listed county.
d/ Forest Service and BLM District Codes: UPM–Umpqua NF, CB–Coos Bay BLM, MD–Medford BLM, KF–Klamath Falls BLM, "Yes" indicates that it is document or suspected to occur in Forest Service Region 6 but not necessarily within forests crossed by the Pacific Connector pipeline.
e/ Oregon Noxious Weed List: Class "A" weeds occur in small enough infestations to make eradication or containment possible or is not known to occur in Oregon, but is present in neighboring states making occurrence in Oregon seem imminent. Class "B" weeds are regionally abundant, but may have limited distribution in some counties. Class "T" weeds are selected from the "A" or "B" lists and are designated as a target species

Note that table 4.5.1.2-4 only lists Class T weeds that have the potential to occur along the pipeline route; however, there are other weed species (e.g., non-Class T species) that are also of concern and could occur along the pipeline project. For example, land-managing agencies are concerned with the management of Medusahead rye (*Taeniatherum caput-medusae*), which is a Class B weed-species (with no Class T status) that has the potential to occur along the pipeline route. All Oregon State noxious weeds that could potentially occur along the pipeline project (including Class A and B species) are listed in Table 3C-4 of Appendix C in Resource Report 3, which was included in Pacific Connector's application to the FERC.

Multiple noxious weeds were documented along the pipeline route during botanical surveys (table 4.5.1.2-5). Occurrences of these weed species would increase the potential for new or expanded growth of noxious weeds as a direct consequence of pipeline construction. Of the weeds documented within the pipeline project area during surveys, only rush skeletonweed, Dalmatian toadflax, and tansy ragwort were Class T weeds (see table 4.5.1.2-4 and 4.5.1.2-5). The basic traits of these three Class T weeds are summarized below:

- Rush skeletonweed readily invades areas of recent disturbance, such as rangelands and pastures. It occurs in Douglas and Jackson Counties in the area of the pipeline, and was found at the following mileposts along the pipeline route: 63.5-63.8, 64.1-64.2, 67.1-67.3, 67.9, 69.0, 69.1, 70.2-70.3, 76.3, 94.7, and 98.3-98.4.
- Dalmatian toadflax thrives in arid rangelands and pastures, and can out-compete desirable forage plants in these areas. It occurs in Jackson and Klamath Counties in the area of the pipeline. It was found at the City of Klamath Falls Pipe Yard, at MP 160.3.
- Tansy ragwort is often found in pastures, clearcuts, and disturbed roadsides. The seeds can remain viable in the soil for many years. The plant is toxic to cattle and horses. It occurs in Coos, Douglas, Jackson, and Klamath Counties in the area of the pipeline, and was found at the following mileposts along the pipeline route: 47.7-47.7, 48.2-48.4, 51.5-51.5, 75.4, 90.3, 91.5-91.7, 93.0, 93.4-93.5, 97.1-97.7, 98.6-99.3, 105.7-105.8, 108.13, 109.8, and 110.2.

TABLE 4.5.1.2-5

Summary of Noxious Weeds found Along the Pacific Connector Pipeline Route during Surveys a/

Common Name *Scientific Name*	**Oregon DOA Class**	**Oregon DOA Target "T" Weed**	**Number of Incidences on Right-of-Way**
Meadow knapweed *Centaurea pratensis*	B	No	7
Yellow starthistle *Centaurea solstitialis*	B	No	18
Rush skeletonweed *Chondrilla juncea*	B	Yes	10
Canada thistle *Cirsium arvense*	B	No	11
Scotch broom *Cytisus scoparius*	B	No	10
English ivy *Hedera helix*	B	No	1
St. Johnswort *Hypericum perforatum*	B	No	2
Dalmation toadflax *Linaria dalmatica (L. genista)*	B	Yes	1
Purple loosestrife *Lythrum salicaria*	B	No	1
Japanese knotweed *Polygonum cuspidatum*	B	No	1
Himalayan blackberry *Rubus discolor*	B	No	40
Tansy ragwort *Senecio jacobaea*	B	Yes	14

a/ Although it was not discovered during surveys (which is why it is not listed in the table), the Forest Service has indicated that at least two populations of Medusahead rye (a Class B weed) are located along the pipeline route.

Although surveys were conducted at an appropriate time of year to identify weed species, the discovery of these weed species during surveys does not indicate that other noxious weeds are not also present within the pipeline right-of-way (for example, additional weeds species may be present in the seedbank). If additional infestations or other invasive/noxious weed species are found, then these would be controlled and monitored as well. Measures aimed at preventing the spread of invasive species and noxious weeds were designed to prevent the spread of all weeds species, not just those that were identified during surveys.

Short- or long-term impacts on any vegetation community could result from establishment and spread of noxious weeds following construction. Noxious weeds can adversely affect an area either when invasive plants become established or when an existing species' population size increases. Invasive or noxious plants can negatively affect habitat by competing for resources such as water and light, changing the community composition, eliminating or reducing native plants, or changing the vegetation structure. The changes in community composition or vegetation structure can reduce native plant populations and can also negatively affect habitat for wildlife. Soil disturbance and/or removal of existing vegetation for pipeline or road construction can provide openings for invasive or noxious plants to establish or spread. Movement of equipment can also provide opportunities for seed transport into new areas. Direct effects of invasions can include the establishment or spread of invasive or noxious plants through the use of new roads after construction, maintenance activities, or by providing a corridor for the establishment and spread of invasive or noxious plants to adjoining lands. In general, habitats with more bare ground, such as grasslands, riparian areas, and relatively dry or open forests, are more susceptible to invasion than are dense, moist forests, high montane areas, and serpentine areas that have relatively closed canopy cover or have extreme climate or soils that are tolerated by fewer invasive plant species. Due to the connectivity of lands by roads and their use, the potential effects of invasive or noxious plants are not limited to the area of initial Project-related disturbance.

Pacific Connector's ECRP includes measures to control noxious weeds, soil pests, and forest pathogens. In addition, Pacific Connector developed an *Integrated Pest Management Plan,*[77] in consultation with the ODA (Butler 2006), BLM, and the Forest Service, to minimize the potential spread and infestation of weeds along the construction right-of-way. This plan can be found in Appendix N to the POD, which was included in Pacific Connector's application to the FERC. This plan includes requirements for surveys conducted prior to construction to determine the presence of noxious weeds; cleaning of construction equipment (in areas where weeds have been identified or when leaving these areas) to prevent the import and spread of weeds; and vegetation clearing and grading requirements in areas of noxious weeds. Additionally, disturbed areas would be replanted with appropriate seed mixes to prevent noxious weed germination. After construction, the right-of-way would be monitored and any noxious weed infestations would be controlled. Pacific Connector would also investigate noxious weed issues raised by landowners during operation of the pipeline.

Construction equipment would be power washed, if necessary, as determined by the EI. In addition, initial inspections of all company and construction contractor vehicles would be performed prior to being allowed on the construction right-of-way. The EI or Pacific Connector's authorized representative would be responsible for performing inspections and registering or tagging the equipment prior to being transported or moved to the right-of-way. Any equipment used within areas where noxious weeds are present (specifically those that are classified as priority A and T as well as selected B listed weeds) would be cleaned by hand, blown down with air, or pressure washed prior to leaving the site. Equipment cleaning on the

[77] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC in June 2013.

right-of-way would occur in a cleaning station approved by the EI. Infested areas and cleaning stations would be mapped to ensure that these areas are monitored during construction and to ensure that weeds at these areas are controlled and not spread.

After construction, Pacific Connector would monitor the right-of-way for infestations of noxious weeds, in compliance with their *Integrated Pest Management Plan*. Targeted weed monitoring would occur in the areas where noxious weeds were identified prior to construction and were previously mapped to ensure that potential infestations do not reestablish and/or spread. Monitoring would also occur in areas along the right-of-way where equipment cleaning stations, hydrostatic dewatering sites, and other temporary project disturbances were located to ensure that infestation at these locations do not occur. Pacific Connector's operational staff or their contractors (limited to personal qualified in noxious weed identification) would be responsible for these monitoring efforts. If infestations occur along the right-of-way, Pacific Connector would make an assessment of the source of the infestation, the potential for the infestation to spread, and develop a treatment plan to control the infestation. The treatment plan would be developed using integrated weed management principles, and if herbicides are used, all applicable approvals would be obtained prior to their use including landowner approvals. Only herbicides that are approved for use on the affected lands (private, state, or federal) would be used. Herbicide treatments would not be conducted during precipitation events or when precipitation is expected within 24 hours to minimize the risk of these chemicals moving beyond the treated areas or into waterbodies. If weeds targeted for herbicide treatments are in the vicinity of sensitive sites, proper buffers would be used in order to prevent the spread of herbicides to these areas. Pacific Connector would consult with the ODA Noxious Weed Control Program or local County Weed Programs for additional support regarding noxious weed control issues that may occur during the pipeline operations. Pacific Connector would conduct follow-up inspections of all disturbed areas until revegetation is successful.

Vegetation Pathogens

In Oregon, the Forest Service and ODF conduct annual aerial surveys of all forested land to determine insect and disease activity status. The surveys indicated the following insect and/or disease activity within 0.5 mile of the pipeline route: Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, lodgepole pine needle cast, and Port-Orford-cedar root disease. Table 3C-3 in the applicant's Resource Report 3 lists the location (by MP when known) of each identified pathogen near the pipeline route. Within the pipeline project area, the western pine beetle and fir engraver are most prevalent. Other diseases that may occur or have potential to occur within the pipeline project area are annosus root rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease. Below are general descriptions of each disease and insect infestation known along the pipeline route.

<u>Douglas-fir Beetle (ODF 2007)</u>

The Douglas-fir beetle is a medium-sized, brown to black colored beetle that exclusively infects Douglas-fir (standing or down trees with diameter at breast height greater than 8 inches). Douglas-fir beetle can be found almost anywhere its host occurs; however, it rarely kills its host tree in the lower elevation of interior southwest Oregon, where the flat-headed borer is usually the cause of Douglas-fir mortality. Two attacks generally occur throughout the year, with an initial attack from April through June, producing piles of reddish or yellowish dust, and then a secondary attack from July through August. The pipeline is adjacent to or intersects documented Douglas-fir beetle infestations on private lands, BLM lands, and lands managed by the Forest Service.

Fir Engraver Beetle (ODF 2005a; Forest Service 2006b)

Fir engraver beetle occurs in mature and pole-sized true fir (grand, white, red, noble), Douglas-fir, Engelmann spruce, and occasionally hemlocks. An attack from fir engraver beetles generally occurs from June through September and can result in dead branches, top kill, or tree mortality. Although outbreaks are often associated with drought events, fir engravers are opportunistic and will invade trees that are stressed during wetter years (i.e., affected by root disease or wounded). The pipeline is adjacent to or intersects documented fir engraver infestations on private lands, BLM lands, as well as lands managed by the Forest Service.

Flatheaded Borer (ODF 2002; Forest Service 2006b; Nelson et al. 2004)

Trees that typically serve as the host for this beetle include Douglas-fir, true firs, western larch, spruce, and western hemlock. The flatheaded borer typically attacks weakened, dead, and recently felled trees in the upper crown resulting in topkill; however, it can infest an entire tree. Outbreaks are usually associated with dead or severely damaged trees, especially after disturbance events such as drought, storm damage, or fire. Within southwest Oregon, this beetle is aggressive, often attacking trees on the edge of stands or adjacent to newly created corridors. In 2003, a greater than 50 percent increase of flatheaded borer infestation was observed in southwestern Oregon. The pipeline route would cross through known occurrences of the flatheaded borer.

Mountain Pine Beetle (ODF 2005b; Forest Service 2006b; Nelson et al. 2006)

This destructive beetle can cause landscape-level tree mortality. Attacks occur most often in dense stands of lodgepole, sugar, western white, and ponderosa pine. Thinning stands of pine is recommended to reduce the severity of mountain pine beetle outbreaks. Within Oregon, mountain pine beetle infestations have increased significantly in the last five years. The current outbreak is expected to continue at least another decade. The pipeline is adjacent to or intersects documented mountain pine beetle infestations.

Western Pine Beetle (Forest Service 2006b)

The host for this beetle is ponderosa pine in southwest Oregon. Successful attacks will kill the host tree. Characterized by dying old-growth trees scattered within a stand or groups of trees in overstocked stands of second growth. Trees weakened by drought or fire damage are especially susceptible. Thinning overstocked ponderosa pine stands and removing infested trees would help reduce the hazard of western pine beetle attacks. The pipeline is adjacent to or intersects documented western pine beetle infestations.

Lodgepole Pine Needle Cast (Hunt 1995; Forest Service 2006b)

This disease results in a severe and sudden loss of needles in coniferous trees. Although it can be caused by insects, drought, excessive shading, or poor soil, needle loss in lodgepole is usually a result of the fungal disease, *Lophodermella* ssp. Spores released from previously infected year-old needles in early summer affect the current year's new needle growth. Trees infected for several years become more susceptible to other diseases. Other than avoiding plantings with offsite stock, no management is usually warranted. Infected sites are unknown; however, Lodgepole Pine Needle Cast most likely exists within the project area.

Port-Orford-Cedar Root Disease (Roth et al. 1987; Forest Service and BLM 2004; Nelson et al. 2006)

This disease is caused by the fungus *Phytophthora lateralis* that infects approximately 9 to 15 percent of federally administered Port-Orford-cedar acreage. The pathogen enters through roots and is usually fatal to old growth or sapling trees it infects. The fungus is spread from soil movement associated with construction and road maintenance, off-road traffic, movement of surface water from infected to uninfected areas, off-road traffic (both walking and motorized), and transfer by hooves of cattle and game animals (Roth et al. 1987; Forest Service and BLM 2004; Nelson et al. 2006). Port-Orford-cedar is geographically limited to southwest Oregon and northwest California and is an ecologically and economically important tree. The root disease is known to occur in Coos and Douglas Counties. The root disease is documented within 0.1 mile of the pipeline route and is known to occur in Coos Bay, Roseburg, and Medford BLM Districts. Appendix R-7 provides additional information on this topic.

Annosus Root and Butt Rot (Schmitt et al. 2000; Hadfield et al. 2006; Forest Service 2006b)

This disease is caused by the pathogen *Fomes annosus*, which can infect all conifers. The most susceptible tree species in the Pacific Northwest are western hemlock, mountain hemlock, grand fir, white fir, and Pacific silver fir. Infected trees suffer root and butt decay and root mortality, which result in reduced vigor, windthrow, predisposition to bark beetles, and eventual mortality. It can spread by windblown spores that germinate on freshly exposed wood (i.e., stumps or wounded trees) or underground transfer from diseased roots to uninfected roots. On the west side of the Cascades, stump infection can occur any time of the year, whereas on the east side of the Cascades, stump infection occurs in the spring and autumn. Infected sites are unknown within the pipeline project area; however, annosus root rot is known to be increasing in Oregon. *F. annosus* may occur within the pipeline project area because western and mountain pine beetles and fir engraver infestations exist and they are known to attack trees infected with *F. annosus*.

Laminated Root Rot (Forest Service 2006b; Nelson et al. 1981)

This disease is caused by a native fungus, *Phellinus weirii,* and infects all conifers, but the most susceptible trees are Douglas-fir, mountain hemlock, grand fir, and white fir, which are often killed. The infected trees usually show evidence of slow crown decline, including thinning and foliage chlorosis, and in the final stages the tree produces numerous small cones or distressed cones before death. Often the trees are wind-thrown and exhibit root balls where most of the roots have rotted off just below the root crown. The decay of the wood looks reddish-brown to brown in the butts and main roots and in later stages will begin to separate along annual rings (i.e., laminate). The fungus spreads through underground root contact and readily penetrates bark of roots of living susceptible trees that have been recently cut (within 12 months). Infected sites are unknown; however, host species are present in the project area.

Dwarf Mistletoe (Hennon et al. 2001; Hadfield et al. 2000)

Dwarf mistletoe (*Arceuthobium* M. Bieb.) is a damaging parasitic plant that affects conifers including Douglas-fir, grand fir, and mountain hemlock. The first symptom of dwarf mistletoe infection is slight swelling at the infection site, which becomes visible one to two years after infection occurs. The variously shaped masses of abnormal branch and twig growth associated with the disease are indications of old infections and are called "witches' brooms", and can vary in size from small, palm-like structures in young infections to large masses of branches weighing several hundred pounds. Dwarf mistletoe can occur in the main stem of trees creating large burl-like structures on the trunk. The dwarf mistletoe alters tree form, reduces vigor and growth rates, reduces seed production, increases susceptibility to other damaging agents, and results in top-killing and tree death; however, the deformation of trees can provide nesting sites and cover for wildlife. This parasite is spread from tree-to-tree by seed. Infected sites are unknown; however, dwarf mistletoe most likely exists within the project area.

Sudden Oak Death (Forest Service 2006b; Nelson et al. 2006)

This disease is caused by a recently introduced water mold, *Phytophthora ramorum*. It has killed large numbers of myrtle and tanoak trees and can also infect many other tree and shrub species, including Douglas-fir. It affects the aboveground plant parts forming sporangia on infected leaves and twigs. In forests, the sporangia spread from tree-to-tree by wind and rain and usually infect the upper crown first. Infected leaves drop on the ground allowing the sporangia to be transported through a variety of other methods, including boots, vehicles, animals, and streams. Within Oregon, *P. ramorum* has caused bore cankers and death to tanoaks, shoot dieback in Pacific rhododendron and evergreen huckleberry, and leaf blight in cascara and Oregon myrtlewood. Since 2001, state and federal agencies have been trying to eradicate sudden oak death in Oregon by cutting and burning infected host plants and uninfected adjacent plants. It has already killed extensive areas of myrtle and tanoak trees in California and hundreds of acres in Curry County, Oregon, which lies adjacent to two counties (Coos and Douglas) that would be crossed by the pipeline. Infected areas in Curry County are approximately 80 miles from the pipeline's location. ODF and the Forest Service conduct *P. ramorum* detection surveys in at-risk forests and systematic surveys in tanoak forested areas throughout southwest Oregon. To date, no accounts of sudden oak death have been documented within the project area.

Black Stain Root Disease (Hessburg et al. 1995)

This disease is caused by the fungus *Leptographium wageneri*, and affects several western conifer species. Species affected include Douglas-fir, ponderosa pine, Jeffery pine (*Pinus jeffreyi*), pinyon pine (*pinus edulis*), and singleleaf pinyon (*Pinus monophylla*). This fungus blocks the movement of water to foliage by attacking the tree's water conducting tissues. Tree growth is stunted and needles are permanently shed; in addition, infected trees become more susceptible to attacks from bark beetles. This fungus is likely transmitted by soil disturbance and insects. Although this disease is not widespread, the Forest Service has indicated that this disease could affect Douglas-fir trees of 30 years or less in age, as well as ponderosa and Jeffery pines of any age, and is found within the project area (personal communication Paula Trudeau; Forest Service Silviculturist).

Potential Effects of Pathogens and Proposed Avoidance/Minimization Measures

Insects and diseases can adversely affect a forest if pipeline associated activities introduce new or spread existing infestations. Trees may be more susceptible to infestation that are damaged during clearing activities and/or have soil compacted over their roots, including those within UCSAs. Equipment can transport insects or disease in or out of an area; as a result, the pipeline's right-of-way and the use of roads can spread or introduce insects or disease to new areas. Diseases could also be transferred from one area to another via hydrostatic test water. The spread of insects or disease along the pipeline would result in both short- and long-term effects, such as reduced species diversity due to invasion or infestation, and a loss of habitat function for wildlife.

Multiple infestations of insect parasites and tree pathogens already exist along the Pacific Connector pipeline route (table 4.5.1.2-6). Those occurrences increase the potential for new or expanded infestations or infections as direct result of pipeline construction.

TABLE 4.5.1.2-6

Summary of Known Infestations of Insect Parasites and Tree Diseases Along the Pacific Connector Pipeline Route a/

Tree Insect or Disease	Land Ownership	Number of Incidences Along Pipeline Route	Approximate Length (miles) of Route Affected
Douglas-fir Beetle	BLM/Forest Service	5	0.3
Fir Engraver	BLM/Private/Forest Service	13	3.3
Flatheaded Borer	BLM/Private/Forest Service	16	1.7
Mountain Pine Beetle	Forest Service	2	0.7
Pine Engraver	Private	1	N/A – TEWA
Port-Orford-Cedar Root Disease	Private	2	0.1
Western Pine Beetle	BLM/Private/Forest Service	10	0.9

Mileages rounded to nearest tenth of a mile.
a/ Summarized from Table 3C-3 in Appendix 3C of Pacific Connector's Resource Report 3.
Source Data: ODF 2004 through 2011 aerial GIS data [Online: http://egov.oregon.gov/ODF/PRIVATE_FORESTS/fh.shtml#Survey_Maps___Data].

Pacific Connector's *Integrated Pest Management Plan* identifies BMPs and conservation measures that would be implemented to minimize the spread of forest pathogens and insects along the pipeline route. Pacific Connector would identify/verify areas infested with forest pathogens during timber cruises prior to construction and implement minimization measures, including but not limited to cleaning equipment and vehicles upon entering/departing infested areas, applying sporax/borax on freshly cut stumps and wounds to reduce spread of root rot, and utilizing standard logging practices that minimize or prevent damage to standing trees adjacent to the Pacific Connector pipeline. Listed below are some measures for specific insect or diseases that would be implemented within infected areas.

- Douglas-fir beetle – Within areas where Douglas-fir beetle infestations have been documented, methylcychexenone capsules (a natural beetle repellent) would be applied to trees along the edge of the construction right-of-way. This treatment would occur before beetle flight in April to protect remaining stands of Douglas-fir and to prevent the spread of Douglas-fir beetle.
- Fir engraver – When clearing the construction right-of-way within true fir stands, Pacific Connector would utilize logging practices that directionally fall timber into the right-of-way, as well as store logs away from trees adjacent to the right-of-way to minimize or prevent damage to standing trees. Additionally, fresh slash greater than 4 inches provides breeding material for the beetles and can contribute to outbreaks. Slash greater than 4 inches would be treated.

- Flatheaded borer – Pacific Connector would minimize damage to adjacent trees when clearing and maintaining the right-of-way, including felling trees within the right-of-way away from adjacent, standing trees.
- Western pine beetle – In overstocked, infested stands, Pacific Connector would remove infested trees before beetle emergence in early June to reduce potential for infestation, if feasible. Also, if a mature ponderosa pine tree is identified with western pine beetle infestation within, but on the immediate edge of the construction right-of-way and would not pose a safety or construction hazards, it would be retained for future snag recruitment to benefit wildlife. Thinning overstocked ponderosa pine stands and removing trees infested with western pine beetles would help reduce the hazard of additional attacks.
- Port-Orford-cedar root disease – The BLM and Forest Service conducted a risk assessment to determine if there was a need for the Project to implement additional management practices to control *P. lateralis*, and determined that no special mitigation is required along the pipeline's right-of-way or haul routes (see appendix R). However, Pacific Connector has proposed additional measures as part of their Plan of Development. To minimize or prevent the spread of *P. lateralis* along the pipeline, Pacific Connector would implement the following in areas with Port-Orford-cedar, whether stands are infested or not (adapted from BLM 1994a): (1) pressure wash equipment and vehicles prior to entering uninfected areas and prior to departure of infested areas; (2) limit ground-disturbing construction and maintenance activities to the dry season, if feasible; and (3) prevent use of right-of-way in Port-Orford-cedar areas from off-road recreationists by blocking access. Pacific Connector would revegetate Port-Orford-cedar areas using disease-resistant strains of seedlings.
- Laminated root rot – Infected stands would be documented and revegetated with resistant species (native cedars, pines, spruces, and hardwoods).
- Dwarf mistletoe – In the event that dwarf mistletoe is found within the pipeline right-of-way, Pacific Connector would consult with the agencies to determine the appropriate plan to minimize its spread.
- Black stain root disease – As was discussed for dwarf mistletoe, in the event that black stain root disease is found within the pipeline right-of-way, Pacific Connector would consult with the agencies to determine the appropriate plan to minimize its spread.
- Annosus root and butt rot – During timber cruises that would occur prior to vegetation clearing, sites infected with annosus root and butt rot would be documented. Management to reduce tree loss from *F. annosus* varies depending on tree species affected. To reduce the spread of annosus root rot along the pipeline, dry borax would be applied to freshly cut stumps and wounds inflicted on trees adjacent to the construction right-of-way in areas identified with infestations of annosus root rot, especially when true firs and pine are the tree species present. In general, dry borax would be applied within 1 to 2 hours following cutting or working within these areas, and would not exceed more than 24 hours. Unless the specific strain of annosus root disease is known (p-type strain or s-type strain), cut surfaces of all susceptible species would be treated in areas where the disease may be occurring to prevent spread. P-type strain occurs mainly on pines and incense cedar, but also on hardwoods and brush; the s-type strain infects spruces, firs, Douglas-fir, western redcedar, and hemlocks.

Habitat Fragmentation

Fragmentation, or breaking up of contiguous areas of vegetation into smaller patches that become progressively smaller and isolated over time, has occurred and continues to occur within areas crossed by the pipeline route. Fragmentation has occurred within the area as a result of natural causes (e.g., landslides and windthrow) as well as previous and ongoing land use activities, including timber harvesting, as well as the development of agriculture areas, urban growth, roads, and utility corridors. The conditions within these fragments are affected by the reduced patch size as well as habitat alterations resulting from edge effects. Forest edges play a crucial role in ecosystem interactions and landscape function, including the distribution of plants and animals, fire spread, vegetation structure, and wildlife habitat. Creation of forest edge adjacent to dense canopy would impact microclimate factors such as wind, humidity, and light, and can lead to a change in species composition within the adjacent forest or increase invasion by invasive species. Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. Increased solar radiation and wind can desiccate vegetation by increasing evapotranspiration, can affect which species survive along the edge (typically favoring shade intolerant species), and can impact soil characteristics. Fragmentation and a loss of habitat connectivity can also impact wildlife (see section 4.6).

Although any habitat type can be fragmented, of the habitat types crossed by the pipeline, forested habitats and their associated species are likely the most sensitive to fragmentation. Existing patch size, patch isolation, and edge characteristic (i.e., the contrast or the relative difference among adjacent patches) of coniferous and/or mixed forest patches of different age classes (old growth, late successional, mid-seral, regenerative, and clearcut) were evaluated along the pipeline's centerline. During this assessment, (1) the distance of the pipeline's centerline with individual patches was assumed to be indicative of patch size; (2) the distance separating patches of the same age class along the centerline was assumed to be indicative of patch isolation; and (3) the contrast between one forest age category and another forest age category and/or with a non-forested vegetation type (e.g., pasture or agriculture, road or altered vegetation, waterbodies) was used to specify whether an edge was "hard" (i.e., high contrast as an edge between mid-seral and clearcut forest types) or "soft" (i.e., low contrast as between late successional and mid-seral or regenerating forest types). Patches of old-growth forest that were adjacent to late successional forest patches were combined as LSOG. Table 4.5.1.2-7 summarizes the existing patch characteristic of forest age classes crossed by the pipeline's centerline.

TABLE 4.5.1.2-7

Existing Patch Characteristics of Different Coniferous and Mixed Forest Seral Age Classes Crossed by the Pipeline

		Forest Seral Age Class			
Measurement	**Statistic**	**LSOG**	**Mid-Seral**	**Regenerating**	**Clearcut-Early Regeneration b/**
	Number of Patches	370	579	544	141
Patch Size (Centerline intercept distance, feet)	Mean	581.8	397.7	476.7	425.6
	Median	288.0	187.2	294.0	267.6
	Maximum	6,566.2	4,384.4	4,679.7	3,915.4
	Minimum	0.3	0.3	1.5	0.5

TABLE 4.5.1.2-7

Existing Patch Characteristics of Different Coniferous and Mixed Forest Seral Age Classes Crossed by the Pipeline

		Forest Seral Age Class			
Measurement	**Statistic**	**LSOG**	**Mid-Seral**	**Regenerating**	**Clearcut-Early Regeneration b/**
Patch Isolation (Centerline distance between adjacent patches, feet)	Mean	1,803.0	1,622.2	1,294.2	5,824.6
	Median	159.3	207.5	117.4	171.7
	Maximum	50,777.9	126,093.3	56,413.37	102,016.9
	Minimum	1.4	1.0	1.0	1.0
Patch Edge Contrast (Percent of Patches with Edge Type) a/	1 Hard Edge	38.4%	35.2%	41.7%	36.2%
	2 Hard Edges	50.8%	46.5%	34.4%	30.5%
	1 Soft Edge	16,8%	21.9%	15.1%	2.8%
	2 Soft Edges	2.7%	6.9%	5.3%	0.7%

a/ If an edge of younger age class patch is adjacent to a similar age class patch, the edge contrast is neither "Hard" nor "Soft".
b/ Early regeneration includes areas that were recently cut in the past 10 years, but greater than five years since harvest.

The orientation of a fragment's edge can affect the extent and magnitude of edge effects because the amount of solar radiation that falls on the newly created edge would depend on the direction it faces, its latitude, time of year and time of day (solar azimuth and solar altitude), and height of trees in the area that would cast shadows on the new edge (Chen et al. 1995). Because these values constantly change temporally and spatially, the edge effects would also constantly change along the pipeline, as tree shadows would extend different distances across the right-of-way depending on the time of year or aspect of the edge. This would result as some areas would be in shade at one point in the year (reducing edge effects) and in sunlight during another portion of the year (increasing edge effects).[78] As a result, the changing amounts of solar radiation, due to tree shadows, would occur along the entire route although the shortest shadows (and most solar radiation) would always occur on the summer solstice when the solar altitude is at its maximum. Harper et al. (2005) estimated that edge effects to vegetation communities in forests could occur up to 300 feet (91.4 meters) from the edge (note that edge effects can be greater for specific wildlife species; see section 4.6).

Table 4.5.1.2-8 lists the acreage of interior forests that would be affected, both directly and indirectly, by the pipeline's contribution to edge effects. As shown in this table, approximately 944 acres of interior forest would be directly affected by construction of the pipeline, while approximately 4,561 acres would be indirectly affected (i.e., would be within 100 meters of newly created edges).

To minimize the effects of the pipeline project on fragmentation and edge effects, Pacific Connector would replant native shrubs and trees within the temporary construction right-of-way outside of the 30-foot-wide operational pipeline maintenance corridor right-of-way, per the requirements found in its ECRP (e.g., by revegetating the area, the hard edge along the fragment would be reduced, thereby minimizing the effects of fragmentation and edge effects).

[78] For example, assume the 95-foot-wide pipeline construction corridor is oriented northwest to southeast at 135 degrees from north. At a location in the vicinity of the pipeline (longitude=123.0 degrees West, latitude=42.5 degrees North) on June 21, the sun would be shining from the east (azimuth ≈91.5 degrees) at 0815 (Pacific Standard Time [PST]) with solar altitude of ≈ 37.6 degrees. A tree 100 feet tall on the southwest-facing edge of the right-of-way would cast a shadow 130 feet which, given the angle and width of the right-of-way, would fall short of reaching the opposite side (northeast-facing edge) by about 5 feet. On May 21, however, the sun in the same position would have cast a shadow of about 170 feet at 0745 (PST) and on July 21 at 0800 (PST) the shadow would extend about 160 feet. In both instances, the edge opposite the eastern sun would be in shadow.

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

Landowner	Land Use Allocation	Age Classes a/, b/, c/	Direct Effects to Interior Forest (acres): Construction Right-of-Way	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal / Pipe Yards	Total by Age Class	Total Direct Effects	Indirect Effects to Interior Forest (acres): *100-meter Buffer from Vegetation Removal*	Total Indirect Effects
BLM - Coos Bay	LSR - RO 261	L-O	<1	<1	0	0	<1	6	16	46
		M-S	2	<1	0	0	2		14	
		Regen	1	<1	<1	2	4		15	
	Unmapped LSR d/	L-O	15	<1	4	0	19	21	137	141
		M-S	<1	<1	<1	0	1		3	
		Regen	<1	<1	0	0	1		<1	
	Other	L-O	<1	<1	<1	0	<1	34	3	212
		M-S	13	5	1	0	20		125	
		Regen	8	4	<1	0	13		84	
	Subtotal - Coos Bay	*L-O*	15	1	4	0	20	**61**	157	**399**
		M-S	16	6	2	0	23		142	
		Regen	10	5	1	2	18		100	
		TOTAL	**41**	**11**	**6**	**2**	**61**		**399**	
BLM - Roseburg	LSR - RO 261	L-O	2	<1	<1	0	2	5	15	48
		M-S	1	0	0	0	1		15	
		Regen	<1	<1	0	<1	2		18	
	LSR - RO 223	L-O	17	3	14	0	34	43	175	221
		M-S	2	<1	2	0	5		15	
		Regen	2	<1	1	0	5		32	
	Unmapped LSR d/	L-O	15	4	12	0	30	30	116	123
		M-S	<1	<1	<1	0	<1		<1	
		Regen	<1	<1	<1	0	<1		6	
	Other	L-O	17	4	33	0	54	90	166	322
		M-S	3	3	1	0	7		46	
		Regen	10	5	14	0	29		110	
	Subtotal - Roseburg	L-O	51	11	58	0	120	**169**	472	**714**
		M-S	7	3	3	0	13		76	
		Regen	13	6	15	1	36		166	
		TOTAL	**71**	**21**	**77**	**1**	**169**		**714**	
BLM - Medford	Other	L-O	36	12	13	0	61	**83**	230	**327**
		M-S	11	1	4	0	17		72	
		Regen	3	<1	<1	0	4		25	
	Subtotal - Medford	**TOTAL**	**50**	**15**	**18**	**0**	**83**		**327**	

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

Landowner	Land Use Allocation	Age Classes a/, b/, c/	Direct Effects to Interior Forest (acres): Construction Right-of-Way	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal / Pipe Yards	Total by Age Class	Total Direct Effects	Indirect Effects to Interior Forest (acres): *100-meter Buffer from Vegetation Removal*	Total Indirect Effects
BLM - Lakeview	Other	L-O	0	0	0	0	0	0	7	**13**
		M-S	0	0	0	0	0		6	
		Regen	0	0	0	0	0		0	
	Subtotal - Lakeview	**TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	
Umpqua N.F.	LSR - RO 223	L-O	27	3	16	0	45	52	162	244
		M-S	2	<1	0	0	2		55	
		Regen	2	1	1	0	5		27	
Umpqua N.F. (continued)	Other	L-O	21	3	9	0	33	57	122	263
		M-S	11	2	7	0	20		112	
		Regen	3	<1	0	0	4		30	
	Subtotal Umpqua National Forest	L-O	47	6	25	0	78	**109**	284	**507**
		M-S	13	2	7	0	22		167	
		Regen	6	2	1	0	9		57	
		TOTAL	**66**	**10**	**33**	**0**	**109**		**507**	
Rogue River N.F.	LSR - RO 227	L-O	34	3	18	0	55	**105**	234	**527**
		M-S	3	<1	1	0	5		48	
		Regen	28	3	15	0	46		245	
Subtotal - Rogue River National Forest		**TOTAL**	**65**	**5**	**35**	**0**	**105**		**527**	
Winema N.F.	Other	L-O	6	<1	3	0	9	20	42	140
		M-S	1	<1	<1	0	2		24	
		Regen	6	<1	3	0	9		74	
Subtotal Winema National Forest		**TOTAL**	**13**	**1**	**6**	**0**	**20**		**140**	
Other Landowners	None	L-O	41	12	24	0	78	**398**	179	**1,934**
		M-S	84	20	71	<1	176		830	
		Regen	80	24	40	0	144		925	
	Subtotal - Other Landowners	**TOTAL**	**206**	**56**	**136**	**<1**	**398**		**1,934**	
Total Indirect/Direct Effects to Interior Forest	LSR - RO 261	L-O	2	0	<1	<1	2	11	31	94
		M-S	3	0	<1	0	3		30	
		Regen	2	0	<1	<1	6		33	
	LSR - RO 223	L-O	44	0	5	30	79	95	337	466
		M-S	4	0	<1	2	6		70	
		Regen	5	0	2	3	9		59	
	LSR - RO 227	L-O	34	0	3	18	55	105	234	527
		M-S	3	0	<1	1	5		48	
		Regen	28	0	3	15	46		245	

TABLE 4.5.1.2-8

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline Project

Landowner	**Land Use Allocation**	**Age Classes a/, b/, c/**	**Direct Effects to Interior Forest (acres)**						**Indirect Effects to Interior Forest (acres)**	
			Construction Right-of-Way	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal / Pipe Yards**	**Total by Age Class**	**Total Direct Effects**	***100-meter Buffer from Vegetation Removal***	**Total Indirect Effects**
Total Indirect/Direct Effects to Interior Forest (continued)	Unmapped LSR d/	L-O	29	4	15	0	49		254	
		M-S	<1	<1	<1	0	1	52	3	264
	Unmapped LSR d/	Regen	<1	<1	<1	0	1		7	
	Subtotal LSR	***TOTAL***	**156**	**19**	**85**	**3**	**263**	***263***	***1,351***	
	Other	L-O	81	21	57	0	159		569	
		M-S	40	12	14	0	66	***283***	384	**1,276**
		Regen	30	11	18	0	58		323	
	Subtotal Other	***TOTAL***	**357**	**43**	**89**	**0**	**283**		***1,276***	
	None	L-O	41	12	24	0	78		179	
		M-S	84	20	71	<1	176		830	
		Regen	80	24	40	0	144	***398***	925	**1,934**
	Subtotal - Other Landowners	***TOTAL***	**206**	**56**	**136**	**<1**	**398**		**1,934**	
Total Indirect/Direct Effects to Interior Forest		***L-O***	231	45	146	0	422		1,604	
		M-S	136	33	88	<1	257	**944**	1,365	**4,561**
		Regen	145	40	76	3	265		1,592	
		TOTAL	**513**	**118**	**310**	**3**	**944**		**4,561**	

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.
b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
c/ The "Regenerating" category (Regen) describes those forest areas that are regenerating (tree age 5 to 40 years), but do not include recently harvested but regenerating forest (approximately 5 to 10 years – or early regenerating forest).
d/ Unmapped LSRs include occupied marbled murrelet stands and known owl activity centers that occur on NWFP Matrix lands. Areas identified as Unmapped LSRs include those provided by BLM (NSR 2012), as well as occupied marbled murrelet stands (delineated by BLM) that were not identified as unmapped LSRs (LSR3) by BLM but occur on Matrix lands.

Fire Regimes

Fires play a substantial role in shaping the composition and structure of vegetative communities found in southern Oregon. The Pacific Connector pipeline would pass through diverse areas, from Coos Bay to the Klamath Basin, each with a distinct fire regime. Table 4.5.1.2-9 lists the mean fire return interval (i.e., mean fire frequency in the area) as well as the total acres that have burned between 2002 and 2011 (based on existing fire data) for the fifth field watersheds crossed by the pipeline.

TABLE 4.5.1.2-9

Historic Average Fire Frequency and Extent of Acreage Burned in Watersheds Crossed by the Proposed Pacific Connector Pipeline

Ecoregion	HUC – Fifth-Field Watershed	Mean Fire Return Interval a/	Total Acres Burned (2002–2011) b/
Coast Range	Coos Bay-Frontal Pacific Ocean	126-150 Years	0
	Coquille River	81-90 Years	0
	North Fork Coquille River	151-200 Years	0
	East Fork Coquille River	126-150 Years	0
	Middle Fork Coquille River	61-70 Years	0
Klamath Mountains	Olalla Creek-Lookingglass Creek	21-25 Years	0
	Clark Branch-South Umpqua River	26-30 Years	0
	Myrtle Creek	61-70 Years	0
	Days Creek-South Umpqua River	46-50 Years	4,697
	Upper Cow Creek	41-45 Years	942
Cascades	Elk Creek	36-40 Years	17
	Trail Creek	26-30 Years	315
Klamath Mountains	Shady Cove-Rogue River	21-25 Years	27
Cascades	Big Butte Creek	26-30 Years	959
Klamath Mountains	Little Butte Creek	26-30 Years	3,552
Eastern Cascades Slopes and Foothills	Spencer Creek	31-35 Years	0
	John C Boyle Reservoir-Klamath River	26-30 Years	11
	Lake Ewauna-Klamath River	61-70 Years	24
	Mills Creek-Lost River	91-100 Years	3

a/ Data from LANDFIRE (2007).
b/ Data from BLM_Fire_History shapefile (BLM 2013). Acres rounded to nearest whole acre.

At the time this FEIS was being finalized there was a new fire in progress that included portions of the Pacific Connector pipeline route. The Stouts Creek Fire started near Milo, Oregon, on July 30, 2015. By September 1, 2015, the fire had grown to approximately 26,500 acres and had burned into portions of the proposed pipeline route between about MPs 96 and 109. When the fire has been controlled, the BLM and Forest Service will survey the area to assess the impacts of the fire and how it changes habitat along the pipeline route. See also additional discussion in section 4.1.9.1 of this FEIS.

Construction of the Pacific Connector pipeline could increase the risk of fires. However, the exact risk of fires would be dependent on local conditions and construction activities. The risk for fires would be greatest in the areas crossed by the Project that experience hot, dry conditions, and lowest in the areas that experience cool, wet climates. The pipeline route crosses a wide range of ecozones, with different vegetation types, elevations, and climates. For example, the city of Klamath Falls on the east end of the pipeline route is located at an elevation of about 4,100 feet above MSL in the high desert sagebrush steppes of the Klamath Basin, and averages 13 inches of precipitation per year with 21 days over 90°F. In contrast, the city of Coquille, on the west end of the pipeline route, at an elevation of 50 feet above MSL, is located on the west side of the Douglas-fir forested Coast Range, and averages 55 inches of precipitation per year with just one day over 90°F.

Certain activities associated with construction and operation of the Pacific Connector project (such as prescribed burning of slash, mowing, welding, refueling with flammable liquids, and parking vehicles with hot mufflers or tailpipes on tall dry grass) could increase the risk of wildland fires, especially if these activities occur within the fire season. Even small fires, created during these activities, could have far-reaching consequences on vegetative communities. For example, large forest fires could occur if small, low-intensity herbaceous ground fires, ignited within the herbaceous cover maintained along the permanent right-of-way, utilize the more dense vegetation located near forest edges as a ladder, allowing access to the forest's canopy. This could trigger a high intensity crown fire that could spread to adjacent areas, away from the pipeline's route. If fire frequencies were to increase due to Project activities, vegetative communities could shift to a species composition more adapted to higher fire frequencies. Members of the public have stated it is possible that the cleared right-of-way could serve as a fire break for large crown fires, thereby reducing the extent of a fire's spread (see appendix W); however, as discussed above, the presence of the cleared right-of-way could also increase the risk of crown fires occurring in the first place.

Pacific Connector prepared a *Fire Prevention and Suppression Plan* (Appendix K to the POD, which was included in Pacific Connector's June 2013 application to the FERC) to reduce the risk of wildland and structural fires. This plan contains measures to limit fire risk, such as requiring that all employees participate in a fire training program. Other fire prevention measures that Pacific Connector would implement include prohibiting employees from smoking when working or driving through forested areas; allowing only permitted campfires; burning slash under permitted conditions; restricting blasting activities to between 1:00 p.m. and 8:00 p.m., with no fuses used, and firefighting gear at blasting locations; equipping all non-turbo-charged engines in vehicles used on the right-of-way with approved spark arresters; requiring power saws to meet spark arrestor guidelines, have exhaust screens, and be used more than 20 feet from refueling areas; parking all vehicles in designated areas; having vehicles carry firefighting gear and placing appropriate tools at work sites; and requiring one 5-gallon water pump for each welding unit. In addition, Pacific Connector would coordinate with appropriate landowners and local fire districts to ensure that fire prevention and suppression activities consider pipeline safety. In addition, Pacific Connector prepared a *Prescribed Burning Plan* (Appendix R to its POD).

4.5.1.3 Environmental Consequences on Federal Lands

The Pacific Connector pipeline route would cross lands managed by federal agencies including the Forest Service, BLM, and Reclamation. The pipeline would pass through portions of federal land designations that are intended to protect vegetation or habitats: such as Riparian Management Areas, Riparian Reserves, and LSRs. These federal land designations, as well as the effects that the pipeline would have on these areas, are addressed in section 4.1.

BLM – Forest Operations Inventory

The BLM tracks vegetation, land management treatments, and disturbance within each district during operations inventories. These data and/or attributes are then transferred to a GIS coverage called the Forest Operations Inventory (FOI). The FOI describes and classifies forest cover (vegetation), site class, denudation cause, dominant species, understory species, treatments, age class, and stand condition (BLM 2006a).

Table O-6 in Appendix O lists the acres of impact that would occur to FOI from both construction and operation of the pipeline. As shown in table O-6, there would be approximately 801 acres of impact during construction of the pipeline to FOIs, which includes about 174 acres on the Coos Bay District, 335 acres on the Roseburg District, 274 acres on the Medford District, and 18 acres on the Lakeview District.

Forest Service – Plant Series and Plant Association Groups

The Forest Service classifies potential vegetation based on plant series, and plant association groups (PAGs). Plant series are based on the climax dominant trees of a stand (e.g., the Douglas-fir series). Plant series can be subdivided into PAGs, which are described primarily by the presence or absence of plant species, as well as the abundance of a species based on environmental variables, including soil, aspect, slope, slope position, and moisture. Not all three National Forests crossed by the Pacific Connector pipeline route have identified PAGs or plant series, and these unidentified areas are noted as "not currently in model" (Forest Service 1996). Table O-7 lists the acres of impact that would occur to PAGs and plant series from both construction and operation of the pipeline. As shown in table O-7, there would be approximately 587 acres of impacts during construction of the pipeline to PAGs and plant series, which includes about 212 acres on the Umpqua National Forest, 283 acres on the Rogue River National Forest, and 92 acres on the Winema National Forest. The Douglas-fir series would be the most heavily affected PAG.

The following describes the seven plant series that would be crossed by the pipeline, based on GIS coverage.

<u>Douglas-Fir Series</u>

Douglas-fir occurs in all PAG series within elevations ranging from sea level to 5,600 feet. Usually overstory presence of Douglas-fir indicates recent ground disturbance while presence and dominance in the understory can indicate hot, dry conditions, which is characteristic of the Douglas-fir Series. Many other tree species may be present that are also tolerant of drought-like conditions, such as ponderosa pine, incense cedar, and canyon live oak (*Quercus chrysolepis*). Within Umpqua National Forest, the following shrubs/plant associations may occur within the Douglas-fir Series: poison oak (*Toxicodendron diversilobum*), canyon live oak, chinquapin, salal, and species associated with ultramafic parent materials. Potentially canyon live oak and Douglas-fir may occur on the Rogue River National Forest.

<u>Mountain Hemlock Series</u>

In Southwest Oregon, mountain hemlock occurs at high elevations, ranging from approximately 3,950 feet to 6,690 feet in the Cascades, with cold temperatures and moderate precipitation. Associated parent material is highly variable, although pumice, andesite, and basalt are the most common. Mountain hemlock and Shasta red fir are dominant tree species in the overstory, with western white pine and Douglas-fir occasionally occurring. Within the Rogue River National Forest, the Mountain Hemlock Series may be associated with grouse huckleberry in deep soils at higher elevations, Pacific rhododendron at lower elevations and warmer conditions, and/or with the wildflower sidebells pyrola (*Pyrola secunda*).

Shasta Red Fir Series

The Shasta Red Fir Series is representative of a variety of California red fir found in southwest Oregon and northern California generally at higher elevations (4,000 to 6,900 feet) where the climate is cool and moist. Shasta red fir is typically the dominant tree in the overstory, although on warmer sites, white fir is present and on cooler sites, mountain hemlock is present. Within the Rogue River National Forest, the mountain sweet-root/Shasta Red Fir Series association may potentially be found which is typically located at sites with lower precipitation. In the Winema National Forest, the Shasta Red Fir series is found within the Cascade Province of Southwest Oregon.

White Fir Series

This species is most abundant in Southwest Oregon and will occur on a variety of sites and therefore is not specific to slope, aspect, soil type, or elevation. White Fir Series generally occurs on cool sites, with an average rainfall varying between 45 inches in drier areas of the Cascades to 102 inches near the coast. As a result of frequent disturbances, other early seral species become the dominant overstory tree in the White Fir Series, such as Douglas-fir and Shasta red fir, which are present within the Rogue River National Forest. Also, dwarf Oregon-grape is common and widespread within the Series and may occur within the area crossed by the pipeline. Based on GIS coverage, white fir-Shasta red fir is crossed on the Winema National Forest.

Grand Fir Series

No specific description has been created for this series. However, based on GIS coverage, grand fir trees may be dominant within stands located in the Umpqua National Forest, with a canyon live oak association.

Jeffrey Pine Series

This species is scattered throughout Jackson and Douglas Counties and usually occurs on dry, ultramafic parent material, mainly serpentine and peridotite with high exposed gravel, surface rock, and bedrock components. As a result of the serpentine/periodotite parent material this series is associated with, many unique and rare species can be found. This series is found within a wide elevational range, from 1,200 feet to 6,000 feet; however, most occurrences are concentrated near 2,000 feet. It can occur on all aspects and slope positions although it is most common on the southerly aspect and mid-slope position. Often Douglas-fir and incense cedar are associated with the Jeffrey Pine Series, which has an open canopy characteristic. Within the Umpqua National Forest, Jeffrey pine (*Pinus jeffreyi*) has the potential to occur with high grass understory coverage.

Western Hemlock Series

This plant series is known to occur in drier conditions on Umpqua National Forest, and the associations crossed by the pipeline are salal, Oregon-grape, and rhododendron. The series is associated with low to moderate elevations. Because of the frequent disturbances in southwest Oregon, the overstory of this series is generally dominated by Douglas-fir with the understory predominately western hemlock; however, within the western hemlock/salal-dwarf Oregon-grape association, both western hemlock and Douglas-fir are present in the overstory.

Measures Implemented on Federally Managed Lands

Listed below are the avoidance and minimization measures that would be implemented on federally managed lands, in addition to those described above:

- Compensation for impacts would be negotiated on a case-by-case basis.
- Disturbed areas would be replanted to prevent noxious weed germination, and disturbed areas would be revegetated with seed mixes described in the ECRP (Appendix I of the POD).
- The authorized officer for the BLM or Forest Service may inspect and approve straw material used on federal lands to verify that it is certified noxious weed free. Gravel/rock used on federal lands would be from weed-free sources as well, and approved by the agencies authorized representative.
- Pacific Connector has agreed to plant the easement with native trees/shrubs described in the ECRP. Affected riparian areas would be replanted extending 100 feet from the streambanks on federal lands. All plantings proposed for federally administered lands must be approved by each agency's authorized representative Agency silviculturists and botanists would determine when sites have been successfully revegetated.
- Replanting of NFS lands would be in accordance with agency vegetation requirements, which may include planting native hardwood and shrubs in addition to conifers to ensure species diversity.

The BLM, Forest Service, Reclamation, FWS, and Pacific Connector are currently working together to develop projects that could be implemented in order to mitigate for environmental impacts on federally-managed lands, as well as ensure that the Pacific Connector pipeline is consistent with the objectives of LMPs. The mitigation projects that have been identified to date that are a part of the proposed action may be found in section 2.1.4. Below is a brief summary and example of the projects that have been identified to date:

- The decommissioning of roads within LSRs that the Forest Service has determined are no longer required.
  - Roads which the Forest Service has identified as "surplus" or unneeded would be decommissioned and these roadbeds would be tilled to a depth of 18 inches. Tillage on federally managed lands would be directed by a Soil Scientist, and would use equipment designed to promote rooting depths needed to facilitate native vegetation recovery and proper water infiltration.
  - The process of decommissioning roads could result in short term impacts, including a temporary increase in erosion during road treatments, temporary disturbance to wildlife during treatments, temporary loss of vegetation if roads need to be cleared in order to remove culverts or side-cast materials, and an increased risk of invasive species as a result of soil disturbance. In addition, the creation of snags could result in short term impacts to vegetation during their installation within stream or terrestrial habitat.
- Conversion of matrix lands to LSRs and enhancement of converted lands.
- Purchasing commercial timber lands and passing the title to the BLM to replace Matrix Lands that would be reallocated to LSRs.

   - These lands could either be adjacent to the pipeline or be situated adjacent to existing BLM lands to block up ownership, increase connectivity, and reduce potential future fragmentation.

- Funding non-commercial silvicultural projects that would create or accelerate the development of old-growth characteristics on federal lands.
- Funding silvicultural projects (pre-commercial or commercial) aimed at reducing fuel loads and minimizing the risk of stand-replacing fires.
- Creating snags to enhance riparian or terrestrial habitat.
- Fence or otherwise exclude cattle and off-road vehicles from sensitive areas to protect habitat.

Noxious Weeds

The BLM objective for weeds is to contain and/or reduce noxious weed infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) and avoid introducing or spreading noxious weed infestations in areas, as outlined in the BLM's multi-state environmental impact statement, Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, as well as the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007). The BLM is specifically concerned with the impacts of weeds on LSRs (see section 4.1) and seeks to eliminate or control weeds that adversely affect those areas. Elsewhere, the BLM surveys for noxious weed infestations, reports them to the ODA, and coordinates with them to reduce infestations while using methods that do not conflict with the objectives of each BLM district's RMP.

The Forest Service's objective for invasive plants and noxious weeds is similar to BLM's objectives (described above). Control of noxious weeds by the Forest Service is done in a variety of ways depending on the local national forest's plans for invasive species control. On NFS lands, preventive management is critical to an effective control program. The agency utilizes management direction provided in the *Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants Final Environmental Impact Statement* (Forest Service 2005b). Noxious weeds classified as target species that occur on federally managed lands are listed in table 4.5.1.2-5.

In order to prevent or limit the spread of invasive species and noxious weeds, all construction equipment would be inspected to ensure that it is clean and free of potential weed seed, prior to transporting equipment to the construction right-of-way. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment that could serve as a vector for invasive species would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities. In addition, equipment would be cleaned prior to entering any mapped areas infested with noxious weeds of priority A and T and selected B listed weeds within each National Forest.

Because the BLM lands crossed by the pipeline are not contiguous, but are instead spread out in a checkerboard pattern, Pacific Connector feels that it is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposes that where BLM lands are contiguous to NFS lands, the cleaning stations be located to include the adjacent BLM lands.

Additionally, equipment would be inspected and cleaned at stations located adjacent to mapped noxious weed infestation areas that were identified during pre-construction surveys on federally-managed lands. The cleaning stations would be located and approved by the EIs and authorized agency representative; these locations would also be mapped for future monitoring efforts to determine if potential infestations occur at these sites and, if they do, to ensure that appropriate control treatments are applied. Monitoring efforts for weed species would be similar to those described above, except that Pacific Connector has proposed to conduct monitoring on federally managed lands annually for a period of at least three to five years. However, the BLM and Forest Service have indicated that they would require that monitoring on federally managed lands be conducted every three to five years for the life of the Project, and that this would be a condition of the Right-of-Way Grant. Therefore, **we recommend that:**

- **Prior to construction, Pacific Connector should file with the Secretary a revised *Integrated Pest Management Plan* that addresses BLM and Forest Service requirements related to monitoring of invasive plant species on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service.**

Vegetative Pathogens

The existing conditions related to known occurrences of insects or pathogens are identical to the discussion presented in section 4.5.1.2. Insects or pathogens that have the potential to occur within the project area include Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, lodgepole pine needle cast, Port-Orford-cedar root disease, annosus root rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease (see section 4.5.1.2). The effects that could occur as well as the measures that would be implemented for the prevention of infestation by insects or pathogens on federally managed lands would be similar to those discussed above, with the exception of the following:

- *Douglas-fir beetle*—No Douglas-fir down wood, 12 inches or larger in diameter, would be left in areas on NFS lands where there are known infestations of Douglas-fir beetle.
- *Fir engraver*—Pacific Connector would use the BLM and Forest Service fuel loading specifications to minimize slash accumulations.
- *Port-Orford-cedar root disease*—All equipment entering NFS lands would comply with all Forest Service *P. lateralis* mitigation requirements. The Forest Service (Region 6) and BLM prepared management objectives for affected federally managed lands in 2004 to help control the spread of the fungus. The objectives focus on maintaining disease-free watersheds, preventing spread through sanitation, seasonal restrictions for activities, and reestablishing Port-Orford-cedar using resistant and non-resistant seedlings.
- *All pathogens*—Directional tree falling would be required on all NFS lands, including areas with no known insect/disease occurrence, to prevent residual tree damage/injury and disease infection.

Wild-Harvesting of Non-Timber Forest Products

Wild-harvesting is the act of gathering food, decorative, or medicinal botanical products that grow naturally on lands not normally associated with agriculture. The non-timber forest products harvested near the pipeline route are of three categories: floral greens, edibles, and medicinals. Some of the more common of these are salal, beargrass, seasonal evergreen boughs, Christmas trees, mushrooms, berries, nettles, prince's pine (*Chimaphila umbellate*), Oregon-grape (*Mahonia nervosa*), and St. Johnswort (*Hypericum perforatum*). This harvesting of non-timber forest products is widespread on public lands in the Pacific Northwest and can occur year-round (OPB 2006).

The Forest Service and BLM grant permits to wild-harvest for both recreational and commercial uses. The permit process provides forest managers with the means to track demand for products, the amount of products removed from the forests, and to protect sensitive resources (Forest Service 2006c). The Forest Service divides these permits into two major categories: (1) convertible, and (2) non-convertible. The convertible permits are for products, other than timber sales, for which the volumes collected can be converted into board feet, such as permits to collect fire wood. Non-convertible permits are for other products such as mushrooms or berries for which the volumes collected depend on the specific permit applied for; however, the Forest Service estimates that only 25 to 33 percent of harvests are done through this permitting process in some locations (OPB 2006).

Some recreational and commercial harvesters could be temporarily displaced during pipeline construction. Additionally, some of the forest products typically harvested would be removed during vegetation clearing for the Pacific Connector pipeline. However, the pipeline right-of-way and roads would also create new access into forested areas. As a result, it is possible that wild harvesting could increase as a result of the operation of the pipeline project.

4.5.2 Timber

4.5.2.1 Jordan Cove Project

There is no known merchantable timber at the site of the Jordan Cove LNG facilities. The trees that would be cut at the site of the facilities are not considered merchantable; however, Jordan Cove has committed to conduct a timber cruise at the site prior to construction to confirm this. If any merchantable trees are found within the site, they would be salvage logged and sold while the unmerchantable timber, timber slash, and brush would be pulverized in a tub grinder and stockpiled as mulch. The mulch would be saved for future erosion control of recontoured sand dunes created post-construction.

4.5.2.2 Pacific Connector Pipeline

Pipeline construction would require clearing all timber from a 95-foot-wide temporary right-of-way and TEWAs. Timber removal and construction activities would span a two-year period. Year One would mostly consist of vegetation clearing and timber removal along the majority of the pipeline route, and some pipeline installation in select areas, such as at HDDs and within the Klamath Basin. Year Two would consist of the remaining timber removal not completed during Year One, the majority of pipeline installation activities, and construction of aboveground facilities.

While Pacific Connector anticipates that timber clearing would typically be done from May through November (the usual dry period in Oregon), timing restrictions would be imposed within habitat for federally listed NSO and MAMU (see section 4.7). Timber clearing within MAMU stands or within 300 feet of MAMU stands would occur outside of the MAMU breeding season (April 1 to September 15) in order to prevent impacts to nesting MAMU. Timber removal is expected to occur during Year One of the Pacific Connector construction window; however, if timber removal is not completed prior to the MAMU breeding season, timber removal would continue later in Year One and early in Year Two (between September 16 and March 31) to avoid the MAMU breeding season. Habitat removal within 0.25 mile of an NSO activity center would occur outside of the breeding season (from October 1 through February 28) whether in Year One or in Year Two.

The degree of impact that would occur to forest and timber resources would depend on the logging methods used, quantity of lumber removed, and the age of affected stands. The Pacific Connector pipeline would cross approximately 41.3 miles of LSOG forests, 43.6 miles of mid-seral forests, and 60.9 miles of recently harvested forested lands (see table 4.5.1.2-1). Table 4.5.2.2-1 lists the log types that occur along the pipeline's route.

TABLE 4.5.2.2-1

Merchantable Timber to be Cleared for the Proposed Pacific Connector Pipeline, by Class and Age

Type of Timber	Diameter to Breast Height (inches dbh)	Inside Top Bark Height Diameter (inches)	Age
Small conifer sawlog	10-20	6-10	26–60 years
Medium conifer sawlog	20-30	8-12	61–100-125 years
Large conifer sawlog	30 and larger	8-16	125–250 years; with an unquantified population of ancient relic trees 300 to 500 years

While timber cruises have not yet been conducted, information available indicates that approximately 1,642 acres of large mature trees over 40 years in age and approximately 1,240 acres of small to medium trees under 40 years in age would be harvested during construction of the pipeline (see table 4.5.1.2-2). A portion of these 1,240 acres of small to medium trees would not be merchantable (e.g., those less than 25 years in age). Future timber production would be lost on these young stands. The exact number and board feet of these non-merchantable trees would be determined during timber cruises. Operation of the pipeline would permanently affect approximately 530 acres of forest (see table 4.5.1.2-3),[79] so this amount would be removed from the future timber base. This impact would be because trees would not be allowed to grow within the maintained easement within 15 feet of the centerline. This would include about 314 acres of trees more than 40 years old, and about 215 acres of trees under 40 years old.

Timber cruises would be conducted prior to vegetation clearing to determine timber volumes, values, and species composition within forested lands. Pacific Connector would be required to retain qualified foresters and logging engineers to develop site-specific logging plans for each area to be logged. These plans would identify the size, height, volume, and value of trees in each portion of the construction right-of-way, how the timber would be felled and yarded, where landings and log decks would be placed, the haul routes that would be used to remove the logs, and how logging debris would be disposed of. The FERC requires that all operations be contained within the certificated work area, so it is important to identify methods for falling, yarding, decking, and any additional temporary roads that may be needed for hauling logs prior to the start of construction. Logging methods would vary by location, and would not be known

[79] Less than one acre would be permanently affected as a result of access roads (see table 4.5.1.2-3).

until timber contractors evaluate site-specific conditions. The logging contractors would be solicited by a request for proposal. These proposals would be evaluated by Pacific Connector and contracts would be awarded to the most qualified bidder(s). The exact timber harvest and decking requirement locations would be determined by the contractor within the access roads and staging areas already approved for the pipeline.

Merchantable timber would be removed and sold according to landowner stipulations. In limited areas, TEWAs have been identified for log storage and decking along the pipeline alignment that would be located in existing cleared areas adjacent to existing roads where feasible log storage could occur for extended periods, if necessary. Pacific Connector has designed the construction right-of-way to minimize additional TEWAs, in order to reduce overall project disturbance. However, the construction footprint is not large enough in many areas to both accommodate the logs cleared from the right-of-way and accomplish efficient construction activities simultaneously; therefore, cut timber would be removed from the right-of-way to avoid project delays due to right-of-way congestion.

Clearing of forest is a two-step process: tree felling followed by yarding. Pacific Connector's *Clearing Plan* outlined 15 different scenarios that may be used to cut and remove timber from the right-of-way along the pipeline route, based on slope, stand density, and tree types.

The specific logging methods would not be determined until after a contractor has been selected through the bidding process for each construction spread. Pacific Connector expects that the use of all logging methods may be necessary during clearing to efficiently remove timber from the right-of-way, depending on the site-specific geographic conditions. Timber cutting can be done by mechanical means (e.g., using tracked feller-buncher, saw, or shear) or by hand methods with a chainsaw. Alternative harvest equipment could include tracked crawler stroke-delimber and tracked crawler-chipper. Yarding can be done by cable or helicopter. Ground-based skidding and cable yarding would likely be the standard methods. Ground-based skidding would use tracked grapple and rubber-tired grapple equipment. Ground-based yarding could use shovel logging methods (with tracked feller-buncher, hydraulic grapple heel boom, or dangle-head processer).

In some isolated rugged topographic areas with poor access, helicopter logging may be used. Cable and helicopter logging methods would minimize the potential for soil compaction. Helicopter yarding is currently proposed for the following locations, but the exact locations would not be finalized until a contractor is selected for project construction:

MP 18.1 – 19.3	MP 77.8 – 79.9	MP 101.3 – 102.3
MP 37.1 – 38.4	MP 92.4 – 94.5	MP 108.5 – 110.4
MP 46.7R – 47.2R	MP 95.1 – 97.1	MP 116.3 – 117.8
MP 60.5 – 61.5	MP 97.7 – 98.0	MP 123.3 – 125.1

Any timber cleared from the right-of-way that would be used for instream or upland wildlife habitat diversity structures would be stored on the edge of the right-of-way or in temporary extra work areas for later use during restoration efforts. Prior to clearing operations, the EI or Pacific Connector's authorized representative would flag existing snags on the edges of the construction right-of-way or TEWAs where feasible to save from clearing. These snags would be saved as and used in LWD placement projects to benefit primary and secondary cavity nesting birds, mammals, reptiles, and amphibians. During this process, other large diameter trees on the edges of the construction right-of-way and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible. Some of these trees would be girdled to create snags to augment the number of snags along the right-of-way to benefit cavity nesting birds, mammals, reptiles, and amphibians; however, snags that are determined to be a threat to worker safety would be removed.

Pacific Connector proposes that all operations and tree felling would occur within the certificated construction work area limits, and that trees within the certificated construction work area limits would be felled or sheared so as to prevent damage to adjacent trees, facilities, or structures. This may not be practical in steep areas where trees often must be felled on the contour to reduce breakage. Much of the forested portion of the route crosses steep mountainous areas. Failure to fall trees properly would result in a loss of timber available to local industries and loss of value to the landowners and land management agencies. Also, logging roads in some areas crossed by the pipeline have not been used in many years and are covered with young trees. These roads would require clearing and major reconstruction if needed for hauling logs.

Danger trees are those trees at risk of falling on workers or vehicles and thus would need to be removed for safety reasons. A tree may be at risk of falling for a number of reasons including the tree's location and the presence of defects, insects, disease, work activities, and weather conditions. Such trees would be felled in advance of logging, pipeline construction, road construction/reconstruction, and road maintenance. Additionally, danger trees could be created from trees felled for the pipeline. This would occur if trees outside of approved construction areas are damage during felling of harvested timber. While this could result in growth loss, for which Pacific Connector would compensate the land-management agency (or landowner on private lands) for any trees removed and any loss in timber productivity, the FERC requires that all operations be contained within the certificated work areas. Danger trees would be designated by qualified Pacific Connector representatives, in accordance with OSHA standards and the Forest Service/BLM–published *Field Guide for Danger Tree Identification and Response* (Forest Service and BLM 2008). Danger trees would be directionally felled, when consistent with OSHA guidelines, away from the construction right-of-way if trees are to be left, and towards the construction right-of-way if trees are to be removed. Since this would require a variance to FERC requirements, consultation with authorized agency representatives would be required prior to approval. Pacific Connector would compensate the respective land manager/owner for any merchantable danger trees that are felled. If danger trees are identified outside of the approved construction limits, the location of the trees, access to them, and removal would have to be identified and approved by an authorized agency representative using the FERC variance process.

Logs would not be stored next to conifer trees bordering the sides of the right-of-way to avoid damage to live trees. Logs planned for removal from the site would be hauled off the site as soon as practical following yarding in order to prevent disease problems, as well as potential theft problems. Slash pieces larger than 8 inches in diameter may be decked for short periods in agency or landowner designated and approved storage areas or in places where roads cross the right-of-way and made available for removal by firewood permits or for habitat improvement projects. However, Pacific Connector has stated that they may place LWD in UCSAs adjacent to standing conifers.

Where feasible, logs yarded out of wetlands or riparian zones would be skidded with at least one end suspended from the ground so as to minimize soil disturbance. Pacific Connector proposes that any debris entering a waterbody as a result of felling and yarding of timber would be removed as soon as practical after entry into the waterbody and shall be placed outside the 100-year floodplain where practical. Logs and slash would not be yarded across perennial streams unless fully suspended. During logging/clearing operations, the direction of log or slash movement would be conducted to minimize sediment delivery to waterbodies, including intermittent streams. Logs firmly embedded in the bed or bank of waterbodies that are in place prior to felling and yarding of timber would not be disturbed, unless they prevent trenching and fluming operations. Any existing logs that are removed from waterbodies to construct the pipeline crossing would be returned to the waterbody after the pipeline has been installed, backfilling is complete, and during the time the streambanks are being restored.

Pacific Connector would implement the following measures to reduce impacts on timber:

- All tree felling and vegetation clearing would occur within the certificated construction work areas, except for danger trees adjacent to the right-of-way, additional work areas, and travel corridors. Trees within the certificated construction work areas would be directionally sheared or felled so as to prevent damage to adjacent trees, facilities, or structures.
- Danger trees would be felled in advance of logging, pipeline construction, road construction/ reconstruction, and road maintenance. Danger trees would be directionally felled, using chainsaws, away from the permanent right-of-way if trees are to be left and towards to right-of-way if trees are to be removed.
- Landings would not be located in wetlands.
- Logs and slash would not be yarded across perennial streams unless fully suspended over the stream and adjacent banks. Where yarding across intermittent streams is necessary, log movement would be designed to minimize sediment delivery to streams.
- Logs firmly embedded in the bed or bank of waterbodies that are in place prior to felling timber would not be disturbed during logging and yarding operations unless they prevent trenching and fluming operations.
- TEWAs would be in currently cleared areas next to roads.
- Most timber removal would be accomplished through ground skidding and cable yarding; helicopter yarding may be used in some areas that are difficult to access. Where ground skidding is used, the following measures would be employed to minimize significant detrimental soil disturbance (compaction and displacement):
  - low ground weight (pressure) vehicles would be used;
  - logging machinery would be restricted to the 30-foot permanent right-of-way wherever possible to prevent soil compaction;
  - the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment;
  - designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the right-of-way over the pipeline trenching area; and

- landings, yarding, and load-out areas used for timber harvesting would be scarified or subsoiled (depending on the vegetation to be restored) after use and prior to the rainy season where the potential for sediment delivery to waterbodies is possible.

- Logging slash would be treated immediately. Material designated to remain on site to meet resource concerns would be placed in designated UCSAs along the edge of the right-of-way and then scattered/redistributed across the right-of-way during final cleanup and reclamation (following seeding). In upland areas, stump removal would be limited to the trenchline and areas where grading is necessary to construct a safe, level working plane.
- Off-site slash disposal and/or burning may occur in areas where slash is concentrated, such as landings. Slash would be machine or hand piled with the outer edge of piles no closer than 20 feet from the outer drip line of live trees, and burned according to state burning requirements and landowner stipulations. Burns would occur during the wet season.
- Outside of the 30-foot-wide permanent pipeline easement, kept clear of trees with roots that could compromise the integrity of the pipeline coating, the temporary construction area would be restored and revegetated using native seeds and saplings according to the ECRP.

State Lands

Less than 1 percent of the Pacific Connector pipeline would cross State Forests. The proposed route would cross the Southwest Oregon and the East Oregon Forest Practices Region, which contains mature forest. Trees within this portion the right-of-way would be cut and merchantable trees would be sold as directed by ODF. As stipulated within ORS 527.670(3), a written plan must be submitted to the ODF State Forester before extracting timber within:

- 100 feet of a stream classified as Type F (stream with fish or fish and domestic water use) or Type D (stream with domestic water use but no fish use);
- 300 feet of a specific site involving threatened or endangered wildlife species, or sensitive nesting, roosting, or water sites;
- 300 feet of any resource site identified in OAR 629-665-0100 (Sensitive Bird Nesting, Roosting, and Watering Resource Sites on Forestlands), OAR 629-665-0200 (threatened and endangered species that use Resource Sites on Forestlands), or OAR 629-645-0000 (Significant Wetlands); and
- 300 feet of any nesting or roosting site, or critical habitat of threatened or endangered species listed by the FWS or by the ODFW Commission.

Pacific Connector would prepare and submit to the ODF State Forester for approval a written plan describing how the pipeline would be in compliance with the Forest Practices Act (OAR 629-605-0170), prior to harvesting activities. In addition to the written plan, Pacific Connector would be required to submit a Notification to the ODF. The Notification serves three purposes: notification of a forest operation (ORS 527.670), a request for a Permit to Use Fire or Power Driven Machinery (PDM, ORS Chapter 477), and notice to the Department of Revenue of timber harvest (ORS 321.550).

4.5.2.3 Environmental Consequences of Timber Extraction on Federal Lands

Pacific Connector produced a *Right-of-Way Clearing Plan for Federal Lands* that outlined how it would clear timber along the pipeline route. It also produced a *Prescribed Burning Plan* to outline procedures for burning slash along the right-of-way after forest-clearing activities.[80]

Timber cruises on federally managed lands would be conducted by the land management agencies or by a third-party contractor approved by the land management agency (but financed by Pacific Connector), according to a timber cruise design that the agencies approve. Each National Forest and the four BLM Districts crossed by the pipeline would administer its own timber sale contract. Pacific Connector would be the contractor for harvesting activities on federal lands, although logging would likely be done by subcontractor.

Timber sale boundary designation, volume estimation, appraisal, and contract preparation would be accomplished as negotiated between Pacific Connector and the federal land managers. Tree-marking would be done via agency tracer paint used under the supervision and accountability of the respective agency. Pacific Connector would be responsible for logging and marketing the timber. Any timber sold from federal land must be processed domestically and not exported.

The agencies would use a Tree Measurement Timber Sale Contract with the standard provisions for payment and log accountability. Many of the operational requirements typically detailed in such a timber sale contract, such as erosion control, road maintenance, and slash disposal, are expected to be contained in the Right-of-Way Grant and would be incorporated into the timber sale contract. Performance bonding typically required in such a timber sale, if included in the grant and considered adequate, would be used to cover operations performed under the timber sale contracts. Agency sale administrators would oversee timber disposal operations to ensure they are carried out following any site-specific requirements as well as to ensure proper log accounting for specially-designated revenues. Logs from different federal agencies may be segregated at shared landings.

The BLM would require that Pacific Connector purchase all merchantable timber (7 inches dbh). The BLM does not intend to establish a value for young trees below merchantable size thresholds removed during clearing and pipeline construction. The authority and procedures the BLM would use to dispose of merchantable timber on BLM lands involved in the pipeline are addressed in the Title 43 CFR 5400 regulations. BLM may sell the right-of-way timber by competitive bidding or through negotiated sale where it is impracticable to obtain competition. Right-of-way timber would be sold under lump sum timber sale contract(s) at not less than the appraised value as determined by the BLM. Timber sale contracts would be prepared, offered, and administered by each BLM District involved. The Forest Service would appraise and establish a separate contract rate for two products: 1) sawtimber (minimum of 6 inches diameter inside bark), and 2) non-sawtimber (minimum of 3 inches diameter inside bark). The Forest Service would establish a value for reproduction timber destroyed by the Pacific Connector Pipeline Project. The authority and procedure the Forest Service would use to dispose of merchantable timber cut for construction of the pipeline are addressed under Title 36 CFR

[80] Both plans were filed as part of the POD (Appendices R and T, respectively), as stand-alone reports included with Pacific Connector's June 2013 application to the FERC.

223.12, Permission to cut, damage, or destroy trees without advertisement. This regulation authorizes the Forest Service, under the issuance of a right-of-way or special use authorization, to sell the timber directly to Pacific Connector at the current appraised value. Pacific Connector intends to negotiate one contract with the Forest Service covering all three National Forests crossed by the pipeline route.

Table 4.5.2.3-1 summarizes the estimated volume of timber that would be harvested on federally managed lands. The timber volume estimates provided in table 4.5.2.3-1 were derived using professional forestry methodologies and protocols to provide a basic timber volume inventory for the pipeline. A cruise-inventory of stand types (conifer, brush, riparian, roads, rock pits, etc.) was compiled along forested areas of the pipeline project route using aerial photography and ground visits. Each stand type was ground visited and inventory-cruise plots were established in each type to result in a 5 to 8 percent level of accuracy for determining Scribner decimal C log rule gross and net volumes. Twenty percent of plots were full measure quarter-acre (58.9 feet circular). To determine gross thousand board feet (MBF) timber volumes, "Local" volume tables were developed for each species by stand type to determine gross volume by two inch diameter class total height. Dilworth, MB&G, Atterbury, and Forest Service timber cruising protocols were used to determine volume, grade, and cruise downfall. No further deductions were taken for harvesting breakage or local scaling rules-of-thumb factors for hidden defects.

TABLE 4.5.2.3-1

Forest Stand Type and Net Volume (MBF) on BLM and NFS Lands

		Timber Class (MBF)				
County	**Jurisdiction**	**Small Conifer Sawlog**	**Medium Conifer Sawlog**	**Large Conifer Sawlog**	**Mixed Conifer/Hardwood**	**Total Volume (MBF)**
Coos a/	BLM	360	270	1,680	24	2,334
Douglas	Forest Service	360	595	1,764	35	2,754
	BLM	480	702	2,016	40	3,238
Jackson	Forest Service	600	540	3,192	51	4,383
	BLM	480	486	1,680	22	2,668
Klamath	Forest Service	240	135	1,008	20	1,403
	BLM	108	54	420	17	599
Total	***Forest Service***	***1,200***	***1,270***	***5,964***	***106***	***8,540***
	BLM	***1,428***	***1,512***	***5,796***	***103***	***8,839***
	Total	**2,628**	**2,782**	**11,760**	**209**	**17,379**

a/ There are no NFS lands crossed by the Pacific Connector pipeline in Coos County.
MBF – thousand board feet

Pacific Connector estimated that about 17,379 MBF of timber would be cut and removed from the pipeline right-of-way across federal lands. To put these values into perspective, approximately 15.8 MBF are needed to build a 2,000-square-foot house; therefore, this would be enough timber to build approximately 1,100 houses of this size. Pacific Connector proposes that slash from timber clearing be stored on or at the edge of the right-of-way and scattered/redistributed across the right-of-way during final cleanup and reclamation according to BLM and Forest Service fuel loading specifications to minimize fire hazard risks. This material would be pulled back onto the right-of-way during final cleanup after seeding. Where it is not feasible to pull the slash back onto the right-of-way after seeding, seeding in these areas (broadcast or hydroseeding) would occur with specifications to ensure adequate seed coverage. Slash would not be stored for prolonged periods of time within areas infested by pathogenic insects such as Douglas-fir beetle, Douglas-fir engraver beetle, Douglas-fir pole beetle, or flatheaded borer. Scattering the slash across the right-of-way would hinder OHV traffic on the right-of-way and would act as a natural mulch to minimize erosion.

Section IV.F.3.e of the FERC's *Plan* states that if wood chips are used as mulch to not use more than 1 ton per acre of chips and to add an equivalent of 11 pounds of available nitrogen where chips are used as mulch. The purpose of Section IV.F.3.e is to ensure that revegetation efforts are not hindered due to the decaying process of large amounts of wood chips which can bind up soil nitrogen and impede revegetation. Because more than 1 ton per acre of woody material (logs, slash, and chips) may be scattered across the right-of-way during final cleanup in many areas, Pacific Connector proposed a modification to Section IV.F.3.e of the FERC's *Plan*. Pacific Connector claims it would be impractical and infeasible to remove this material from the right-of-way, and it is a typical silvicultural practice in the Project area to leave forest slash in logged areas. Pacific Connector would utilize the fuel loading standards of the BLM and the Forest Service as the limit for the quantity of woody debris that would be distributed across the right-of-way to minimize fire hazard risks for this proposed modification. Furthermore, it is expected that the woody slash material would not deplete soil nitrogen in the short term, during revegetation establishment, because the size of the woody material that would be scattered on the right-of-way would be large and would not readily decay in the short term. However, as proposed in the Section 10.8 of the ECRP, Pacific Connector would apply a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer (16:16:16 - nitrogen, potassium, and phosphorus) on all disturbed areas to be reseeded, except in wetlands. This fertilization rate would apply 32 pounds per acre of elemental nitrogen, potassium, and phosphorus. The elemental nitrogen rate would also satisfy FERC's requirement to add nitrogen where wood chips are used as mulch (see Section IV.F.4.e. of the FERC's *Plan*). The use of fertilizers on federally managed lands would require approval and coordination with the respective agency prior to use. We find this proposed modification acceptable.

On NFS lands, the maximum amount of slash that would be scattered across the right-of-way would be 12 tons per acre, which would be distributed over the following fuel loading size classes:

Fuel Loading Specification by Size Class

Size Class (diameter)	tons/acre a/
0-1/4 inch	<1
1/4–3 inches	4-8
3-8 inches	7-12

a/ Total fuel load should not exceed 12 tons per acre.

On BLM lands, the maximum amount of slash that would be scattered across the right-of-way would be 15 tons per acre, which would be distributed over the following fuel loading size classes:

Fuel Loading Specification by Size Class

Size Class (diameter)	Tons/Acre a/
0-1/4 inch	< 1
1/4 -8 inches	5-8
>8 inches	10-15

a/ Adapted from Forest Service Fuel Loading Standards.

As provided by the Forest Service, dead and downed woody debris greater than 16 inches in diameter does not contribute to fire hazard and would be maintained on site. Slash may be chipped and scattered across the right-of-way provided that the average depth of wood chips covering the area does not exceed 1 inch following application. This chip depth would be sufficient to stabilize the soil surface from erosion while allowing grass seed to germinate and seedlings to develop. It is not expected to significantly increase fuel hazards as long as the maximum tonnage for fuel loading does not exceed 12 tons per acre. On BLM and NFS lands, larger slash pieces (more than 8 inches in diameter) may be removed from the project area and decked in designated storage sites, as stipulated by these agencies, or on the right-of-way at road crossings. This material would be made available to the public through the agencies' firewood programs.

In areas where the fuel loading exceeds these standards, Pacific Connector would machine or hand pile and burn the excess material depending on the site location. Burning would occur during the appropriate burning season and according to the conditions permitted by the BLM, the Forest Service, and the ODF (OAR 629-615-300). Pacific Connector has outlined measures for burning slash and excess small timber in its *Prescribed Burning Plan*. Burning on federal lands would follow the *Interagency Prescribed Fire Planning and Implementation Procedure Guide* (BIA et al. 2008). The Forest Service would seek all necessary air pollution emission permits and approvals from appropriate Oregon state agencies before allowing a prescribed burn. In fact, on NFS lands, the Forest Service may decide to conduct the burns for the pipeline project.

Pacific Connector would submit a reforestation plan to the BLM and the Forest Service for approval during easement acquisition. Following construction, previously forested areas within the temporary construction right-of-way and TEWAs would be replanted in accordance with Oregon reforestation rules (OAR 629-610-0000 through 629-610-0090), BLM Management Directions, and Forest Service Standards and Guidelines (i.e., National Forest Management Act requirements and Forest stocking standards). However, areas within the 30-foot-wide permanently maintained right-of-way would remain cleared and maintained in an herbaceous state to facilitate periodic checks of the pipeline. This would result in a permanent loss of timber production on approximately 119 acres within BLM lands and on approximately 104 acres of NFS lands. Pacific Connector would compensate the Forest Service and BLM for this lost in productivity. The BLM and Forest Service would each be responsible for determining the value of the timber that would be affected by the Pacific Connector pipeline on lands they manage.

Note that not all cleared areas would be replanted. The 30-foot-wide right-of-way would remain cleared and maintained in an herbaceous state to facilitate periodic checks of the pipeline. This would result in a loss of timber production over the operational life of the Project on approximately 119 acres within BLM lands and on approximately 104 acres of NFS lands. Because timber production would be foregone during this period, Pacific Connector would compensate the BLM and Forest Service for a corresponding loss of productivity. The BLM and Forest Service would each be responsible for determining the value of the timber production losses that would be caused by the Pacific Connector pipeline on lands they manage. Compensation would be based on standard timber cruise protocols.

4.6 WILDLIFE AND AQUATIC RESOURCES

4.6.1 Terrestrial Wildlife

The project area provides suitable habitat for a number of wildlife species associated with the coastal, mid-coastal, interior foothills, and mountain terrains that construction and operation of the Project could affect. The types of wildlife habitat that would be affected by the Project and the wildlife species potentially located in those habitats are described below. Wildlife species that have special status under federal or state laws or statutes are discussed in section 4.7.

4.6.1.1 Jordan Cove LNG Terminal

Approximately 178 species of amphibians, reptiles, birds, and mammals were recorded in uplands on or adjacent to the Jordan Cove Project site (i.e., the LNG terminal facility, South Dunes Power Plant, and North Point workers camp) during surveys conducted in October 2012, in early 2006, and from June to December 2005.

ODFW Habitat Categories

Characterizations of wildlife habitats potentially affected by construction of the Project are based on resource agency consultations, on-the-ground surveys, and published reports. In accordance with its Fish and Wildlife Habitat Mitigation Policy, the ODFW has established the following six classifications for habitats, based on dominant plant, soil, and water associations of value to the support and use of fish and wildlife:

- Category 1 – irreplaceable[81], essential habitat[82] that is limited;[83]
- Category 2 – essential habitat that is limited;
- Category 3 – essential habitat, or important[84] habitat that is limited;
- Category 4 – important habitat;
- Category 5 – habitat having a high potential to become essential or important habitat; and
- Category 6 – habitat that has a low potential to become essential or important habitat.

The area affected by the construction of the LNG terminal and associated facilities (including the South Dunes Power Plant, workers camp, etc.) encompasses approximately 397 acres, and an additional 49 acres from temporary disturbance associated with establishing mitigation sites (see table 4.6.1.1-1). Several areas within the terminal tract would be preserved and not affected by construction, while other areas may be restored to higher value habitat by contouring, landscaping, and vegetation plantings typical of the coastal dune setting of the North Spit. Restored

[81] "Irreplaceable" means that successful in-kind habitat mitigation to replace lost habitat quantity and/or quality is not feasible within an acceptable period of time or location, or involves an unacceptable level of risk or uncertainty, depending on the habitat under consideration and the fish and wildlife species or populations that are affected. "Acceptable", for the purpose of this definition, means in a reasonable time frame to benefit the affected fish and wildlife species (OAR 635-415-0025).
[82] "Essential Habitat" means any habitat condition or set of habitat conditions that, if diminished in quality or quantity, would result in depletion of a fish or wildlife species (OAR 635-415-0025).
[83] "Limited habitat" means an amount insufficient or barely sufficient to sustain fish and wildlife populations over time (OAR 635-415-0025).
[84] "Important Habitat" means any habitat recognized as a contributor to sustaining fish and wildlife populations on a physiographic province basis over time (OAR 635-415-0025).

construction areas would be converted to ODFW Habitat Category 4. Table 4.6.1.1-1 lists the temporary and permanent acres of impact to each habitat type for each Project component. Of the jurisdictional terminal facilities, the slip and access channel would affect the most acres of land (66 acres), including ODFW habitat categories 2, 3, 4, and 6. Of the non-jurisdictional facilities, the South Dunes Power Plant would affect the most acres of land (58 acres) comprising the same categories listed above for the slip and access channel. For temporary construction areas, a majority of the habitat affected would be Category 6; however, Categories 2 (less than 1 acre), 3 (33 acres), and 4 (47 acres) would have some impacts from temporary construction.

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Slip and Access Channel [12] (Access Channel and Marine Slip)	*66*	*66*
Shallow Subtidal (Category 3)	0	3 c/
Salt Marsh (Category 2)	0	<1 c/,d/
Eelgrass (Category 2)	0	3 c/
Deep Subtidal (Category 3)	0	15 c/
Algae/Mud/Sand (Category 2) f/	0	4 c/
Intertidal Unvegetated Sand (Category 2) f/	0	4 c/
Coastal Dune Forest (Category 3)	0	16
Shrub (Category 4)	0	<1
Herbaceous (Category 4)	0	19
Developed (Category 6)	0	1
Marine Access Pipeway [3] (LNG Transfer Line)	*9*	*9*
Coastal Dune Forest (Category 3)	0	9
Developed (Category 6)	0	<1
LNG Tank Area [5] (LNG Storage Tank Area)	*27*	*27*
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	21
Liquefaction Process Area [4]	*20*	*20*
Coastal Dune Forest (Category 3)	0	20
Developed (Category 6)	0	<1
Refrigerant Storage Area [2]	*2*	*2*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	1
Flare Area [7] (Ground Flare)	*1*	*1*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	<1
Fire Water Ponds [6] (Terminal Fire Water Ponds)	*4*	*4*
Herbaceous (Category 4)	0	4
Terminal Site Access [1] (North Terminal Access)	*4*	*4*
Scrub-Shrub Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	1
Herbaceous (Category 4)	0	2
Construction Dock [8] (Barge Berth)	*3*	*3*
Shallow Subtidal (Category 3)	0	<1
Algae/Mud/Sand (Category 2)	0	<1 c/
Intertidal Unvegetated Sand (Category 2)	0	1
Coastal Dune Forest (Category 3)	0	<1
Developed (Category 6)	0	<1
Control Building/Plant Warehouse/Maintenance Building [R1A] (Terminal Operator Building and Warehouse)	*8*	*8*
Coastal Dune Forest (Category 3)	0	4
Unvegetated Sand (Category 3)	0	<1
Herbaceous Shrub (Category 4)	0	1
Developed (Category 6)	0	2
Access/Utility Corridor [R1](Utility Corridor and East Access Road)	*11*	*11*
Emergent Wetland (Category 2)	0	<1
Forested Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	3

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Unvegetated Sand (Category 3)	0	4
Riparian Forest (Category 3)	0	<1
Herbaceous Shrub (Category 4)	0	2
Open Water (Category 2)	0	<1
Developed (Category 6)	0	<1
Gas Processing Area [9, 9A]	*13*	*13*
Salt Marsh (Category 2)	0	<1 c/,d/,e/
Algae/Mud/Sand (Category 2)	0	<1 c/,d/
Herbaceous Shrub (Category 4)	0	10
Emergent Wetland (Category 2)	0	<1
Herbaceous (Category 4)	0	1
Open Water (Category 3)	0	<1
Developed (Category 6)	0	2
Stormwater Pond/Laydown [11] (g/) (Shared Jurisdiction between FERC and EFSC) (Stormwater Pond)	*11*	*11*
Herbaceous Shrub (Category 4)	0	11
Developed (Category 6)	0	<1
Pacific Connector Meter Station	*0 h/*	*0 h/*
Herbaceous Shrub (Category 4)	0	0
Industrial Wastewater Pipeline Relocation	*13*	*13 (5)*
Herbaceous (Category 4)	0	6 (0)
Herbaceous Shrub (Category 4)	0	<1 (0)
Shrub (Category 4)	0	<1 (0)
Developed (Category 6)	0	7 (5)
Water/Raw Water Line (Raw Water Pipeline Extension)	*3*	*3 (1)*
Herbaceous (Category 4)	0	<1 (0)
Developed (Category 6)	0	2 (1)
North Point Workforce Housing Project Bridge	*<1*	*<1*
Salt Marsh (Category 2)	0	<1 c/,e/
Algae/Mud/Sand (Category 2)	0	<1 c/
Shrub (Category 4)	0	<1
TOTAL JURISDICTIONAL FACILITIES	**195**	**195**
Non-Jurisdictional Facilities		
South Dunes Power Plant	*58*	*58*
Emergent Wetland (Category 2)	0	1
Coastal Dune Forest (Category 3)	0	<1
Shrub (Category 4)	0	<1
Herbaceous (Category 4)	0	12
Herbaceous Shrub (Category 4)	0	13
Open Water (Category 3)	0	<1
Developed (Category 6)	0	31
Southwest Oregon Resource Security Center (SORSC)	*8*	*8*
Forested Wetland (Category 2)	0	<1
Emergent Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	<1
Shrub (Category 4)	0	<1
Developed (Category 6)	0	<1
TOTAL NON-JURISDICTIONAL FACILITIES	**66**	**66**
Temporary Construction Areas		
Heavy Equipment Truck Haul Road o/	*8*	*8*
Coastal Dune Forest (Category 3)	0	<1
Herbaceous (Category 4)	0	<1
Herbaceous Shrub (Category 4)	0	<1
Shrub (Category 4)	0	<1
Developed (Category 6)	0	7
Slurry/Decant Water Pipeline Route (p/) (Slurry and Return Water Pipelines)	*1*	*1*
Developed (Category 6)	0	1
Field Supervision Trailers (Terminal Construction Trailers)	*- i/*	*- i/*
Tank Staging Area	*- i/*	*- i/*

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Concrete Batch Plant Area	*- k/*	*- k/*
Tank Roof Fabrication	*- j/*	*- /*
Process Staging Area	*- j/*	*- j/*
Offices (Construction Offices at Roseburg Forest Products Property)	*1*	*1*
Developed (Category 6)	0	1
Laydown (Laydown Area at Roseburg Forest Products)	*13*	*13*
Developed (Category 6)	0	13
Open Areas	11	11
Developed (Category 6)	0	11
Parking (Parking at Roseburg Forest Products)	*1*	*1*
Developed (Category 6)	0	1
Craft Areas (Craft Areas at Roseburg Forest Products)	*<1*	*<1*
Developed (Category 6)	0	<1
Warehouse/Storage (Warehouse/Storage at Roseburg Forest Products)	*1*	*1*
Developed (Category 6)	0	1
Fabrication (Fabrication Areas at Roseburg Forest Products)	*4*	*4*
Developed (Category 6)	0	4
LNG Loading Berth Dune (Southeastern Berth Dune Area)	*15*	*15*
Coastal Dune Forest (Category 3)	0	13
Developed (Category 6)	0	2
Sand Dune Area (Northern Terminal Sand Dune Area)	*7*	*7*
Scrub-Shrub Wetland (Category 2)	0	<1
Coastal Dune Forest (Category 3)	0	6
Herbaceous (Category 4)	0	<1
Laydown Area	*21*	*21*
Coastal Dune Forest (Category 3)	0	14
Herbaceous (Category 4)	0	8
Laydown Area (Gas Processing Plant Laydown Area)	*4*	*4*
Herbaceous Shrub (Category 4)	0	3
Developed (Category 6)	0	<1
North Point Workforce Housing Project Site (North Point Workers Camp)	*48*	*48*
Shrub (Category 4)	0	5
Herbaceous Shrub (Category 4)	0	13
Herbaceous (Category 4)	0	18
Developed (Category 6)	0	12
Construction Laydown g/	*- l/*	*- l/*
Construction Laydown g/	*- l/*	*- l/*
Laydown – South Dunes g/	*- m/*	*- m/*
Excavated Materials Haul Road	*- n/*	*- n/*
TOTAL TEMPORARY CONSTRUCTION AREAS	**136**	**136**
Preserved Wetlands Area [E3] (Eastern Henderson Marsh)	*11*	*0*
Emergent Wetland (Category 2)	4	0
Scrub-Shrub Wetland (Category 2)	4	0
Coastal Dune Forest (Category 3)	<1	0
Herbaceous (Category 4)	2	0
Preserved Wetlands Area [E1](Northeastern Terminal Wetlands Area)	*28*	*0*
Forested Wetland (Category 2)	17	0
Emergent Wetland (Category 2)	2	0
Coastal Dune Forest (Category 3)	8	0
Shrub (Category 4)	<1	0
Herbaceous Shrub (Category 4)	<1	0
Preserved Wetlands Area [E5] (Western South Dunes Power Plant Wetlands Area)	*7*	*0*
Emergent Wetland (Category 2)	4	0
Coastal Dune Forest (Category 3)	1	0
Herbaceous Shrub (Category 4)	2	0
Open Water (Category 4)	<1	0
Developed (Category 6)	<1	0
TOTAL UNDISTURBED AREAS	**45**	**0**
Wetland Mitigation Sites g/		
West Jordan Cove Mitigation Area	*3.7*	*3.7*
Salt Marsh (Category 2)	0.5	0.5

TABLE 4.6.1.1-1

Acres of ODFW Habitat Affected by the Construction and Operation of the Project

Area a/	Land Area (acres)	Land Affected by Construction (acres) b/
Herbaceous (Category 4)	0.1	0.1
Herbaceous Shrub (Category 4)	2.1	2.1
Riparian Forest (Category 3)	0.7	0.7
Developed (Category 6)	0.3	0.3
West Bridge Mitigation Area	*2.0*	*2.0*
Scrub-Shrub Wetland (Category 2)	0.4	0.4
Unvegetated Sand (Category 3)	0.1	0.1
Coastal Dune Forest (Category 3)	0.4	0.4
Riparian Forest (Category 3)	0.1	0.1
Shrub (Category 4)	0.4	0.4
Developed (Category 6)	0.6	0.6
Kentuck Mitigation Area	*43.6*	*43.6*
Emergent Wetland (Category 2)	42.5	42.5
Open Water (Category 4)	1.1	1.1
TOTAL WETLAND MITIGATION AREAS	**49.3**	**49.3**
TOTAL PROJECT AREA	**491**	**446**

a/ Numbers or letters in brackets refer to area designations shown on figure 2.1-2.
b/ Under *Jurisdictional Facilities* and *Non-jurisdictional Facilities*, acres shown represent both temporary and permanent effects. Numbers in parentheses represent permanently affected acres where they differ from temporarily affected acres. *Temporary Construction Areas* and *Wetland Mitigation Sites* would only have temporary effects.
c/ The estuarine habitat acreages affected presented in this table may vary slightly from those used in the U.S. Army Corps of Engineers (COE) 404/Section 10 Permit Application and other areas of this report. Minor adjustments to affected area boundaries, including adjustments created to allow for buffers around estuarine resources, were made for the COE permit application. These adjustments were made to ensure the Project footprint reviewed in the permit process is sufficient to address potential modifications that may occur during that process, including potential changes to the Project footprint in the final design and any additional mitigation measures that may be required to address potential impacts to estuarine resources. The ODFW habitat acreages remain as being based on reasonable boundaries at the time the Project was designed. All other references to estuarine impacts shall be based on the adjusted acreage amounts used in the COE permit application, which include a contingency to ensure all areas affected by the Project will be covered by the permit process.
d/ Effects presented in the Section 10/404 permit are combined for Mill Site/South Dunes Site and include the Gas Processing/Shared areas.
e/ Salt Marsh is considered "Intertidal" in the 6/13/2013 Section 404 Submittal by DEA.
f/ Algae/Mud/Sand + Intertidal Unvegetated Sand is equal to "Intertidal", as referenced in the COE 404/Section 10 Permit Application and other areas of the Resource Report.
g/ These areas are associated with the construction and operation of the gas processing facility and are included with the areas for the LNG Terminal even though they are adjacent to the non-jurisdictional South Dunes Power Plant site.
h/ Pacific Connector Pipeline Project metering area may be used for laydown depending on the timing of Project construction. Effects due to operation of this area are addressed in Pacific Connector's FERC resource reports.
i/ Individual temporary construction area is included in total for Area 5.
j/ Individual temporary construction area is included in total for Area 4F.
k/ Individual temporary construction area is included in total for Areas 4F and 6.
l/ Individual temporary construction area is included in Area 10.
m/ Individual temporary construction area is included in Area 11.
n/ Area is included in Project site area and access/utility corridor.
o/ Area calculation based upon the length of the heavy equipment truck haul road to the point where the road joins with the access/utility corridor or other areas already included in the totals for temporary construction impact.
p/ Area calculation based upon the length of the pipelines from the slip to the access/utility corridor, at which point the affected area is already included in the area affected by the access/utility corridor.
q/ Areas presented in this table are the maximum area disturbed during construction and may be greater than the areas used to determine mitigation requirements for DSL and COE Permits.

Below we discuss the habitats found within the Jordan Cove terminal tract, their vegetation cover, associated wildlife, and ODFW habitat categories.

Upland Habitats

Uplands on the North Spit contain coastal dune forest, riparian forest, shrubs, grasslands (herbaceous), and unvegetated sand dunes. Dominant overstory for coastal dune forest include Douglas-fir, western hemlock, shore pine, Sitka spruce, and Port-Orford-cedar, with an understory including evergreen huckleberry, salal, bearberry, rhododendron, California wax myrtle, and manzanita. Shore pine and Sitka spruce forests constitute the habitat with the greatest structural complexity on the North Spit and support the greatest diversity of wildlife species. The trees, snags, and downed logs in these forests provide important breeding, foraging, and cover habitat for a variety of wildlife species: upland amphibians seek cover in downed logs, and many bird species, including raptors, woodpeckers, and songbirds, nest and forage in these habitats.

Coastal dune forest and riparian forest habitats are classified as Category 3 because they are essential to wildlife but not limited (OAR 635-415-0025). Species that depend on these habitat types include the American marten, bats, and some songbirds. Loss of this habitat category could result in the depletion of some species on a local scale. Construction of the Project would affect about 100 acres of coastal forested dune habitat.

Herbaceous, herbaceous shrub, and shrub habitat types are all classified as Category 4 because they are not essential or limited, but they are still important to wildlife. The vast majority of these habitats lie on dredge spoils covered by weedy herbaceous and shrub species. Shrub species present within these habitats include young shore pine and invasive species such as Scotch broom and Himalayan blackberry. Herbaceous vegetation in these habitat types includes native species such as seashore lupine, small-head clover, and beach strawberry, together with invasive species such as European beachgrass, colonial bentgrass, and sweet vernal grass. These habitats have been extensively degraded historically, and only provide habitat for generalist species such as deer, small mammals, and a limited suite of songbirds (DEA 2014). No specific wildlife species are known to depend on these habitats, and their loss would not likely result in depletion of any species. Construction of the Jordan Cove Project would affect a total of about 155 acres of herbaceous, herbaceous shrub, and shrub habitat.

Open Water or Wetland Habitats

Open water and wetland habitats on the North Spit are composed of several freshwater lakes, ponds, forested and shrub wetlands, and emergent wetlands and marshes, together with the Coos Bay estuary and its associated shoreline, including mudflats. The overstory in forested wetlands on the North Spit consists of shore pine, Hooker willow, red alder, and Sitka spruce, with an understory of Pacific crabapple, Douglas spirea, twinberry, and slough sedge. Scrub-shrub wetlands are commonly dominated by Hooker willow, with salmonberry, slough sedge, skunk cabbage, and Pacific crabapple. Emergent wetlands are typically dominated by slough sedge, with spreading rush, water parsley, Pacific silverweed, salt grass, cattail, bulrush, and aquatic floating plants like pond lily. Salt marsh and algae-covered mudflats are also included in the wetland habitat types.

Habitats found in this environment support a rich terrestrial wildlife community, including mammals, birds, reptiles, and invertebrates; aquatic species found these habitats are discussed below in section 4.6.2. Terrestrial wildlife species that use open water and wetland habitats (inland, estuarine, or marine) on the North Spit are generally specialized, or are strongly associated with one habitat type. However, there are dozens of species that may occur within the project area that are very well adapted to utilizing one, two, or all three of these open water and wetland habitats, as seasonal conditions warrant. Resident and migrant shorebirds congregate on the tidally inundated mudflats along the shore of Coos Bay, to forage on the invertebrates in the shallow waters and exposed mudflats, especially during low tides. Raptors known to use open water and shoreline habitats include the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Circus cyaneus*), and peregrine falcon (*Falco peregrinus*). Mammals that also forage in wetlands and near shore environments include raccoon (*Procyon lotor*), mink (*Neovison vison*), and striped skunk (*Mephitis mephitis)*.

Forested, scrub-shrub, and emergent wetlands are classified as Category 2, because they are essential for wildlife, and limited, but can be replaced through mitigation. Construction of the LNG terminal would affect about 38 acres of wetlands (see table 4.4.3.1-1).

Construction of the access channel to the terminal would include 29 acres of open water within Coos Bay (see figure 4.6-2 in section 4.6.2). This area contains salt marsh, eelgrass, intertidal, and subtidal habitats. Approximately 12 acres of this area that would be affected by the construction and operation of the LNG terminal is also classified as Category 2, because it is essential for wildlife, and limited, but can be replaced through mitigation.

Developed Habitat

Developed areas include portions of the LNG terminal site that have been significantly disturbed by previous development and industrial use, including land use activities such as demolished mill foundations/concrete pads, unvegetated cut slopes, rocked yards, paved roads, parking lots, gravel roads, concrete laydown areas, log deck storage areas, and sandy roadside areas. Developed lands have limited potential to become important or essential wildlife habitat, and therefore are classified as Category 6. About 102 acres of developed lands would be affected by construction of the Jordan Cove Project.

ODFW Habitat Category Mitigation Measures

On May 22, 2014, Jordan Cove filed its *Wildlife Habitat Mitigation Plan* with the FERC, to comply with the ODFW Fish and Wildlife Habitat Mitigation Policy under OAR 635-415-000 to 00025 (see appendix S of this EIS). According to that policy, project proponents can protect and maintain habitat areas to replace or mitigate for impacts on Category 1-4 habitats. Construction of the Jordan Cove Project facilities would affect a total of approximately 27 acres of Category 2, 115 acres of Category 3, and 120 acres of Category 4 habitats (note than numbers are approximate due to rounding in table 4.6.1.1-1). To mitigate for the loss of those habitats, Jordan Cove would acquire or control about 259 acres of county or privately owned land at three parcels outside of its terminal tract, but still in the vicinity of the North Spit (table 4.6.1.1-2; see also figure 4 in the *Wildlife Habitat Mitigation Plan* [appendix S]). These parcels would be set aside for long-term preservation, and maintained by a third-party non-profit organization that meets the requirements of ORS 271.714(3)(b).[85] The mitigation parcels would mitigate for impacts shown in table 4.6.1.1-1. Jordan Cove is continuing to work with ODFW to finalize its Project-specific *Wildlife Habitat Mitigation Plan* to comply with state policy.

[85] Currently, Jordan Cove is negotiating with the Coos Watershed Association to fulfill the role of the non-profit third party to preserve and manage the habitat mitigation areas.

TABLE 4.6.1.1-2

Proposed Mitigation Parcels, Vegetation Types, and Acres of Habitat Categories To Be Preserved

Parcel	Acres of Mitigation	Owner	Habitat Type (acres) Coastal Dune Forest	Riparian Forest	Shrub	Herbaceous Shrub	Herbaceous	Unvegetated Sand
P (Panhandle)	105	Port	33	0	4	30	64	1
S (North Bank)	70	Private	69	1	0	0	0	0
W (Lagoon)	84	Private	0	0	5	23	27	2
Total	**259**	--	**102**	**1**	**9**	**53**	**91**	**3**

Note: Acreages rounded to nearest whole acre. Rows/columns may not sum correctly.
Source: Jordan Cove *Wildlife Habitat Mitigation Plan* (appendix S of this EIS).

Terrestrial Animals in the Project Area

Terrestrial wildlife that may occupy the project area includes mammals, birds, amphibians, reptiles, and invertebrates.

Mammals

The BLM has documented 58 mammal species on the North Spit (BLM 2005). This includes large mammals, such as mountain lion (*Felis concolor*), Roosevelt elk (*Cervis elaphus roosevelti*), American black bear (*Ursus americanus*), and black-tailed deer (*Odocoileus hemionus*). Wildlife surveys conducted for Jordan Cove in 2005, 2006, and 2012 documented 11 mammal species within the terminal tract (LBJ 2006; SHN 2013): beaver (*Castor canadensis*), Roosevelt elk, Virginia opossum (*Didelphis virginiana*), North American porcupine (*Erethizon dorsatum*), mountain lion, Townsend's chipmunk (*Neotamias townsendi*), black-tailed deer, harbor seal (*Phoca vitulina*), raccoon, Douglas' squirrel (*Tamiasciurus douglasii*), and American black bear. Nine species of bats are known to occur on the North Spit. While bat-specific surveys were not completed by Jordan Cove, the mosaic of habitat types within the area suggests bat presence is potentially high. Unidentified bats were observed in one of the buildings on the Roseburg Forest Products property on July 21, 2005.

The construction and operation of the LNG terminal would reduce the amount of habitat available for big game species, and vehicle traffic related to the Project would increase the potential for collisions. However, due to the limited amount of natural habitat that would be affected within the LNG terminal tract, the amount of dune and wetland habitat that would be preserved, the amount of previous disturbance at the site, and existing industrial activities in the area, we conclude that the Project would not have significant population-level adverse effects on mammal species that currently occupy the North Spit.

Breeding and roosting sites for bats at the LNG terminal tract are limited, because of the small amount of forest that would be affected, as well as the absence of more typical bat habitat such as cliffs, rock outcrops, bridges, caves, and mines. Some habitat for those species that roost under bark is available in the dune forest habitat on the LNG terminal site. As with other mammals, it is not anticipated that construction and operation of the LNG terminal would have significant adverse effects on bat populations.

Birds

Migratory birds, which include all native birds in the U.S., with the exception of upland game birds, are protected under the MBTA, as described in section 1.5.1.10. Additionally, EO 13186 was enacted, in part, to ensure that the environmental analysis of a federal action evaluates the impacts of that action on migratory birds, and the federal agency and its project proponents avoid, minimize impacts, conserve species, and restore and enhance migratory bird habitat. EO 13186 states that emphasis should be placed on species of concern, priority habitat, and key risk factors. In March 2011, FERC and FWS finalized an MOU to implement EO 13186. Conservation of migratory bird habitats, avoiding or minimizing take of migratory birds, and developing effective mitigation measures to restore or enhance habitats on lands affected by energy projects are included as obligatory elements in the MOU. The MOU also places emphasis on, but is not exclusive to, birds of conservation concern (BCC).

The project area is located within the Pacific Flyway path for migratory birds. Birds that are known or that likely occur along the waterway and within the LNG terminal site include seabirds, shorebirds, waterfowl, passerines (songbirds), wading birds, and raptors. The BLM has documented 275 avian species using habitats on or near the North Spit of Coos Bay (BLM 2005). In addition, LBJ Enterprises (2006) documented 151 avian species during surveys of the LNG terminal tract, including two additional species not documented by the BLM.

The FWS maintains a list of migratory BCC that was developed as a result of a 1988 amendment to the Fish and Wildlife Conservation Act; the list was most recently updated in 2008. The Fish and Wildlife Conservation Act mandates that the FWS "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing" under the ESA. The goal of the BCC list is to prevent sensitive, rare, or otherwise vulnerable species from being listed under the ESA, by implementing proactive management and conservation actions and ensuring that these species be considered in accordance with EO 13186. BCC that potentially occur in the project area are listed in table 4.6.1.1-3. Federally- or state-listed species that are also BCC are not included below, as they are discussed in more detail in sections 4.7.1 and 4.7.2.

TABLE 4.6.1.1-3

Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat

Common Name	Scientific Name	Timing of Potential Occurrence	Expected Habitat
bald eagle	*Haliaeetus leucocephalus*	year-round	Near large bodies of water
peregrine falcon	*Falco peregrinus*	winter/year-round	Open habitats, nests on cliffs
black oystercatcher	*Haematopus bachmani*	year round	Coastal beaches, bays, and estuaries
whimbrel	*Numenius phaeopus*	Migration	Coastal marshes, beaches, rocky shores
long-billed curlew	*Numenius americanus*	Winter	Fields, dry prairies, mudflats
marbled godwit	*Limosa fedoa* (ssp. *beringiae* only)	Winter	Beaches, mudflats, shallow pools
red knot	*Calidris canutus*	Migration	Beaches and mudflats
short-billed dowitcher	*Limnodromus griseus*	Winter	Beaches, mudflats, shallow ponds
Caspian tern	*Sterna caspia*	Migration	Coastal areas
black swift	*Cypseloides niger*	Migration	Forages over forests and open areas
rufous hummingbird	*Selasphorus rufus*	summer/migration	Coniferous forests
olive-sided flycatcher	*Contopus cooperi*	Summer	Coniferous forests
vesper sparrow	*Pooecetes gramineus* (ssp. *affinis* only)	Very unlikely to occur in vicinity of Project	Open fields and pastures

TABLE 4.6.1.1-3

Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat

Common Name	Scientific Name	Timing of Potential Occurrence	Expected Habitat
Western grebe	*Aechmophorus occidentalis*	Winter	Marshes, lakes, and bays
lesser yellowlegs	*Tringa flavipes*	Migration	Marshes, ponds, wet meadows, lakes and mudflats
Hudsonian godwit	*Limosa haemastica*	Rare	Marshes, beaches, flooded fields, and tidal mudflats
Allen's Hummingbird	*Selasphorus sasin*	Summer	Chaparral, thickets, brushy hillsides, open coniferous woodlands, and gardens near coast
willow flycatcher	*Empidonax traillii*	Summer	Low brushy vegetation in wet areas
purple finch	*Carpodacus purpureus*	Year-round	Wooded areas

Sources: FWS (2008a); Sibley (2000); NatureServe (2009, 2013)

Seabirds

Thirteen seabird species breed along Oregon's coast, with offshore rocks and islands providing critical nesting habitat and important rest-over locations. Seabirds depend on relatively undisturbed coastal nesting habitats and on the rich coastal waters for food (Oregon Ocean Resources Management Task Force 1991). Foraging habitat can differ by species; some species such as the sooty shearwater (*Puffinus griseus*) and the northern fulmar (*Fulmarus glacialis*) are found primarily along the mid and outer shelf, while California gull (*Larus californicus*) and western gull (*Larus occidentalis*) occur only in the nearshore (Oregon Ocean Resources Management Task Force 1991). Foraging sea birds can be encountered along the LNG vessel transit route, at the terminal site, and in adjacent Coos Bay water.

Shorebirds

Coos Bay is one of a number of important areas for shorebirds between San Francisco Bay and British Columbia. Key areas for migrating shorebirds include Coos Bay and the beaches and deflation plains in the ODNRA. Coos Bay's extensive eelgrass (*Zostera marina*) beds, productive sloughs, intertidal algal flats, and substantial tidal marshes provide valuable habitat for thousands of shorebirds. Foraging habitat for shorebirds includes inter-tidal mudflats, rocky inter-tidal, estuaries, salt marshes, and beaches; salt marshes are used for resting and preening. The vast majority of shorebirds are migratory and non-breeders in Coos Bay. An important exception is the western snowy plover (*Charadrius alexandrinus nivosus*), which nests on upper beaches on the North Spit (this species is discussed in more detail in section 4.7). Shorebirds are most likely to be encountered along the beaches of the North Spit, and within the bay along tidal mudflats, salt marshes, and other exposed estuarine habitat.

Waterfowl

Waterfowl habitat is as diverse as the birds themselves, varying from ocean surf to fields and open meadows to upland streams (FWS 2007a). The southern Oregon coast provides wintering and migratory habitat for waterfowl of the Pacific Flyway. Coos Bay is recognized as an important migration and wintering waterfowl location. Coos Bay had the third highest total count of waterfowl on the Oregon Coast in a March 1992 aerial survey. Waterfowl are most likely to be encountered within Coos Bay and the immediate near shore habitat.

Passerines (Songbirds)

Breeding and feeding habitat for migratory passerines is associated with terrestrial and wetland habitat within Coos Bay. Important habitat includes coastal scrub-shrub, coastal dune forest and palustrine wetlands. In the case of swallows, human-made structures can be important structures for nesting colonies. Passerines are likely to occur in all habitats at the terminal site.

Neotropical migrants (birds that breed in North America and overwinter in the tropics) were observed during surveys of the waterway and LNG terminal. These are largely forest-nesting species and thus could be affected by vegetation clearing that would be required for construction and operation of the LNG terminal and slip. Examples of neotropical migrants detected at the LNG terminal site include olive-sided flycatcher (*Contopus cooperi*), Wilson's warbler (*Wilsonia pusilla*), orange-crowned warbler (*Vermivora celata*), and Swainson's thrush (*Catharus ustulatus*).

Wading Birds

Several wading bird species are resident within the Coos Bay area and the North Spit. Wading birds are typically colonial when nesting and therefore are sensitive to anthropogenic disturbance at breeding sites. Wading birds hunt in a variety of habitat types from fields and meadows to palustrine and estuarine wetlands. Wading birds are likely to occur in the shoreline habitats at the terminal site.

At least two historic great blue heron (*Ardea herodias*) rookeries occur close to the Jordan Cove LNG terminal site area. One rookery is located about 2,000 feet to the east of the LNG terminal site and about 300 feet from Jordan Cove Road (on both sides of Trans-Pacific Parkway) (LBJ 2006). This rookery was first visited by Project biologists on November 1, 2006, during a site visit with ODFW and BLM biologists. At that time, the rookery was found to be inactive although it contained nests. The BLM biologist noted that it has been inactive the previous two breeding seasons (BLM 2006b). Another historical rookery is located adjacent to the LNG terminal site on the south side of Henderson Marsh; it has not been active for several years (BLM 2006b). No evidence of great blue heron breeding in the area was observed during the 2005, 2006, 2012, or 2013 surveys.

Raptors

Raptors (i.e., hawks and owls) are abundant year-round residents in Coos Bay. The BLM has observed 14 species (BLM 2005), and surveys conducted by LBJ (2006) detected both peregrine falcons and bald eagles near the Jordan Cove site. Coos Bay and the North Spit provide a mosaic of habitat types with abundant prey for raptors. White-tailed kites were observed during 2005 surveys especially near Henderson Marsh. Ospreys are relatively common near river estuaries and bays and nests on human-made structures including the Roseburg Forest Products facility lights.

Predatory birds are most likely to be encountered within terrestrial habitats in the Coos Bay area. Osprey, falcons, and eagles may occur in the nearshore habitats along the waterway for LNG vessel transit and at the terminal site. Falcons in particular are likely to be associated with salt marsh and tidal mudflats where shorebirds are likely to be abundant.

Potential Project-related Effects on Birds and Proposed Mitigation Measures

Migratory bird species would likely experience disturbance due to the construction and operation of the Jordan Cove Project. Effects on birds would most likely be related to modification of habitat. However, areas affected by the Jordan Cove Project are relatively small in comparison to the total habitat available in Coos Bay, and within the larger Bird Conservation Region 5. Effects to migratory birds from both jurisdictional and non-jurisdictional facilities are included in this analysis and mitigation approach.

Nesting habitat for migratory birds occurs within areas that would be cleared for the LNG terminal and related facilities. The Project would alter and disturb breeding and non-breeding habitat and could affect prey populations. The removal of 67 acres of coastal dune forest, 67 acres of grasslands (herbaceous), and 40 acres of shrubs could affect nesting and foraging opportunities for songbirds and raptors that occupy upland habitats. The impact of the construction of the slip and access channel on wetlands would be the permanent loss of approximately 8 acres of intertidal, 3 acres of shallow subtidal, and 3 acres of eelgrass. These are all habitats utilized by seabirds, waterfowl, wading birds, and shorebirds. The loss of wetland habitat would be offset by the creation of in-kind mitigation areas proposed by Jordan Cove at the Kentuck Slough, West Jordan Cove, and West Bridge wetland mitigation sites.

The great blue heron rookery located 300 feet from the Jordan Cove Road would be subject to potential disturbance from noise from construction traffic using Jordan Cove Road. The rookery is currently subject to noise from truck traffic delivering chips to the Roseburg wood chip export facility. Similarly, the historic rookery on the south side of Henderson Marsh could be affected by construction noise if the rookery was active during site construction. Jordan Cove would conduct spring status assessments annually of both great blue heron rookeries, as reuse by this species could occur. If biologists from other agencies (such as ODFW and BLM) conduct rookery surveys on the North Spit, Jordan Cove may use the results of these agency surveys. If either rookery becomes active, Jordan Cove, in consultation with ODFW, would develop an appropriate mitigation plan depending on the status of construction or potential for indirect effects. No mitigation for potential impacts would be required as long as the rookeries are inactive.

During operation of the Project, birds would be at risk of colliding with terminal facilities, including the LNG storage tanks. This risk is expected to be low given the visibility of the facilities, but could increase during storms, dense fog, at night, or at other times with reduced visibility. The facilities would be well lit at night, which could attract birds. There is some evidence that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high-intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. With the low-intensity lighting to be used, the likelihood of adverse effects to birds from collisions with the LNG storage tanks is minimal. Birds may also be drawn to the terminal flares. For example, some 7,500 songbirds were killed in September 2013 when they flew into the flare at the Canaport LNG import terminal in Saint John, New Brunswick, Canada (CBC News 2013).

Birds would also be at risk of colliding with LNG vessels in the waterway during operation of the terminal. Although the annual ship traffic would increase due to the Project, LNG vessels in the navigation channel would be traveling slowly and escorted by tugboats. Even with the addition of 90 LNG vessel visits a year, the number of deep draft ships using Coos Bay would be less than historic levels. Therefore, we conclude that LNG vessel marine traffic in the waterway would not cause significant adverse effects to birds.

Jordan Cove proposes to implement various measures to avoid, minimize, and in some instances mitigate, impacts on birds and their local habitats. If the construction schedule allows, all vegetation clearing at the LNG terminal would be conducted prior to March 1 or after August 31 to ensure most nesting birds have fledged. If construction activities must occur during the nesting season, Jordan Cove would conduct focused pre-construction surveys to determine if there are active migratory bird nests present to ensure that impacts to nesting birds are avoided. The surveys would be conducted within the construction limits and within 100 feet (200 feet for raptors) of the construction limits. If active nests are encountered within the limits of the survey, construction and vegetation removal activities would be halted in the immediate vicinity until a qualified biologist has determined that the individuals have fledged from the nest (evacuated) or that the nest has failed from natural causes. If no active nest is encountered within the limits of the survey, construction and vegetation removal would proceed with caution with an eye out for active bird nests. Empty or abandoned nests would be removed; permits are not required to remove an empty or abandoned nest or to remove or alter the structure the nest is built in or on (FWS 2003). Jordan Cove would coordinate with the FWS prior to proceeding with construction, and any consultation exchange with the FWS would be provided to the FERC. Further description of avoidance, minimization, and mitigation measures to decrease impacts to migratory birds is provided in the *Migratory Bird Conservation Plan* filed with FERC on February 13, 2015.

Structures associated with the Project would be monitored to discourage use by avian predator species. Frequent inspections would ensure that nests are not being constructed and all nests found would be removed immediately, before birds could lay eggs. It is anticipated that there would be sufficient inspections (i.e., daily) and other activities mandated by safety and security requirements to keep the structures nest free. However, in the unlikely event that a nest becomes established and it is not discovered until eggs or young birds are present, the disposition of the nest would be handled in accordance with the provisions of the MBTA in consultation with the FWS.

The flares at the LNG terminal would probably not adversely affect birds. This is because these would be ground flares at low elevation (115 feet high), and would only be used for temporary periods, such as during start-up and upset situations. Jordan Cove can also implement measures that would minimize impacts on birds from terminal lighting. However, Jordan Cove would not develop its final lighting plan until final design. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file with the Secretary its final lighting plan, for review and approval by the Director of OEP, to include measures that would reduce impacts on wildlife, together with documentation that the plan was developed in consultation with appropriate resource agencies, including the FWS, NMFS, and ODFW.**

Additionally, in February 2015 both Jordan Cove and Pacific Connector filed their own draft *Migratory Bird Conservation Plan*. Both companies continue to work with FWS to finalize their plans; therefore, **we recommend that:**

- **Prior to construction, Jordan Cove and Pacific Connector should each file with the Secretary a copy of their final *Migratory Bird Conservation Plan*, and documentation that their plans were developed in consultation with the FWS.**

Amphibians and Reptiles

The BLM recognizes 11 species of amphibians (8 salamanders, 3 frogs) occurring on the North Spit (BLM 2005). Despite the presence and continual threat of invasion by non-native bullfrogs (*Rana catesbeiana*), two native amphibian species were observed within suitable habitat during the wildlife surveys conducted 2005, 2006, and 2012 for the LNG terminal (LBJ 2006; SHN 2013)—the northern red-legged frog (*Rana aurora*) and northwestern salamander (*Ambystoma gracile*)—which are abundant within some wetlands within the terminal tract.

The BLM has observed at least 10 species of reptiles on the North Spit (BLM 2005), including the northwestern pond turtle (*Clemmys marmorata marmorata*). However, the northwestern pond turtle was not observed during wildlife surveys of the Jordan Cove LNG terminal area (LBJ 2006; SHN 2013). Reptiles observed during Project surveys in 2005, 2006 and 2012 included the northern alligator lizard (*Elgaria coerulea*) and northwestern garter snake (*Thamnophis ordinoides*) (LBJ 2006; SHN 2013). Potential Project-related impacts on amphibians and reptiles would include mortality from construction if they were not able to avoid equipment or traffic, and habitat loss. Fill activity in wetlands would impact amphibians and reptiles. Removal of dune forest for the Project would reduce habitat for the clouded salamander, should this species occur in these areas. Jordan Lake and nearby wetlands on the east side of the terminal tract may offer suitable breeding habitat for the western toad, although the species was not found during surveys of the site. Jordan Cove would mitigate for the loss of habitat and wetlands by acquiring nearby parcels that would preserve upland vegetated habitats and wetlands.

Jordan Cove proposed that in order to mitigate potential impacts on amphibians and reptiles it would conduct pre-construction surveys for the northern Pacific pond turtle, northern red-legged frog, and clouded salamander. Individuals located within the construction area would be captured and transported to suitable nearby habitats, agreed to with the ODFW.

Invertebrates

Inland sand dunes at the North Spit are used extensively by certain species of terrestrial insects, primarily beetles, centipedes, and millipedes. Flying insects are also common throughout the site and are fed upon heavily by barn swallows (BLM 2005). Potential Project-related impacts on terrestrial invertebrates would include mortality from construction if they were not able to avoid equipment or traffic, and habitat loss. Jordan Cove would mitigate for the loss of habitat by acquiring nearby parcels that would preserve upland vegetated habitats and wetlands.

General Impacts on Terrestrial Wildlife from Construction and Operation of the Project

During construction of the Project, direct impacts on animals could include mortality if less mobile individuals are unable to avoid equipment or vehicles or cannot flee away from an oil or fuel spill. More mobile species would likely be displaced from the terminal area during active construction to adjacent similar habitats. Wildlife near the LNG terminal could also be disturbed by construction activities and noise, and may move farther away.

However, the primary impact on wildlife from construction and operation of the LNG terminal would be habitat loss. The natural habitats that are most important to wildlife would include forested dunes and wetlands. About 67 acres of dune forest would be permanently removed for operation of the terminal. The Project would affect about 4 acres of wetlands and about 32 acres of open water including salt marsh, eelgrass, intertidal, and subtidal habitats. Jordan Cove would mitigate for the loss of wildlife habitat by acquiring 259 acres at three nearby parcels that would be preserved as replacement habitat, as discussed above.

There could be indirect effects on wildlife because of increased human presence resulting from the Project. Construction of the LNG terminal would take approximately 42 months, and the number of construction personnel would peak at 2,100 workers. Approximately 145 people would be employed during operation of the terminal. The current number of people employed at facilities operating on the North Spit is approximately 110 (Southport – 70, Roseburg – 20, DB Western – 20). The increase in the number of people in the area could potentially lead to indirect effects on wildlife, such as food or trash attracting predators. However, during construction and operation, the Project site would be kept clear of construction debris and food wastes that could attract predators. Covered, animal-proof receptacles would be provided in eating and break areas, parking lots, and at appropriate locations around the construction site. During construction, the site would be policed on a daily basis to remove any food or other debris left by construction workers. During operations, the Project site would be regularly inspected to ensure that no garbage is allowed to accumulate.

Noise associated with construction of the Project could also affect wildlife. Construction-related noise could affect animal behavior, foraging, or breeding patterns, and cause wildlife species to move away from the noise or relocate in order to avoid the disturbance. Noise from construction of the LNG terminal should be similar to typical commercial construction programs, which have noise levels averaging between 47 to 57 A-weighted decibels (dBA) when measured 2,000 feet away (H&K 1994). Noise from construction of the terminal is discussed in detail in section 4.12.2.4. Construction of the terminal would occur over a period of about three years. Noise associated with construction would be intermittent, and may be operated on two 10-hour shifts, 6 days per week, with the potential to increase to a 24/7 schedule if required. However, given the high level of current activity on the North Spit, including existing industrial operations and vehicle and rail traffic,[86] and the temporary and short-term nature of Jordan Cove's construction activities, Project-related construction noise is not expected to adversely affect wildlife in the region.

Operation of the Project may also affect wildlife. For example, the terminal would be visited by about 90 LNG vessels per year. It is possible that an LNG vessel in transit in the waterway could strike seabirds or shorebirds, an oil or fuel leak from a ship could affect terrestrial wildlife along the shorelines of the navigation channel, or vessel traffic may cause shoreline erosion. Jordan Cove and the operators of the LNG vessels would implement measures that would reduce the

[86] Current ambient noise levels measured at the BLM boat ramp parking lot on the North Spit about 2 miles south of the Jordan Cove terminal site ranged from 40.8 to 47.6 dBA. See section 4.12.2.4 of this EIS.

potential for oil or fuel spills from LNG vessel marine traffic in the waterway. LNG vessels have a double hull that would keep fuel and oil onboard and prevent a spill. Furthermore, each LNG vessel would maintain a shipboard oil pollution emergency plan. Studies conducted by Jordan Cove have shown that LNG vessels transiting at slow speeds within the Coos Bay navigation channel are not likely to result in large waves that could cause major shoreline erosion.[87]

Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. When an LNG vessel is not in the berth, the lighting would be reduced to that required for security. Other industrial facilities on the North Spit (Roseburg, Southport, DB Western) already have night lighting. We have recommended above that Jordan Cove produce a final lighting plan prior to construction, for our review and approval, that outlines measures to be implemented to ensure that facility lighting would not have major impacts on wildlife.

Operation of the South Dunes Power Plant would result in increased emissions of nitrogen oxides and carbon monoxide. Estimated air emissions, air quality standards and compliance with regulatory requirements, and proposed mitigation measures for air quality are addressed in detail in section 4.12.1 of this EIS. The LNG terminal would be required to operate in compliance with U.S. ambient air quality standards, which were established to protect individuals from adverse impact from criteria air pollutants. While some types of wildlife with permeable skin may absorb airborne pollutants directly and are thus particularly sensitive to increases in air pollution, compliance with federal and state standards is expected to also protect wildlife by minimizing increases in air quality degradation and pollution.

Operational noise from the Jordan Cove Project could have long-term impacts on wildlife on the North Spit. We predict that operational noise from the LNG terminal would have an equivalent sound level (L_{eq}) of 42 dBA and day-night sound level (L_{dn}) of 48.4 dBA when measured about 1.4 miles away. This compares to current ambient L_{dn} noise levels of about 47.4 to 51.6 dBA in the city of North Bend, just southwest of the airport (see section 4.12.2.4 of this EIS). Because there is existing noise generated by other industrial facilities on the North Spit, and noise from the Jordan Cove Project would be less than the FERC standard of 55 dBA at noise sensitive areas (NSA), we conclude that operational noise from the terminal would not significantly affect wildlife.

Mitigation for impacts related to the construction of the terminal and supporting facilities is covered under the ODFW Habitat Category Mitigation Measures section above, and in more detail in Jordan Cove's *Wildlife Habitat Mitigation Plan* (appendix S). Special status species that could be affected by the Project, and relevant mitigation for those impacts, are discussed in section 4.7.

4.6.1.2 Pacific Connector Pipeline Project

The areas crossed by the Pacific Connector pipeline route provide diverse habitats for wildlife, including forests, shrublands, and grasslands. These habitats support an array of wildlife species.

[87] See *Technical Report – Draft, Volume 2 – Jordan Cove Energy Project and Pacific Connector Gas Pipeline, Coastal Engineering Modeling and Analysis*, filed by Jordan Cove as Appendix H.2 in Resource Report 2 included with its May 2013 application to the FERC.

Overall, 47 amphibian and reptile, 278 bird, and 106 mammal species are known or suspected to occur in the project area, based on their habitat associations (habitats known or likely to be crossed by the pipeline) or direct observation.

Wildlife Habitats

Wildlife associations with habitats in the Pacific Connector Pipeline Project area include the following (adapted from Johnson and O'Neil 2001):

- close association: a species is known to depend on a specific habitat for part or all of its life history requirements (feeding and reproduction) implying that the species has an essential need for a particular habitat for its maintenance and viability;
- general association: a highly adaptable species that is supported by a number of habitats that provide for its maintenance and viability; and
- present: a species that occasionally uses a habitat that provides marginal support for its maintenance and viability.

Sixteen wildlife habitats (Johnson and O'Neil 2001) coincide with one or more Oregon GAP vegetation types found in the Pacific Connector pipeline area. These wildlife habitat categories are: (1) Westside Lowland Conifer-Hardwood-Forest, (2) Montane Mixed Conifer Forest, (3) Southwest Oregon Mixed Conifer-Hardwood Forest, (4) Ponderosa Pine Forest and Woodlands, (5) Westside[88] Oak and Dry Douglas-fir Forest and Woodlands, (6) Western Juniper/Mountain Mahogany Woodlands, (7) Sagebrush Steppe, (8) Westside Grasslands, (9) Eastside Grasslands, (10) Herbaceous Wetlands, (11) Westside Riparian-Wetlands combined with Eastside Riparian-Wetlands, (12) Agriculture, Pastures, and Mixed Environs[89]**,** (13) Developed-Urban and Mixed Environs, (14) Coastal Dunes and Beaches, (15) Open Water-Lakes, River, and Streams, and (16) Bays and Estuaries. Wildlife species associations with these habitats provide a basis for evaluating Project effects on biodiversity and in some cases, on individual species. One additional category is not specifically addressed within Johnson and O'Neil (2001), but is well represented within the project area: Shrublands. Table 4.6.1.2-1 lists the miles of each of these habitat types crossed. Westside Lowland Conifer-Hardwood Forest and Southwest Oregon Mixed Conifer-Hardwood Forest are the habitats most affected, with 63.4 and 48.3 miles impacted, respectively.

Specialized habitat features also occur within the vicinity of the project area. Such features include cliffs that provide nesting for peregrine falcons and possibly other raptors. Snags provide roosting locations for several bat species, and nesting locations for cavity-nesting birds. LWD is present, which could be used by reptiles and amphibians.

Grasslands and/or meadows provide habitats for animals that are adapted to areas dominated with perennial bunchgrasses and forbs. A wide variety of species use grasslands and meadows, including songbirds, amphibians, and reptiles. We estimate that the pipeline route would cross about 12.3 miles of grasslands (see table 4.6.1.2-1).

[88] Westside versus eastside in these habitat definitions refer to west or east of the Cascade Range.
[89] Mixed environs refer to border areas between developed or agricultural areas, such as fencerows, roadsides, field borders, and shelterbelts.

TABLE 4.6.1.2-1

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/f/ (miles)	Mid-Seral Forest Crossed b/f/ (miles)	Clearcut/ Regenerating Forest Crossed c/f/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	9.2	21.3	32.9	63.4	27.4	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	1.6	0.9	4.0	6.4	2.8	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	24.4	9.7	14.3	48.3	20.8	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	3.7	4.7	5.9	14.4	6.2	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	2.5	2.4	0.0	4.9	2.1	32 - Herpetofauna 113 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	0.0	4.3	3.8	8.1	3.5	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**41.3**	**43.6**	**60.9**	**145.9**	**62.9**	
Grasslands Shrubland	Shrub-steppe	–	–	–	15.5	6.7	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	–	–	–	10.2	4.4	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	–	–	–	1.9	0.8	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	–	–	–	**27.6**	**11.9**	
Wetland/ Riparian e/	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	0.1	0.0	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	–	–	–	5.6	2.4	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	–	–	–	**5.7**	**2.5**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	32.1	13.8	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	–	–	–	**32.1**	**13.8**	
Developed/ Altered	Urban and Mixed Environs	–	–	–	16.5	7.1	37 – Herpetofauna 131 – Birds 63 – Mammals
	Subtotal				**16.5**	**7.1**	
Barren	Coastal Dunes and Beaches	–	–	–	<0.1	0.0	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	–	–	–	**<0.1**	**0.0**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	1.3	0.6	17 – Herpetofauna 94 – Birds 20 – Mammals
	Bays and Estuaries	–	–	–	2.5	1.1	1 – Herpetofauna 132 – Birds 12 – Mammals
	Subtotal	–	–	–	**3.8**	**1.6**	

TABLE 4.6.1.2-1

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/f/ (miles)	Mid-Seral Forest Crossed b/f/ (miles)	Clearcut/ Regenerating Forest Crossed c/f/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated d/
	Project Total	**41.3**	**43.6**	**60.9**	**231.8**	**100.0**	

Note: Mileages rounded to nearest tenth of a mile; values less than 0.1 miles shown as "<0.1". Rows/columns may not sum correctly due to rounding.
a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
d/ Numbers of species associated with each habitat type crossed by the Pacific Connector Project were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.
e/ Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of Project impacts to wetlands.
f/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage; thus, miles are identified only in the "total miles" column.

Wetlands provide habitat for migrating and breeding waterfowl, shorebirds, waterbirds, songbirds, mammals, amphibians, and reptiles (ODFW 2006b). Riparian zones (including forested wetlands) support high species diversity (Johnson and O'Neil 2001). In total, the pipeline route would cross about 5.7 miles of wetlands and riparian habitats.[90]

The pipeline route would cross about 146 miles of woodlands and forest habitats. Deciduous hardwood species, such as oak and tanoak, occur within the project area. Mixed coniferous and deciduous forests, deciduous-dominated riparian areas, and oak woodlands are found most often in Douglas and Jackson Counties. In Coos County, many of the historical deciduous woodlands have been reduced as a result of conifer plantings and changes in fire frequency and intensity, as well as conversion to agricultural and residential uses. A wide variety of species use deciduous and young conifer forest habitats, including songbirds, reptiles, and small mammals.

Mature (greater than 40 years old), late successional (80 to 175 years old), and old-growth (greater than 175 years old) forests are unique, important habitat elements. Tree species common in mature to old-growth forests are western hemlock, Douglas-fir, western redcedar, Sitka spruce, red alder, and bigleaf maple (Chappell et al. 2001). Bird species that are obligates of old-growth forests include the federally threatened NSO and MAMU (further discussed in section 4.7). Old-growth forests are most common along the pipeline route within the Klamath Mountains.

The acres of wildlife habitat (categories from Johnson and O'Neil 2001) that would be affected by construction of the Pacific Connector pipeline are listed in table 4.6.1.2-2. Westside Lowland Conifer Forest (1,435 acres), Southwest Oregon Mixed Conifer-Hardwood Forest (919 acres), Agriculture, Pastures, and Mixed Environs (896 acres), and Urban and Mixed Environs (696 acres) are the wildlife habitats that would be most affected by construction (table 4.6.1.2-2).

[90] Following wetland regulation protocols, the length of wetlands crossed is approximately 11.6 miles total for all Project elements. See section 4.4 for results of jurisdictional wetland delineation and discussion of Project impacts to wetlands.

At aboveground facilities, native habitats would be cleared, and on private lands the area would be permanently converted into developed-industrial land. During operation of the pipeline, a 30-foot-wide corridor, centered over the pipe, would be kept clear of trees. As a result, areas cleared of forest during pipeline construction would be maintained in a shrub/herbaceous state within this 30-foot-wide corridor. The remainder of the temporary pipeline construction right-of-way would be revegetated with native species. However, it would take a long time for forested and shrub-steppe habitat to regenerate. Other habitats within the temporary construction right-of-way would be restored relatively quickly. A 10-foot-wide corridor centered on the pipeline may be mowed annually and maintained in an herbaceous state. The remainder of the 30-foot-wide corridor within the permanent easement may be subject to vegetation clearing every three years. However, routine vegetation clearing would only be done between August 1 and April 15 of any year, to reduce impacts on nesting birds during the typical spring and summer breeding season. The acres of wildlife habitat that would be affected by operation of the Pacific Connector Pipeline are listed in table 4.6.1.2-3.

TABLE 4.6.1.2-2

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites d/	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/Disposal	Access Roads (TARs/PARs/ Improvements) e/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal by Age Class	Subtotals: Subtotal by Habitat Type	Percent of Total Habitat
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O a/	105	0	23	107	0	<1	0	0	235	1,435	25.8
		M-S b/	255	0	67	115	4	2	7	0	450		
		C-R c/	386	<1	177	148	5	<1	33	0	750		
	Montane Mixed Conifer Forest	L-O a/	18	0	1	7	0	0	0	0	26	119	*2.1*
		M-S b/	9	0	<1	4	0	0	0	0	14		
		C-R c/	45	0	17	16	0	<1	0	0	78		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O a/	282	0	52	118	2	1	0	0	455	919	16.5
		M-S b/	113	0	32	47	0	3	0	0	194		
		C-R c/	161	0	46	62	<1	<1	0	0	270		
	Ponderosa Pine Forest and Woodlands	L-O a/	42	0	15	3	0	0	0	0	60	222	4.0
		M-S b/	57	<1	10	<1	<1	<1	0	0	68		
		C-R c/	69	0	16	7	<1	<1	0	0	93		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O a/	30	0	10	5	0	<1	0	0	45	84	*1.5*
		M-S b/	28	0	8	3	0	<1	0	0	39		
		C-R c/	0	0	0	0	0	0	0	0	0		
	Western Juniper and Mountain Mahogany Woodlands	L-O a/	0	0	0	0	0	0	0	0	0	103	1.9
		M-S b/	46	0	8	0	<1	<1	0	0	55		
		C-R c/	44	0	4	0	0	<1	0	0	48		
	Subtotal Forest-Woodland		**1,689**	**<1**	**487**	**643**	**11**	**10**	**41**	**0**	**2,882**	**2,882**	***51.8***
	Percent of All Forest-Woodland		***58.6***	***0.0***	***16.9***	***22.3***	***0.4***	***0.3***	***1.4***	***0.0***	***100.0***	***100.0***	
Grasslands-Shrubland	Sagebrush Steppe	n/a	62	0	14	0	7	<1	0	31	n/a	115	*2.1*
	Shrublands	n/a	120	<1	38	8	0	2	0	0	n/a	169	*3.0*
	Westside Grasslands	n/a	116	<1	94	6	<1	2	21	0	n/a	239	*4.3*
	Eastside Grasslands	n/a	22	0	4	<1	1	<1	92	0	n/a	120	*2.2*
	Subtotal Grasslands-Shrubland		**320**	**<1**	**151**	**13**	**10**	**5**	**113**	**31**	n/a	643	*11.6*
Wetland / Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O a/	0	0	0	0	0	0	0	0	0	4	*0.1*
		M-S b/	<1	0	<1	0	0	0	0	0	2		
		C-R c/	2	0	<1	<1	0	0	0	0	3		
		Shrub	<1	0	<1	0	0	0	0	0	n/a	<1	*0.0*
	Herbaceous Wetlands	n/a	65	0	34	<1	0	<1	0	0	n/a	98	*1.8*
	Subtotal Wetland / Riparian		**69**	**0**	**35**	**<1**	**0**	**<1**	**0**	**0**	n/a	103	*1.9*
Agriculture	Agriculture, Pastures, and Mixed Environs		364	<1	195	1	3	5	325	0	n/a	896	*16.1*
	Subtotal Agriculture		**364**	**<1**	**195**	**1**	**3**	**5**	**325**	**0**	**n/a**	**896**	***16.1***

TABLE 4.6.1.2-2

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: Construction Right-of-Way	Pipeline Facilities: Hydrostatic Discharge Sites d/	Pipeline Facilities: Temporary Extra Work Areas	Pipeline Facilities: Uncleared Storage Areas	Pipeline Facilities: Rock Source/Disposal	Pipeline Facilities: Access Roads (TARs/PARs/Improvements) e/	Pipeline Facilities: Pipe Yards	Pipeline Facilities: Aboveground Facilities - Klamath Compressor Station	Subtotals: Subtotal by Age Class	Subtotals: Subtotal by Habitat Type	Subtotals: Percent of Total Habitat
Developed / Barren	Urban and Mixed Environs	n/a	21	0	80	<1	61	<1	533	1	n/a	696	12.5
	Roads	n/a	144	0	68	17	2	<1	12	0	n/a	244	*4.4*
	Beaches	n/a	0	0	7	0	0	0	0	0	n/a	7	*0.1*
	Subtotal Developed / Barren		**166**	**0**	**155**	**17**	**63**	**<1**	**545**	**1**	**n/a**	**947**	***17.0***
Open Water	Open Water - Lakes, Rivers, Streams	n/a	11	0	5	2	<1	<1	<1	0	n/a	19	0.3
	Bays and Estuaries	n/a	74	0	2	0	0	0	0	0	n/a	76	*1.4*
	Subtotal Open Water		**86**	**0**	**7**	**2**	**<1**	**<1**	**<1**	**0**	**n/a**	**95**	***1.7***
	Subtotal Non-Forest		**1,005**	**<1**	**543**	**33**	**76**	**11**	**983**	**32**		**2,683**	***48.2***
	Percent of All Non-Forest		***37.5***	***0.0***	***20.2***	***1.2***	***2.8***	***0.4***	***36.6***	***1.2***		***100.0***	
Project Total		n/a	**2,694**	**1**	**1,030**	**676**	**87**	**21**	**1,024**	**32**		**5,565**	
Percent of Pipeline Facilities		n/a	***48.4***	***0.0***	***18.5***	***12.1***	***1.6***	***0.4***	***18.4***	***0.6***		***100.0***	

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

d/ Small brush or trees may be cleared by a rubber-tired rotary or flail motor (brush hog) or by hand with machetes/chainsaws. No soil disturbance would occur. A rubber-tired hoe would be utilized to lay the discharge line and to remove the saturated hay bales or filter bags upon completion of hydrostatic discharge.

e/ Portions of some of the PARs are located within the construction right-of-way and, therefore, there is some duplication in the acreage calculations. Impacts associated with existing access roads that would be improved (e.g., by widening) would affect an additional 14 acres. Habitat types affected by existing road improvement activity identify the habitat type adjacent to the access road, although the majority of the 14 acres is assumed to be road surface or immediate roadside that has been previously disturbed.

TABLE 4.6.1.2-3

Summary of Operation-Related Disturbance to Habitat by the Proposed Pacific Connector Pipeline (acres a/)

			Pipeline Facilities									
General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age**	***30-foot Maintenance Corridor***	**Permanent Access Roads**	**Subtotal Late Successional Old-Growth Forest**	**Subtotal Mid-Seral Forest**	**Subtotal Clearcut / Regenerating Forest**	**Subtotal By Habitat Type e/**	**Permanent Easement (50-foot)**	**Road Improvements**	**Aboveground Facilities**	**Total Operation Impacts by Habitat Type**
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	33	<1					56	<1		
		M-S c/	78	<1	33	78	120	232	132	2	<1	**232**
		C-R d/	120	<1					202	<1		
	Montane Mixed Conifer Forest	L-O b/	6	0					10	0		
		M-S c/	3	0	6	3	15	24	5	0	<1	**24**
		C-R d/	14	<1					24	<1		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	88	0					147	1		
		M-S c/	35	0	88	35	52	175	59	3	<1	**175**
		C-R d/	52	<1					86	<1		
	Ponderosa Pine Forest and Woodlands	L-O b/	13	0					23	0		
		M-S c/	17	0	13	17	21	52	29	<1	0	**52**
		C-R d/	21	0					36	<1		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	9	0					15	<1		
		M-S c/	9	0	9	9		18	15	<1	0	**18**
		C-R d/	0	0					0	0		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	0	0					0	0		
		M-S c/	15	0	0	15	14	29	25	<1	<1	**29**
		C-R d/	14	<1					23	0		
Subtotal Forest-Woodland			**530**	<1	**150**	**158**	**222**	**530**	**885**	**9**	**<1**	**530**
Grasslands-Shrubland	Sagebrush Steppe	n/a	19	0	n/a	n/a	n/a	19	31	<1	31	**49**
	Shrublands	n/a	38	<1	n/a	n/a	n/a	39	64	2	<1	**39**
	Westside Grasslands	n/a	37	<1	n/a	n/a	n/a	38	62	1	<1	**38**
	Eastside Grasslands	n/a	7	0	n/a	n/a	n/a	7	12	<1		**7**
Subtotal Grasslands-Shrubland			**101**	**<1**	**n/a**	**n/a**	**n/a**	**102**	***169***	**4**	**31**	**132**
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	0	0					*0*	0		
		M-S c/	<1	0	0	<1	<1	<1	<1	0	0	**<1**
		C-R d/	<1	0					<1	0		
		Shrub	<1	0	n/a	n/a	n/a	<1	<1	0	0	**<1**
	Herbaceous Wetlands	n/a	20	<1	n/a	n/a	n/a	20	34	<1	0	**20**
Subtotal Wetland/Riparian			**22**	**<1**	**n/a**	**n/a**	**n/a**	**22**	***36***	<1	**0**	**22**
Agriculture	Agriculture, Pastures, and Mixed Environs	n/a	116	<1	n/a	n/a	n/a	117	193	<1	1	**117**
Subtotal Agriculture			**116**	**<1**	**n/a**	**n/a**	**n/a**	**117**	***193***	<1	**1**	**117**

TABLE 4.6.1.2-3

Summary of Operation-Related Disturbance to Habitat by the Proposed Pacific Connector Pipeline (acres a/)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age	Pipeline Facilities						Permanent Easement (50-foot)	Road Improvements	Aboveground Facilities	Total Operation Impacts by Habitat Type
			30-foot Maintenance Corridor	Permanent Access Roads	Subtotal Late Successional Old-Growth Forest	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal By Habitat Type e/				
Developed / Barren	Urban and Mixed Environs	n/a	7	<1	n/a	n/a	n/a	7	11	0	1	**8**
	Roads	n/a	54	<1	n/a	n/a	n/a	54	86	0	<1	**54**
	Beaches	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	0	**<1**
	Subtotal Developed / Barren		**60**	**<1**	**n/a**	**n/a**	**n/a**	61	***98***	**0**	**1**	**61**
Open Water	Open Water - Lakes, Rivers, and Streams	n/a	5	<1	n/a	n/a	n/a	5	8	0	0	**5**
	Bays and Estuaries	n/a	9	0	n/a	n/a	n/a	9	15	0	0	**9**
	Subtotal Open Water		**14**	**<1**	**n/a**	**n/a**	**n/a**	**14**	***23***	**0**	**0**	**14**
	Subtotal Non-Forest		**313**	**2**	**0**	**<1**	**<1**	**315**	**518**	**5**	**33**	**347**
	Project Total		**843**	**2**	**150**	**158**	**222**	**845**	**1404**	**14**	**34**	**877**

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as "<1".
Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

e/ Subtotal by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves located within the 30-foot maintenance corridor).

Shaded cells identify acres of wildlife habitat within the defined area but are not included in the overall Project total because: 1) only the 30-foot Maintenance Corridor included within the 50-foot Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the project.

ODFW Habitat Characterization

Pacific Connector has coordinated extensively with ODFW to categorize habitats according to ODFW's Habitat Mitigation Policy (see February 13, 2015, response to DEIS recommendation #21). On February 13, 2015, Pacific Connector filed a *Wildlife Habitat Mitigation Plan* for impacts on non-federal lands. Pacific Connector will continue to consult with ODFW on additional mitigation actions where necessary, and to prepare the final *Wildlife Habitat Mitigation Plan*. We are recommending above (section 4.6.1.1) that Pacific Connector file its finalized *Migratory Bird Conservation Plan* with the FERC prior to construction.

Table 4.6.1.2-4 summarizes the impacts on ODFW Habitat Categories resulting from construction and operation of the pipeline project. ODFW habitat categories across all lands (non-federal and federal) most affected by construction and operation of the Project are Categories 2 (1,694 acres) and 6 (852 acres). ODFW Habitat Category 1 would be the least affected (80 acres).

TABLE 4.6.1.2-4

Summary of ODFW Habitat Categories and Impact (Acres) from the Pacific Connector Pipeline Project within Non-Federal and Federal Lands a/

Proposed Action	Project Component	ODFW Habitat Category (acres of Habitat Affected) b/					
		1	2	3	4	5	6
Impact on Non-Federal Lands							
Construction Impact	Removed c/	17	889	747	657	712	749
	Modified d/	1	130	126	111	1	10
Operational Impact	30' Maintenance Corridor e/	4	201	132	135	77	35
	Aboveground Facilities f/	0	<1	31	<1	<1	<1
Impact on Federal Lands							
Construction Impact	Removed c/	63	804	89	35	<1	103
	Modified d/	21	249	14	6	<1	7
Operational Impact	30' Maintenance Corridor e/	18	197	17	8	<1	18
	Aboveground Facilities f/	0	<1	0	<1	0	<1
Total Pipeline Project Impacts (Federal and Non-Federal Lands)							
Construction Impact	Removed c/	80	1694	836	692	713	852
	Modified d/	22	379	140	117	1	16
Operational Impact	30' Maintenance Corridor e/	22	399	149	143	77	53
	Aboveground Facilities f/	0	<1	31	<1	<1	<1

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Summarized from Table 2 in the Habitat Categorization for the Project (see Appendix 3F of Resource Report 3).

b/ Category 1 – irreplaceable, essential habitat that is limited
Category 2 – essential habitat that is limited
Category 3 – essential habitat, or important habitat that is limited
Category 4 – important habitat
Category 5 – habitat having a high potential to become essential or important habitat
Category 6 – habitat that has a low potential to become essential or important habitat

c/ Construction components considered for habitat removal include construction right-of-way, temporary extra work areas, aboveground facilities, pipe storage yards, hydrostatic test sites, rock source and disposal sites, and temporary and permanent access roads. Although habitat may not necessarily be removed (i.e., an industrial site used for a pipe storage yard), acres have been included in the "removed" column.

d/ Modified acres include habitat potentially affected within identified uncleared storage areas (UCSAs).

e/ Within the 30-foot maintenance corridor, habitat would be maintained in an herbaceous and/or shrub state, cutting or removing vegetation greater than 6 inches in height; however, in areas with pre-construction habitat types of agricultural land, bare ground such as beaches, waterbodies, wetlands, and estuarine habitat types, the maintenance corridor would be restored to its pre-construction habitat type or land use. This acreage does not include aboveground facilities.

f/ Aboveground facilities, including meter stations and communication towers, block valves, and a compressor station, would be maintained in a non-herbaceous, industrial state (graveled and/or concrete) for the life of the project.

Pacific Connector is continuing to work with ODFW to finalize its Project-specific *Wildlife Habitat Mitigation Plan* in order to comply with State policy.

Terrestrial Animals in the Project Area

Mammals

Based on their distributions in southwestern Oregon and habitat associations described by Johnson and O'Neil (2001), 107 species of mammals may be present in habitats that coincide with and/or are adjacent to the Pacific Connector pipeline. The most numerous groups likely to occur are rodents (46 species, such as Baird's shrew, coast mole, least chipmunk, and Douglas' squirrel), carnivores (19 species, such as coyote, gray fox, black bear, and mink), and bats (13 species; see section below). Mammal species with special state or federal status are discussed in section 4.7.

The highest diversity of mammals can be expected in the Johnson and O'Neil (2001) Agriculture, Pastures, and Mixed Environs habitat (77 species with some association), followed by Eastside and Westside Riparian-Wetlands habitat (76 species). Mammalian species diversity is also relatively high in Westside Lowland Conifer-Hardwood-Forest (66 species), Southwest Oregon Mixed Conifer-Hardwood Forest (64 species), Westside Oak, Dry Douglas-Fir Forest and Woodlands (62), Montane Mixed Conifer Forest (60 species), as well as in Developed-Urban and Mixed Environs (63 species). The lowest species diversity of mammals is expected in Bays and Estuaries (12).

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to mammals. Because it will not be known where mammals are specifically located, impacts were quantified by impacts to habitats in which they could occur (see table 4.6.1.2-1). The Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population-level impacts on these species. For more information on special status mammal species that could be affected by the Project, see our BA (FERC 2015) and the BE (appendix L of this EIS).

Wild Horses

The BLM and the Forest Service manage wild horses to ensure healthy herds and healthy rangelands in Oregon. The Pokegama Herd Management Unit (HMU) is located in the southwestern corner of Klamath County and the southeast corner of Jackson County, on both private and BLM lands within the Lakeview District. While the pipeline does not cross it, the HMU is in the general vicinity of the Project. From 1972 to 2005, the average number of horses in the HMU was 42.7, but the population has ranged from 23 horses in 1973 to 55 horses in 1992, 1995, 1996, 1999, and 2000. These counts are based on ground and aerial surveys. Relative to other wild horse herds (which increase about 22 percent per year), the Pokegama herd has a low yearly increase of 4 to 5 percent. This may be due to illegal removal or mountain lion predation (BLM 2002d). The Project is not expected to impact the Pokegama wild horse herd.

Bats

Fifteen species of bat occur in Oregon; 13 of the species potentially occur within the project area. All of the species except for little brown myotis, big brown bat, and Brazilian free-tailed bat have some special status, whether identified by the State as sensitive, the FWS as a Species of

Concern, or by the BLM or the Forest Service as a Sensitive Species. Special status species are discussed in section 4.7; special status bats are listed in table O-3 of appendix O. Uses of different habitats that may occur along the pipeline route vary between little brown myotis, big brown bat, and Brazilian free-tailed bat (table 4.6.1.2-5).

TABLE 4.6.1.2-5

Non-Special Status Bat Species and Associated Habitats Likely to Occur Within the Project Area

Species	Distribution in Southern Oregon	Habitats	Foraging Habitat
Little brown myotis *Myotis lucifugus carissima*	Yearlong throughout Oregon	Associated with all habitats described in table 4.6.1.2-1	Forages for insects in scattered trees, along edges of dense timber, near water in shrub-grassland
Big brown bat *Eptesicus fuscus*	Yearlong throughout Oregon	Associated with all habitats described in table 4.6.1.2-1	Forages for insects over forest canopy, along roads/edges through trees, forest clearing
Brazilian free-tailed bat *Tadarida brasiliensis mexicana*	Non-migratory southern Oregon only	Westside Lowland Conifer-Hardwood Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Ponderosa Pine Forest and Woodlands, Westside Oak and Dry Douglas-fir Forest and Woodlands, Western Juniper and Mountain Mahogany Woodlands, Shrub-steppe, Westside Grasslands, Westside Riparian-Wetlands, Herbaceous Wetlands, Agriculture, Pastures, and Mixed Environs, Urban and Mixed Environs, Open Water - Lakes, Rivers, and Streams	Forages for insects within heated buildings or outside during warm spells during winter. During other periods, will forage almost anywhere from valley bottoms to Cascade / Siskiyou Mtn. crest, foraging long distances, e.g., 30+ miles round trip per night

Sources: Maser and Cross (1981), Verts and Carraway (1998), Johnson and O'Neil (2001), Weller (2008), ODFW (2013a)

All of the bat species consume insects, and most are associated with tree-dominated habitats that occur within the project area. Bats have roosts used by nursing females and young, roosts used during daylight, and hibernacula that are used to survive during winter while hibernating or in torpor. White-nose syndrome is a disease of hibernating bats, caused by a fungus that affects skin for the nose, ears, and wings of hibernating bats (USGS 2013). The fatal disease is currently limited to the eastern United States, and has not been detected in Oregon. Bat populations in the state are being monitored for the disease because the epidemic appears to be moving from east to west (ODFW 2011a).

Timber clearing in winter and early spring would coincide with the bat hibernation period. Bats utilizing trees for hibernation could be killed by timber clearing. Timber clearing in spring and early summer would coincide with natal or maternity periods, but would not occur after April 1 in order to avoid the migratory bird nesting season. Females and young inhabiting roosts in tree cavities would likely be killed if occupied roost trees and/or snags were felled. Likewise, bats utilizing day roosts under loose bark or snag with cavities between April and September could be killed by timber clearing. Young bats would likely be killed if roost trees were felled before they were able to fly. Most bat species, especially Townsend's big-eared bat, are sensitive to disturbance and would abandon disturbed roosts (Csuti et al. 2001; Verts and Carraway 1998; ODFW 2013a). This disturbance and subsequent abandonment could have energetic repercussions, potentially decreasing successful reproduction and survival.

Noise from traffic and other sources is believed to interfere with bats' echolocation (Jones 2008). We estimate that noise from general construction of the pipeline could be about 72 dBA at 300 feet. Project-related traffic and other construction noise would be limited to daylight hours, except for HDDs, and would mostly avoid periods when bats use echolocation to forage. Consequently, Project noise would not have significant adverse effects on bat populations. Pipeline construction noise is discussed in more detail in section 4.12.2.2.

Night lighting could act as barriers to bat movements (Kuijper et al. 2008), reduce bat activity in the immediate vicinity (Stone et al. 2009), or have an opposite effect by attracting nocturnal insects (Svensson and Rydell 1998; Rydell and Racey 1993). The Klamath Compressor Station and Clarks Branch Meter Station would be equipped with outside lighting to support night work activities. During normal operations, nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight hours are short.

Pacific Connector would build three new communication towers at the Klamath Compressor Station and Clarks Branch and Jordan Cove Meter Stations, ranging in height from 26 to 140 feet tall. In addition, Pacific Connector would use eight existing communication towers, the tallest of which would be 250 feet high at Winston. It is possible that bats could fly into the communication towers. Use of eight currently existing towers is not expected to impact habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers are unlikely to have a significant impact on bats, as they would not have guy wires or lighting, which would decrease the possibility of collisions but would not entirely eliminate that risk.

Because it will not be known where bat roosts are specifically located, impacts to bats were quantified by impacts to habitats in which they could occur. Of forested habitats to be affected by the Project, 821 acres of late-successional forest and 820 acres of mid-seral forest would be affected during construction (table 4.6.1.2-2). Because of the low percentage of all available habitat in the area being cut, and the dispersed nature in which tree-roosting bats typically roost in the west, the Project is not expected to have population-level impacts on these bat species. For more information on special status bat species that could be affected by the Project, see the BE in appendix L.

Birds

Based on their distributions in southwestern Oregon, 278 bird species may be present in habitats that would be crossed by the Pacific Connector pipeline (Johnson and O'Neil 2001). The highest diversity of bird species can be expected in habitats associated with agriculture, pastures, and mixed environs (173 species). Many species are also associated with riparian-wetland habitats (154 species), herbaceous wetlands (136 species), bays and estuaries (132 species), and developed-urban and mixed environs (131 species; table 4.6.1.2-1). The fewest number of bird species are associated with sagebrush shrub-steppe (75) and eastside grasslands (79).

Annual breeding bird survey (BBS) counts were used to determine additional potential bird species presence within habitats crossed by the Pacific Connector pipeline. Fewer species have been documented on BBS routes (227 species observed) than the number of species associations of wildlife habitats coinciding with the project area (278 species expected). The disparity is likely due to several factors: the BBS does not usually document all of the species possibly present at the time of the survey (i.e., nocturnal owls and birds that do not sing or call regularly); species reported are present only during the season of the survey; and survey routes may not include or be representative of all habitat types crossed by the pipeline. Regardless, the BBS survey counts can be used as an index of some species' population trends over time.

The Pacific Connector pipeline crosses two Bird Conservation Regions (BCRs): (1) BCR 5 – Northern Pacific Rainforest, from MP 1.5R to MP 168; and (2) BCR 9 – Great Basin, from MP 168 to MP 228.1. Bird species diversity and population trends in the region surrounding the project area were evaluated from data collected on 33 BBS routes that have been surveyed within 50 miles of the Project (17 routes within BCR 5, 16 routes within BCR 9). Of the 231 species observed on the BBS routes, 9 species are BCC within BCR 5 (excluding the MAMU, discussed in section 4.7) and 20 species are BCC within BCR 9. BCC in the project area are listed in table 4.6.1.2-6. Local population trends within each BCR were estimated from average number observed per BSS route if data were sufficient (average occurrence per route per year ≥1, average number of routes per year with species counted ≥5). Regional population trends within BCRs were obtained from USGS (Sauer et al. 2011).

TABLE 4.6.1.2-6

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name Scientific Name	Regional BCR Trend 1993 to 2012	Local Trend 1994 to 2013	Confirmed Breeding Dates a/	
			Earliest	Latest
BCR-5, Northern Pacific Rainforest				
Pelagic Cormorant *Phalacrocorax pelagicus*	No Trend	Insufficient Data	22 Mar	26 Jul
Bald Eagle *Haliaeetus leucocephalus*	Increasing (p<0.05)	Insufficient Data	8 Mar	9 Aug
Northern Goshawk *Accipiter gentilis*	No Trend	Insufficient Data	10 May	9 Aug
Peregrine Falcon *Falco peregrinus*	Increasing (p<0.10)	Insufficient Data	26 Apr	26 Jul
Caspian Tern *Sterna caspia*	No Trend	Insufficient Data	14 Jun	19 Jul
Marbled Murrelet *Brachyramphus marmoratus*	No Analysis	Insufficient Data	No data	
Rufous Hummingbird *Selasphorus rufus*	Decreasing (p<0.05)	No Trend	22 Mar	2 Aug
Olive-sided Flycatcher *Contopus cooperi*	Decreasing (p<0.05)	No Trend	14 Jun	30 Aug
Willow Flycatcher *Empidonax traillii*	Decreasing (p<0.05)	No Trend	7 Jun	9 Aug
Vesper Sparrow *Pooecetes gramineus*	Decreasing (p<0.10)	Insufficient Data	26 Apr	16 Aug
Purple Finch *Carpodacus purpureus*	No Trend	No Trend	10 May	19 Jul
BCR-9, Great Basin				
Eared Grebe *Podiceps nigricollis*	No Trend	Insufficient Data	31 May	23 Aug
Bald Eagle *Haliaeetus leucocephalus*	Increasing (p<0.05)	Increasing (p<0.01)	8 Mar	9 Aug
Ferruginous Hawk *Buteo regalis*	No Trend	Insufficient Data	29 Mar	19 Jul
Golden Eagle *Aquila chrysaetos*	No Trend	Insufficient Data	22 Feb	19 Jul
Peregrine Falcon *Falco peregrinus*	Increasing (p<0.10)	Insufficient Data	26 Apr	26 Jul

TABLE 4.6.1.2-6

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name Scientific Name	Regional BCR Trend 1993 to 2012	Local Trend 1994 to 2013	Confirmed Breeding Dates a/ Earliest	Confirmed Breeding Dates a/ Latest
Yellow Rail *Coturnicops noveboracensis*	No Analysis	Insufficient Data	7 Jun	5 Jul
Snowy Plover *Charadrius alexandrinus*	No Analysis	Insufficient Data	17 May	5 Jul
Long-billed Curlew *Numenius americanus*	No Trend	Insufficient Data	19 Apr	12 Jul
Calliope Hummingbird *Stellula calliope*	No Trend	Insufficient Data	31 May	26 Jul
Lewis's Woodpecker *Melanerpes lewis*	No Trend	Increasing ($p<0.05$)	24 May	23 Aug
Williamson's Sapsucker *Sphyrapicus thyroideus*	No Trend	Insufficient Data	17 May	26 Jul
White-headed Woodpecker *Picoides albolarvatus*	Increasing ($p<0.05$)	Insufficient Data	24 May	26 Jul
Willow Flycatcher *Empidonax traillii*	Decreasing ($p<0.05$)	Increasing ($p<0.05$)	7 Jun	9 Aug
Loggerhead Shrike *Lanius ludovicianus*	No Trend	Insufficient Data	10 May	19 Jul
Pinyon Jay *Gymnorhinus cyanocephalus*	Decreasing ($p<0.05$)	Insufficient Data	7 Jun	19 Jul
Sage Thrasher *Oreoscoptes montanus*	Decreasing ($p<0.05$)	Decreasing ($p<0.01$)	10 May	26 Jul
Green-tailed Towhee *Pipilo chlorurus*	No Trend	No Trend	17 May	9 Aug
Brewer's Sparrow *Spizella breweri*	No Trend	No Trend	3 May	9 Aug
Black-chinned Sparrow *Spizella atrogularis*	No Analysis	Insufficient Data	No data	
Sage Sparrow *Amphispiza belli*	No Trend	Insufficient Data	10 May	9 Aug
Tricolored Blackbird *Agelaius tricolor*	No Trend	No Trend	12 Apr	9 Aug

a/ Breeding dates from Adamus et al. (2001).

For BCR 5 regional trends, peregrine falcons and bald eagles are increasing and for the rest of the birds either there is a decreasing trend (4), no trend (4), or no analysis (1). For BCR 5 local trends, there are either insufficient data (7 birds) or no trend (4 birds). For BCR 9 regional trends, bald eagle, peregrine falcon and white-headed woodpecker have increasing trends, the willow flycatcher, sage thrasher, and pinyon jay display a decreasing trend, and for the rest of the birds either there is a no trend (12) or no analysis (3). The local trend for BCR 9 is increasing for bald eagle, Lewis' woodpecker, and willow flycatcher and decreasing for sage thrasher. For the other birds in BCR 9, there are 3 exhibiting no local trend and the rest do not have sufficient data to report a trend.

Many migratory bird species have been observed during the annual Christmas Bird Count (CBC), sponsored by the Audubon Society. At least 243 bird species (common names are reported and have not been standardized) have been counted at seven locations proximate to the Pacific Connector Pipeline Project area. While 152 bird species have been reported by both BBS and CBC, 91 species have only been reported by the CBC. The species include various seabirds (auklets, murres, guillemots, jaegers, gulls, albatrosses, shearwaters, and cormorants), waterfowl (scoters, geese, swans), and shorebirds (dowitchers, sandpipers, plovers, turnstones).

Several raptor species are known or suspected to nest, migrate, and seasonally reside in the general vicinity of the pipeline route. Those reported for BBS routes in the region include turkey vulture, osprey, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-shouldered hawk, Swainson's hawk, red-tailed hawk, ferruginous hawk, golden eagle, American kestrel, American peregrine falcon, and prairie falcon. Several additional raptor species have only been observed during CBC surveys. Those include rough-legged hawk, gyrfalcon, and merlin.

There are also several species of owls that have been documented on BBS routes and are likely to occur in the areas crossed by the pipeline. They include barn owl (*Tyto alba*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), northern pygmy-owl (*Glaucidium gnoma*), barred owl (*Strix varia*), great gray owl (*Strix nebulosa*), short-eared owl (*Asio flammeus*), and NSO. Owls seen only during the winter CBC surveys include northern saw-whet owls and burrowing owls. Additionally, Johnson and O'Neil (2001) list flammulated owls (*Otus flammeolus*) and long-eared owls (*Asio otus*) as occurring in habitat types coinciding with the Pacific Connector pipeline route. The burrowing owl (*Athene cunicularia*), boreal owl (*Aegolius funereus*), flammulated owl, great gray owl, and northern pygmy owl have special state or BLM status and are addressed in section 4.7. The NSO has threatened state and federal status and is discussed in more detail in section 4.7.

Take of migratory bird occupied nests, eggs, pre-fledgling young, and potentially adults would be minimized by Pacific Connector's commitment to various seasonal restrictions during Project construction. Tree felling and brush removal on all construction spreads would be conducted outside of the primary migratory bird nesting season, which is April 1 through July 15. In addition, tree felling within 0.25 mile of an NSO activity center would occur after September 30 and before March 1, and tree felling within 300 feet of MAMU stands would occur after September 15 but before March 31. Additional restrictions for other migratory birds are listed in the February 13, 2015 draft migratory bird conservation plan. While these timing restrictions would minimize take of migratory birds, some direct mortality could occur outside of the peak nesting season. Therefore, species with existing declining population trends, whether on local or regional levels, including the BCC species included in table 4.6.1.2-6, are expected to be most affected by direct take, habitat loss, and alteration of habitats adjacent to the Project.

Numbers of migratory birds, nests, and eggs that might be taken during vegetation clearing and/or construction in BCRs 5 and 9 were estimated and summarized in table 4.6.1.2-7. Indirect effects to migratory birds such as nest parasitism and predation are discussed below. These effects could add to overall impacts to migratory birds described here.

TABLE 4.6.1.2-7

Numbers of Migratory Birds Potentially Nesting within Habitats Affected along the Pipeline Centerline in BCR 5 and BCR 9

	Migratory Bird Nesting Habitats Present in the Pacific Connector Pipeline Project Area														
Estimate for BCR	**Westside Lowland Conifer-Hardwood-Forest**	**Montane Mixed Conifer Forest**	**Southwest Oregon Mixed Conifer-Hardwood Forest**	**Ponderosa Pine Forest and Woodlands**	**Westside Oak, Dry Douglas- fir Forest and Woodlands**	**Western Juniper/Mountain Mahogany Woodlands**	**Shrub-Steppe**	**Westside Grasslands**	**Eastside Grasslands**	**Herbaceous Wetlands**	**Westside Riparian-Wetlands-Eastside Riparian-Wetlands**	**Developed—Urban and Mixed Environs**	**Agriculture, Pastures, and Mixed Environs**	**Total Estimated Birds/Nests**	**Total Estimated Eggs/Juveniles**
BCR-5, North Pacific Rainforest															
Miles of Habitat Crossed	62.89	3.98	44.23	9.53	5.40	0	6.57	9.89	0.40	3.21	0.35	0.26	9.42	∑ = 155.13 miles	
Total Birds in Habitat, All Species	1,103	52	773	134	98		16	57	0	6	0	0	124	2,363	10,035
Total Birds with Adequate Data a/	1,037	51	746	130	94	0	16	56	0	6	0	0	124	2,260	9,599
And with Likely Nesting b/	831	43	603	102	76	0	8	45	0	6	0	0	98	1,812	7,865
And with Possible Nesting b/	14	1	7	1	0	0	0	0	0	0	0	0	1	24	89
And with Unlikely Nesting b/	121	6	85	17	11	0	8	9	0	0	0	0	16	273	1,033
And with Unknown Nesting b/	71	1	51	10	7	0	0	2	0	0	0	0	9	151	613
Total with Inadequate Data a/	66	1	27	4	4	0	0	1	0	0	0	0	0	103	436
BCR-9. Great Basin															
Miles of Habitat Crossed	0	2.46	4.45	7.25	0	9.77	5.14	0	1.47	2.23	0.07	1.25	22.94	∑ = 57.03 miles	
Total Birds in Habitat, All Species		54	158	277		346	171		48	114	1	47	1,213	2,429	10,811
Total Birds with Adequate Data a/		52	152	264		334	169		47	97	1	45	1,154	2,315	10,285
And with Likely Nesting b/		20	78	139		170	68		15	36	0	20	543	1,089	4,955
And with Possible Nesting b/		0	2	4	0	3	19	0	8	17	0	4	156	213	1,695
And with Unlikely Nesting b/		32	63	106	0	140	71	0	21	30	1	19	366	849	2,982
And with Unknown Nesting b/		0	9	15	0	21	11	0	3	14	0	2	89	164	654
Total with Inadequate Data a/		**2**	**6**	**13**	**0**	**12**	**2**	**0**	**1**	**17**	**0**	**2**	**59**	**114**	**526**

a/ Adequate data determined for a species if observed (Sauer et al. 2014) on an average of 5 or more BBS routes per year with an average of 1 bird or more counted per route per year during the 20-year period, 1994 to 2013.

b/ Species nesting on right-of-way likelihood based on proportion of the home range/territory area (see Figure 3.5-1 in the *Migratory Bird Conservation Plan*) that would overlap the pipeline right-of-way, high proportions for small home ranges, low proportions for large.

To estimate the amount of bird and egg take, data were compiled for BBS routes within 50 miles of the Project. Numbers of birds for species observed each year on a route were divided by the length of the BBS route (birds per mile), averaged each year for routes reporting the species, and averaged for the 20-year period 1992 to 2011. For each species that had a close or general association with habitats affected by the Project, the average number of birds per mile was multiplied by miles of habitat affected in each construction spread 1 through 4 (miles of habitat affected are included in table 4.6.1.2-7). Each bird evaluated as likely or possibly nesting within the construction right-of-way was assumed to have a nest and clutch of eggs, the number of which was assumed to be the highest in the range of eggs for species' clutch size (Csuti et al. 2001; Marshall et al. 2006). Estimated numbers of birds, nests, and eggs vary by habitat and amount of habitat that would be affected by vegetation clearing and/or construction during each species' nesting season. Pacific Connector has developed seasonal timing restrictions for timber felling, logging, clearing and construction activities to minimize and avoid potential effects to migratory birds in the Project area (see summary above and Attachment B to Pacific Connector's February 13, 2015 filing). Those species' buffers were intersected with the pipeline centerline through nesting habitats crossed for each spread and the overall distance along the centerline was reduced by the amounts of buffers that were intersected. For example in Spread 1, the total length of centerline was 44.7 miles but was reduced to 24.8 miles due to timber restrictions within buffers for murrelets and spotted owls. Consequently, the effects to nesting birds, nests, and eggs were also reduced with reductions in estimated take under the MBTA.

Edge habitat created by the Project right-of-way is expected to have positive and negative impact on bird species. Expected positive effects are increased diversity and density of bird species, increased access to a variety of food resources, and increased ground cover favoring ground-nesting species (Rosenberg and Raphael 1986). Potential negative impacts include increased brood parasitism, increased nest depredation in grasslands, forests and edge habitats, and lower nesting success (Thomas and Towiell 1982; Burger et al. 1994; Vickery et al. 1994; Marini et al. 1995; Danielson et al. 1997; Brand and George 2000). There have been declines of sagebrush-dependent migratory passerine bird species with loss of sagebrush steppe vegetation and increased fragmentation in remaining sagebrush-dominated habitats (Knick and Rotenberry 1995; Knick et al. 2003). Densities of Brewer's sparrow and sage sparrow, as well as other species dependent on sagebrush for nesting habitat, were greatly reduced near well-field roads and pipelines compared to densities beyond 300 feet (Ingelfinger 2001). Nest parasitism by brown-headed cowbirds is especially likely in fragmented shrub-dominated habitats (Vander Haegen and Walker 1998). Such impact could be facilitated over the long term because maintenance of the 30-foot permanent easement would create areas of early-seral habitat throughout the operational life of the project. These corridor areas would not only provide habitat used by some wildlife species, but could also connect patches of suitable habitat, allowing wildlife to move between one patch and another (Turner et al. 2001).

Corvids, including common ravens and American crows (also jays and magpies), are opportunistic predators and will prey on other species' nests (Marzluff and Neatherlin 2006; Vander Haegen et al. 2002; Luginbuhl et al. 2001). Studies have shown that corvid populations expand and nest predation increases near human developments (Marzluff and Neatherlin 2006) and corvid predation increases in habitats that have been fragmented by humans (Vander Haegen et al. 2002). The local population of common ravens has been increasing during the breeding period within BCR 9 and during winter on CBC count circles in proximity to the Project. Potential impacts to nesting birds by predatory corvids attracted to the right-of-way would be addressed by ensuring that all construction contractors practice appropriate and responsible trash disposal every day.

Bald eagles, northern goshawks, and peregrine falcons have nest sites within 3 miles, some much closer to the Project (ORBIC 2012). Other raptor species have been observed, some nesting, along the Project route during surveys focusing on other rare species. Bald eagles, ospreys, sharp-shinned hawks, Cooper' hawks, goshawks, golden eagles, red-shouldered hawks, red-tailed hawks, peregrine falcons, great horned owls, western screech owls, NSOs, barred owls, northern pygmy owls, great gray owls, and turkey vultures have been reported during surveys in 2007 and 2008 but nest sites were not included in the documentation. Some of these raptor species have probably nested in the Project vicinity in the past. As previously described for migratory birds, timber clearing and project construction during the breeding period would affect raptors by taking nest, eggs, young, and adults.

FWS has drafted *Guidelines for Raptor Conservation in the Western United States* (Whittington and Allen 2008). The draft guidelines recommend spatial buffers for nests of breeding raptors during the breeding periods, which vary by location across the western states. Table 4.6.1.2-8 lists the raptor species that have been reported along the Pacific Connector Pipeline Project route

TABLE 4.6.1.2-8

FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline

Common Name	Scientific Name	Spatial Buffer (miles)c/
Hawks, Eagles, Falcons		
Osprey	*Pandion haliaetus*	0.25
Bald Eagle a/	*Haliaeetus leucocephalus*	0.5–1.0
Northern Harrier b/	*Circus cyaneus*	0.25
Sharp-shinned Hawk	*Accipiter striatus*	0.25
Cooper's Hawk	*Accipiter cooperii*	0.25
Northern Goshawk	*Accipiter gentilis*	0.50
Red-shouldered Hawk	*Buteo lineatus*	0.25
Red-tailed Hawk	*Buteo jamaicensis*	0.33
Ferruginous Hawk b/	*Buteo regalis*	1.00
Golden Eagle	*Aquila chrysaetos*	0.50
American Kestrel b/	*Falco sparvarius*	0.125
Peregrine Falcon	*Falco peregrinus*	1.00
Owls		
Western Screech Owl	*Megascops kennicottii*	0.125
Great Horned Owl	*Bubo virginianus*	0.125
Northern Pygmy Owl	*Glaucidium gnoma*	0.25
Burrowing Owl b/	*Athene cunicularia*	0.25
Northern Spotted Owl	*Strix occidentalis caurina*	0.50
Barred Owl	*Strix nebulosa*	0.25
Great Gray Owl	*Strix nebulosa*	0.25
Short-eared Owl b/	*Asio flammeus*	0.25
Northern Saw-whet Owl	*Aegolius acadicus*	0.125

Source: Whittington and Allen (2008)
Note: Includes special status species that are otherwise addressed in section 4.7.
a/ Spatial buffer dependent on line-of-sight to nest.
b/ Species added to table based on occurrence on BBS routes.
c/ Spatial buffers used in the Draft Migratory Bird Conservation Plan were based on buffers provided by the FWS, Forest Service, and BLM (see appendix F in FERC DEIS). Note that the National Bald Eagle Management Guidelines (FWS 2007) recommend a 660-foot (200 m) buffer surrounding nests during the breeding season applied to timber harvest, road construction, chain saw, and yarding operations (assumed similar to timber clearing & pipeline construction).

by one source or another and the recommended spatial buffers during nesting periods (not included in the table). Human disturbances within spatial buffers risk nest abandonment by adults and nest failure (Whittington and Allen 2008).

Surveys of known nests of raptor species with nesting buffers that intersect the pipeline right-of-way would be conducted prior to tree clearing. Those species include bald eagle, great gray owl, and peregrine falcon. If nests are active, clearing trees and disturbance by airplane or helicopter within buffers would be delayed until after the nesting period. Survey protocols are contained in the draft *Migratory Bird Conservation Plan* that was filed with the FERC on February 13, 2015.

Pacific Connector would use eight existing communication towers and construct three new towers (see table 2.1.2.2-2). Communications towers are estimated to kill millions of birds each year, with mortality near guyed towers greater than self-supporting towers. Also, the majority of bird-tower collisions are reported from towers over 500 feet tall (Gehring 2004). Most bird-tower collisions occur at night, generally during conditions with low visibility, and during the day under foggy conditions. Bird-tower collisions may also increase with lighting on the towers. Research indicates that white strobe lights on towers may create less of a hazard to migratory birds, although these types of lights are not allowed within three nautical miles of an airport. Additionally, some research has indicated that marking guy-wires to make them more visible may reduce avian mortality (FCC 2006).

Use of eight currently existing towers is not expected to impact habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers would not have guy wires or lighting and are either 26 or 140 feet tall, which would decrease the possibility of bird collisions but would not eliminate that risk entirely. Some additional mortality could occur from collision with towers, but given the low height and the fact that towers do not have lighting or guy wires, additional mortality is expected to be minimal.

As described above, there could be take of migratory birds including nests, eggs, young, and adults from tree clearing occurring outside of the peak migratory bird nesting season. Where vegetation clearing cannot be avoided during the breeding season, Pacific Connector would have qualified biologists perform pre-construction surveys of the area to be disturbed, plus a 20-foot buffer adjacent to areas affected. If nests are encountered, Pacific Connector would work with FWS to avoid nests as feasible. Laws and regulations regarding the treatment of migratory birds, including the MBTA and EO 13186, are described above (see section 1.5.1.10). In accordance with the March 2011 MOU between the FERC and the FWS to implement the policies of EO 13186, a draft *Migratory Bird Conservation Plan* was developed in coordination with the FWS for the Project. The *Migratory Bird Conservation Plan* identifies avoidance and minimization strategies, as well as habitat restoration and compensatory mitigation actions. With incorporation of avoidance, minimization, and mitigation strategies, the Project is not expected to have population-level impacts on migratory bird species. We are recommending above (section 4.6.1.1) that Pacific Connector file its finalized *Migratory Bird Conservation Plan* with the FERC prior to construction.

Harvested Wildlife

Several species of mammals and birds are harvested by recreation and/or subsistence hunting. With the exception of wildlife harvest administered and managed under tribal authorities, hunting is regulated by the ODFW within defined Wildlife Management Units. Big game species that may occur in the areas crossed by the Pacific Connector pipeline route include black-tailed deer, mule deer, Roosevelt elk, Rocky Mountain elk, black bear, and cougar. Demographic data and harvest data for harvested wildlife are compiled by ODFW and are available in online reports, listed by animals taken by each hunt unit. For example, 43,098 deer and 18,136 elk were taken in 2012 in the entire state of Oregon.

Two subspecies of mule deer occur within the Pacific Connector pipeline area: the larger Rocky Mountain mule deer, usually found east of the Cascade Mountain crest, and the black-tailed deer, generally found west of the Cascades (ODFW 2008a). A second species, Columbian white-tailed deer, was recently state and federally delisted (2003) and may occur between Olalla Creek and Clarks Branch Road in Douglas County (ODFW 2007a), within an area considered by ODFW and Douglas County "peripheral big game range" (Wood 2007). Black-tailed deer are considered management indicator species (MIS) for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b).

In eastern Oregon, mule deer are mainly confined to open woods or isolated mountain ranges, although they once ranged into sagebrush plains in canyons or rimrock. During the winter, a period considered critical for the mule deer, they descend to lower elevations to browse sagebrush, bitterbrush, rabbitbrush, juniper, and mountain-mahogany, which are high in fats (ODFW 2003a, 2011b; Csuti et al. 2001). In western Oregon, black-tailed deer are found in heavy brush areas at the edges of forests and chaparral thickets, but not in dense forests. Black-tailed deer prefer early successional stages created by clear-cuts or burns, providing grasses, forbs, and shrubs (ODFW 2008a; Csuti et al. 2001). Most black-tailed deer that summer in the high Cascades winter at lower elevations on the west slope, although some wintering may occur east of the Cascade crest (ODFW 2008a). Winter loss of black-tailed deer is generally far less than for mule deer, because the snow does not remain on the valley floors for extended periods and a crust does not form on the surface as it does on the east side of the Cascades (ODFW 2008a). Within Jackson County, black-tailed deer are highly migratory and often move along well-defined migration trails at night during the months between October and March (ODFW 2007a). In Douglas County, Columbian white-tailed deer are most often associated with riparian habitats, although they are known to use a variety of lower elevation habitat types, such as grasslands, grass shrub, oak woodlands, coniferous woodlands, and mixed deciduous and coniferous woodlands (FWS 2003a).

Rocky Mountain elk inhabit most of eastern Oregon and Roosevelt elk occupy most of western Oregon with concentrations in the Cascades and Coast ranges. They are known to make significant movements in response to disturbances from humans and predators, as well as seasonal weather patterns. Rocky Mountain elk is considered an MIS for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b).

Numerous studies have shown that both Rocky Mountain and Roosevelt elk are sensitive to human disturbances such as motorized travel on and off roads (Rowland et al. 2000). Roads are generally avoided by elk when they are open, but are heavily utilized by elk as travel corridors when closed. Several herds of elk are known to winter on the western slopes of the Cascades (ODFW 2003b). Summer elk forage consists of a combination of lush forbs, grasses, and shrubs, which is usually attained at higher elevations within wet meadows, springs, and riparian areas in close proximity to forested stands. Forage becomes less abundant and accessible in winter and the nutritional quality declines. Winter range is usually within forested sites, which provide protection against weather as well as lichens and other plants used as forage (ODFW 2003b); however, in Jackson County, winter range also consists of other habitat types such as grassy meadows, recent clearcuts, industrial forestlands, agricultural fields, orchards and urban edges. Most elk range is on BLM and NFS lands (ODFW 2003b); however, within the Pacific Connector pipeline area, most winter range occurs on private lands (table 4.6.1.2-9). Jackson County has the most winter range affected by the Project, followed by Klamath County, then Douglas County.

TABLE 4.6.1.2-9

Designated Big Game Winter Range Crossed by the Pacific Connector Pipeline

Winter Range or Management Area	Miles Crossed Per Landowner			
	BLM	Forest Service	Other a/, b/	Total
Douglas County				
Big Game Winter Range – Umpqua National Forest	0.0	0.6	0.0	0.6
Douglas County Total	**0.0**	**0.6**	**0.0**	**0.6**
Jackson County				
Sensitive Wildlife Area c/	2.3	0.0	2.3	4.6
Especially Sensitive Deer and Elk Winter Range d/	11.1	1.4	19.7	32.3
Jackson County Total	**13.5**	**1.4**	**22.0**	**36.9**
Klamath County				
Deer Low/Medium Density Winter Range e/	0.0	0.0	4.3	4.3
Deer Low/Medium Density Winter Range f/	0.3	0.0	12.8	13.0
Elk Winter Range g/	0.0	0.0	1.2	1.2
Klamath County Total	**0.3**	**0.0**	**18.3**	**18.5**
Overall County	**13.8**	**2.0**	**40.3**	**55.4**

Note: Rows/columns may not sum correctly due to rounding. Mileages rounded to the nearest tenth of a mile (values below 0.1 are shown as “<0.1”).
a/ Other includes non-federal lands, such as private, county, and state.
b/ Seasonal restrictions are specific to landownership. "Other" designation is stipulated by ODFW.
c/ Sensitive Wildlife Areas coverage was provided by ODFW from Jackson County big game GIS coverage. This area also incorporates Forest Service Deer Winter Range coverage (Trail Creek).
d/ Especially Sensitive Deer and Elk Winter Range coverage was provided by ODFW from Jackson County big game GIS coverage. This area also incorporates BLM Deer (Camel Hump, BFRA Salt Creek, Little Butte Creek South) and Elk (Camel Hump, BFRA Salt Creek) Winter Management Area coverages, as well as Forest Service Deer Winter Range coverages (Big Butte Creek, Lake Creek).
e/ Deer Low/Medium Density Winter Range coverage was provided by ODFW from digitizing efforts of Klamath planning maps. This is the Keno Unit Winter Range (Milburn 2007).
f/ Deer Low/Medium Density Winter Range coverage was provided by ODFW from digitizing efforts of Klamath County planning maps. This area also incorporates BLM Deer Winter Management coverages (Stukel, South Bryant).
g/ Elk Winter Range for Eastern Oregon(ODFW 2013; available online: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259).

Big-game winter ranges have been delineated for management planning efforts within Jackson and Klamath Counties and typically include winter ranges for both deer and elk (ODFW 2003a). The big-game winter management areas were digitized in GIS from Jackson and Klamath Counties’ planning maps by ODFW and are still considered to be in draft form (Wood 2007). The delineated areas do not necessarily represent complete deer and elk winter ranges within each county, but designate areas that provide some level of protection for big-game winter range while allowing development to occur (Milburn 2007). Pacific Connector consulted with ODFW to ensure that the correct big game habitat coverages were considered (as described in Pacific Connector’s April 27, 2015 data response filing with FERC). Upland game birds that may be harvested in the project area include sooty grouse, ruffed grouse, mountain quail, ring-necked pheasant, California quail, mourning dove, and wild turkeys (ODFW 2012b; Forest Service 2007). Harvested small game and furbearer species that occur in the project area are beaver, bobcat, gray fox, red fox, marten, mink, muskrat, otter, raccoon, badger, coyote, nutria, opossum, spotted skunk, striped skunk, and weasel (Hiller 2011).

During construction of the Pacific Connector pipeline, there would be short-term, localized effects on hunter success rates within the affected hunt units. When construction in a particular hunt unit coincides with hunting seasons, hunter utilization and success in the immediate vicinity would probably be adversely affected for the duration of construction in that area. However, hunter success rates for any species in each affected hunt unit are relatively low despite seemingly extensive hunter efforts (ODFW 2014a).

Where the Pacific Connector pipeline crosses existing roads, the newly created corridor would be potentially accessible from each road and probably more so at points crossed where access roads are adjacent to previously dense and/or forested habitats. The Project would require construction of 13 PARs. Increased hunter success as a result of those access points is likely but any changes in success cannot be predicted or estimated because so little area (the pipeline corridor) within any given hunt unit would be subject to increased hunter access.

After construction, there could potentially be a secondary impact (Comer 1982) on harvest rates because of increased access by hunters using the pipeline right-of-way to access remote areas. In addition, big game species utilizing a cleared right-of-way may be more likely to be harvested than animals in forested habitat. Increased public recreation along cleared rights-of-way in the fall hunting season, especially near crossings of existing access points, has been documented elsewhere (Crabtree 1984).

Increased public access because of the cleared pipeline right-of-way could increase poaching of game animals and non-game wildlife on a local level. Enforcement of wildlife regulations is the responsibility of the Oregon State Police, Fish and Wildlife Division. Individual incidences of illegal harvest are reported in the Fish and Wildlife Division Newsletter. From those records, it appears that poaching is somewhat commonplace in southwest Oregon. In the April 2007 edition, a deer poaching investigation near the proposed route (Eagle Point, Jackson County) led to 130 charges, including 23 felonies, against 8 suspects. Those particular crimes involved several black-tailed deer (Freeman 2006) but, according to the April 2007 Fish and Wildlife Division Newsletter, other species that have been poached include elk, turkeys, and even livestock. More recent newsletters describe poaching in the area as well (January 2014, December 2013, and October 2013). There is no information to relate poaching effects to wildlife population status.

Within big game winter management areas in Douglas, Jackson, and Klamath Counties, mature and regenerating forest would be converted to an herbaceous/shrub vegetative cover for the long term, increasing the amount of forage available to big game adjacent to forested stands potentially used for thermal cover (table 4.6.1.2-10). Forested areas would be the most commonly affected, followed by grasslands/shrublands. Temporary impact areas that are forested, regenerating, or recently clear-cut stands removed during construction on big game winter range would be replanted with trees after construction of the pipeline, eventually providing similar habitat to that present prior to construction.

TABLE 4.6.1.2-10

Acres of Habitat Types Affected within Big Game Winter Ranges by Construction and Operation of the Pacific Connector Pipeline by Landowner

Project Component	County	Landowner	Acres of Habitat Affected in Winter Range: Forest – Woodland	Regenerating or Clear-cut Forest	Grasslands/ Shrublands	Wetland/ Riparian a/	Other Terrestrial Habitat b/	Total Habitat
Pacific Connector Pipeline and Facility Construction	Douglas	Umpqua National Forest	9	0	0	0	0	9
	Jackson	Medford BLM	114	28	68	0	<1	209
		Rogue River National Forest	12	4	3	0	0	20
		Private / State Forest	133	52	106	10	37	338
		Jackson County Total	*259*	*85*	*177*	*10*	*37*	*567*
	Klamath	Lakeview BLM	3	0	1	0	0	4
		Private/Other	39	29	99	<1	33	200
		Klamath County Total	*42*	*29*	*99*	*<1*	*33*	*203*
Total Pipeline and Facility Construction			**309**	**113**	**276**	**10**	**70**	**779**
Pacific Connector Operation/ Maintenance 30-foot Corridor c/	Douglas	Umpqua National Forest	2	0	0	0	0	2
	Jackson	Medford BLM	27	6	15	0	0	48
		Rogue River National Forest	4	1	1	0	0	5
		Private / State Forest	33	12	24	2	7	78
		Jackson County Total	*64*	*20*	*39*	*2*	*7*	*131*
	Klamath	Lakeview BLM	1	0	<1	0	0	1
		Private/Other	11	8	23	<1	7	50
		Klamath County Total	*11*	*8*	*23*	*<1*	*8*	*51*
Total Operation/Maintenance Corridor			**77**	**28**	**62**	**2**	**15**	**184**
Revegetation Outside 30-foot Maintenance Corridor d/	Douglas	Umpqua National Forest	7	0	0	0	0	7
	Jackson	Medford BLM	87	22	53	0	1	161
		Rogue River National Forest	8	3	2	0	0	15
		Private / State Forest	100	40	82	8	31	260
		Jackson County Total	*195*	*65*	*138*	*8*	*31*	*436*
	Klamath	Lakeview BLM	2	0	<1	0	0	3
		Private/Other	28	21	76	<1	26	150
		Klamath County Total	*31*	*21*	*76*	*<1*	*25*	*152*
Total Revegetation Outside Operation/ Maintenance Corridor			**232**	**85**	**214**	**8**	**55**	**595**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre. Acreages less than 1 are shown as "<1".

a/ Wetland acreages rounded to nearest tenth of an acre. Acreages less than 0.1 acre shown as "<0.1".

b/ Other terrestrial habitat includes agriculture, developed, and barren. Restoration efforts will allow habitat type to be converted back to original state.

c/ Upland 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state less than 6 feet in height. Riparian 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state within a 10-foot corridor centered over the pipeline and the additional 10 feet either side of the pipeline will be maintained in an herbaceous/shrub/tree state less than 15 feet in height (see Typical Drawings 3430.34-X-0015, 3430.34-X-0016 and 3430.34-X-0017 in Appendix 1B to Resource Report 1).

d/ Habitat Revegetation: trees planted within forested habitats, including regenerating and clear-cut forest; grasses and shrubs planted within non-forested habitat and 30-foot maintenance corridor (except riparian areas). On private lands, revegetation will occur in consultation with the landowners.

Sources: BLM Deer and Winter Management Areas, Forest Service Deer Winter Range, ODFW 2007 GIS data delineated from County planning maps, ODFW 2013 Elk Winter Range for Eastern Oregon.

In addition, big game are expected to be displaced from habitats adjacent to construction-related disturbance. In general, deer and elk return to habitats from which they have vacated within some relatively short period of time, which would likely depend on the time of year, available hiding cover, and duration of local disturbances. Following reclamation of the pipeline corridor, big game may utilize the corridor for travel and for foraging, depending on vegetation species planted and rapidity of successful revegetation.

Construction of the Pacific Connector pipeline may coincide with big game calving and fawning times, generally in late spring (May to early June). Calving and/or fawning areas may be close to winter ranges or may be at higher elevations than winter range. During active construction, big game would most likely avoid construction areas and may be adversely affected in one or more ways, including increased energy expense if they escape from disturbances or are displaced to areas of deeper snow accumulation, use of suboptimal habitats that do not provide adequate functions (food, shelter, escape cover), and use of habitats that increase the risk of predation. The expected consequences of these responses would be decreased over-winter survival and decreased calving/fawning success (for example, see Bradshaw et al. 1998).

The BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. Pacific Connector would apply the following ODFW, BLM, and Forest Service recommended seasonal closures for big game winter range (with the exception of big game winter range located in Klamath Basin, where a waiver would be obtained): November 15 to April 1 (BLM), December 1 to March 31 (Forest Service), and non-federal lands from November 15 to April 1 (private and state). Timber felling and construction activities may occur within ODFW, BLM, and/or Forest Service big game winter ranges in Douglas (Umpqua National Forest), Jackson, and Klamath counties to minimize or avoid effects to migratory birds, NSO, and MAMU. Pacific Connector will consult with ODFW, BLM, and the Forest Service while finalizing the *Wildlife Habitat Mitigation Plan* to allow a variance/waiver for project activities within areas with recommended big game seasonal timing restrictions.

Elk and deer may use maintained pipeline rights-of way for feeding areas, especially when hunting is not occurring (Lees 1989; Jageman 1994). The Pacific Connector pipeline right-of-way would provide an opportunity for developing high quality feeding areas (Lees 1989) for elk and deer species, especially if noxious weeds are controlled and high-quality native forage is seeded. Within big-game winter range disturbed by the pipeline, Pacific Connector would seed disturbed areas with preferred deer and elk forage species. Additionally, Pacific Connector would control noxious weeds on the right-of-way on all lands crossed including both summer and winter rangelands, because it is a priority management objective to maintain native forage species (ODFW 2003a).

The ODFW expressed concern that open trenches during construction of the Pacific Connector pipeline could entrap deer and elk. To minimize potential impact of open trenches on big game within delineated big-game winter and summer range, Pacific Connector would leave breaks at least 5 feet wide at approximately 0.5-mile intervals, and at visible wildlife trails, to serve as routes for big game to cross the construction right-of-way until pipe is ready to be installed (Forman et al. 2003). Alternatively, Pacific Connector would install soft plugs (backfilled trench materials) in the trench after excavation at these distances to provide wildlife passage.

Additionally, 20-foot gaps would be left in spoil and topsoil stockpiles at all hard or soft plug locations, and a corresponding gap in the welded pipe string would be left in these locations. Suitable ramps would also be installed from the bottom of the trench to the top to allow any wildlife that enters the trench to escape.

Pacific Connector would install barriers at locations along its pipeline route to discourage unauthorized public access to the right-of-way. These barriers may include boulders, dirt berms, log barriers, signs, and locked gates. Slash from clearing operations would be redistributed on the right-of-way, to improve habitat and to make OHV travel difficult. These barriers should minimize OHV access to the right-of-way and reduce unauthorized hunting or poaching of game animals (see section 4.10.2.5 of this EIS for a further discussion about OHV traffic).

Amphibians and Reptiles

Based on their distributions in southwestern Oregon, 23 species of amphibians and 24 species of reptiles may be present in habitats that would be crossed by the Pacific Connector pipeline route (Leonard et al. 1993; Nussbaum et al. 1983). Habitats in the area of the pipeline that support the highest diversity of reptiles and amphibians include Wetlands/Eastside Riparian-Wetlands (38 species), Developed, Urban, and Mixed Environments (37 species), and Mixed Conifer-Hardwood Forest (35 species). One reptile species (western terrestrial garter snake) is potentially found within bays and estuarine habitats. Amphibian and reptile species that could potentially occur near the Project include, but are not limited to, tiger salamander, clouded salamander, tailed frog, western toad, western pond turtle, sagebrush lizard, rattlesnake, king snake, western fence lizard, gopher snake, and rubber boa.

Some amphibian species potentially occurring within the Pacific Connector Pipeline Project area are associated with a variety of habitats and as a result, are common and widespread with healthy populations, such as the Pacific tree frog and rough-skinned newt. Other species that have been documented within the project area, such as the Oregon spotted frog (listed as threatened under the ESA, addressed in section 4.7) and the foothill yellow-legged frog, are declining (ODFW 2006b). Amphibians demonstrate close associations with aquatic and riparian habitats, though they may occur in other habitat types if not too distant from water, for example, the ensatina (a lungless salamander), which is found in forests. Amphibians with extremely limited distributions and relatively specific ecological requirements may be more at risk of further population declines (Walls et al. 1992). Some threats to amphibians within habitats crossed by the Project include loss of habitat and its connectivity, changes in hydrology and water quality, predation, and competition with invasive species (ODFW 2006b).

Reptiles potentially within the Pacific Connector Pipeline Project area are also associated with a variety of habitats crossed, although not all are as closely associated with water and/or water-dominated features as amphibians. The primary threats to reptiles are habitat loss and fragmentation, predation, and competition with nonnative invasive species, such as turtles, fish, and bullfrogs (ODFW 2006b).

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to amphibians and reptiles. Because it will not be known where amphibians and reptiles are specifically located, impacts were quantified by impacts to habitats in which they could occur (see table 4.6.1.2-2). The Pacific Connector Pipeline Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population level impacts on these species. For more information on special status amphibian and reptile species that could be affected by the Project, see the BE in appendix L. Habitat mitigation as described in the CMP (Appendix O of our BA) would benefit amphibian and reptile species affected by the Project.

Invertebrates

The Pacific Connector pipeline may affect terrestrial invertebrates. Arthropods occur within all habitat types crossed by the pipeline, though terrestrial mollusks (gastropods) are considerably more restricted. With few exceptions, terrestrial mollusks are generally found in moist habitats associated with springs, seeps, decaying wood, moist mature forests, and habitats maintained in the coastal "fog" zone near the ocean. Other invertebrate species would likely be widespread and abundant throughout the project area; some examples include *Peromyscopsylla selenis*, earthworm (*Lumbricus variegatus),* orb weaver spider (family *Araneidae)*, and grass spiders (*Agelenopsis* spp.*)*.

Impacts discussed below under General Impacts on Terrestrial Wildlife would be relevant to invertebrates. Because it is not possible to predict specific locations where invertebrates would occur, impacts were estimated based upon impacts to habitats in which they could occur (see table 4.6.1.2-2). Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population-level impacts on these species. For more information on special status invertebrate species that could be affected by the Project, see our BA (FERC 2015) and the BE in appendix L. Habitat mitigation as described in the CMP would benefit invertebrate species affected by the Project.

General Impacts on Terrestrial Wildlife and Measures to Reduce or Mitigate Impacts

Many species have very specific habitat requirements that may or may not be present in the project area and would not be described in the relatively broad habitat types used in this section (habitat types described by Johnson and O'Neil 2001). Consequently, the assumption has been made that if a species' occupied range is known or likely to coincide with the project area, and if general habitat types that would be affected by the Pacific Connector pipeline could include more specific habitat components required by that species, then the species could occur and be affected in some way by the Project.

Short-term impacts on wildlife would occur during construction, and also extend beyond for habitats that may not be returned to former levels of functionality for up to five years following restoration. Long-term impacts on wildlife occur when it takes longer than five years for affected habitats and their functions to be fully restored to their pre-construction condition. Direct impacts on habitats, whether by vegetation removal, conversion of one type to another, alteration of key components, or degradation due to proximity of disturbances, indirectly affect wildlife populations. Indirect impacts on wildlife are often subtle, difficult to document, and may be expressed over the long term. There may be some lag between the time of construction impacts on habitats and the detection of indirect impacts on wildlife populations. In addition to variability over time, indirect impacts on wildlife due to direct impact to habitats may be variable over space so that the expression of impact may occur some distance away from the impact source.

Individuals of some wildlife species may be directly affected by construction of the Project if they are killed by vehicles traveling to and from construction sites. Species most susceptible to vehicle-related mortality include those that are inconspicuous (salamanders, frogs, snakes, small mammals), those with limited mobility (amphibians), burrowing species (mice and voles, weasels, beaver, frogs and toads, snakes, subterranean mollusks), and wildlife with behavioral activity patterns making them vulnerable, such as deer that are more active at dusk and dawn, and wildlife that may scavenge roadside carrion (Leedy 1975; Bennett 1991; Forman and Alexander 1998; Trombulak and Frissel 2000). Direct mortality of species could also occur during right-of-way maintenance operations, such as mowing.

Other species are likely to be displaced from habitats that are cleared of vegetation (passerine birds, and tree-dependent/cavity-dependent birds and mammals such as woodpeckers and bats) and from areas adjacent to construction sites (waterfowl, raptors and medium-sized mammals). Populations may also be negatively affected if individuals emigrate from habitats affected by project-related disturbances. Displacement of mobile wildlife would most likely be a short-term effect. Once construction and restoration of the right-of-way is complete, displaced individuals are expected to return to the original area they occupied. However, if adjacent habitats are at carrying capacity for the species, displaced individuals could be adversely affected by competition for resources, increased susceptibility to predation, or disease that may be facilitated by crowding.

Activities associated with construction of the Pacific Connector Pipeline Project could decrease individuals' reproductive success by increasing neonate or nest abandonment and possibly by interfering with breeding behaviors, sustenance, and growth of fetuses and/or young, conception rates, and fetal survival. These direct impacts may negatively affect population growth through diminished rates of survivorship and fecundity.

Impacts, both long-term and short-term, could occur to amphibians and reptiles associated with waterbodies and the riparian areas. Removal of riparian vegetation along stream edges that are crossed by the Project could increase sedimentation input into the waterbody and/or increase water temperatures. Changes in hydrology could also occur within wetlands and waterbodies used for breeding, limiting dispersal or reducing breeding habitat (ODFW 2006b).

Construction of the pipeline through upland forests would require removal of deciduous and coniferous trees and would remove those habitat features over the long-term. It would take many years for trees to grow to their original size in temporary workspaces in cleared forested areas that are restored and revegetated after construction. Former forested habitats within Pacific Connector's 30-foot-wide operational right-of-way would be converted to shrub-sapling dominated or herbaceous cover for an extended period of time (50 years or more). This conversion could benefit some wildlife species that characteristically inhabit shrub or grassland habitats, but would be detrimental to wildlife species adapted to forest interiors. Construction through forested areas could also result in the removal of snags and LWD that are used by a variety of wildlife, including cavity nesters and bats.

Construction through existing shrub-dominated areas would mostly result in short-term habitat loss. After restoration and revegetation, grasses and shrubs would be allowed to regenerate across the entire right-of-way. There would be longer-term impacts in some areas, where shrubs, such as species of sagebrush, would require longer than 5 years to become reestablished to their former condition and density. Loss of this habitat type could potentially affect certain species of birds and mammals that utilize shrubs, by reducing forage and nesting opportunities.

Noxious Weeds and Invasive Species

Short- or long-term impacts to wildlife habitat could also result if the pipeline causes the establishment and spread of noxious weeds, as well as other invasive species (animals and microbes) not native to a region. In general, habitats with more bare ground, such as grasslands, riparian areas, relatively dry, open forests, and disturbed areas such as roads are more susceptible to invasive species establishment than are dense, moist forests, high mountain areas, and serpentine areas that have relatively closed plant cover or have extreme climate or soils.

Noxious weeds often out-compete native vegetation. They displace native species by spreading rapidly and utilizing resources (nutrients, water, sunlight) that can eventually lead to a weed-dominated monoculture. Such transformed habitat can be unsuitable to former wildlife inhabitants. Often, as habitat quality degenerates, wildlife diversity declines. For example, purple loosestrife forms dense monocultures that inhibit native vegetation, causing decreasing species' diversity, limit water flows and wildlife access to water, and in some instances can make waterfowl nesting areas unsuitable (Whitson 1996).

In addition, weed infestations can create highly flammable fuel loads (Bio-Integral Resource Center, no date). Fires in wildlife habitat can directly kill animals that are not able to flee, and can modify habitat rendering it unsuitable for certain species. For a summary of noxious weed species found along the pipeline route, see table 4.5.1.2-4.

Clearing of vegetation from the linear right-of-way and soil disturbance from right-of-way grading could increase the chance of spreading noxious weeds through the removal of native, established species and soil disturbance, which could encourage the establishment of invasive plants. Equipment moving along the right-of-way could also bring seeds from one place to the next, aiding the spread of these species. Pacific Connector has measures in place to help prevent this as described in the ECRP and POD. Weed surveys would take place prior to vegetation removal, and areas would be pretreated through mowing and herbicide spot treatment. Any infested areas found would be cleared to minimize the spread of invasive plants. Equipment would also be inspected and cleaned of any dirt, plant seeds, and microbes prior to moving to new areas of the pipeline. During restoration, disturbed areas would be revegetated with native seed mixtures. Monitoring would take place to ensure that no non-native plants establish themselves in lands disturbed by pipeline activities. Due to measures that would be employed before, during, and after construction, the risk of the pipeline causing noxious weeds to spread in the area of the pipeline should be low.

Pacific Connector would mitigate for the spread of noxious weeds, forest pathogens, and soil pests by following the measures outlined in its *Integrated Pest Management Plan*.[91] Further measures for controlling the spread of noxious weeds are contained in its ECRP. See section 4.5.1.2 for more details on invasive plants and mitigation measures.

Invasive insects, mites (e.g., spruce spider mite), and terrestrial mollusks (e.g., the predatory spotted leopard slug) can similarly disperse along a newly created corridor where native

[91] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC.

vegetation formerly presented barriers to dispersion. In general, invasive exotic wildlife species can adversely affect native species and their populations through various pathways, singly or in combination that include:

- introduction of disease or parasites to native wildlife;
- interbreeding (hybridization) with native wildlife;
- competition for habitat with native wildlife;
- degradation of habitat of native wildlife; and/or
- predation on native wildlife.

Measures outlined in the *Integrated Pest Management Plan* would help decrease impacts of invasive insects.

Invasive animals such as introduced bullfrogs have adversely affected various native frog populations through predation (Hayes and Jennings 1986), including populations of Oregon spotted frogs in Washington (Watson et al. 2000). Bullfrogs prey on and out-compete native frog species. They spread very quickly due to their prolific nature, lack of predators, ability to travel long distances over dry land, and wide habitat and diet preferences. Pacific Connector has developed BMPs to avoid the potential spread of the aquatic invasive species and pathogens of concern during Project hydrostatic testing operations (see the *Hydrostatic Testing Plan*[92]).

The range of the barred owl has expanded and this species competes with NSO for prey resources. Barred owl expansions have made headway into NSO habitat due to fire suppression allowing more trees to grow in the northern Great Plains, enabling the owls to cross over from the eastern United States into NSO range on the west coast. More aggressive than NSOs, they are able to out-compete the threatened species (Livezey et al. 2007). Impacts on NSO from barred owl expansion are further discussed in section 4.7.

Herbicides

Herbicides could affect native plant species, thereby affecting wildlife habitat and potentially the animals themselves. While adverse effects to wildlife tend to be low, some symptoms include breakdown of vital organs, reduction in numbers of healthy offspring, decreased fitness, and direct mortality (Forest Service 2005b). Amphibians can be deformed or killed by some herbicides if these chemicals get into the water. Herbicides tend to form residue on grasses more readily than other vegetation; therefore, wildlife that eats grass, as well as those species above them on the food chain, tend to be most susceptible to the effects of herbicides (Forest Service 2005b).

Currently, according to the Pacific Northwest Weed Management Handbook (Peachey et al. 2007), all herbicides used in forests to control brush and weed-trees include one of the following: 2,4-D, glyphosate, imazapyr, picloram, ticlopyr, and clopyralid, described below.

2,4-D is moderately toxic to animals but depends on species and formulations. For example, dogs are more sensitive to 2,4-D organic acids than rats and humans and dogs have developed malignant lymphomas when exposed to 2,4-D applications. 2,4-D does bio-accumulate, though general risk to browsing wildlife is considered low (Tu et al. 2001).

[92] See Appendix M to the POD, which was included in Pacific Connector's application to the FERC.

Glyphosate is of low toxicity to animals and birds. There appears to be relatively little bioaccumulation. Toxicity of glyphosate-based pesticides to amphibians varies with developmental stage because there is some evidence that some formulations may interfere with metamorphosis (Howe et al. 2004).

Similarly, imazapyr is of relatively low toxicity to birds and mammals and appears to be rapidly excreted in urine and feces with no residues accumulating in viscera, muscle, fat, or blood. Imazapyr has not caused mutations or birth defects in animals (Tu et al. 2001). Adverse effects to terrestrial and aquatic animals appear to be unlikely (Durkin and Follansbee 2004).

Picloram has long-term persistence in the environment, and chronic exposure of wildlife is of concern. Picloram is water soluble and thus highly mobile. Studies on mice found effects to offspring of adults that had ingested the herbicide, including death, low birth weights, and birth defects (Cox 1998a).

Triclopyr is only slightly toxic to birds and mammals although sub-lethal doses applied for 29 days in diets of forest songbirds caused weight loss and behavioral changes (Tu et al. 2001). A study of three species of frogs in Ontario, Canada, found that low concentrations of triclopyr butoxyethyl ester inhibited their avoidance behavior. Researchers concluded that exposure to 1.2 ppm of triclopyr is likely to paralyze the more sensitive tadpoles (Cox 2000). A metabolite of triclopyr, 3,56-trichlorol-2-pyridinol, is toxic to animals (Forest Service 2005b).

Clopyralid is relatively non-toxic to fish, birds, mammals, and other animals, although it does not degrade rapidly (soil half-life of 40 days). Consequently, herbivores consuming clopyralid may accumulate residues in their livers and kidneys (Tu et al. 2001). One study found that weights of rabbit fetuses decreased at both low and high doses of clopyralid. Skeletal abnormalities were also observed in these fetuses at all doses and at the highest dose, accumulation of excess fluid around the brain was evident, which resulted in small brains and enlarged skulls (Cox 1998b). Information is absent on adverse effects to terrestrial mollusks for the range of herbicides discussed.

In accordance with Pacific Connector's ECRP, only specific spots would be treated with herbicides to control noxious weeds, with landowner approval. Because the previously mentioned herbicides are generally of low toxicity to animals, direct adverse effects to wildlife from applied herbicides along the pipeline route or adjacent to aboveground facilities should be low, especially if applied according to directions on labels.

Noise

Noise from construction and operation of the Pacific Connector Pipeline Project is discussed in detail in section 4.12.2.2 of this EIS. We estimate that noise from general construction of the pipeline could range from the L_{eq} of about 93 dBA at 50 feet, to 85 dBA at 100 feet, and 72 dBA at 300 feet. Ambient sound levels in much of the Pacific Connector pipeline route area probably would be similar to the Arcata Fish and Wildlife Office's projections (FWS 2006a). Ambient sound is defined as the sound qualities as they might exist currently and might include human-generated sources over the long term. The typical ambient sound level for forest habitats ranges from 25 dB to 44 dB. Considering ambient sound as a base, noise levels associated with some common machines and activities that would be present during pipeline construction are included in table 4.6.1.2-11. Noise from HDD drilling would range from L_{dn}[93] of about 34 to 79 dBA at the nearest NSAs. This compares to current ambient L_{dn} levels at these residences ranging from about 42 to 66 dBA. Double rotor helicopters may be used for timber clearing along a portion (26 miles) of the Pacific Connector pipeline route. This type of helicopter generates noise of about 92 dBA within 700 feet of its area of use. Operation of the Klamath Compressor Station would result in estimated L_{dn} noise of about 56 dBA at an NSA located about 1,000 feet away. Current ambient noise at this residence is an L_{dn} level of about 43 dBA.

TABLE 4.6.1.2-11

Common Sound Levels for Equipment/Activities Potentially Associated with the Pacific Connector Pipeline

Measured Sound Source	Range of Reported dB Values (at Distance Measured 50 feet)	Relative Sound Level a/
Forest Habitats	25 – 44	Ambient
Yelling	70	Low
Chain Saw (various types/conditions)	61 – 93	Low – Very High
Pickup Truck (idle to driving)	55 – 71	Very Low – Moderate
Mowers	68 – 85	Low – High
Log Truck	77 – 97	Moderate - Very High
Dump Truck	84 – 98	High - Very High
Rock Drills	82 – 98	High - Very High
Pumps, Generators, Compressors	87	High
Drill Rig	88	High
General Construction	84 – 96	High – Very High
Track Hoe	91 – 106	Very High – Extreme
Helicopter or Airplane (various types/conditions)	96 – 112	Very High – Extreme
Rock Blast	112 b/	Extreme
Logging Helicopter (Columbia double rotor)	108 – 123	Extreme

Source: FWS (2006a)
a/ A general, subjective ranking of noise levels created by the sources considered when used for analysis of relative noise effects on species.
b/ Blasting required for the Pacific Connector pipeline would be underground and muffled, which should result in a lower dB value at 50 feet.

Noise could potentially impact wildlife for a short duration during pipeline construction activities, including clearing and grading the right-of-way, and HDD operations. The average time a given point along the pipeline would be disturbed by construction noise is approximately 8 weeks. This would vary, as the speed at which crew would be able to work would be affected by terrain, construction methods, weather, and environmental windows. Some portions of HDD operations would occur as 12-hour work shifts, while other activities would normally occur as 24-hour-per-day operations. The overall duration of HDD operations should last from 2 to 4 weeks at each site.

Distances at which noise would attenuate to ambient levels would depend on local conditions such as tree cover and density, topography, weather (humidity), and wind, all of which can alter background noise conditions. Consequently, short-term impacts on wildlife by construction noise would vary along the length of the pipeline route.

Noise would most likely displace wildlife some distance away from noise sources especially if wildlife species are nearby. However, any short-term effects to wildlife by noise would occur

[93] $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $L_{eq(24)}$ with 10 dBA added to the nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for the greater sensitivity of people to sound during the nighttime hours.

simultaneously with human presence and the presence of heavy machinery normally required for pipeline construction. Most likely, any impacts to wildlife due to noise could not be separated from those due to all other construction-related activities occurring concurrently. Noise and human presence would move along the construction right-of-way, albeit at a rather slow pace. Therefore, impacts to wildlife because of noise would be of short duration and spatially localized.

Research has demonstrated varying short-term reactions of wildlife to noise. Most research has focused on wildlife reaction to more constant noise generated by roads and high-volume traffic (e.g., Forman and Alexander 1998). However, some research has recorded wildlife reaction to airplanes, sonic booms, helicopters, artillery, and blasting that could produce similar reactions from noises associated with construction activities for the Pacific Connector Pipeline Project.

Golden et al. (1980) provided the following behavioral and physiological reactions of animals to known noise levels ranging between 75 and 105 dB from various disturbances, including aircraft:

- fish demonstrate reduced viability, survival, and/or growth (20 dB for 11 to 12 days);
- ungulates become nervous and/or run (82 to 95 dB) or panic (95 to 105 dB);
- waterfowl flock (80 to 85 dB), move and/or become nervous (85 to 95 dB), or startle (95 to 105 dB); and
- birds scare (85 dB).

Raptors and other forest-dwelling bird species have demonstrated more adverse impacts to project-generated sound during nesting and breeding when levels substantially exceed ambient conditions existing prior to a project (i.e., by 20 to 25 dB experienced by the animal) and when the total sound level is very high and exceeds 90 dB. Such impact could potentially result in egg failure or reduced juvenile survival, malnutrition or starvation of the young, or reducing the growth or likelihood of survival of young. However, these effects may be minimal; Awbrey and Bowles (1990) found that raptors flushed from their nests while incubating did not leave the eggs exposed for more than 10 minutes and concluded that multiple, closely spaced disturbances would be required to cause lethal egg exposure. Some raptors, for example osprey, refuse to be flushed from their nest despite closely approaching helicopters (Poole 1989).

Specific studies to determine impacts to wildlife from noise generated from construction of a pipeline have not been conducted. However, it is expected that construction noise in remote areas that are relatively free from noise would have a greater potential to disrupt wildlife. Potential impact to wildlife from some noises generated from construction activities can be evaluated to an extent, such as noise from vehicles and/or increased road traffic, blasting, helicopter timber harvest or pipeline delivery, and aerial fly-overs.

Animals could flee the area because of helicopter disturbance. In the case of birds, this could cause eggs to be left unincubated. For all animals, this disturbance could have negative energetic effects. Mitigation for helicopter noise includes operational restrictions, such as maintaining a high altitude and flight paths away from noise sensitive areas whenever possible. A lengthy discussion on helicopter noise effects to MAMU and NSO is provided in our BA (FERC 2015).

The DOT (2004) has summarized numerous studies and literature that have reported the effects of noise on wildlife, specifically focusing on impacts from roads. Overall, existing information suggests that fish are unlikely to be adversely affected by noise levels produced from road traffic; reptiles and amphibians show some barrier effect due to roads (but no clear evidence of a noise effect alone); bird numbers and breeding can be strongly affected by the proximity of roads; large mammals can be repelled by road/vehicle noise; and small mammals do not appear to be adversely affected by road noise.

Blasting may be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs within the trench profile. Approximately 100 miles of the pipeline alignment is considered to have high blasting potential, although not all substrate within those areas identified may require blasting to achieve the required trench depth. Blasting activities may involve a single blast or a repetitive blasting sequence. Blasting during trench excavation is discussed in more detail in section 4.2.2.5.

Noise from blasting would be short term and localized. The noise associated with blasting activities is reported to be in the range of 112 dB within 50 feet of the trench (see table 4.6.1.2-11), and may cause alarm in wildlife such as mule deer. However, noise from blasting for this Project would be mitigated and expected to generate lower decibel levels, because charges would be underground and muffled with blasting mats. In comments on the DEIS, ODFW recommended the use of blasting mats whenever explosives are required; Pacific Connector is proposing to use blasting mats. We conclude that noise from blasting would not have significant adverse effects on wildlife and would not cause population-level impacts that may alter foraging or breeding behavior over the long term.

In 2005, a study was conducted during a 4,000-foot HDD crossing of the Nooksack River crossing in Whatcom County, Washington, to determine if drilling noise associated with the HDD (noise levels between 47 and 52 dBA at the study area) had a negative impact on wintering bald eagles. Eagles were observed from November 1, 2005, through April 7, 2006, and results indicated that bald eagles were not negatively affected by HDD rig activity (Edge Environmental, Inc. 2006).

Pacific Connector proposes to cross the Coos, South Umpqua, Rogue, and Klamath Rivers using HDD technology. Noise studies conducted for the HDD of each proposed crossing determined that, with the use of mitigation measures (such as special vinyl fabric acoustic tents or other barriers), noise levels at the four crossings are not expected to exceed current ambient noise levels. With mitigation, noise levels associated with the drilling equipment at each site are not expected to exceed the Oregon State noise regulations of 55 dBA during the day and 50 dBA at night within 25 feet of a residence. To ensure adequate mitigation and monitoring, we are recommending Pacific Connector file HDD noise mitigation plans for review and approval prior to construction (see section 4.12.2.4). Noise impacts on wildlife from the operation of the drilling equipment from the HDD crossings at Coos, South Umpqua, Rogue, and Klamath Rivers should be negligible.

A minimal increase in ambient noise levels would occur during periodic right-of-way vegetation maintenance activities (i.e., mowing, chainsaws) during operation. The major source of operational noise for the Project would be from the Klamath Compressor Station, which is located in an area surrounded by rural residences, agricultural lands, and rangelands and grasslands. Noise from the compressor station would be long term, but localized to one site. The expected increase in L_{dn} noise levels would range from 2.1 dBA to 16 dBA above current ambient noise at the nearby NSAs during normal station operations. In terms of environmental noise impacts, an increase to the ambient sound level of 10 dBA typically results in the perception of a doubling of sound. Consequently, the Klamath Compressor Station would have noise impacts on the surrounding NSAs because of the very quiet existing ambient conditions. With appropriate mitigation measures, we expect the compressor station to operate below our standard of 55 dBA at all but the closest NSA, for which we have recommended additional monitoring and mitigation measures (see section 4.12.2.4). This sound level could have localized adverse effects on wildlife near the station.

Habitat Fragmentation and Edge

One manifestation of fragmentation is the amount of edge created through otherwise contiguous habitats. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "near its perimeter, where influences of the surroundings prevent development of interior environmental conditions" (Forman 1995:38). As compared to interior habitats, edge habitats generally support different species composition, structure, and species' abundance. For example, vertebrate species richness (bird and amphibian) has been positively associated with edges in fragmented Douglas-fir forests (Rosenberg and Raphael 1986), although species benefitted are typically habitat generalists.

Along with the creation of edge, pipeline construction would further fragment habitat. Habitat fragmentation has already occurred to some extent in the areas crossed by the pipeline route because of existing residential developments, tree harvests, roads, and utility corridors. These sources of habitat fragmentation are expected to increase in the foreseeable future outside of protected areas such as LSRs. Fragmentation can also affect the rate and scope of blowdowns in forested habitats (the effects of blowdowns are discussed in more detail within section 4.5).

Because the pipeline is linear, the created patch associated with the new edge would be narrow and elongated unlike edges created by forest practices (Forman and Gordon 1986). Creation of edges by the Project would affect seral stands differently. Douglas-fir or western hemlock would be replanted during restoration of temporary work areas, including TEWAs, within the pipeline right-of-way (except in the 30-foot wide maintenance corridor centered on the pipe), where conifers would be removed during construction activities. If 12-inch-tall Douglas-firs and western hemlocks are replanted during restoration and they are not harvested later, trees of both species could be about 70 feet tall in 50 years at the end of the Project life. Permanent impacts to forested habitats would include about 154 acres of LSOG forests, at least 169 acres of mid-seral forests, and 223 acres of clearcut/regenerating forests, because replanting on non-federal lands is dependent on landowner approval (see table 4.6.1.2-3).

Douglas-fir and western hemlock planted adjacent to edges of clearcut and/or early regenerating stands (assuming conifers from 1 to 10 feet tall at the time of construction) would modify edges with the seral stands from hard to soft to no edge as they grow. In 50 years, which is the operational life of the Project, trees replanted in temporary workspaces outside of the 30-foot maintenance corridor would similarly modify edges of regenerating and mid-seral stands adjacent to the right-of-way, from hard to soft edge characteristics as tree heights increase. As the replanted trees grow, edge contrasts would decrease, as would effects on forest interiors, because taller trees would reduce direct solar radiation and increase soil moisture and humidity along the edges of stand interiors (Chen et al. 1993; Heithecker and Halpern 2007).

Different species composition and abundance occurs in edge habitats (Forman and Gordon 1986) than within patch interiors, depending on species' tolerances for the variation in microclimatic parameters. Some terrestrial amphibians, for example, have narrow temperature and moisture tolerances (Spotila 1972; Feder 1983). Moist, cool, and stable microclimatic conditions are essential to these species. Loss of canopy cover and coarse woody debris can affect amphibians' microclimatic conditions. Some wildlife species use right-of-way corridors created by pipelines and other linear utilities. For example, bird species' diversity in powerline corridors through forested vegetation was found to be higher in the corridor than within the adjacent forest (Kroodsma 1984). Often present along the edge are higher levels of flower and fruit production, pollinator, and frugivore densities and seed dispersal. Also, deer and elk use of available browse within corridors or on edges of corridors that are adjacent to hiding and thermal cover have been documented (Hartley et al. 1984; Brusnyk and Westworth 1985).

Few studies have evaluated the establishment of forage within pipeline corridors and utilization by big game. The study conducted in Alberta by Brusnyk and Westworth (1985) focused on forage and browse production on a 17-year-old pipeline right-of-way and on a 2-year-old right-of-way. They compared big game use (moose, deer, and elk) of forage on the two rights-of-way to use in adjacent undisturbed forest ecotones and undisturbed forest. Deer appeared to utilize browse in the 17-year-old corridor but returned to adjacent undisturbed forest, probably utilizing available hiding or thermal cover. Deer utilized the corridors for travel in early winter prior to limiting snow depths. Elk utilized forage on the two-year-old right-of-way primarily where portions were adjacent to forested habitats. The principal conclusion of this study was that pipeline corridors increased local habitat diversity and that diversity—juxtapositions of browse or forage to undisturbed forested habitat—influenced use of the corridors by ungulates, not necessarily due to increased vegetative production, per se, within pipeline rights-of-way.

Increased herbivore density provides a food source for predators (Forman 1995), so predator density can be increased along the edge. With heavy browsing at the edge, wind can penetrate further into the woods, effectively widening the edge; however, vegetation management within corridors can decrease bird densities (de Waal Malefyt 1984) and rabbit and deer densities (Hartley et al. 1984), depending on whether maintenance involves mowing or application of herbicides. Similar impacts are expected during maintenance operations, primarily by mowing or hand cutting Pacific Connector's right-of-way. Pacific Connector's operations would typically use mechanical methods or where access of machinery is infeasible then manual clearing is used to maintain the existing right-of-way, and herbicides are only used where necessary to control some noxious weeds.

During right-of-way restoration, Pacific Connector would create habitat diversity features within the right-of-way corridor, such as rock and brush piles, that would provide habitat for a variety of wildlife species including mollusks, amphibians, and small mammals. Such features reduce fragmentation effects of abrupt edge characteristics by creating local irregularities. LWD placed within and/or across the right-of-way may eventually contribute to microsite diversification and provide corridors for some wildlife (e.g., terrestrial mollusks) to travel across an otherwise potential barrier. Such movements would be essential to avoid potential genetic isolation of relatively non-mobile species.

4.6.1.3 Wildlife on Federal Lands

Wildlife species present on federal lands crossed by the Project would be similar to those discussed for all land ownerships above in section 4.6.1.2, including mammals, birds, amphibians, reptiles, and invertebrates. Wildlife on federal lands is managed under a variety of directives. Species managed on federal lands include NWFP S&M species, BLM and Forest

Service sensitive species, and federally threatened, endangered, and proposed species. The presence of and impacts to these species on federal lands are discussed in section 4.7.

The Forest Service additionally identifies MIS, which include wildlife monitored during forest plan implementation to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent (FSM 2620.5). On the Umpqua National Forest, MIS include NSO, pileated woodpecker, primary cavity excavators (nesters), pine marten, Roosevelt elk, Columbian black-tail deer, peregrine falcon, bald eagle, and steelhead (water quality indicator). On the Rogue River National Forest, MIS species include Columbian black-tailed deer, Roosevelt elk, pine marten, NSO, pileated woodpecker, and primary cavity excavators (nesters). On the Winema National Forest, MIS include NSO, pileated woodpecker, northern goshawk, three-toed woodpecker or black-backed woodpecker, bald eagle, mule deer, resident trout, and pine marten. Potential effects of the Project on MIS, and by association wildlife with similar habitat needs, are assessed in the MIS Report (appendix M of this EIS). Additionally, impacts to some of these species (Roosevelt elk, Columbian black-tailed deer, peregrine falcons, northern goshawks, mule deer, and bald eagles), including impacts on federal lands, are discussed above in section 4.6.1.2.

Fifteen of the 16 wildlife habitats crossed by the Project as a whole are crossed on federal lands; only the wildlife habitat “Bays and Estuaries” is not affected on federal lands. Wildlife species’ associations with these habitats provide a basis for evaluating Project effects on wildlife. The acreage of each wildlife habitat affected on federal land during construction, and the number of herpetofauna (i.e., amphibians and reptiles), birds, and mammals associated with those habitats are shown below in table 4.6.1.3-1. Agriculture and Westside Riparian-Wetlands/Eastside Riparian-Wetlands have the highest number of associated species (282 and 268, respectively), but have very few acres affected. Southwest Oregon Mixed Conifer-Hardwood Forest has the most species associated of forest types (224) and has a substantial number of acres affected.

TABLE 4.6.1.3-1

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O’Neal (2001) Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	157	83	126	367	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	26	14	67	107	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	374	93	130	597	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	44	9	23	76	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	35	1	0	37	32 - Herpetofauna 113 – Birds 62 – Mammals

TABLE 4.6.1.3-1

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
	Western Juniper and Mountain Mahogany Woodlands	0	3	0	3	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**637**	**204**	**346**	**1,186**	
Grasslands Shrubland	Shrub-steppe	–	–	–	68	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	–	–	–	20	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	–	–	–	2	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	–	–	–	**90**	–
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	<1	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	–	–	–	1	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	–	–	–	**2**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	1	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	–	–	–	**1**	
Developed/ Altered	Urban and Mixed Environs	–	–	–	29	37 – Herpetofauna 131 – Birds 63 – Mammals
	Roads	–	–	–	81	N/A
	Subtotal	–	–	–	**110**	
Barren	Coastal Dunes and Beaches	–	–	–	2	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	–	–	–	**2**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	2	17 – Herpetofauna 94 – Birds 20 – Mammals
	Subtotal	–	–	–	**2**	
	Project Total	**637**	**204**	**346**	**1,392**	

Note: Rows and columns may not sum correctly due to rounding. Acreages rounded to nearest whole acre; values less than 1 acre shown as "<1".
a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
d/ Numbers of species associated with each habitat type crossed by the Pacific Connector pipeline were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.
e/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage, thus acres are identified only in the "total acres" column.

Additionally, ODFW habitat categories affected by the Project on non-federal and federal lands are shown in section 4.6.1.2, table 4.6.1.2-4 above. These values provide context for the quality of wildlife habitat affected by the Project both within and outside federal lands.

Impacts on wildlife would be similar on federal lands to those discussed for all land ownerships above in section 4.6.1.2, including direct mortality to individuals unable to move away from construction equipment, noise and visual disturbance during construction, and habitat loss and modification. Less mobile wildlife species that are not able to move away from construction activities during clearing and site preparation could experience direct mortality. More mobile species would likely be displaced from the site during active construction. Wildlife in the vicinity of the Project could also be disturbed by construction activities and noise, and may move away from the construction site. However, the primary impact to wildlife from construction and operation of the Project would be habitat loss.

The discussion of impacts on big game in section 4.6.1.2 under Harvested Wildlife includes impacts to big game on federal lands. Table 4.6.1.2-9 lists the miles of designated big game winter range crossed by the Project within and outside federal lands, and table 4.6.1.2-10 lists the acres of habitat types within big game winter ranges affected by Project construction and operation within and outside federal lands.

Seasonal road closures on public lands have been applied to big-game winter range within BLM and NFS lands to minimize the effect of winter stress on deer and elk. Additionally, the BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. The following are recommended seasonal closures for big game winter range: November 15 to April 1 (BLM), December 1 to April 30 (Forest Service), and December 1 to March 31 (private and state). Pacific Connector notes that the numerous seasonal restrictions to protect applicable species pursuant to the ESA and the MBTA will require timber-clearing activities to be conducted outside nesting seasons during the spring and summer months. Therefore, Pacific Connector will be required to complete timber-clearing activities during recommended seasonal closures for big game winter range and appropriate waivers for recommended seasonal big game closures will be necessary.

Impacts to wildlife associated with habitats available in LSRs and Riparian Reserves would be generally similar to those described above wherein direct impact could occur during clearing and pipeline construction if individuals are killed, injured, and/or displaced to other locations where possible mortality increases and/or fecundity decreases. Direct impact to late-successional and riparian habitat (removal and/or conversion to different vegetation) may indirectly affect wildlife by decreasing the amount of habitat locally available and decreasing the effectiveness of adjacent habitats in providing life-requisite functions for wildlife. That impact would not be able to be mitigated on-site and is assumed to persist through the long term, although impact would be offset by the actions listed in the *Compensatory Mitigation Plan* (appendix F-1). Impacts to species inhabiting other, non-forested habitats within the affected areas in LSRs, Riparian Reserves and the Matrix would be similarly affected, although the amount of time required to restore affected habitats would be shorter. Impacts on federal lands and resources from the Project are addressed fully in section 4.1, including potential impacts to LSRs and Riparian Reserves.

Loss of snags is expected to be a long-term impact. Estimates of snag density (numbers per acre) that would be affected within the construction right-of-way and TEWAs were made on each of the three National Forests in the project area during timber reconnaissance conducted in 2007 (Chapman 2007). Estimates of snag density by size class (inches dbh) and decay class (hard or soft) are provided in table 4.6.1.3-2. Within the areas affected by construction, conifer snags less than 13 inches dbh are generally most dense on each forest, although there are numerous hardwood snags in that size category on the Rogue River National Forest. Most of the smaller snags (less than 13 inches dbh) were observed as hard wood, rather than softened due to decay.

TABLE 4.6.1.3-2

Snag Density Estimates on NFS Lands

National Forest	Tree Type	Decay Class	Estimates of Snag Density (Number per Acre) by Size Category (inches dbh) <13	13-24	25-36	>36
Umpqua	conifer	Hard	5	<1	1	0
		Soft	<1	<1	<1	<1
Rogue River	conifer	Hard	1	<1	<1	<1
		Soft	0	1	<1	0
	hardwood	Hard	2	0	0	0
		Soft	0	<1	0	0
Winema	conifer	Hard	3	<1	<1	0
		Soft	0	<1	<1	0

Because no other portions of the pipeline route have been similarly examined, there is no information to suggest that snag density on National Forests is similar to snag densities on lands under different management and ownership. Nevertheless, loss of snags regardless of decay class is expected to be a long-term impact because recruitment of new snags within the affected areas would take much longer than five years.

4.6.2 Aquatic Resources

4.6.2.1 Waterway for LNG Vessel Traffic

The waterway for LNG vessel traffic to Jordan Cove's terminal contains a diverse collection of anadromous, estuarine, and marine organisms and associated habitats. The marine environment along the transit route outside of Coos Bay consists of varied habitats used by aquatic organisms including commercial and recreational fish and shellfish such as salmon, crabs, shrimp, and marine mammals including whales, seals, and California sea lions. This habitat includes gently sloping nearshore intertidal and subtidal sand area near the Coos Bay mouth and rocky shoreline to the south. Habitats near the mouth of the bay range from sand beaches to rocky shorelines. Offshore, deeper soft bottom habitats extend over 100 feet deep with main pelagic surface water along the ship transit route.

The Coos Bay estuary is described in section 4.4.2.1. Several freshwater streams and sloughs enter the bay, so that its habitats range from marine to estuarine. The bay contains shellfish resources, as well as marine fish. It is a migration corridor for salmon and steelhead that spawn and rear in the streams that drain into Coos Bay. The bay along the transit route for LNG vessel marine traffic contains mostly sloping beaches with algae and eelgrass beds that supply important habitat for the estuarine organisms. A total of over 14,000 acres of habitat is present in Coos Bay, including some 1,400 acres of eelgrass beds.

Many fish and shellfish species are common within the waterway leading to the Jordan Cove LNG terminal (see appendix O, table O-1). Most of these aquatic species are briefly mentioned below, and are discussed in more detail in our EFH Assessment attached with our BA (FERC 2015), submitted to the NMFS concurrently with the issuance of the DEIS.

Marine Fish

Species of groundfish, pelagic, anadromous, and marine species would be present in the waterway for LNG vessel traffic to the terminal, in the nearshore and marine waters outside of the Coos Bay estuary. This includes a variety of rockfish, flatfish, shark, skates, sturgeon, sablefish, cod, and migratory fish such as anchovy and sardine and in the outer regions may rarely include some highly migratory species such as thresher shark and tuna.

Marine fish communities within Coos Bay consist of species found in estuarine and marine waters. Their distribution and abundance varies with physical factors such as bottom conditions, slope, current, salinity, and temperature, as well as season, which can affect migration and spawning timing. Some of the more commonly abundant fish include Pacific herring, and the non-native American shad. Most fish species are migratory or seasonal, spending only part of their life in these waters. Other common seasonal marine fish species include surfperch, lingcod, rock greenling, sculpin, surf smelt, Pacific herring, English sole, black rockfish, northern anchovy, eulachon, longfin smelt, Pacific tomcod, sandsole, and topsmelt. California halibut is also present in the bay near Jordan Cove. A few common species like kelp greenling and starry flounder reside in the bay year-round. The bay from just beyond the LNG terminal site to its mouth is a prime feeding area for many local and seasonal fish species.

Fish abundance varies with salinity. Near NCM 1.5, the sloughs are mostly of high salinity, while farther up the bay, near NCM 15.5, sloughs are generally brackish, of lower salinity. Toward the mouth of the bay, the salinity is higher, especially in the summer, which is when the number of fish increase.

Anadromous Fish

A common group of anadromous fish species found in the waterway for LNG vessel traffic to the terminal includes Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, white and green sturgeon, and American shad. Anadromous is a term describing fish that return from the ocean to the rivers where they were born in order to spawn. Adult anadromous fish spend a portion of their adult life in the ocean; the amount of time varies among the species. Sexually mature adults migrate or "run" from the ocean and estuaries upstream to fresh water streams to spawn in shallow gravel stretches. The fertilized eggs drop into the intergravel spaces. Hatched fry remain in these spaces for a time and then emerge to occupy rearing areas of quiet waters, usually pools or backwaters. After a period of time, which varies with the species, juveniles migrate downstream to estuaries typically late winter to summer depending on race and species. There they undergo smolting (physiological maturation to adjust from fresh to salt water) before entering marine waters as juveniles. They typically rear in the ocean for one to five years before returning as adults to their natal streams to spawn. Salmon typically return to streams in late summer through fall. Steelhead and sea-run cutthroat trout may return to streams in the summer, fall, winter, or spring depending on species and race. Salmon species die after spawning but some steelhead and anadromous coastal cutthroat survive to return to the ocean, and can spawn again. Steelhead typically remain in freshwater streams after emergence for two to three years before migrating to the ocean, with adults returning to spawn in their fourth or fifth year. Sea-run cutthroat usually remain in fresh water for two to four years before smolting and migrating to saltwater, usually staying in the estuaries or near shore (Behnke 1992).

There are eight species of coldwater anadromous fisheries in the project area: Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, and green sturgeon. The Oregon Coastal Coho Salmon Evolutionarily Significant Unit (ESU) is present in the project area and is listed under the ESA. The North American Green Sturgeon – Southern Distinct Population Segment (DPS), which is listed as Threatened under the ESA, may be present or migrate through Coos Bay. The Project effects to the listed species are discussed in section 4.7.

Shellfish

A large and diverse population of benthic and epibenthic invertebrates is present beyond the entrance to Coos Bay. Clams, crabs, oysters, and shrimp make up important components of these invertebrates in the bay. Some of the most abundant and commercially important of these species include bentnose clams, Pacific oyster (which is grown commercially), Dungeness crab, and ghost shrimp. Distribution varies along the route from the LNG terminal to the bay mouth. Principal subtidal clam beds are found in the lower bay and South Slough. Clam Island, located at the mouth of Coos Bay, has an abundance of recreationally important clams. Some of the highest recreational harvest of clams and crabs occurs at the mouth of Coos Bay. Razor clams are an important commercial and recreational species. Within Jordan Cove, ghost shrimp, a commonly harvested bait shrimp, are found in the fine sediment and eel grass beds. Mud shrimp are also harvested in this region.

Coos Bay contains one of only three known native Oregon coastal populations of the Olympia oyster. Within its native range, this species has significantly diminished from historical levels (National Fish and Wildlife Federation et al. 2010). Efforts have been taken in the bay to restore this species and improvements in bay water quality and sediment have resulted in self-sustaining populations over the last two decades (Groth and Rumrill 2009; Rumrill 2007). A pilot restoration project began in 2010 that resulted in stocking 4 million juvenile Olympic oysters in South Slough. Because of its low abundance and efforts to improve the quality of the Coos Bay environment and its survival, the Olympia oyster is not harvested.

Status of Fish in the Project Area

The status of federally listed fish species and other commercial fish species that are managed under the MSA is presented in our EFH Assessment attached with our BA (FERC 2015), submitted to the NMFS concurrently with the issuance of the DEIS; this information is summarized in section 4.7 and in the EFH sections below.

ODFW has evaluated the status of salmon and steelhead, trout, and other selected species of interest. The status, or risk, is based on the threat to the conservation of a unique group of populations in the near term (5 to 10 years). The criteria used for evaluating the status of these species included consideration of six varied factors including: as status of existing population, habitat use, abundance, productivity, reproductive independence and hybridization. The details of the methods are presented in ODFW (2005).

ODFW used these factors to determine the status of what they designate Species Management Units (SMUs). SMUs are groups of populations from a common geographic area with similar genetic and life history characteristics. ODFW classified each SMU into one of five status categories: (1) not at risk, (2) potentially at risk, (3) at risk, (4) extinct, and (5) not assessed. This rating system was only directly applied to the SMUs, not individual populations. The Coos River system has populations in 10 SMUs. Of these, three of the SMUs were rated as "not at risk," one "potentially at risk," four "at risk," and two "not assessed." Two of the four SMUs rated "at risk" (spring Chinook and chum salmon) are actually extinct within the Coos basin. The species and SMU ratings of the Coos River system populations are:

- coastal spring Chinook salmon – At Risk (extinct in the Coos River system);
- coastal chum salmon – At Risk (extinct in the Coos River system);
- Pacific lamprey – At Risk;
- coastal winter steelhead – Potentially at Risk;
- coastal cutthroat trout – Not at Risk;
- coastal coho salmon – Not at Risk;
- coastal fall Chinook salmon – Not at Risk;
- western brook lamprey – Not Assessed;
- southern green sturgeon – Not Assessed; and
- white sturgeon – Not Assessed.

Marine Mammals

Thirty-seven species of marine mammals occur in Oregon, including 7 species of baleen whales, 7 species of toothed whales, 17 species of dolphins and porpoises, 5 species of pinnipeds (seals and sea lions), and sea otters (NMFS 2008).

Steller sea lions, California sea lions, northern elephant seals, and Pacific harbor seals use haulout sites in the vicinity at Cape Arago, Three Arch Rocks, and Shell Island, along the southwest Oregon Coast. Eight species of whales are federally and state-listed. All marine mammals are protected under the MMPA and were included in Jordan Cove and Pacific Connector's IHA application to NMFS on October 8, 2014 (Jordan Cove and Pacific Connector 2014). Threatened and endangered marine mammals are discussed in more detail in section 4.7.

Sea Turtles

Four species of sea turtles have been documented off the coast of Oregon: the green, olive ridley, leatherback, and loggerhead sea turtles. Sea turtles potentially occurring in the transit route are protected under the ESA and are discussed in detail in section 4.7.

Operational Impacts and Mitigation Measures To Be Implemented Along the Waterway for LNG Vessel Transit

<u>Vessel Strikes</u>

Jordan Cove anticipates that as many as 90 LNG vessels each year would use the waterway to reach its terminal. In addition, in accordance with the WSR and LOR, there must be three tugboats and additional security ships that assist each LNG vessel in transit along the Coos Bay navigation channel. These vessels have the potential to strike aquatic species, including sea turtles and marine mammals, and seabirds and shorebirds during their transit to and from the Jordan Cove terminal.

In the open ocean prior to entering the Coos Bay navigation channel, it is estimated that LNG vessels would travel at speeds of about 12 knots. Jordan Cove has proposed to provide measures supplied by NMFS to minimize potential ship strikes to cetaceans, and possibly other listed (sea turtles) and non-listed marine species by LNG vessels in a *Ship-Strike Reduction Plan*. Jordan Cove would provide operators of LNG vessels that would visit the terminal with copies of this plan for avoidance of marine mammals or sea turtles while in transit at sea. Some of the suggested measures could include the following:

- train LNG vessel crews to watch out for and avoid marine mammals and sea turtles;
- keep on board vessels copies of marine species reference guides, such as *Marine Mammals of the Pacific Northwest, including Oregon, Washington, British Columbia and South Alaska* by Pieter Folkens (2001);
- request LNG vessels to establish navigation policies when marine mammals or sea turtles are sighted, including:
  - maintain a distance of 90 meters or greater.
  - attempt to maintain a parallel course to the animal and avoid abrupt changes in direction until the animal has left the area.
  - reduce speed when pods or assemblages of marine mammals or sea turtles are observed nearby; and
- report sightings of any injured or dead marine mammal or sea turtles to the NMFS, regardless of whether the injury or death was caused by the LNG vessel. If the injury or death were caused by collision with an LNG vessel heading to or from the Jordan Cove terminal, the FERC would be notified within 24 hours of the incident. Information to be provided would include the date and location (latitude/longitude) of the strike, the ship name, and the species, if possible.

LNG vessels would enter the waterway at speeds between 8 and 10 knots, and slow between 4 to 6 knots as they proceed up the Coos Bay navigation channel to the Jordan Cove terminal. As required by the WSR, two tugs would escort each LNG vessel within the navigation channel, and another tug would assist in docking the vessel at the terminal. Use of tugs would allow the LNG vessels to maintain steerage even at these slow speeds.

Most sea turtles, marine mammals, and seabirds and shorebirds would be able to avoid LNG vessels traveling at slow speed through the waterway. Even with the additional LNG vessels in the waterway, the number of ships would still be below historic levels for deep-draft traffic to the Port. Effects on aquatic resources from LNG vessels would be not much greater than the effects of current deep-draft cargo ships visiting the Port. Based on the reduced speed of the LNG vessels and the efforts by Jordan Cove to increase the awareness of vessel operators, we conclude that the incidence of accidental strikes of aquatic species by LNG vessels in transit to and from the Jordan Cove terminal would be low.

Ship Grounding

Some commenters raised the possibility that an LNG vessel waiting offshore to enter Coos Bay, either to avoid another ship coming out of the Port or seeking proper tidal conditions, could lose anchorage or steerage and run aground on the North Spit, like the *New Carrisa* incident of 1999. A ship grounding would have the potential to impact aquatic resources, as oil and fuel could leak from a grounded vessel. However, a Coast Guard investigation found that the *New Carrisa* grounding was caused by the captain's error in not having the ship well anchored.

We conclude that it would be highly unlikely that an LNG vessel transiting in the waterway would become grounded. All LNG vessels visiting the Jordan Cove terminal would have to adhere to Coast Guard regulations, including anchoring procedures offshore, in addition to the measures outlined in the WSA, WSR, and LOR. A pilot would board the LNG vessel to guide it through the Coos Bay navigation channel, and the vessel would be accompanied by tugs and security escort boats to keep it on course. In addition, the geometry of the navigation channel would keep the LNG vessel within its confines, away from the shore.

Shoreline Erosion from Waves and Propeller Wash

Propeller wash from LNG vessels and tugboats transiting the waterway to and from Jordan Cove's terminal could cause shoreline and bottom erosion, and displace bottom organisms due to scour. Wakes and waves caused by vessels in the waterway could increase erosion along the shoreline and resuspend loose sediments in the bay. Increased erosion and suspended sediment levels can adversely affect fish eggs and fish survival, benthic community diversity and health, and spawning habitat. At high concentrations, suspended sediments can affect oxygen exchange over the gills, resulting in weakened individuals or mortality. Waves from vessels breaking on the shoreline can also cause fish stranding. The possible magnitude and effects of the Jordan Cove Project on shoreline erosion were approximated by Jordan Cove through model studies, the results of which are discussed below.

Model Parameters

To estimate the effects of waves and propeller wash from LNG vessels in Coos Bay, Jordan Cove developed two separate model approaches. One was developed by Moffat & Nichol (2008) and another by CHE (2011b). Both used similar baseline information but different approaches to determine likely effects on shoreline erosion. These models assumed that upon entering Coos Bay, LNG vessels would travel at approximately 8 to 10 knots (9.2 to 11.5 miles per hour [mph]) within the first mile of the Coos Bay entrance. For the remainder of the route to the Jordan Cove Terminal, LNG vessel speed would be approximately 6 knots (6.9 mph) or less. Both models considered the effect of waves at varied locations from near the mouth of Coos Bay to Jordan Cove's marine slip. The Moffat & Nichol model assumed about 200 vessel transits per year (combined inbound and outbound; about 180 combined vessel transits are proposed) of a 934-foot-long vessel traveling at about 6 knots (6.9 mph).

The CHE (2011b) model, however, used the wake generated by the tugboats traveling at the same speed as the LNG vessel, which would actually generate larger waves. CHE (2011b) also compared the effect of LNG vessel waves to that generated by existing large vessel traffic in the Coos Bay route and compared that to existing large vessel induced waves and natural wind wave's energy and size. CHE selected model points that were considered "sensitive" areas. Their model assumed 113 round trips (i.e., 226 vessel channel transits) of LNG vessels annually traveling at about 6 knots (6.9 mph) along most of the navigation channel but 4 knots (4.6 mph) near Jordan Cove's terminal.

Wave Model Results

The Moffat & Nichol (2008) model found that the maximum wave height generated would be about 1.1 feet. Although waves of this size occur throughout much of the bay, they only occur about 2 percent or less of the time annually based on the locations modeled. Among the seven locations chosen by Moffat & Nichol, the model predicted that the waves generated would equal from 0.0 to 3.1 percent of the annual wave energy at these locations above the current wave energy level.

The CHE (2011b) model compared the two measures of potential changes of shoreline waves from LNG vessel activity. The first was a comparison of single event (one vessel passage) shoreline wave energy (as measure by wave velocity) to that of existing large Coos Bay vessels already occurring. The other comparison was the overall cumulative yearly effect of LNG passage to that of existing vessels and that generated by natural wind waves. Their model results showed that the single passage events of LNG vessels would have slightly less shoreline wave impact (as measured by average wave velocity at the shore) per event than that of large existing vessel passage. This model estimated example direct shore wave height to be less than about 0.6 foot for the assumed mean higher high water tidal conditions for LNG vessel passage.

The CHE model simulated varied natural wind and tidal conditions (1,080 total combination conditions) to estimate wave effects on the shore sediment transport. One example of data results for high wind conditions indicated a maximum wave height near 0.9 foot high at some shore locations (assuming a 22 knot [25.3 mph] west wind). The model results indicated that nearly all of the annual shoreline wave-generated sediment transport would be generated by natural wind waves (greater than about 90 percent at all locations modeled). Overall, the model estimated that additional waves generated by the new LNG vessel traffic could increase shoreline sediment transport at the modeled point by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves).

While both of the models indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG vessels through Coos Bay, the effects would be small because increased waves would occur infrequently, contribute a very small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur within the bay. Therefore, the total effect is likely to be within the range of natural annual variability of wave conditions.

Additionally, the analysis indicates that the outer mile of the entrance, where LNG vessels would be traveling at 8 to 10 knots (9.2 to 11.5 mph), may have higher vessel-generated waves because of the greater speed. However, this area is already less protected from naturally occurring ocean-generated waves (this region directly faces the ocean entrance) and likely has higher background naturally generated waves than the regions farther in the bay. Overall, increased sedimentation and disruption of aquatic nearshore habitat from additional tugboat- and LNG vessel–generated waves would be unlikely because of the factors noted above.

Propeller Wash Model Results

Effects of propeller wash on bank and bed erosion were estimated by the two reports noted above. The two models estimated the likely bottom velocity and effects to sediment along the entire route. These models considered boat and bottom sediment characteristics in the area of interest and tidal levels when transport and docking would occur.

The Moffat & Nichol (2008) report indicated that along most of the route (approximately from NCM 1 to the new access channel for the Jordan Cove terminal) bottom disturbance would be slight within the navigation channel. The bottom velocity caused by the propeller would be similar to the maximum velocity of peak tides (about 4 fps). However, near the docking location, they estimated bottom velocity would be roughly double, or about 7 to 8 fps. The report noted that along most of this route the main channel bottom is considered coarse (sand and sandstone). This type of substrate is hard to suspend and rapidly settles. Generally, along most of the route no marked bottom disturbance or sediment suspension would occur, as the increased velocity would be similar to maximum tidal currents. Within about the last half- to quarter-mile before reaching the slip (based on the point selected for modeling) is where bottom velocity is increased. Some increased bottom scour and locally elevated turbidity may occur in this area but the effects would be limited in dimension. Disturbance would be limited, partly due to the coarse (mostly sand) bottom substrate that is relatively resistant to resuspension and rapidly settles.

The CHE (2011b) report found slightly different results using a different model. It reported that maximum bottom velocity in a narrow band along the route would be 13 fps, higher than the previous report. This report also noted that maximum velocity diminished rapidly from directly below the propeller to along the edge of the navigation channel (150 feet from mid-channel), where finer more easily suspended sediment would occur less than 0.6 fps, which is below levels that would suspend fine sediment. Based on model results, bottom velocity greater than about 4 fps would occur only in an approximately 80-foot-wide band. Therefore, velocity generated by the propeller in excess of tidal flow velocity would be limited to a narrow band in the mid-channel, limiting the area where sediment may be suspended from propeller actions of the LNG vessel. However, as noted by Moffat & Nichol (2008), this region is generally of coarser sediment that is less prone to suspension.

The CHE (2011b) report also modeled likely bottom disturbance from existing large vessel transit (assumed 106 trips annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG vessels (projected 113 trips annually). Therefore, during LNG transit, where these high bottom velocities occur, some benthic organisms would be disrupted and some sediment would be moved during arrival and departure. This would occur below the intertidal area. Mobile organisms would be able to return to the region, while some benthic organisms could be permanently displaced. Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current induced suspension. Overall, some loss of benthic organisms could occur from LNG vessel propeller wash during each transport trip near the slip approach, but the magnitude would be small and likely less than currently occurs under each existing large vessel trip.

The CHE (2011b) report also modeled velocities and likely effects on sediment scour at the access channel and marine slip from the tugboats pushing of LNG vessels into the dock. Assuming very high power use by the tug to dock the LNG vessel, the model estimated maximum velocity on the far bank (about 275 feet from the propeller) would be mostly less than 2.0 fps, which would be unlikely to erode the bank. Furthermore, this area would be armored so no erosion would occur. Near the bottom, maximum velocity in the channel would be about 2.16 fps. Sediment analysis suggests that over 95 percent of the bottom material (mostly silt/clay size) in the access channel would be susceptible to suspension at this velocity. The report also estimated that bottom scour would be limited to about 2 inches over a limited bottom area (approximately 100 by 50 feet) in the access channel. Some bottom disturbance would likely occur during docking. In most cases, this disturbance is likely to be much less than estimated because of the conservative assumptions used for this model. While some sessile benthic organisms may be displaced during LNG vessel docking, the limited occurrence and magnitude of bottom disturbance and sediment suspension would result in unsubstantial effects on organisms in the slip.

Fish Stranding

Fish stranding can occur when fish become caught in a vessel's wake and are deposited on shore by the wave generated by the vessel's passing. Stranding typically results in mortality unless another wave carries the fish back into the water. A recent study of strandings (Pearson et al. 2006) suggests that a series of interlinked factors act together to produce stranding during a ship passage. These factors include:

- Water-surface elevation—Low tides are generally more likely to result in strandings than high tides.
- Beach slope—Low-gradient beaches are generally more likely stranding locations than high-gradient ones.
- Wake characteristics—Ship wakes that result in both the greatest drawn-down and run-up on the beach are generally most likely to result in strandings. Wake characteristics are influenced by a number of dynamics including vessel size and hull form ("short and fat" vessels have a greater displacement effect and generate larger wakes than "long and thin" vessels); vessel draught (the smaller the under-keel clearance, the larger the wakes; thus, loaded vessels are more likely to result in strandings than unloaded vessels); vessel speed (fast moving vessels generate larger wakes than slow vessels); and the distance between the passing vessel and the beach (strandings are generally more likely at beaches close to the shipping channel than more distant beaches). Fish strandings were observed because of four types of vessel passages including oil tankers, container ships, car carriers, and bulk carriers (in order of the vessels observed to cause the highest to lowest stranding frequency).
- Various biological factors—For example, the larger the number of subyearling salmon that are present near the shoreline, the more fish that are likely to be stranded; salmon that are larger and relatively strong swimmers are generally less prone to stranding.
- Vessel speed—No stranding has been observed on the Columbia River at speeds less than 8 to 9 knots (about 10 mph).

All of these factors can vary simultaneously, making it difficult to predict the location and to what degree strandings may occur. A few areas may have the potential to strand fish in Coos Bay. One is the mud flats on the west side of the navigation channel along the Coos Bay and Empire Range that have beach morphology that has been shown to have potential for stranding, especially at low tide. Jordan Cove (Moffat & Nichol 2008) modeled the potential wave height and overall energy from 200 LNG vessel transits a year (combined inbound and outbound). As noted above, the wave's height would not exceed that of normal conditions in Coos Bay and vessel-induced waves contribute a small portion of total waves in the bay. In addition, the LNG vessels would be arriving and leaving at high tide, which is a period when gently sloping beaches are mostly covered, and less likely to be dewatered from waves. The maximum vessel speed once within the navigation channel, about 6 knots, is less than that observed to cause stranding in the Pearson et al. (2006) study. The one exception is near the Coos Bay entrance (first mile), when vessels may be traveling 8 to 10 knots. While waves generated in this portion of the waterway may be larger than farther in the bay, this is an area likely already receiving larger ocean-generated waves, so the vessel-generated waves would be little different than current conditions in this region. Additionally, the presence in Coos Bay of subyearling Chinook salmon, which are the outmigrating fish most likely to be stranded, is limited to the summer months, approximately mid-June through the end of August. Considering the conditions, including LNG vessels entering and leaving at high slack tide, low velocity in most areas, wave height within normal range, and infrequent occurrence of susceptible fish, it appears unlikely that LNG vessel traffic in the waterway would substantially contribute to fish stranding.

LNG Spills

In a highly unlikely scenario, there could be an accidental spill of LNG from a vessel transiting in the waterway. As more fully discussed in section 4.13 of this EIS, spilled LNG would vaporize as warmed by ambient temperature and, if the LNG ignited, a fire could result. The greatest threat to aquatic organisms near an LNG spill would be from changes in water temperature. A spill of LNG would float on the water surface and not mix, but in the process of changing state from solid to liquid would rapidly cool off the upper water layers closest to the LNG spill. As the LNG would vaporize and turn to natural gas, it would be less dense than air and would rise above the water. Aquatic species in the waterway would not be directly affected unless individuals come in direct contact with the LNG. Should an aquatic species directly contact the LNG when it is first released, it could have its flesh frozen because the temperature is very low. The chance of this occurring would be remote because it would require the individual to be near the water surface at the direct point of the LNG spill, before it warms. If an LNG spill from a vessel in the waterway were to ignite, it would cause localized heating of the surface water. Neither the cooling nor heating would likely cause the overall water column to change temperature to the point of affecting aquatic organism beyond the surface layer at the time of initial spill or ignition. Aquatic species, other than possibly the smallest planktonic stages and shellfish, near this spill would be able to detect undesirable temperatures and avoid the LNG spill by swimming away.

As explained in section 4.13, in the entire history of LNG vessel transport worldwide, there has never been a major incident resulting in a large LNG spill or fire on water. The mitigation measures outlined in the WSA, WSR, and LOR would protect public safety and the environment, and ensure that aquatic resources would not be adversely affected by LNG vessel traffic in the waterway to Jordan Cove's terminal.

Fuel or Oil Spills

Fuel (e.g., diesel) used for LNG vessel propulsion could possibly leak or be spilled while en route in the waterway; likewise, oil could be spilled. LNG vessels would have measures aboard to contain fuel or oil spills should they occur, as required under the Coast Guard required hazardous spill response plan for vessels in U.S. waters of 2013 (78 FR 60099). Additionally, LNG vessels are double hulled, which should prevent the escape of fuel or oil. The chance of a spill is low, and any quantities leaked are likely to be small. As reported by Pacific

States/British Columbia annual reports (http://oilspilltaskforce.org/documents/), the number of oil spills reported from fishing, recreational, and other harbor marine vessels in Oregon ranged from about 9 to 65 per year, which is infrequent considering that thousands of marine vessels, both recreational and commercial, use Oregon coastal marine waters. We conclude that fuel or oil leaks from LNG vessels transiting in the waterway to and from the Jordan Cove terminal are not likely to have adverse effects on aquatic resources.

Introduction of Nuisance Species

Exotic or nuisance organisms are unlikely to be transported to Coos Bay by LNG vessels. LNG vessel origin locations are unknown at this time; they could originate from ports across the Pacific. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously implement hull plating preservation and maintenance programs. Failure to preserve and maintain hull plating not only raises short-term operation costs but also sets the stage for increased long-term hull maintenance costs. There is a particular sensitivity to this engineering and economic reality regarding commercial vessels operating at the higher end of the sailing rates schedule, as is the case for LNG vessels.

In addition to the antifouling program measures, fluid dynamics plays a practical role as a barrier to the introduction of invasive species. The amount of water that passes over the hull and through the sea chest is a massively large volume. (A sea chest is an opening with associated piping in the hull below the waterline to provide seawater to condensers, pumps, and other associated equipment.) The velocity of the seawater, abrasive by nature, along the hull would be expected to "waterblast" off anything that is not affixed to the hull (e.g., a barnacle). The sea chest would have the equivalent of untold multiples of seawater exchange such that an organism would be flushed out with much more velocity and volume of water than the accepted international ballast exchange procedure.

Ballast water may be another source of non-native organisms. Water is held in the ballast tanks and cargo holds of LNG vessels to provide stability and maneuverability during a voyage when vessels are not carrying cargo. Normal ballast exchange requires only three changes of water through the ballast tanks to purge any loading port organisms before arrival at the unloading port. These exchanges are done at sea and the exchanges occur at relatively low velocity. LNG vessels would discharge ship-ballast water as they load LNG at the receiving terminal.

All vessels would be required to comply with ballast water management requirements promulgated by U.S. law (e.g., Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990; 1996 National Invasive Species Act) and agency programs (Department of Defense/EPA regulations at 40 CFR 1700, which implement §312(n) of the CWA), and establish discharge standards for vessel ballast water. Additionally, Coast Guard regulations, Mandatory Practices for All Vessels with Ballast Tanks on All Waters of the United States, require proper cleaning of fouling organisms on the boat exterior, anchor, and anchor lines in manner to prevent the likelihood of exotic species being transferred between ports. In addition, ships must adhere to a Ballast Water Management Plan, which is to be kept onboard, and must maintain a Ballast Water Record Book to record the intake and discharge of ballast water. On September 2006, a federal district court ruled that by September 30, 2008, the EPA needed to take specific action to ensure that shipping companies comply with the intent of the CWA and restrict the discharge of ballast water into United States waters (Buck 2006).

EPA developed specific requirements for ballast water treatment under the Vessel General Permit requirement under the CWA NPDES program to reduce the chance of releasing invasive organisms in U.S. waters in 2013 (78[7] FR 121938 [April 12, 2013]). This regulation requires that beginning December 19, 2013, all newly built large vessels will be required to treat ballast water to kill potential invasive organisms, with older vessels of the size that would be used for the Project having some delay in implementation of this requirement (first scheduled dry dock date after January 1, 2016). Prior to implementing treatment of ballast water, all large vessels that would discharge ballast water within 200 miles of the U.S. coast will be required to exchange ballast water outside of this 200-mile area. The required treatment of water would ultimately be an improvement over the requirement to just exchange ballast water to "flush" potential invasive organisms outside of the 200-mile territorial waters of the U.S., which was reported to reduce organisms by 88 to 99 percent (National Research Council 2011). The new requirement for treatment level is to reduce most organism types to less than 10 living organisms per cubic meter of ballast water. While this requirement may not eliminate all risk of invasive species entering waters, it is a substantial measure that would reduce the risk of project actions introducing invasive organisms into waters of the project area. Several other regulations apply to ballast water management and discharge that would be followed by all LNG vessels; these regulations would also aid in both ensuring reduction of discharge of potentially invasive species and, through vessel inspections, that procedures are followed, as noted in Jordan Cove's Resource Report 3. The FERC has assumed that these provisions apply both to the import and export of nuisance species, and by compliance with this Act and other regulations, the LNG vessels would not likely cause exotic nuisance species to be introduced into Coos Bay, U.S. waters, or the ports of destination of the LNG cargos.

Essential Fish Habitat

The MSA was established to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Federal agencies that authorize, fund, or undertake activities that may adversely affect EFH must consult with the NMFS. Although absolute criteria have not been established for conducting EFH consultations, the NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, the ESA, and the Federal Power Act in order to reduce duplication and improve efficiency (50 CFR 600.920(e)). Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS, Section 10 permit).
2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH should include:
   - a description of the proposed action;
   - an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species;
   - the federal agency's views regarding the effects of the action on EFH; and
   - proposed mitigation, if applicable.

3. EFH Conservation Recommendations – After reviewing the EFH Assessment, the NMFS should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.
4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to the NMFS. The action agency may notify the NMFS that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH.

The FERC, as the action agency, is consolidating the EFH and the ESA process for all portions of the Project. This includes development of an EFH assessment and BA together for submittal to the NMFS and FWS with a request to initiate formal consultation.

Section 302 of the MSA established regional fishery management councils. Among other responsibilities, these councils develop management plans for each fishery that requires conservation and management. Section 303(a) (7) of the MSA requires that these fishery management plans describe and identify EFH. The Project would be constructed and operated within the region of the Pacific Fishery Management Council (PFMC). The PFMC has developed four fishery management plans for species in Oregon marine, estuarine and freshwater areas: Pacific Groundfish, Coastal Pelagic Species, Salmon and Highly Migratory Species. EFH is described and identified as everywhere that species managed by the PFMC occur.

EFH occurs both in the Pacific Ocean off the southwestern Oregon coast, and within Coos Bay. The locations of EFH within the waterway for LNG vessel transit to the Jordan Cove terminal are illustrated in figure 4.6-1. The area in this figure generally of greatest concern for potential impacts to EFH from LNG vessel–related actions is that shown as the "wetted area." Additional EFH habitat of concern would occur along the potential LNG vessel transit route extending out to the 200-mile EEZ (not shown in the figure). Species with EFH in the project area are summarized below.

<u>Groundfish EFH</u>

The groundfish group includes 82 species. For the Pacific coast groundfish fishery, the EFH determination is based on habitat use by life stage for all 82 species within each composite EFH shown in Appendices B-1 and B-3 of the Pacific Coast Groundfish Management Plan (PFMC 2008). The life history descriptions and maps showing species distributions are also available in Appendices B-2 and B-4, respectively, of the Management Plan (PFMC 2008). The EFH of groundfish species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

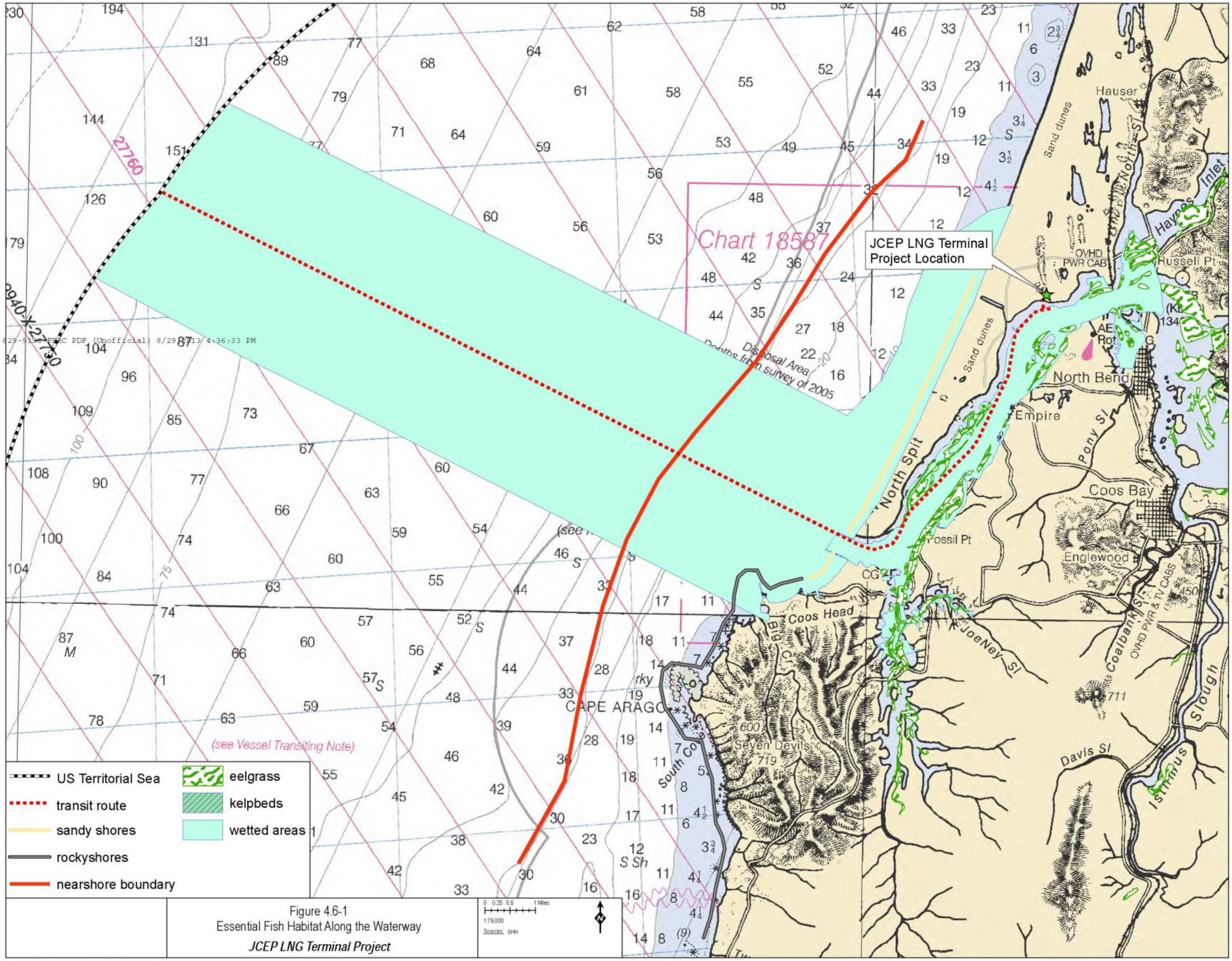


Figure 4.6-1
Essential Fish Habitat Along the Waterway
JCEP LNG Terminal Project

Coastal Pelagic Species EFH

The EFH for coastal pelagic species is defined by the species' temperature and geographic range during all life stages in the past, present, and where they could occur in the future. In addition to all marine and estuarine waters off the Pacific Coast to the limits of the EEZ, EFH for coastal pelagic species also includes portions of the water column where sea surface temperatures range between 50°F (near the U.S./Mexico maritime boundary) and 79°F (seasonally and annually variable) (PFMC 2006). The coastal pelagic species fishery management plans includes five species: Northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel, and market squid. Of these, two species (market squid and Pacific sardine) are known to occur in estuaries (PFMC 1998). The others would be found in the marine waters off the Oregon Coast along the shipping route. The EFH of coastal pelagic species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Pacific Coast Salmon EFH

For the Pacific salmon fishery, the PFMC identified EFH using USGS hydrologic units as well as habitat association tables and life history descriptions for each life stage (PFMC 1999, Appendix A, Amendment 14 to the Pacific Coast Salmon Plan). These areas encompass all streams, lakes, ponds, wetlands, and other currently viable waterbodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In estuarine and marine areas, EFH for Pacific salmon extends from the nearshore and tidal submerged environments within state waters out to the full extent of the EEZ (200 nautical miles). Three species are included in the PFMC management plan: coho, Chinook, and pink salmon. The EFH of salmon is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Highly Migratory Species EFH

Highly migratory fish EFH may exist along the outer portion of the transit route for LNG marine traffic. This EFH is found in temperate waters within the Pacific Council's region. Variations in the distribution and abundance of these species are affected by ever-changing oceanic environmental conditions including water temperature, current patterns and the availability of food. Sea surface temperatures and habitat boundaries vary seasonally and from year to year, with some of the species are much more abundant from northern California to Washington waters during the summer and warm waters years than during winter and cold water years, due to increased habitat availability within the EEZ. The species include five species of shark, tuna, striped marlin, swordfish, and dolphinfish. Based on the EFH habitat defined for these species, few if any, of these species are off the Coos Bay at coastal depths less than 100 fathoms (100 fathoms is the approximate edge of the shipping route defined area in Oregon coastal waters to 3 miles offshore). However, in waters farther offshore some habitat is available for some of these species and life stages out to the 200-mile EEZ. Overall, little EFH for these managed species would be present along the shipping route to the EEZ near Coos Bay. However, depending on the shipping route traveled, additional EFH of the highly migratory species may occur in southern west coast waters where more of these species' habitat may be present. The EFH of highly migratory species is listed and effects assessed in the EFH assessment as part of our BA (FERC 2015).

Project Area Specific EFH Species Characteristics

Within Coos Bay, a subset of these managed species are present including 2 salmon (Chinook and coho salmon), 3 pelagic (northern anchovy, Pacific sardine, and Pacific mackerel), and 29 groundfish species may be in or near Coos Bay, based on typical habitat use of these species. The general life history and expected habitat use within and near the project area are shown in our BA and EFH assessment (tables 5.1.1-1, 5.2.1-1, and 5.3.1-1; FERC 2015).

Based on sampling (e.g., ODFW data from 1996 to 2000), 13 groundfish, 2 salmon, and 1 pelagic species would be considered common. The information below provides details on most of these fish species use within the Bay, relative to the Project site.

Managed groundfish and coastal pelagic species are not estuarine resident species and therefore utilize Coos Bay on a seasonal basis, primarily in summer months. During the summer, the estuary may be utilized as a forage area for juveniles and adults and as a nursery area for larvae and juveniles. Starry flounder spawn near river mouths and sloughs. Juvenile starry flounder are found exclusively in estuaries. Sampling in upper Coos Bay from 1979 to 1990 showed that young-of-the-year flounder are present at least in the spring and summer months (Wagoner et al. 1990). Flounder and sole are found in sandy or muddy substrate and juveniles are found in shallow water near rivers and in estuaries in eelgrass beds. Adults generally are found in deeper waters in the winter and migrate to shallower water in the spring. English sole juveniles depend heavily on inter-tidal areas, estuaries, and shallow nearshore waters for food and shelter.

Adult Chinook and coho salmon may utilize habitat in the transit route in Coos Bay for migration and offshore for migration and feeding. Adults would return to the rivers in late summer and fall. Juveniles and smolts may use the transit route in Coos Bay for resting and foraging during emigration in the spring and summer, and offshore for migration and feeding. ODFW (2005) has captured coho and Chinook salmon, starry flounder, northern anchovy, and sand sole in the Jordan Cove area adjacent to the Project site.

The black rockfish is the only member of the rockfish family that is consistently caught in Coos Bay (Wagoner et al. 1990). The copper, blue, grass, canary rockfishes, and bocaccio are occasionally caught. The rockfishes are in the lower areas of Coos Bay, mainly during the late spring and summer months (Wagoner et al. 1990). Black rockfish are not known to spawn in estuaries. Rockfish recruit to seagrass beds in shallow, soft bottom embayments (Love et al. 1991). Johnson et al. (2003) reported that juveniles of many commercially important species utilize eelgrass habitat in Southeastern Alaska. Rockfish juveniles settle into shallow, vegetated habitats for rearing. Vegetated habitats (eelgrass and kelp) provide refuge from predators and access to prey. Juvenile rockfish may also be closely associated with seagrass drift for both feeding and refugia while they move between pelagic and near shore habitat (Nightingale and Simenstad 2001a). Rockfish have not been seined by ODFW in or near the immediate Project slip area, indicating that this area is not likely utilized by rockfish.

Black rockfish and cabazon were the most abundant juvenile rockfish species captured within Coos Bay (near the entrance) between June 2003 and December 2005 (Schlosser and Bloeser 2006). Trap sites were located in eelgrass beds, along dock pilings and in sandy bottom habitat near the entrance to Coos Bay. Juvenile chilipepper, copper, grass, yellowtail, and kelp greenling were also captured near the entrance.

Lingcod begin life in near-surface marine waters and estuarine areas. Juvenile lingcod primarily use estuaries, entering to feed, while adults are usually found in marine waters of 100 to 150 meters deep. Lingcod lay eggs in rocky, marine subtidal areas. Larvae are found in the near-surface marine waters and estuarine areas. In this life stage, lingcod feed primarily on copepods, eggs, and other crustaceans. As it matures, lingcod are commonly found in shallow, inter-tidal areas of bays near algae and seagrass beds.

Phillips (1984) described northern anchovy to be transient users of eelgrass. Eelgrass provides indirect benefits to these species as well through contributions to productivity in the estuary, and eelgrass drift may provide cover for coastal pelagic species (Nightengale and Simenstad 2001).

Other species managed by the PFMC that occur in Coos Bay include sand sole and big skate. Sand sole require a sand-mud-eelgrass type of habitat; however, they have not been captured in or near the project area. Big skate occur nearshore and occasionally in the bay (Wagoner et al. 1990).

In offshore waters, along the shipping route out to the 200-mile EEZ, additional species and life stages of groundfish, coastal pelagic species, Pacific Coast salmon and highly migratory species would be present. The details of the species and life stages and likelihood of being present within the EEZ analysis area are presented in our BA (FERC 2015).

Food Web Importance to EFH

Prey species that are important for local EFH fish species rely on many of the same habitat conditions as the EFH fish species. The food web components including phytoplankton, zooplankton, detritus, epiphyton, and submerged aquatic vegetation (e.g., eelgrass, macrophytic algae, referred to as submerged aquatic vegetation [SAV]) are all important in supplying the habitat and food base for EFH species within Coos Bay. For example, submerged grasses or SAV are important habitat for small prey species of adult lingcod (in Appendix B-2 of PFMC 2008). Forage items that are habitat components for the managed species do depend to some extent on estuarine systems. Many species of groundfish and salmonids occupy inshore areas of the lower bay during juvenile stages (e.g., Chinook salmon, coho salmon, English sole) where they feed on estuarine-dependent prey, including shrimp, small fishes, and crabs. As they mature and move offshore, their diets in many cases change to include fish, although estuarine-dependent species (e.g., shrimp, crabs) can still constitute an important dietary component.

A variety of habitats of importance occurs along the transit route for LNG marine traffic. They include fresh, estuarine, and marine waters. Within Coos Bay are estuarine environments with freshwater streams and slough. The habitat in the marine environment includes shallow sandy shorelines, and nearshore and offshore rocky environments. Also up and down the coast are rocky reefs and kelp forest regions but pelagic and deep ocean waters with soft bottoms habitats are most common directly along the route outside of the bay (ODFW 2005). The fish and other aquatic organisms along this route are highly diverse and abundant containing very important EFH habitat for many species.

Impacts on EFH Along the Waterway for LNG Vessel Transit and Measures to be Implemented to Avoid or Reduce Effects on Aquatic Resources

A summary of potential impacts to EFH is shown in table 4.6.2.1-1. The details of the effects on EFH and aquatic species that occupy that habitat from ship grounding, propeller wash, wake waves, fish strandings, introduction of non-native species, and cargo, fuel, and oil spills related to LNG vessel transit in the waterway, as well as measures that would be implemented to minimize these impacts, are discussed above.

TABLE 4.6.2.1-1

Potential Impacts to EFH due to LNG Vessel Traffic Along the Transit Route

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500 meter (1,914 fathom) depth.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to multiple groundfish species EFH (see section 4.6.2.2 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see section 4.6.2.2 for impacts and mitigation)
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	Accidental spills of hazardous substances, entrainment	Minimal adverse effects or less than substantial effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see section 4.6.2.2 for impacts and mitigation)
Highly Migratory Species	EFH is defined by temperature ranges, salinity, oxygen levels, currents, shelf edges, and sea mounts. Based on species characteristics closest EFH would be beyond the 40-fathom depth off of Coos Bay. b/	Accidental spills of hazardous substances	Minimal adverse effects or less than substantial effects to highly migratory species EFH (see section 4.6.2.2 for impacts and mitigation)

a/ PFMC (2006; fact sheet, update version, July 24, 2006)
b/ PFMC (2007)

4.6.2.2 Jordan Cove LNG Terminal

Jordan Cove's LNG terminal and related facilities would be located on the bay side of the North Spit, along the shoreline from Henderson Marsh north to geographic Jordan Cove. The access channel would be located on the north side of the existing Coos Bay navigation channel, beginning at the confluence between the Jarvis Turn and the Upper Jarvis Range at about NCM 7.3. The site is near the transition zone between fresh and marine waters in the bay.

Coos Bay contains a variety of habitat for anadromous, marine, and estuarine fish species. A large diverse invertebrate population exists in Coos Bay. Shellfish (predominantly clams, crabs, and shrimp) are of significant economic importance to the Coos Bay area. Of marine mammals in Coos Bay, only the harbor seal has been observed during field surveys at the proposed location of the Jordan Cove access channel. No turtles have been observed or would be expected in the bay. Fish, shellfish, and marine mammals that may occupy Coos Bay are more fully discussed in the section 4.6.2.1.

Juvenile and larval life stages of vertebrate and invertebrate marine organisms are varied in the bay and near the terminal site. Over 35 species of icthyoplankton have been documented in Coos Bay (Miller and Shanks 2005). There are some seasonal trends, with highest occurrence October through May, but fewer differences by month in the upper bay than near the ocean. The only terminal facility in Coos Bay would be the access channel. Shanks et al. (2010, 2011) sampled zooplankton and icthyoplankton in Coos Bay near the Jordan Cove terminal. The data were collected on incoming and outgoing tides, and included monthly and quarterly sampling over a 24-hour period. The sampling was intended to determine seasonal, tidal, and daily changes in abundance of zooplankton including larval fish, shellfish, potential salmonid prey organisms, and other miscellaneous zooplankton that may occur in the project area. A variety of zooplankton were found to be present within the bay (see table 4.6.2.2-1). Among the potential salmonid forage items, copepod adults, lavaceans, harpacticoid copepods, and Daphnia had the highest peak abundance. Overall, larval fish abundance was generally low, with those that spawn primarily in or near estuaries common (surf smelt, sand lance, and staghorn sculpins). At times, other larval or juvenile fish were relatively abundant including English sole, buffalo sculpin, anchovy, and pipefish. A total of nine fish species were captured. Primary fish species spawn in winter and early spring, and larval fish were most abundant in winter samples (Shanks et al. 2011). Over 12 taxa of crab and shrimp larvae were also collected, including some recreational and commercially important crab and shrimp species, such as Dungeness crab and ghost shrimp larvae.

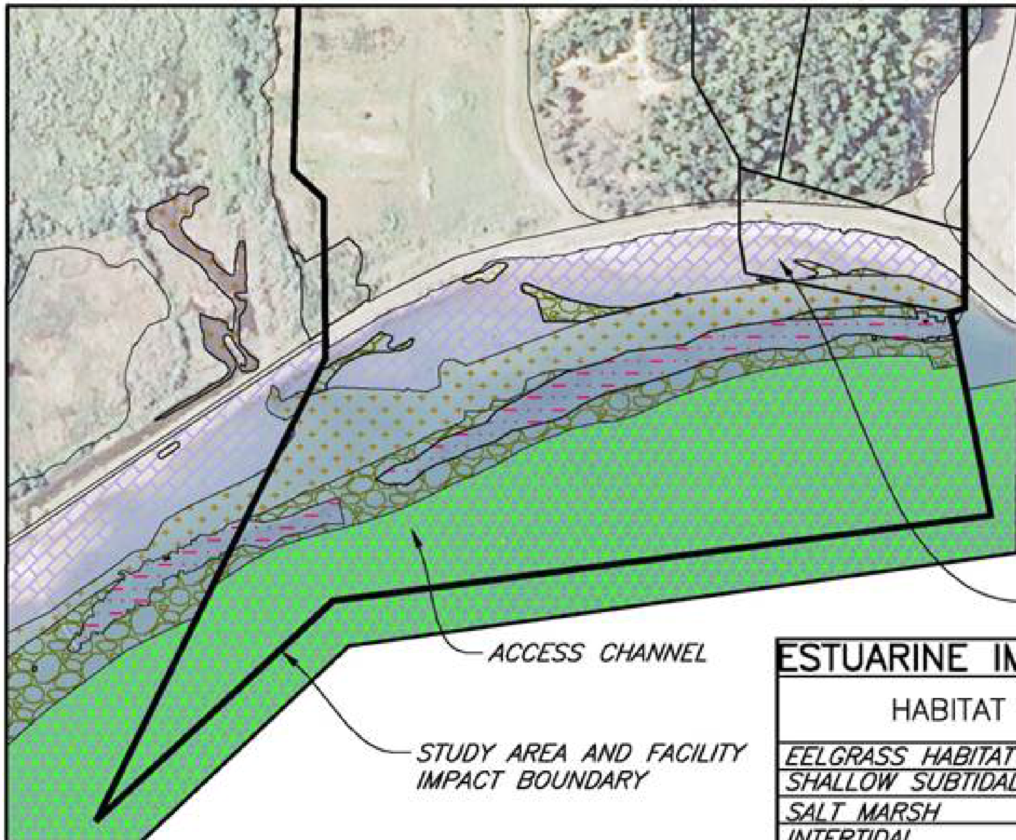
TABLE 4.6.2.2-1

Taxa Groups Collected in Coos Bay Near the Proposed Jordan Cove Terminal During 2009–2011

Categories	Specific Taxa
Fish larvae/juvenile	Surf smelt, sand lance, staghorn sculpin, buffalo sculpin, anchovy, pipefish, English sole, gunnel, pricklefish
Crab/Shrimp larvae	Porcelain crabs, pea crabs, green crab (invasive), xanthid crabs, majid crabs, cancer crabs (e.g., Dungeness, rock crab), Lithodidae, Hippidae, Pagurid (hermit crabs), Callinassa (ghost shrimp), Sergestid shrimp, Pachygrapus crassipes (striped shore crab)
Gastropod and Bivalves larvae	Mytilus (mussels), Clinocardium (cockles), Bivalve juveniles, Gastropod juveniles
Larval Invertebrates	Barnacle nauplii and cyprids, Mytilus larvae, bivalve larvae
Cnidaria/ctenophore	Sea anemone, Hydroids, sea goose berry
Polychaete Worm Larvae	Marine worms
Salmonid Food Prey	Mysids, Amphipods, Isopods, Cumaceans, Copepod adults, Harpacticoid copepods, Calanoid copepods, Daphnia, Larvaceans, larval fish

Source: Shanks et al. (2010, 2011)

The access channel and barge berth facility for Jordan Cove's terminal would cover about 30 acres below the MHHW. This would include less than 1 acre of salt marsh, about 10 acres of intertidal area of unvegetated sand plus algae/mud/sand habitat, about 3 acres of shallow subtidal, about 15 acres of deep subtidal and SAV, and about 3 acres of eelgrass (Evans 2014). The habitat areas affected by the access channel are illustrated on figure 4.6-2 and listed in table 4.6.2.2-2.



EXPLANATION

- INTERTIDAL UNVEGETATED SAND
- ALGAE/MUD/SAND
- EELGRASS
- SHALLOW SUBTIDAL
- DEEP SUBTIDAL

IMAGE SOURCE: 2011 NATIONAL AGRICULTURAL IMAGERY PROGRAM
DATA SOURCE: DAVID EVANS AND ASSOCIATES, INC
JCEP ODFW HABITAT (08/2013)

ESTUARINE IMPACT ACREAGE AT LNG TERMINAL

HABITAT	SLIP/ACCESS CHANNEL	BARGE BERTH
EELGRASS HABITAT	2.50	–
SHALLOW SUBTIDAL	3.30	0.07
SALT MARSH	0.06	–
INTERTIDAL	8.08	1.43
DEEP SUBTIDAL	15.40	–

1.INTERTIDAL=INTERTIDAL UNVEGETATED SAND + ALGAE/MUD/SAND
2.BARGE BERTH WAS PREVIOUSLY REFERRED TO AS CONSTRUCTION DOCK

NOTE:

THIS FIGURE HAS BEEN REVISED BASED ON THE 2013 JCEP LNG TERMINAL DESIGN AND HABITAT MAPPING OF THE SUBMERGED AQUATIC VEGETATION (SAV) AND ASSOCIATED ESTUARINE HABITAT IN THE SLIP AND ACCESS CHANNEL.

1"=400'

0 400

Figure 4.6-2
Submerged Aquatic Vegetation within the Slip and Navigation Channel

TABLE 4.6.2.2-2

Estuarine Habitat Affected from Construction of Jordan Cove LNG Facilities

	Acres Affected					
Habitat Type	**Slip and Access Channel**	**Barge Berth**	**Gas Processing Facility/Shared**	**North Point Bridge**	**North Point Workforce Housing**	**Trans-Pacific Parkway/Hwy 101 b/**
Eelgrass Habitat	3	0	0	0	0	0
Shallow Subtidal	3	<1	0	0	0	0
Salt Marsh	<1	0	<1	<1 a/	a/	0
Intertidal	8	2	<1	0	0	<1
Deep Subtidal	15	0	0	0	0	0
Total	**29**	**2**	**<1**	**<1**	**0**	**<1 b/**

Note: Columns/rows may not sum correctly due to rounding. Acres are rounded to nearest whole acre. Acreages less than 1 acre are shown as "<1".
a/ Shared locations, bridge is located in workforce area
b/ Not shown: two marine wetland areas (J and M) near the LNG site with <1 acre of impact.
Source: Jordan Cove response to data request September 17, 2013 and Evans (2014)

Submerged grasses are one of the important major habitat components in Coos Bay. Recreationally and commercially harvested species such as clams and shrimps, Dungeness crab, English sole, and salmonids use the eelgrass beds extensively. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. ODFW (1979) conducted habitat mapping in Coos Bay and documented intertidal and subtidal aquatic beds. Submerged grass meadows provide cover and food for a large number of organisms including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; and, larger fish, crabs and wading birds that forage in the meadows at various tides. Eelgrass provides shelter for a variety of fish and may lower predation, allowing more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fishes.

The maintenance dredging disposal Site F, located just north (about 300 feet) of the North Jetty at the mouth of Coos Bay, within 2,000 feet of and extending out about 3 miles from the shore (figure 2.1-11), has many of the same anadromous and marine species found in Coos Bay and discussed in section 4.6.2.1. Trawl sampling in the site has identified 28 species including herring, anchovy, sculpin, flatfish, rockfish, greenling, skate, and others (Hinton and Emmett 1994). A flatfish, speckled sanddab, was the most abundant. Chinook and coho salmon migrate through and may feed in this area, both as juveniles and adults. Shellfish were not common here, but include some Dungeness and red rock crab and *Cragon* shrimp and smooth bay shrimp.

Project activities associated with the LNG terminal that could potentially impact aquatic resources include in-water construction activities, habitat modification, water appropriations, artificial lighting, and accidental spills of hazardous materials. Measures that would be implemented by Jordan Cove to avoid or reduce impacts on aquatic resources are discussed below.

Construction of Jordan Cove's LNG Terminal Facilities and Potential Impacts on Aquatic Resources

The Jordan Cove LNG terminal would include an access channel and marine slip. The entire access channel would be located within Coos Bay, while the majority of the marine slip would be excavated or dredged from an existing upland on the North Spit. Many of the construction supplies for the facility would be provided through transport by marine barge and break bulk ships.

Dredging Activities

About 1.3 mcy would be removed by marine dredging during creation of the access channel in the bay. The creation of the access channel would result in the modification of about 31 acres of present-day subtidal and intertidal habitat to deeper water habitat in the bay. The dredging operation to create the access channel would change physical conditions of the bay bottom in this area, locally altering the bathymetry and potentially altering the morphology and water currents. About 16 acres of intertidal to shallow subtidal habitat, including approximately 3 acres of SAV eelgrass habitat and less than 1 acre of salt marsh, would be modified to primarily deep subtidal habitat during the dredging process of the deepened channel. Increasing depth and removal of vegetation would reduce the quality of habitat for juvenile salmonids and other juvenile marine species.

The construction of the access channel would impact local aquatic resources by removal or conversion of some habitats. There would also be short-term turbidity from dredging in the bay, and additional erosion of the shoreline during construction activities could result in sedimentation. To control upland soil erosion and potential sedimentation, Jordan Cove would follow the measures outlined in its ESCP; for marine waters, measures in the *Excavated and Dredged Material Management Plan* (Moffatt and Nichol 2013) would be followed.

There is also the potential for an accidental oil or fuel leak from dredging equipment to affect aquatic resources in the bay. To avoid or reduce impacts from oil or fuel leaks, Jordan Cove developed a preliminary draft SPCCP.[94]

About 37 acres of current upland habitat excavated and dredged to create the marine slip would be converted to open water, primarily deep subtidal habitat. While this area would have little intertidal habitat due to steep banks, it would supply some subtidal habitat that would not have been present without the Project. This habitat, however, would be highly disturbed due to large vessel arrivals and departures, and would generally be of low quality habitat for most species.

Jordan Cove has identified two specific sites in Coos Bay that would be set aside and/or developed as compensatory mitigation[95] for loss of tidal and subtidal habitat from dredging. The loss of 3 acres of eelgrass would be mitigated by development and planting of about 8 acres of off-site new eelgrass habitat in bay south of the west end of the Southern Oregon Regional Airport runway. The area proposed has been used successfully for eelgrass mitigation in the past. The details of the plan, measures of success, and contingencies are provided in the *Compensatory Wetland Mitigation Plan, Part B: Estuarine Impacts*.[96] This plan is similar to that approved by the ODSL under permit #37712-RF.

[94] This plan was attached as appendix K.2 to Resource Report 2 of Jordan Cove's application to the FERC filed in May 2013.

[95] Jordan Cove included in its application to the FERC the *Oregon Gateway Marine Terminal Draft Estuarine Resource Mitigation Plan*, attached as Appendix B.3 of environmental Resource Report 3.

[96] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* (Federal Permitting) filed with the FERC in April 2015, as part of supplemental information for their 404/10 permit application.

The impact on the other estuarine habitats (non-eelgrass) would be mitigated with reestablishment of tidal flow on about 47 acres of unvegetated mudflats in Kentuck Slough, just less than three times the affected acreage, at the site of a former golf course. Kentuck Slough is located on the east shore adjacent to the main inner bay between the project area and Coos River mouth. This area is close to the main Coos Bay river channel, which would benefit early marine-rearing juvenile salmonids. However, some details have changed and final acceptance of the adequacy of the plan to replace lost habitat by ODSL or other resource agencies is pending. Therefore, we have recommended that Jordan Cove continue to consult with the COE, NMFS, ODSL, and ODFW and other appropriate resource agencies to develop a final wetland mitigation plan for permanent impacts on eelgrass and other estuarine habitats (see section 4.4).

Following mitigation efforts, Jordan Cove would monitor the sites to ensure that all criteria for successful mitigation (e.g., acreage amount, condition of vegetation, function) have been met. Monitoring would occur for at least five years and up to eight years for the eelgrass site and five years for the intertidal sites, unless different periods are specified by agencies. Should eelgrass sites not be successful, the condition(s) causing lack of success would be evaluated. If failure resulted from errors in planting, the sites would be replanted. If there were other problems and the site was not viable, discussion would occur between Jordan Cove and the agencies to determine alternative mitigation strategies. For the intertidal flat, if the mitigation site does not meet performance standards, including the identification of potential concerns for the surrounding infrastructures, the potential causes of the deficiencies or concerns would be evaluated and solutions offered to the agencies. Considering the mitigation measures proposed, and the implementation of mitigation plans, construction and operation of the LNG terminal would have only short-term impacts on marine aquatic resources in Coos Bay.

The major impacts on marine and estuarine organisms would result from increased turbidity and sediment during dredging operations. A large quantity of suspended sediment can reduce light penetration, which in turn reduces primary production of both pelagic and benthic algae and grasses. Increased suspended sediment can affect feeding of benthic and pelagic filter feeding organisms (Brehmer 1965; Parr et al. 1998), and the settling of the suspended particles can cause local burial, affect egg attachment, and modify benthic substrate. High enough levels can have direct adverse effects to fish ranging from avoidance to direct mortality. Use of pumps to convey the material from the cutter heads in a hydraulic dredging operation would serve to contain most of the siltation caused by the dredging. The siltation would be conveyed with the material removed to the disposal area where it would settle out before being discharged back to the waterbody. The suspended sediment and turbidity levels would decline to ambient levels following completion of dredging activities. Jordan Cove included with its application to the FERC a study produced by Moffatt and Nichol entitled *Report on Turbidity Due to Dredging*.[97]

Dredging of the access channel would result in temporary siltation and sedimentation impacts similar to those that currently occur during COE maintenance dredging of the Coos Bay navigation channel. On average, the COE removes approximately 550,000 cy from the bar, 200,000 cy from NCM 2 to 12 and 150,000 cy from NCM 12 to 15 each year.

The ambient turbidity levels in the water (generated by flows, waves and ship traffic) create a background level of turbidity. Within Coos Bay, turbidity measurements taken at the Charleston

[97] This report was filed as Appendix F.2 of Resource Report 2.

Bridge over a two-year period show an average summer turbidity level of 10 mg/l and an average winter level of 27.3 mg/l. Some individual events (e.g., winter storms) measured at the Charleston Bridge were recorded between 100 and 500 mg/l. Aquatic organisms in Coos Bay are adapted to and exposed to periods of high to moderate turbidity during the winter months. Dredge operations are expected to result in similar effects, with higher concentrations of TSS in the immediate area of dredging.

Within the access channel, dredging would be conducted using a hydraulic (suction) dredge with a cutterhead or mechanical (clamshell) dredge. While the hydraulic dredge is preferred, the mechanical dredge may be needed in portions of the nearshore area due to buried woody debris. Cutterhead dredges use a rotating cutter to loosen soil particles, while mechanical dredges have closing scoop bucket to remove sediment. A model commissioned by Jordan Cove (Moffatt and Nichol 2006a) provides a range of turbidity from dredging activities by dredge type with consideration of likely velocity of the tidal current. The highest resultant turbidity for a hydraulic dredge was modeled to be approximately 500 mg/l at the cutterhead with a current velocity of 0.2 meters/second with maximum spread of turbidity decreasing to approximately 14 mg/l at 200 feet from the cutterhead under high water velocity (1.0 meters/second). For a mechanical dredge, the maximum concentration would be 6,000 mg/1 at the dredge site, decreasing to 50 mg/l within 660 feet under high water velocity (1.0 meter/second). Maximum spread of elevated sediment from the actual dredge location only occur during brief periods (less than two hours) of elevated tidal velocity. For both dredge types at lower tidal velocities, turbidity values would be at or below average seasonal background levels within 660 feet or less. Other than at the actual dredge location, average daily (24-hour) turbidity levels would not exceed background levels of 10 to 30 mg/l for the mechanical dredge and would be even less for the hydraulic dredge.

During the dredging process, some small fish, larvae, and fish eggs could be entrained. Larger fish would be able to avoid this process and would likely actively avoid the area during the dredging disturbance process. In a review of many maintenance dredge studies through 1998, Reine et al. (1998) concluded that “much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging.” Based on this review, it appears that entrainment of marine fish and shellfish species would not be a substantial impact to the local marine resources. Impacts would be minimized by the current in-water work windows (October 1 to February 15) and by maintaining the cutterhead near the bottom if a hydraulic dredge is used.

If salmonids are exposed to moderate to high levels of turbidity (suspended sediment) for prolonged periods, a number of adverse effects could occur including behavioral changes, sub-lethal effects, and increased mortality from predators. Dredging is expected to create spikes of high to moderate turbidity in a localized area. Effects to salmonids are expected to be slight and not measurable due to the limited area affected and the short duration of dredging operations, and limitations on construction periods. Rearing and migrating salmonids including ESA listed salmon, which should be uncommon in Coos Bay during the in-water work window, would likely avoid active work areas.

In Coos Bay, suspended sediment from dredging activity could affect shellfish, including clams and other filter feeders within the immediate vicinity and downstream of the access channel. The major commercial oyster-growing areas in the bay are upstream of the access channel.

Therefore, dredging conducted by Jordan Cove should not adversely affect those commercial oyster beds.

Jordan Cove's dredging would also directly remove benthic organisms (e.g., worms, clams, benthic shrimp, starfish, and vegetation) from the bay bottom within the access channel. Mobile organisms such as crabs, many shrimp, and fish could move away from the region during the process, although some could be entrained during dredging so that direct mortally or injury could occur. Based on 1978 maps of shellfish (Gaumer et al. 1978), shrimp, soft shell calms, bentnose clams, and cockles are located within the intertidal areas near the slip and within dredge areas (west of the Roseburg Forest Products Company site). ODFW captured Dungeness crab and red rock crab in this area during 2005 seining efforts. Varied species could be injured or killed during dredging operations. Dungeness crabs and sand shrimp (*Crangon* spp.) can be especially susceptible to entrainment, although many survive dredging (Reine et al. 1998). Reine et al. (1998) reviewed dredging studies and concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Dredge entrainment studies over a four-year period in the Columbia River found no juvenile or adult salmonids entrained during dredging, although some other pelagic fish were entrained (Larson and Moehl 1990).

It is reported that benthic communities on mud substrates in Coos Bay, when disturbed by dredging, recovered to pre-dredging conditions in 4 weeks (McCauley et al. 1977). However, recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Because of the large quantity being dredged, it may take a longer than four-week period relative to typical dredging and thus the benthic communities in the areas to be dredged may take a more varied length of time to recover. In addition, because the shallow area would be converted to deeper water habitat than what is currently there, some long-term reduction in benthic production would occur. Some of this net loss would be offset by added annual benthic production from the newly formed 37-acre slip habitat, even though it would likely be of poor quality. We would also expect increased organic matter production to the Coos Bay system from Jordan Cove's proposed eelgrass and wetland mitigation sites, which would be provided at 3:1 habitat replacement for shallow water and intertidal habitat removed by slip dredging and development.

Additionally, high oxygen demand sediment could be encountered during dredging. This could remove oxygen from the local water areas, putting local organisms at risk from insufficient oxygen. This effect would be temporary, and tidal exchange would be expected to replenish oxygen. In most cases, where dredging and disposal occurs in open coastal waters, estuaries, and bays, localized removal of oxygen has little, if any, effect on aquatic organisms (Bray et al. 1997). Also, Nightingale and Simenstad (2001b) reviewed literature in a summary document on effects of dredging and could find no empirical data indicating reduction in oxygen was an issue of concern for estuarine and marine organisms for dredging actions.

Dredging may also resuspend nutrients to the water column and could affect primary production. At low levels, this could be of benefit, increasing phytoplankton production, which could benefit prey species eaten by fish. However, in estuaries, this production is limited by turbidity and flushing, so any effects would be slight and local.

Maintenance dredging, which would occur every three to five years, would keep the navigation channel depth as it is currently and the LNG slip depth as originally developed. Thus, the current habitat structure of the navigation channel would remain unchanged and slip area would be as originally developed following each maintenance dredging cycle.

Construction windows for in-water dredging, developed by the state, are intended to reduce the likelihood of salmonid presence during their critical life stages in the region where effects may be greatest. The in-water work window (October 1 through February 15) would minimize the exposure of juvenile salmonids to increased turbidity during outmigration but would occur during much of the adult salmonids' upstream migration. Resident estuarine species, however, would be present during the in-water work window.

New Deepwater Habitat

The construction of the slip and berth would add a new region of deeper water habitat in Coos Bay. The area would have steep riprap sides which would likely have reduced biological diversity in shoreline habitat. The deeper areas may have slightly different fish composition than the main bay but overall the change in depth would be slight relative to the main adjacent navigation channel. Based on COE surveys, the navigation channel adjacent to the proposed site is -44 feet deep, with proposed slip depth -45 feet similar to the local deep bay areas, although to the side of the channel. While future composition of the channel species cannot be predicted, it appears conditions are not substantially different than the adjacent navigation channel area. This may, however, result in some species composition differences locally. It will remain a relatively disturbed area for organisms, with the frequency of LNG vessel traffic likely reducing its overall benefit to fish and invertebrate resources. However, the final use of this new environment and changes in use from the existing conditions cannot be completely estimated at this time and conditions may take time to fully develop. Aquatic resources, such as fish, shellfish, and marine mammals that may use Coos Bay, are under the management of ODFW and NMFS. In its response to the FERC staff's BA and EFH Assessment (see section 4.7 of this EIS), the NMFS can impose conditions through its BO to protect aquatic resources in the new deepwater habitat created by the Jordan Cove terminal slip.

Pile Driving

Jordan Cove would install 112 steel piles for the LNG vessel berth and loading platform on the east side of the marine slip. These piles would all be driven land-side adjacent to the berth. Ninety-eight steel piles would be driven to support the tugboat dock on the north side of the slip. These piles would be installed while the upland portions of the marine berth are still isolated from the bay by the berm. Pile driving and other terminal construction-related noise could cause adverse effect to fish in the area of the activity. However, no in-water pile driving would occur, eliminating potential adverse effects on aquatic resources from underwater noise waves. All new pilings will be fitted with devices to prevent perching of piscivorous birds, as a measure to avoid impacts to fish species such as fall Chinook salmon, coho salmon, and steelhead juveniles.

Noise in air produced by pile driving was modeled by Jordan Cove and it was found that the noise contour for sound levels greater than 65 dB extended less than 0.25 mile from pile driving operations. It can be assumed that the distance to noise greater than 100 dB root mean squared (RMS) - the in-air disturbance threshold for pinnipeds - would be much less than that, although it was not modeled by Jordan Cove. Laughlin (2007) found that the maximum noise in air 300 feet from a 36-inch hollow concrete pile was 98.3 dBA while the noise 300 feet from a 36-inch-diameter steel pile as 96.7 dBA. Therefore, it is unlikely that sound levels of 100 dB RMS or greater in air would be experienced within 300 feet of the piles at the LNG terminal site.

Jordan Cove would consult with NMFS to design a monitoring and adaptive management plan including the development of a pinniped safety zone. Should exceedances of the NMFS noise criteria be measured during pile driving, pile driving would cease and additional mitigation measures would be implemented. These measures could include the use of a different type of pile cap or hammer cushion, re-design of the bubble curtain, or other measures identified through consultation with NMFS. Following completion of the pile driving, Jordan Cove would provide a written report on hydroacoustic monitoring to NMFS. While these are the designated plans, Jordan Cove would need to obtain concurrence from NMFS on the adequacy of the plans and provide these to FERC. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Jordan Cove should file with the Secretary, for review and approval by the Director of OEP, a *Monitoring and Adaptive Management Plan* to ensure compliance during construction with NMFS underwater noise criteria for the protection of pinnipeds, and documentation that the plan was formulated in consultation with the NMFS.**

<u>Erosion and Runoff from Upland Facilities</u>

Impacts on marine resources could occur from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills during construction. While no streams are present in the upland portion of the terminal, the removal of current vegetation could modify the character and amount of water runoff into the bay.

Nearshore vegetation clearing could indirectly affect aquatic resources in the bay; however, the amount of nearshore vegetation that would be removed for this Project is small. Other than an existing disturbed shoreline near the South Dunes Power Plant area that would be used as a temporary laydown area, no planned nearshore disturbance would occur outside of the upland and shoreline excavated and dredged to create the marine slip for the terminal. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing erosion control and revegetation measures from its ESCP.

During construction of the LNG terminal facilities, stormwater runoff could erode disturbed soils, creating sediment in nearby surface waters, and impact local aquatic resources. Stormwater runoff from the disturbed portions of the site would be managed in accordance with Jordan Cove's ESCP. Following appropriate treatment, such as electro-coagulation, chemical flocculation, or filtration, if needed, all construction stormwater from the LNG terminal site would be directed toward the slip.

Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a preliminary draft site-specific SPCCP to minimize the potential for accidental releases of hazardous materials.

Hydrostatic Testing

Approximately 28 million gallons of water would be used for hydrostatic testing of the LNG storage tanks prior to placing them in service. The source of water would be local untreated potable supply from the CBNBWB. After completion of the test, the water would be discharged to the on-site firewater pond. Permits would be obtained for all wastewater discharges as required by ODEQ. Water discharges would be treated, if necessary, to comply with discharge permits. If treatment were required, treatment procedures would be developed prior to discharge. Approximately 5 million gallons of the hydrostatic test water would be retained in the firewater pond, reducing the need for additional water to fill the pond. The remaining water would be discharged through the existing industrial wastewater discharge pipeline, which connects to the previously existing ocean discharge diffuser location at a rate of about 1.8 million gallons per day. Given that the water would be used inside the LNG storage tanks, chemicals would not be added, the water would be tested for quality and treated if necessary prior to discharge, and would enter the ocean through a diffuser allowing rapid dissipation and mixing, the release of hydrostatic test water would not likely affect the ocean aquatic environment.

Construction Supply Vessel Transit

The applicant has estimated that much of the supplies needed for construction of the terminal and related facilities would be transported by break bulk ships and barges. They indicated that over a two-year period about 82 break bulk vessel and 18 barge trips would transport supplies to the proposed barge berth site. These vessels would likely be similar to those used for typical transport of materials that currently occur into Coos Bay. Currently, about 60 deep-draft commercial cargo ships and 50 barges arrive in Coos Bay per year; while the frequency of vessel traffic would increase during the two-year period, effects to marine resources would likely be similar to those that would normally occur from standard commercial vessel traffic. The types of effects would be similar to those described for LNG vessel traffic but likely less due to a reduced number of trips and smaller vessel size. See section 4.6.2.1 for details of analysis of LNG transport effects.

Vessel Strikes

These vessels have the potential to strike aquatic species, including sea turtles, marine mammals, seabirds, and shorebirds during their transit to and from the proposed Jordan Cove barge berth. Like LNG vessels, equipment supply vessels would be required to follow a *Ship-Strike Reduction Plan* and would likely be restricted to a reduced speed within Coos Bay. This would limit overall risk of vessel strikes for these vessels. However, the barge transport would have higher risk of marine mammal strikes than break bulk vessels as they would be paralleling migration routes along the coast area north and south of Coos Bay. Compared to current deep draft and barge transport to Coos Bay, there would be about a 50 percent increased risk of vessel strikes relative to current conditions for those two years of equipment transport. However, due to the small number of trips (about 18 round trips total over a two-year period), we conclude that the increased risk is not significant.

Ship Grounding

A ship grounding would have the potential to impact aquatic resources, as oil and fuel could leak from a grounded vessel. We conclude that it would be highly unlikely that a commercial equipment vessel transiting in the waterway would become grounded. All large commercial vessels visiting the Jordan Cove barge berth would have to adhere to Coast Guard regulations, including anchoring procedures offshore, in addition to the measures outlined in the WSA, WSR, and LOR. In most cases, a local pilot would be on board to guide vessels through the channel including accompanying tugs. Channel geometry of the navigation channel would also keep the vessel away from the shore.

Shoreline Erosion Waves and Propeller Wash

Shoreline erosion and effect of propeller wash would be slight from the increased number of marine vessel transport. The shoreline sediment transport model for LNG vessels projected an increase by 5 to 8 percent over existing conditions (wind-generated waves plus existing large vessel–generated waves). The effect of the barge vessels would be much less. Wave height generated on the shore from LNG vessels would be less than 0.3 foot compared to normal wind waves up to about 1 foot, with normal transport vessels about the same. The smaller vessel sizes of the barges should reduce the proportional effects of these barges on shoreline waves and erosion, making shoreline erosional effects inconsequential.

Propeller wash from docking vessels may disturb some local benthic organisms with scour based on models for the LNG vessels with a bottom area of likely less than 100 by 50 feet. The effect of the equipment supply vessels again would likely be less because of the smaller vessel size of the transport vessels. In addition, there would likely be no main channel effects due to shallower boat depth maintaining propeller wash well above the channel bottom. While some sessile benthic organisms may be displaced during transport vessel docking, the limited occurrence and magnitude of bottom disturbance and sediment suspension would result in unsubstantial effects on organisms in the slip.

Fish Stranding

Fish stranding from increased shipping is unlikely. Wave height generated on the shore from LNG vessels was estimated to be less than 0.3 foot with normal commercial transport vessels compared to normal wind waves up to about 1 foot. However, commercial vessel traffic may not have the channel speed restrictions that would be in place for LNG vessels. The lower speed has been found to reduce the chance of wave stranding events as was noted in studies on the Columbia River where events were only observed with vessel velocities greater than 8-9 knots, which commercial vessels may exceed in Coos Bay. While the chance of stranding events occurring from transport vessels may be greater than those from LNG vessels due to higher speed, the projected wave height, as noted and assuming effects would be the same as for LNG vessels, is still predicted to be low, likely much less than naturally occurring waves in the bay. While the vessel speed may be higher, the vessels are expected to be smaller; thereby minimizing wave height even at greater speeds. With wave height being low, and occurrence of susceptible fish (primarily young of the year juvenile Chinook salmon in the summer) infrequent, it is unlikely that increased equipment supply vessel traffic in the waterway would substantially contribute to fish stranding during the two years of supply transport.

Fuel Oil Spills

While increased vessel traffic would statisticall increase the risk of fuel oil spills, the overall change is unlikely to be a substantial increase in risk to Coos Bay estuary or marine aquatic organisms from the increased commercial vessel traffic. As noted in fuel oil spills for LNG transport, the rate of reported oil spills from vessels in the Oregon Coast area is very low, about 9 to 65 per year for the whole area where thousands of vessels travel annually. We conclude that fuel or oil leaks from additional commercial vessels transiting in the waterway to and from the Jordan Cove terminal during the two years of equipment transport are not likely to have adverse effects on aquatic resources.

Introduction of Nuisance Species

Some of the equipment supply vessels will originate in and return to foreign waters potentially increasing the chance of transporting exotic non-native species to coastal Oregon and Coos Bay waters and return ports. Current and future U.S. laws and Coast Guard and EPA regulations and economic considerations by the transport operators (see section 4.6.2.1) would reduce the risk of transport and discharge of nuisance species to local waters from both the hull and ballast water. As well, because equipment supply vessels will be arriving to unload equipment, ballast water would be most likely added from Coos Bay as the vessels unload, not discharged to local waters, further reducing the risk of potentially adding nuisance species. We have assumed that by compliance with these laws and regulations the commercial equipment supply vessels would not likely cause exotic nuisance species to be introduced into Coos Bay, U.S. waters, or the ports of destination of the returning cargo vessels.

Operation of the Jordan Cove Terminal and Potential Impacts on Aquatic Resources

Water Use by LNG Vessels at Berth

Jordan Cove estimates that about 90 LNG vessels would visit its terminal each year. While at the terminal dock for a period of about 17.5 to 24.5 hours, these LNG vessels would release ballast water while taking on LNG cargo. They also would take in water from the marine slip to cool their engines, and would slightly affect the temperature of the water in the slip due to either the release of warm water after engine cooling or contact with the cool hull after taking on LNG cargo. All of these activities could have effects on aquatic resources in the slip.

Ballast Water

LNG vessels would discharge ballast water into the slip after arriving at the terminal berth and taking on cargo. As explained in section 4.4.2.1, Jordan Cove estimated that an LNG vessel taking on cargo at its berth would discharge about 9.2 million gallons of ballast water into the marine slip during the 17.5 hours it would be hotelled at the terminal. Because the ballast water would have been taken on at sea, it might have slightly higher salinity than the water in Coos Bay that is feed from upstream fresh water sources. The tidal cycling of water in Coos Bay would reduce the impact of more saline seawater from ballast release in the slip on local aquatic resources. We estimate the total slip area to cover about 4.8 mcy (3.7 million m^3) of water. Therefore, the ballast water release would only amount to 1 percent of the entire size of the marine slip. By following Coast Guard and EPA procedures for ballast water, Jordan Cove and the LNG vessels visiting its terminal would probably not introduce exotic non-native organisms from a foreign port into Coos Bay.

Entrainment and Impingement from Vessel Cooling Water Intake

During operation of the terminal, LNG vessels at berth may entrain marine organisms through water taken from the slip to cool engines. Jordan Cove estimates that a 148,000 m^3 LNG vessel would take in about 6.1 million gallons (23,000 cubic meters) of water from the slip for engine cooling while at the terminal dock.

Currently, no additional screening system other than that already employed on the LNG vessels, is proposed for water intakes. The current screen bar spacing on most LNG vessels is about 24 millimeters (mm; about 1 inch) and the total open area (considering screen open area is about 80 to 90 percent of total intake size) of the cooling water intake is about 4 m^2 or 43 ft^2. Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. These screens would not meet NMFS (1997a) screening criteria for juvenile salmonids. The estimated velocity at the opening of the cooling water intake would range from 0.3 to 1.44 fps (0.09 to 0.44 meters/second), depending on the intake rate of cooling water used. NMFS recommends an approach velocity for screening systems for salmonids of less than 60 mm is 0.33 fps, and 0.8 fps for larger juvenile salmonids. These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. The result is likely to be that fish at least up to fry and possibly larger juvenile size salmonids near the intakes may be entrained or impinged during cooling water intake.

In addition, smaller marine and estuarine fish, juvenile stages of crab and shrimp, as well as other zooplankton and eggs and larvae fish could also be entrained. Some estuarine organisms potentially including juvenile salmonids would be removed from Coos Bay with this process during every loading cycle. It is expected that a high portion of juvenile larval stages of fish and invertebrates entrained or impinges would suffer mortality. Nevertheless, natural mortality of these early life stages is extremely high. The result would be less than 1 percent of earliest life stages reaching adult size, with natural mortality over 20 to 30 percent per day during earliest growth periods (Comyns et al. 2003). For example, data from an estuarine cooling water intake site determined that intake water larval stage entrainment, had very low natural survival (Marine Research Inc. 2004, as cited in FERC 2005). On a typical LNG vessel, the location of the water intake would be near the inner portion of the slip at depth of about 30 feet, which would likely reduce overall abundance of organisms in the intake area. Salmonids migrating in Coos Bay would more likely be swimming in the main channel, away from the shoreline and the inset slip, reducing their chance of encountering the LNG vessel intakes. Therefore, the off-channel artificially created marine slip at the Jordan Cove terminal would probably have a lower presence of fish than the rest of Coos Bay.

To make a reasonable estimate of potential loss from cooling water intake, we compared the relative amount of water used by an LNG vessel while at dock at the terminal to the amount of water carried by the tide in Coos Bay past the Project vicinity. There are several assumptions with this method; the three major ones are: (1) organism distribution would be similar in water used to that in the bay as a whole, (2) all organisms entrained would be lost to the system, and (3) no avoidance to entrainment would occur. In addition, the estimate of entrainment loss was compared to what typical natural mortality loss would be for invertebrate and vertebrate life stages that are common in zooplankton as potential salmonid food sources. This information provides a perspective of how entrainment loss may influence food supply relative to natural conditions. This approach was developed in the Shanks et al. (2010, 2011) documents.

The period at the dock would span approximately two tidal cycles (each tidal cycle takes approximately 12 hours). An approximation of spring high tide water exchange in the Project vicinity over one complete high and low tide cycle is 122.5 million m^3 based on data from the SHN Consulting Engineers and Geologist, Inc., technical memo (see Shanks et al. 2010, 2011). Neap tides (tides that occur when the difference between high and low tide is least) are less; however, these were not directly measured. Shanks et al. (2010, 2011) estimated the volume of water passing through Coos Bay in the vicinity of the Jordan Cove terminal during lower tidal levels to be 106 million m^3. Assuming tidal values would mostly vary between two ranges the average volume passing the LNG terminal would be about 2 times 114.25 million m^3. Using the conservative figure of 114.24 million m^3 for water in Coos Bay, we estimate that from 0.02 to 0.03 percent of the water near the marine slip would be taken in for engine cooling while an LNG vessel is at dock at the terminal, based on average tidal exchanges. Theoretically, organisms in this entrained water would be lost to the Coos Bay system and therefore not available as a food source.

The loss of these organisms from entrainment can also be compared to loss from natural mortality in the bay environment. Instantaneous natural mortality rate (per day) can be defined by the function: $M = \ln (N_0/N_t)/-t$, where M is instantaneous mortality rate, and N_0 and N_t are the initial and final abundance of larval after time t (Rumrill 1990). The comparison between entrainment and natural mortality loss of potential larval food organisms was made assuming 100 percent mortality of all organisms entrained during water intake and all mortality occurred during a single day. Additionally, it was assumed that all pelagic zooplankton in the project area during water exchange on an average day (i.e., 114.25 million m^3) suffered one day's natural mortality at the rate determined in the literature.

Rumrill (1990) provides estimates of mortality rates for a variety of marine invertebrate larval and in some cases through juvenile stages. McGurk (1986) supplies similar information for a variety of larval stages of marine fish. These values provide the bases for comparison of potential Project entrainment loss to that from natural mortality. Rumrill (1990) supplied estimates of morality rate using two methods with different data sets. One set is based on the contrast between larval production and subsequent recruitment, and the other is based on the monitoring of larval cohort in the plankton. The lowest and average mortality rates from Rumrill (1990) and McGurk (1986) are shown in table 4.6.2.2-3 for invertebrates and fish larvae. Invertebrate 1 and 2 in this table refer to the two respective rate groups from Rumrill (1990). Average and lowest mortality rates data for larval invertebrates and larval fish from these two sources were similar. Average loss of organisms from entrainment during one LNG vessel loading event would be low, ranging from 0.1 to 0.2 percent of what would occur from natural morality in one day. For the lowest literature mortality rate of larval taxa among those reported, daily entrainment loss would be much higher ranging from 0.7 to 1.8 percent depending on what water volume was used during one vessel loading cycle and which taxa group data are used. These values are conservative estimates when compared to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would.

TABLE 4.6.2.2-3

Comparison of Relative Loss of Larval Invertebrates and Larval Fish from Entrainment to Natural Mortality During Cooling Water Intake for One LNG Vessel Docked at the Jordan Cove Terminal

Mortality Category in Literature Source	Taxa Group b/	Sample size	Natural Mortality Rate M (daily)(M=ln(S)/-t) c/	Estimated Percent Loss from Entrainment Relative to Daily Loss from Natural Mortality a/	
				Low Intake	High Intake
Lowest	Larval Invertebrate 1	14	0.0305	0.7%	0.9%
Lowest	Larval Invertebrate 2	28	0.0161	1.0%	1.8%
Lowest	Larval Fish	29	0.0200	1.0%	1.4%
Average	Larval Invertebrate 1	14	0.1450	0.2%	0.2%
Average	Larval Invertebrate 2	28	0.2470	0.1%	0.1%
Average	Larval Fish	29	0.1969	0.2%	0.2%

a/ Values based on average daily Coos Bay tidal water exchange rate of 114,250,000 m^3, and one LNG vessel water intake of 22,800 m^3 (low) and 31,900 m^3 (high). Assumes 100% mortality of entrained organisms.
b/ Sources: Invertebrates from Rumrill (1990), and fish from McGurk (1986).
c/ S= Survival, t=days, ln=natural log base e

Because about 90 LNG vessel trips a year would occur, LNG loading and water intake use would occur on average every 4 or 5 days. Therefore, relative fish food organism loss from entrainment annually would be considerably less than that estimated. Overall reduction in food sources for marine predators from entrainment of planktonic organisms appears to be slight, considering various factors. On average, water intake would be less than 0.03 percent of the water in Coos Bay passing by the terminal location on a daily tidal cycle, so relatively few organisms would be subject to entrainment assuming similar planktonic organism distribution at the intake. Typical "loss" on average would be about 0.2 percent or less of loss from natural mortality of invertebrate and fish larvae during the day of LNG cargo loading. Even though the number of fish individuals lost is not expected to be large, some mortality would occur. It is expected that the greatest portion of organism and fish that would be entrained would likely be early life stages, as these are unable to avoid entrainment. As noted above, natural mortality is high for these early stages.

We also considered what effect the direct loss of young stages may have on production of older individuals. EPA (2004) examined the effects of entrainment by California power plants on marine fish and shellfish. The document developed natural mortality information by life stage of common marine and estuarine species or groups of species present in the California coastal region. Many of the species groups are common to Coos Bay. This information supplies an additional indication that loss of early life stages because of high natural mortality would not markedly reduce later life stages. Table 4.6.2.2-4 shows the relative survival percent from one life stage to the next up to age 2, and overall percent survival from larval to age 1 and 2, based on the EPA (2004) document. For most taxa, less than 1 percent of larvae would be expected to survive to age 1, as the highest rate of mortality occurs in early life stages. Adult or harvestable populations of a fish species are also affected by many factors (e.g., currents, food, temperature, usable habitat) that are generally independent of numbers or survival of early life stages. Overall, the loss of marine fish and their prey resources from entrainment, relative to numbers in Coos Bay, would be small based on the information discussed.

TABLE 4.6.2.2-4

Selected Survival Values by Life Stage of Marine Species That May Be Entrained or Impinged

Taxa Group/Species b/	Percent Survival by Life Stages a/				
	Larvae to Juvenile	Juvenile to Age 1	Age 1 to Age 2	Larvae to Age 1	Larvae to Age 2
Anchovies	0.03%	12.00%	49.66%	<0.01%	<0.01%
Longfin Smelt	0.17%	40.01%	51.17%	0.07%	0.03%
Pacific Herring	0.90%	50.01%	62.31%	0.45%	0.28%
Other Forage Fish	0.05%	27.53%	19.79%	0.01%	0.00%
Flounder	0.19%	31.98%	69.56%	0.06%	0.04%
Rockfish	36.79%	36.79%	80.65%	13.53%	10.92%
Cabazon	1.87%	40.01%	26.18%	0.75%	0.20%
Sculpins	2.26%	40.01%	65.70%	0.90%	0.59%
Dungeness Crab	30.12%	30.12%	60.65%	9.07%	5.50%
Commercial Shrimp	4.98%	11.53%	11.53%	0.57%	0.07%
Forage Shrimp	0.31%	41.85%	33.29%	0.13%	0.04%
Average	**7.06%**	**32.90%**	**48.23%**	**2.32%**	**1.607%**
Median	**0.90%**	**36.79%**	**51.17%**	**0.45%**	**0.07%**

a/ Values based on natural mortality rates by life stage.
b/ Groups include multiple species defined in Appendix B1 of EPA (2004).

Loss of juvenile salmonids from entrainment or impingements could also reduce adult returns. Survival from smolt stage is highly variable among salmonid size, species, and year and easily can range from less than one to more than 10 percent. NMFS (2008) in their assessment of effects of the Coos Bay airport expansions used a value of 4 percent survival for coho salmon smolts to returning adults. Even so, due to the extremely small portion of total water intake relative to the volume of Coos Bay, likely intake locations (30 feet deep, in the back of the isolated slip) likely away from concentrations of juvenile salmonids, the relative portion of juvenile salmonids that would be entrained and suffer direct mortality would be small.

Overall, the extremely small portion of total water intake relative to the volume of Coos Bay suggests that the loss of zooplankton and icthyoplankton, other marine invertebrates, eggs, larvae, shellfish, and fish including juvenile salmonids due to operation of the Jordan Cove Project would be low in comparison to total available entrainable size organisms in the bay and occurring from natural mortality. Therefore, we conclude that entrainment and impingement from water intake of an LNG vessel at berth at the Jordan Cove terminal would not have substantial adverse effects on marine phase of aquatic resources or their food sources.

Water Temperature in the Slip and Bay

LNG vessels at berth at Jordan Cove's terminal have the potential to both warm the temperature of the marine slip while discharging engine cooling water, and to cool the temperature of the marine slip while loading LNG cargo. Moderate to large temperature increases have the potential to reduce fish and invertebrate growth, reproductive success, and if high enough cause direct mortality. Fish of the north Pacific, including those found in Coos Bay, are adapted to cool water conditions and could be adversely affected by sharp increases in water temperature. Coos Bay temperatures historically remain less than 20°C (McAlister and Blanton 1963).

To cool engines while at dock, LNG vessels may take on about 6.1 million gallons of water from the marine slip. After running this water around its engines, the cooling water would discharged back into the slip at a higher temperature than when first removed. The estimated water temperature of the discharged water would be about 3°C (5.4°F) warmer than ambient water temperature at the discharge port and would be reduced through dilution within a narrow plume to 0.3°C (0.6°F) warmer than ambient within 50 feet of the vessel. Based on an estimated volume of the slip area of 4.8 mcy (3.7 million cubic meters), the average water increase for the total slip volume during one day when an LNG vessel is at dock would range from 0.03 to 0.06°F.

We expect the actual average increase in water temperature in the slip would be less than the higher value estimated. First, tides would be continually exchanging the water, about 25 percent each tidal cycle. Second, LNG cargo loading would cool the temperature of the water around the vessel (possibly in the range of 20 percent reduction of temperature increase). The cooling would be a result of actual vessel hull cooling from the addition of LNG into the vessel at -260°F (-162°C). The cooling vessel hull would absorb heat from the water. Thus, based on estimates of total quantity of heat (in BTUs) in cooling water discharged, it was estimated that the cooling hull would absorb an equivalent of 20 percent of the total quantity of heat gained to the slip.

The modified water temperature would be well below levels that would be considered lethal in the short term (a few days) for salmonids, which would be over about 24 to 26°C (WDOE 2002). While optimum temperatures are much lower for salmonids, short-term local temperature increase would remain well below short-term adverse levels, and any small concentrated changes in temperature including within 50 feet of the discharge port would be easily avoided by fish. Therefore, the cooling water discharge should result in no adverse effect on fish resources from temperature changes. Considering the total volume of water in Coos Bay in comparison to the small volume of heated water discharged, virtually no change in bay temperature would occur from operation the terminal.

Water Runoff and Spills of Hazardous Materials

After construction of the terminal, about 34 acres would be covered by impervious surfaces. There is the potential for stormwater to run off these hard surfaces into the marine slip or bay, carrying sediment or hazardous materials, which may harm aquatic resources. As mentioned in section 2.1.1.10, Jordan Cove would design and construct a stormwater drainage and collection system for its terminal. Stormwater from areas that have no potential for contamination would be allowed to flow into the slip. Stormwater collected in areas that are potentially contaminated with oil or grease would be directed to sumps and then processed through an oily water separator before discharge to the industrial wastewater pipeline.

All areas where LNG may be present would be curbed and graded so that any spill would flow to containment trenches leading to impoundment basins. The two LNG storage tanks would be surrounded by a 65-foot-high barrier.

Any spills of hazardous materials would be handled in accordance with Jordan Cove's SPCCP. We conclude that Jordan Cove has measures in-place to prevent contaminated stormwater and hazardous materials from entering the bay and adversely affecting aquatic resources.

Terminal Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004; Nightingale and Simenstad 2001a). Disorientation may cause delays in migration, while avoidance responses may cause diversion of migratory routes into deeper, less protected waters. In some cases, increased light may attract both predators and potential prey species (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004). Juvenile coho salmon show no response to moderately high light intensity, but become inactive in very low light (Hoar et al. 1957). In contrast, schools of juvenile chum salmon show marked preference for light, while juvenile sockeye prefer the dark. Depending on their reaction, fish may have migration delayed, be moved into less protected deepwater habitat, or they may become more susceptible to predation, as light increases predators' ability to see fish and also may be attracted to the area. Some adverse modification in fish behavior could occur from the lighting present at the terminal, possibly delaying migration, moving fish to less desirable habitat conditions, or subjecting juvenile fish to greater nighttime predation.

Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. The facility would have its highest intensity lighting on shore away from the water, although some lower level lighting would be present near the water. Lighting on the tug dock would be low intensity lighting adequate for safety. No high intensity lighting would be present near the water except possibly during vessel docking. When an LNG vessel is not in the berth, the lighting would be reduced to that required for security and would be focused upon the structures and not be in proximity to the water; therefore, the lighting would not serve as an attractant or deterrent to fish species. When an LNG vessel is at the berth, it would physically block the lighting on the berth from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth. Lighting used would be similar to that already in place at other Coos Bay facilities.

The location of the facility, set back from the main channel of Coos Bay, would reduce fish encountering any shoreline lighting effects. The reduced lighting levels near the water should reduce any behavioral effects to fish near the terminal. As mentioned above, we have recommended that Jordan Cove develop the details of its final lighting plan in consultations with the FWS, NMFS, and ODFW to minimize potential impacts on aquatic resources.

Maintenance Dredging

Jordan Cove has estimated that the volume and frequency of maintenance-dredged material from the slip and access channel would be approximately 115,000 cy every 3 years for the first 9 to 12 years, and 115,000 to 160,000 cy every 5 years thereafter. This equals a removal rate of about 36,000 cy per year for the first 10 years and 33,000 cy per year for the next 10 years. This rate is much less than the annual amount that the COE removes from NCM 2 to 12 (200,000 cy per year). This dredged material may be placed at disposal Site F outside the mouth of Coos Bay (see section 2.1.4 and figure 2.1-11).

Modeling conducted by Jordan Cove and the Port (Moffat & Nichol 2006a) suggests a very narrow range of elevated suspended sediment (greater than 100 mg/l) during low tidal velocity extending out a few hundred feet from where the maintenance dredging would occur in Coos Bay using a mechanical (clamshell) dredge. The highest concentration levels would occur at lowest tidal velocity when dispersion of suspended sediment would be the least. Peak value at the lowest modeled tidal velocity—the point of clamshell dredging—is estimated to be 830 mg/l, with decreasing values away from the actual dredging site to about 125 mg/l at 200 m (660 feet) from the site. During typical tidal cycles, turbidity would be up to 75 mg/l out about 0.2 to 0.4 mile from the dredging site. Moderately low values of 25 to 50 mg/l may extend out to about 3.5 miles depending on flow, sediment composition, and equipment used, for brief peak periods (about 2 hours daily). During high current velocity, peak values at the point of dredging would be about 90 mg/l, decreasing to 25 mg/l in 100 m (330 feet). Average daily (24-hour) values outside of the direct area being dredged would remain in the range of seasonal background levels of 25 to 50 mg/l during the ODFW-allowed dredging window. The number of days dredging would occur would depend on details of equipment used but would likely range from a few days to about a month of dredging to remove about 115,000 cy every three years (COE 2011).

Fish are likely to move from this narrow band of elevated suspended sediments during peak occurrences for short durations during dredging (likely several hours over the largest area affected). Additionally, some benthic organisms (e.g., clams, shrimp, and tubeworms) would be removed during this dredging. Maintenance dredging would occur in October to correspond to the Coos Bay in-water work window and the EPA recommended disposal period for Site F (June 1 through October), which would also avoid major juvenile salmonid presence in the region.

The distribution and location of dredge material deposited at Site F are planned by the COE and EPA, including Coos Bay maintenance channel dredging, to meet anticipated needs and to help extend the effective useful life of Site F. The COE develops annual disposal plans, based on the anticipated volume to be disposed of that year. These annual plans are developed in accordance with the EPA and COE's *Site Material Management Plan*, which is updated every 10 years, based on current bathymetric and environmental characteristics. If additional non-COE disposal is proposed, the COE will produce a disposal plan for that event.

However, the size and characteristics of Site F would allow additional disposal beyond that currently planned (EPA 2006a). Due to non-redistributed mounding in the past at this site, there is some concern about adding additional unplanned dredge materials at Site F that may mound to less than 50 feet deep, a depth consider minimum for safe ship passage (EPA 2009). The planning process and management has been developed and defined in the site management and monitoring plan for Site F. Current average annual disposal at Site F is about 858,000 cy, so maintenance-dredge discharge during the year it occurs would be about a 13 to 19 percent increase every three to five years, or the equivalent of about 4 percent per year over existing disposal.

Changing of the habitat conditions at Site F resulting from "mounding" is also a concern. Should this occur, it may alter normal habitat conditions found in this area, and as noted above may be a shipping hazard. However, bathymetric and photographic surveys would be used to select disposal sites to ensure this does not occur as a result of project site maintenance dredging. The large size of Site F would allow disposal locations to be selected to eliminate or greatly reduce mounding. Maintenance dredge materials, if evenly distributed, would equal about 0.3 inches (0.8 cm) additional sediment to the total area of Site F every three to five years, a relatively small sediment depth change.

The placement of the maintenance-dredged material at Site F would result in periodic impacts to primarily benthic marine organisms, but these impacts would be short term due to rapid recolonization on a small bottom area. Some direct mortality would occur to benthic and slow-moving organisms from burial during disposal at Site F. This may include very early juvenile stages of the locally abundant flatfish, sanddab. Thus, some turbidity would occur from disposal, possibly causing temporary fish avoidance of the region and inhibiting primary production. However, the high energy of the region would rapidly dissipate turbidity plumes generated from discharge, reducing these effects to short term and temporary. Testing of sediment for contaminants occurred under an approved SAP in October 2006, and the sediment has been found to be suitable for clean disposal based on the DMEF of the EPA and COE.

Operational Acoustic Effects

LNG vessel and tug operations along the waterway, operational noise at the terminal, and maintenance dredging would generate underwater sounds pressure levels that could elicit responses in aquatic organisms. The intensity of the sound pressure levels from vessel traffic and dredging activities can vary considerably. However, sound pressure levels are generally in the range of 112 to 160 dB, intensities that may influence organism behaviors or perceptions but are not great enough to cause physiological damage (Richardson 1995; Hastings and Popper 2005; Fisheries Hydroacoustic Working Group 2008). State agencies in Washington, Oregon, and California along with federal agencies have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2011; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered to be levels below which injury effects would not occur to fish from in water noise. These thresholds should be thus suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2 s for fishes more than two grams, 2) a SEL_{cum} of 183 dB re 1 μPa^2 s for fishes less than two grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 μPa for all sizes of fishes (WSDOT 2011). The LNG tanker in the Hatch et al. (2008) study produced sound levels (with one standard error) of 182 ± 2 dB re: 1 μPa @ 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters (Hatch et al. 2008). These vessel noise levels are therefore generally less than threshold levels considered to cause direct harm to fish. Upland operational noise may also travel over water, but is not likely to affect fish, although there may be impacts on marine mammals close to the terminal.

Generally, response to noise impacts would be behavioral and perceptual, and not physiological in nature, as fish and marine mammals would tend to avoid the area during periods of high noise output. We conclude that operational noise would not have significant adverse effects on aquatic resources.

Essential Fish Habitat and Impacts at the Proposed LNG Terminal

EFH and species present in Coos Bay, including near the LNG terminal, are described in detail in section 4.6.2.1, and additionally for Site F above. EFH effects from construction and operation of the LNG terminal and maintenance dredging are summarized in table 4.6.2.2-5. Three habitat types occur within the slip site that would be affected by the slip and access channel that are tidally influenced and function as EFH: the shoreline habitat, SAV, and the open water of Coos Bay. The effects of the LNG terminal and Site F disposal on aquatic resources as described above also apply to EFH species.

TABLE 4.6.2.2-5

Potential Impacts to EFH due to LNG Terminal Construction and Operations

EFH	Description of EFH a/	Project Actions and Potential impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500-meter (1,914-fathom) depth.	• Dredging of 29 acres of estuarine habitat in Coos Bay • Potential food and larval organism impingement/entrainment • Periodic channel dredging and disposal • Accidental spills of hazardous substances	Substantial adverse effects to multiple groundfish species (e.g., rockfish, English soul, Starry flounder) EFH (see section 4.6.2.2 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50°F and 79°F.	• Dredging of 31 acres of estuarine habitat in Coos Bay • Accidental spills of hazardous substances • Periodic channel dredging and disposal • Potential food and larval organism impingement/entrainment	Substantial adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see section 4.6.2.2 for impacts and mitigation)
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Dredging of 31 acres of estuarine habitat in Coos Bay • Accidental spills of hazardous substances • Periodic channel dredging and disposal • Potential food organism impingement and entrainment • Potential impingement and entrainment	Substantial adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see section 4.6.2.2 for impacts and mitigation)

a/ PFMC (2006; updated version July 24, 2006)

Approximately 31 acres of EFH within Coos Bay would be affected by the dredging of the access channel and barge berth. This includes approximately 4 acres of intertidal unvegetated habitats, about 4 acres of algae/mud/sand flats, about 3 acres of eelgrass, and 15 acres of deep subtidal habitat. Other than the deep subtidal habitat, the remaining 16 acres of shallow water habitat including 3 acres of SAV eelgrass beds (figure 4.6-2) would be lost as a result of the dredging. Less than an acre of additional estuarine habitat would be lost due to other project-related construction in the bay. While the construction of the access channel and slip would adversely impact EFH through loss of this narrow band of SAV, the potential adverse impacts on EFH would not be substantial.

Several of the EFH species known for Coos Bay are not present in the vicinity of the Jordan Cove terminal. Rockfish and lingcod have not been seined by ODFW near the terminal location; however, they are known to be present in the bay. Juvenile chilipepper, copper, grass, yellowtail, and kelp greenling were captured near the mouth of Coos Bay only, so habitat they utilize within the bay would be unlikely to be disturbed by the terminal.

During operation of the terminal, LNG vessels at the berth could entrain or impinge aquatic species while taking in engine cooling water. This could result in mortality to early life stages and juvenile species and their local food organisms. However, this impact would not be substantial for EFH species.

A small portion of the 2,700-acre sand/fine sediment bottom nearshore ocean benthic habitat at Site F just off the mouth of Coos Bay would be affected every three to five years from disposal of maintenance dredge material. While some of each of the three management groups have been documented near the Site F dredge disposal site (18 groundfish, 2 coastal pelagic, and 2 Pacific salmon), abundance appears low for many of these species in this area. The uniform high-energy bottom area may restrict high benthic species abundance as well, as indicated by surveys of the region. Impacts to this region are expected to be low from the additional deposition because of the limited use of this region and overall small contribution of sediment amount and frequency relative to total available site area, and plans to distribute sediment to avoid mounding, and maintenance of clean sediment quality added. In addition, the site has been approved as a standard dredge disposal site by EPA partly because impacts to EFH would be limited at this site.

All associated activities, including construction and operation of the LNG terminal, dredging of the slip, maintenance dredging of the channel, and docking and loading of marine vessels, carry the risk of accidentals spill or leaks of hazardous substances occurring. Should these occur, they could have minimal adverse effects to coastal pelagic, groundfish, or Pacific Coast salmon species that may be present near the spill. Effects would be slight because of the procedures that would be in place in Jordan Cove's SPCCP to reduce the chance of spills occurring and magnitude of a spill should one occur.

EFH Conservation and Mitigation Measures for LNG Terminal Construction and Operation

The following measures would be implemented to minimize impacts on EFH from construction and operation of the Jordan Cove terminal:

- the bulk of the slip construction would take place in isolation from Coos Bay by maintaining a portion of the existing shoreline as a berm;
- all dredging in Coos Bay during construction of the marine slip and access channel would occur during the ODFW preferred work windows (October 1 through February 15) to minimize effects on vulnerable life stages of important fish species;
- an SPCCP would be implemented;
- Jordan Cove would develop about 8 acres of new eelgrass habitat at a site in Coos Bay near the Southwestern Oregon Regional Airport to mitigate for the loss of 3 acres of eelgrass removed during construction of the access channel to the terminal;
- about 47 acres of subtidal and intertidal habitats would be restored at the Kentuck Slough site, to mitigate for about 10 acres of intertidal mudflats, about 3 acres of shallow subtidal habitat, less than 1 acre of salt marsh, and other Coos Bay sites affected by construction of the access channel, marine slip, barge berth, and other Coos Bay areas;
- primarily sand and clean materials from maintenance dredging of the access channel and marine slip would be disposed at ocean Site F and nearshore areas to augment North Jetty and Coos Bay-Umpqua beach/dune system;
- disposal locations with ocean Site F would be staggered to allow maximum recovery of sites and dilute impacts, and bathymetric and photographic surveys would be used to select disposal sites; and
- routine bathymetric and photometric monitoring of dredge discharge sites would be conducted to properly locate disposal sites.

4.6.2.3 Pacific Connector Pipeline

The Pacific Connector pipeline would cross or affect 263[98] waterbodies (excluding ditches): 106 perennial streams, 151 intermittent streams, 5 ponds (i.e., 3 stock ponds, 1 excavated pond, 1 natural pond), and Coos Bay (1 crossing). Available data indicate that about 88 of these waterbodies are known or assumed to be inhabited by fish. Appendix O, table O-2, lists information on waterbodies crossed or potentially affected, other than ditches and ponds, and known fish distribution and classification relative to the crossing.

Aquatic Habitat in the Coos Bay Estuary

The pipeline would cross about 2.5 miles of Coos Bay, the largest estuary completely within Oregon. Coos Bay consists of about 14,000 acres of varied intertidal and subtidal substrate habitat conditions including algae beds, eelgrass sites, marsh lands, and mostly unconsolidated substrate. The upper Coos Bay estuarine habitat contains important rearing habitat supplied by estuarine wetlands, algae, and eelgrass beds, which are important conditions for estuarine fish and migratory salmon, as well as commercial oyster beds. The estuarine habitat of the Coos Bay estuary along the pipeline route is located in mostly shallow regions of the Haynes Inlet part of the bay (see figure 4.6-1). Most of the route and associated work areas are in about equal amounts of shallow intertidal and subtidal fine bottom and unconsolidated bottom habitat, with a few regions of mixed seabed of eelgrass, attached algae, and tidal marsh. The fisheries in these habitats include a mix of anadromous and marine species, as well as shellfish, and are described above in section 4.6.2.1.

Aquatic Habitat in Inland Waterways

The freshwater streams crossed by pipeline route include six major subbasins of rivers in southern Oregon. The aquatic habitat crossed by the pipeline outside of Coos Bay is primarily coldwater streams, but with a few warmwater ponds adjacent to the pipeline. Most stream riparian areas crossed are heavily forested, and are therefore shaded by conifer trees, providing typical salmon and/or trout habitat. Several waterbodies crossed are large (over 100 feet wide), but the majority are small waterbodies with generally low flow. Most of the major streams and many of the minor streams crossed contain salmon and steelhead, some of which are federally listed as threatened fish species.

Fishery Types

Fish species present in the pipeline area can be classified as warmwater, coolwater, coldwater resident, anadromous, and estuarine. Coldwater resident and anadromous streams are the most common along the pipeline route and associated facilities other than in Coos Bay estuary, while warm water species are typically associated with ponds in southeast Oregon.

Warmwater, Coolwater, and Coldwater Fish

Typical warmwater species in the pipeline area include black and white crappie, and brown bullhead, which are not native to the region. Warmwater species are present in several lakes near

[98] This number includes waterbodies adjacent to but not crossed by the pipeline that may be affected by construction activities. The pipeline would actually cross 211 waterbodies. Number of waterbodies affected differs from that in section 4.4 because that section includes ditches.

the route and are present at pipeline crossing areas, and are likely in some Klamath Basin streams crossed by the pipeline.

Coolwater fish present in the project area include both non-native and native species. Some important non-native species include smallmouth bass and yellow perch. These fish are often present in lakes, and smallmouth bass may be found in some larger rivers. Other native coolwater species of note include the Lost River sucker, shortnose and Klamath largescale suckers, and blue chub. These latter species occur primarily in the Klamath Basin, in Upper Klamath Lake and its tributaries. Umpqua chub are a species of concern, as this fish species has declined precipitously in the last decade. The pipeline would cross habitat occupied by Umpqua chub. Lost River and shortnose suckers that are listed under the ESA are discussed in section 4.7.

Resident coldwater fish species spend their entire lives in fresh water. Various waterbodies crossed by the Pacific Connector pipeline provide year-long habitat for several resident coldwater fish species. Resident cutthroat trout, rainbow trout, and redband trout are the most common resident coldwater game species along the route. Non-game fish species, some of which migrate between freshwater and marine habitats (e.g., threespine stickleback), and others that are freshwater residents (e.g., speckled and longnose dace, sculpins, chiselmouth, sucker) also may occur in waterbodies in the pipeline area.

Anadromous Fish

Anadromous fisheries in the pipeline area comprise eight species: Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, and green sturgeon (see section 4.6.2.1). Additionally, the Oregon Coastal Coho Salmon ESU listed under the ESA is present in the Coos River Basin and federally listed Southern Oregon/Northern California Coastal Coho Salmon ESU is present in the Rogue River system of the pipeline route (see section 4.7). On July 18, 2008, the Oregon Fish and Wildlife Commission approved the State plan to initiate an effort to re-establish anadromous fish into the Oregon portion of the Klamath River Basin. Although there is no definite timetable, this could result in the ESA-listed Southern Oregon/Northern California coho salmon ESU being present in the Klamath River system upstream of currently impassible Iron Gate Dam at some point in the future. Additionally, a settlement agreement was signed by 45 organizations on February 18, 2010, that includes agreement to restore anadromous fish to this basin, which is currently blocked by dams and diversions. Section 4.6.2.1 summarizes most of the major runs of anadromous salmon, steelhead, and trout species within the pipeline project area and their general timing of life phases.

Marine (Estuarine) Fish

The marine species that may be present along about 2.4 miles of the pipeline route where it would cross Haynes Inlet between about MPs 1.7 and 4.1 are the same as those discussed above for the Coos Bay portion of the waterway for LNG vessel marine traffic to and from the terminal (section 4.6.2.1). However, only fish adapted to tolerance of lower salinity conditions would normally be present because of the influence of freshwater in this region.

Marine (Estuarine) Shellfish

Major invertebrate taxa present in Coos Bay are described in section 4.6.2.1. Invertebrate groups include pelagic (in the water column), epibenthic (residing on sediment surface), and benthic (residing within the sediment) organisms. Pelagic invertebrates include juvenile and larval stages of many species, such as crab, shrimp, clams, worms (polychaetes) as well as adult and juvenile crustacean zooplankton (e.g., copepods). Epibenthic organisms including harpacticoid copepods, snails, amphipods, mussels, oysters are all present to varying degrees. Benthic organisms include clams and the most abundant polychaetes and amphipods, the latter an important food for juvenile salmonids.

Estuarine Oysters

There are two different types of oysters identified along the pipeline route across Haynes Inlet between MPs 1.7 and 4.1: 1) commercially grown non-native Pacific oysters (*Crassostrea gigas*); and 2) native Olympia oysters (*Ostrea lurida*). Neither species can be legally harvested for recreational purposes. Native oyster populations are state-protected to encourage their recovery. Pacific oysters are the private property of their commercial growers.

Four companies lease state lands within Coos Bay to raise Pacific oysters commercially. They seed their beds with juvenile oysters (spat) and later harvest adults. These commercial beds are located on the north and east side of Coos Bay from Glasgow Point (north) to Crawford Point (south). Another commercial oyster operation is in South Slough.

Olympia oysters can be found in the subtidal and intertidal zones of Coos Bay from Haynes Inlet south to Isthmus Slough. Pacific Connector surveyed nearly 7,000 feet of relatively shallow intertidal habitat for Olympia oysters along the pipeline route in Haynes Inlet during late June 2011. Olympia oysters were found growing on riprap at the mouth of Haynes Inlet and on substrates within the pipeline right-of-way. Forty-seven oysters were documented within the right-of-way in addition to oysters present in a 1,400 square foot reef. An overall estimate of oysters that may occur within the pipeline right-of-way is between 100 and 1,000 oysters (Ellis Ecological Services 2011).

Both commercial Pacific oysters and native Olympia oysters could be affected by pipeline construction. There could be oil or fuel leaks from construction equipment. Pacific Connector would implement the measures outlined in its SPCCP to avoid or reduce impacts from an equipment oil or fuel leak. Pacific Connector has routed the pipeline in Haynes Inlet to avoid direct impacts on commercial oyster beds, and the route is not in or near commercial beds except between MPs 2.9 to 3.2 where commercial beds are adjacent to the route. The pipeline would be installed across Haynes Inlet using an open cut, as described in section 4.4.2.2 above in this EIS. Oysters may be affected by turbidity and sedimentation caused by pipeline construction in the bay. Impacts on commercial oyster beds are discussed in section 4.9.2.8 below in this EIS.

Marine Mammals

The marine mammals that may be present along the pipeline route within Haynes Inlet are the same as those discussed for the Coos Bay portion of the waterway for LNG vessel transit to and from the terminal (see section 4.6.2.1), with the exception of large whale species that only inhabit the deep, open ocean. It is possible that killer whales and pinnipeds could be found in Coos Bay. The potentially present marine mammals are protected under the MMPA and were included in Jordan Cove and Pacific Connector's IHA application to NMFS on October 8, 2014 (Jordan Cove and Pacific Connector 2014).

Freshwater Mussels

Limited native freshwater mussels may be present in some streams along the route. Only eight native mussels are present west of the Continental Divide, most of which belong to the genus *Anadonta* (Nedeau et al. 2009). This genera tends to be more often in lakes and pond and quiet pools but may found in swifter waters in protected areas without current sheer. Another species, the Western pearlshell (*Margaritifer falcate*), while most common in large streams can be found in cold small streams only a few feet wide (Nedeau et al. 2009). The distribution relative to the project crossing for mussels species in not known; however, it is possible that some may be present near crossings, especially in larger, low-gradient streams. Two sensitive species (see appendix O) may be present in streams along the route: California floater mussel (*Anadonta californiensis*) and Western ridged mussel (*Gonidea angulata*). The second species is also addressed in the Forest Service's Biological Evaluation (BE; appendix L of this EIS).

Status of Fish in the Pipeline Project Area

The status of federally listed fish species and other commercial fish species that are managed under the MSA is presented in our BA and EFH Assessment (FERC 2015) submitted to the FWS and NMFS. Effects to EFH along the Pacific Connector pipeline route are summarized below. Endangered and threatened species and other special status species are addressed in section 4.7. The status of other state-listed fish species and fisheries of concern are also discussed in section 4.7.

ODFW (2005) has evaluated the status of salmon and steelhead, trout and other selected species of interest. This document did not address all species that may be of concern along the route. The assessed status or risk of these stocks is based on the threat to the conservation of unique groups of populations in the near-term (5 to 10 years) period (see section 4.6.2.1 for criteria details). The species categorized as to status by ODFW are called SMUs. The pipeline route crosses six major subbasins (i.e., USGS hydrologic units). Each of these subbasins include from 1 to 10 SMUs. The ratings of each of the SMUs that correspond to these subbasins are shown in table 4.6.2.3-1. The pipeline would cross a total of 20 SMUs distributed among the six subbasins. The number ranges from 10 SMUs in the Coos hydrological unit to one SMU in the Lost River hydrological unit. A specific SMU population that may be present near an individual crossing area varies within these subbasins.

TABLE 4.6.2.3-1

Status Rating of Fish Populations by Major Subbasins Areas Crossed by the Proposed Pipeline

Group	Species Management Units (SMU)	Risk Category by SMU	Risk Criteria by Subbasin Populations					
			Coos	**Coquille**	**South Umpqua**	**Upper Rogue**	**Upper Klamath River**	**Lost River**
Coho Salmon	Coastal	Not at Risk	None	None	None			
	Rogue	Not at Risk				None		
	Klamath	Extinct					Extinct	
Fall Chinook Salmon	Coastal	Not at Risk	Reproductive Independence	None	None			
	Rogue	Not At Risk				None		
Spring Chinook Salmon	Coastal	At Risk	Extinct	Abundance and Production	Abundance and Production			
	Rogue	Potentially At Risk				Reproductive Independence		
	Upper Klamath	Extinct					Extinct	
Chum Salmon	Coastal	At Risk	Extinct					
Winter Steelhead	Coastal	Potentially at Risk	Reproductive Independence	Reproductive Independence	None			
	Rogue	Not at Risk				None		
Summer Steelhead	Rogue	Not at Risk				None		
	Klamath	At Risk					a/	
Redband Trout	Upper Klamath Basin	At Risk					b/	Distribution and Abundance and Production
Cutthroat	Oregon Coastal	Not at Risk	None	None	None			
	Southern Oregon Coastal	Not at Risk				None		
Other Species of Interest d/	Pacific Lamprey	At Risk	Abundance and Production	Abundance and Production	Abundance and Production	Abundance and Production		
	Western Brook Lamprey	At Risk	Abundance and Production	Abundance and Production	Abundance and Production	Abundance and Production		
	Northern Green Sturgeon	Not Assessed	Abundance					
	Oregon White Sturgeon	Not Assessed	None					
	Lost River Sucker c/	ESA listed					Multiple	Multiple
	Shortnose Sucker d/	ESA listed					Multiple	Multiple

Source: ODFW (2005 and 2014b) for South Umpqua Spring Chinook salmon
a/ Insufficient data for three of six categories for Upper Klamath population
b/ Two Populations: Jenny=Risk: Distribution and Reproductive Independence; Klamath River=Risk: Production
c/ These species not evaluated under the ODFW (2005) document, but are ESA-listed species found in the basins indicated. Risk criteria not assessed but include: passage, reproductive independence, water quality and quantity, distribution and abundance, and others
d/ Species of special concern that were not assessed by ODFW (2005) are not included in this table. See section 4.7 for special species assessments.

Among salmon and steelhead species SMUs, six are rated by the ODFW as "Not at Risk," two "Potentially at Risk," three "At Risk," and two "Extinct." For trout SMUs, two are "Not at Risk," and one is "At Risk." Regarding other species of interest, two are rated "At Risk," and two are "Not Assessed." Additionally, two ESA-listed species, the Lost River sucker and shortnose sucker, are present in the Klamath and Lost River basins. These two species were not included in the ODFW (2005) evaluation. The life history of federal, state, BLM, and Forest Service species of special concern including those with state-designated risk status in all subbasins crossed by the pipeline is provided in appendix O.

The reasons for the "At Risk" rating vary by subbasin and species but include hatchery interaction; exotic species introduction that causes predation, competition or genetic interaction; low abundance and production of the stocks; irrigation diversions and water withdrawals; grazing and forestry practices; and habitat loss, pollution, and fish passage barriers. Non-native fish species may pose an equivalent, if not greater, threat than habitat degradation to native freshwater fish since non-native fish are more widespread in western streams (50 percent) than habitat degradation (18 percent) (Schade and Bonar 2005).

General Impacts and Measures to Reduce or Mitigate Impacts

The pipeline route would cross 2.4 miles of estuarine habitat in Coos Bay and cross or pass near an additional 263 waterbodies (not including ditches), of which about 87 are known or presumed to be inhabited by fish. In addition, 4 new stream crossings would occur along the 14 temporary or 13 permanent roads, 2 of which are known to have fish. Existing roads used by the pipeline project for construction would use existing stream crossings although final design may include new or modified structures at some locations (see below), with a total of 23 streams crossed, 7 of which are perennial streams with 4 known to have fish. Two new temporary construction roads would also cross known fish-bearing streams (TAR 88.63 crossing Days Creek and TAR 128.69 crossing a tributary of Indian Creek).

The entire estuarine habitat and many of the freshwater streams contain EFH habitat. Additionally, many crossings contain ESA listed fish resources as well as other species of concern. Because of the numerous fish waterbody disturbance actions and project actions in watersheds containing special status fish, there is the potential for many special status fish resources to be affected by the pipeline project.

Pacific Connector proposes to cross the Coos Bay estuary using wet open cut dredging. At three large river crossings, HDD methods would be used (Coos, Rogue, and Klamath Rivers), and at two crossings of the South Umpqua River Pacific Connector would use a diverted open-cut method at one and a DP method at the other. Pacific Connector proposes to cross three waterbodies (Kentuck Slough, Catching Slough, and Medford Canal) using conventional bores. All other stream crossings would employ a dry, open-cut method. General stream crossing methods for each of these are described in section 2.4.2.2, and specific crossing methods are listed in appendix O, table O-2. General Project activities potentially impacting aquatic resources include estuarine in-water construction, freshwater in-water construction activities, terrestrial/riparian habitat modification, accidental spills or leaks of hazardous materials, and periodic maintenance of the pipeline. Much of the discussion on types of impact below applies to the salmonids protected under the ESA and other special status species (see section 4.7).

Construction of the Pacific Connector pipeline (early spring through late fall) would coincide with juvenile out-migration and upstream adult migration for most anadromous fish species in most river basins. However, following ODFW recommended in-water construction windows, in consultation with NMFS on suitability relative to listed fish species, should minimize the coincidence of pipeline construction with upstream adult salmonid migration and minimize impact during sensitive spawning periods in the streams. Resident salmonids, which would be primarily cutthroat and/or rainbow trout, spawn in the spring outside of the state approved in-water work windows. During construction within the Coos Bay estuary (October 1 through February 15), adult anadromous salmonids would be present (ODFW 2007b).

The extent of impact on aquatic resources from pipeline construction would depend on the waterbody crossing method, adjacent clearing methods, erosion control, the existing conditions at each crossing location, and the timing of construction. Short-term impacts are likely to last from the initiation of construction up to three years afterward. Potential short-term impacts that degrade habitat could occur with trenching and laying of the pipe at waterbody crossing sites and sometimes adjacent slope runoff. The installation of the pipeline across a waterbody may result in temporary deposit of a limited amount of sediment in that stream, with associated short-term turbidity affecting aquatic species. Pacific Connector would install erosion control devices during construction to reduce sedimentation and in-stream turbidity at waterbody crossings. We expect the pipeline right-of-way to be restored and revegetated immediately after pipeline installation. Except for forested areas, vegetation would reestablished in the area within three years.

Long-term degradation of habitats can occur if flow or sediment regimes are modified in a manner that results in morphological changes to the bed and banks of the channel. Also, in forested areas, shade would be reduced at waterbody crossings for the time it would take trees to grow after restoration and revegetation and future LWD. In streams that have very small flows, lack of shade may raise stream water temperatures and reduce LWD supply, which could in turn affect aquatic species. However, streams with low or intermittent flow generally support smaller fish populations and less diverse species composition.

Pacific Connector developed its project-specific ECRP which includes specifications for waterbody crossing techniques and associated sediment and erosion controls to be implemented during waterbody crossings. A detailed description of construction and mitigation measures that Pacific Connector would implement at waterbody crossings is included in section 4.4.2.5.

In addition to actual waterbody crossings by the pipeline, several of the project-related construction activities, such as improving existing access roads, could indirectly affect aquatic resources by increasing erosion and runoff to nearby streams. The approximate relevant characteristics of these activities and potential effects to aquatic resources are summarized in table 4.6.2.3-2.

TABLE 4.6.2.3-2

Pacific Connector Pipeline Approximate Associated Construction Disturbance and Aboveground Facilities and Their Potential Effects to Aquatic Resources

Category	Facility	Location	Notes	Effects to Aquatic Resources
Pipeline-related facilities	Hydrostatic testing	75 potential sites, 6 sites located outside of construction right- of- way.	A *Hydrostatic Testing Plan* addressing protection procedures has been developed.	Potential erosion to streams and invasive species introduction if not properly managed. Potential flow reduction during withdrawal. Measures from ECRP and *Hydrostatic Testing Plan* (part of the POD) would avoid adverse effects.
	Temporary extra work areas (TEWAs)	574 TEWAs, would impact 239 acres of wetland and 237 waterbodies	81 are known fish bearing	Potential for erosion or hazardous spills. Slight LWD and shade reduction Measures from ECRP and SPCC and other measures in the POD would avoid adverse effects.
	Uncleared storage areas (UCSAs)	65 UCSAs within riparian zones 12 assumed fish, 13 unknown, and 5 non-fish bearing streams	11 waterbodies directly affected (note: unknown 2013)	Some potential for sedimentation effects to aquatic resources. Slight LWD and shade reduction. Measures from ECRP would avoid or reduce adverse effects.
Pipeline-related facilities	Contractor and pipe storage yards.	Of 38 sites, 31 surveyed, 19 no wetlands	12 have wetland or drainage ditches	Potential modification of flow, sediment runoff. Measures from ECRP and SPCCP would avoid adverse effects.
	Rock sources, and permanent disposal sites	Of 42 rock sources, 12 are in riparian areas	Willis Creek and tributary (fish bearing) within 50 feet of disposal site(note: unknown 2013)	Potential sediment runoff to stream. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
Construction access roads	13 new Temporary Access Roads (TARs) segments to be constructed, some near streams	6 near likely fish streams (riparian zone), including 4 crossing fish streams	One TAR on federal Riparian Reserves (*Middle* Creek)	Potential sediment effects and loss of riparian shade. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
	17 new Permanent Access Road (PAR)	Two new PAR near small streams of unknown fish status, no stream crossings	No new PAR on federal Riparian Reserve	Slight effect as measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
	Improved Existing Access Roads	66 access roads would cross 23 streams, including 3 known fish streams	No riparian clearing expected as road width changes near streams would be absent or slight	Potential sediment effects. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.

Fish passage is a potential issue relating to streams crossing by roads that would be used by the project. The final locations of all road-stream crossing and road use levels would not be determined until a construction contractor can assess what final road use would be needed and final designs are developed. However, Pacific Connector, in consultation with ODFW, has developed general plans and designs for methods to be use for road-stream crossings to ensure fish passage is maintained and other impacts are minimized (Pacific Connector Gas Pipeline LP 2015). For temporary and permanent roads, designs may include use of existing instream structures, which could include the protection, repair or replacement of these stream-crossing structures. New culverts may be needed in some areas. Where applicable, fish passage would be ensured for any new structure. However, Pacific Connector may not modify fish passability of existing structures that they use if they are already fish barriers. Pacific Connector would submit a fish passage plan to ODFW and would not construct the crossing until approval is received. Temporary bridges may be used before culverts are installed. These bridges would span above the ordinary water level and be maintained to stay above water levels during use. All new or temporary structures would meet state fish passage requirements, any culvert installation would occur during state designated in water work windows unless otherwise approved by ODFW, and fish passage would be maintained during construction. If temporary bridges are used, they may be installed outside of the in-water work window. In-water activities would meet state turbidity standards reducing turbidity impacts. Riparian disturbance would be kept to that needed for construction. These actions would maintain adequate fish passage and minimized stream disturbance from the use and installation of road-stream crossing structures.

Construction in Estuarine Habitats

During in-water pipeline installation within Coos Bay, fish and other aquatic resources could be affected. Construction of the pipeline across the Coos Bay estuary would utilize a wet-open cut method. The current pipeline route in the bay would span 2.4 miles and disturb approximately 73 acres of subtidal (33 acres) and intertidal (36 acres) habitats (table 4.6.2.3-3).

TABLE 4.6.2.3-3

Areas of Subtidal and Intertidal Habitats within the Coos Bay Estuary Directly Affected by Construction of the Pacific Connector Pipeline

Project Component	Intertidal and Subtidal Habitats Affected a/				Total
	Low Eelgrass	Medium Eelgrass	Mud Flat	Subtidal	
Distance Crossed (mile)	<0.1	<0.1	1.3	1.0	2.5
Area Disturbed 2008 (acre) a/					
Right of Way	1	<1	38	32	72
Temporary Work Areas	0	0	1	0	1
Total	**1**	**<1**	**39**	**32**	**73**
Area Disturbed 2013 (acre) b/	**Low/Medium Eelgrass**				
Right of Way	5 c/		35	33	72
Temporary Work Areas	0		1	0	1
Total	**5**		**36**	**33**	**73**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").
a/ Eelgrass area based on 2008 survey by Ellis Ecological Services (2008).
b/ Eelgrass area bases on 2013 survey by Ellis Ecological Services (2013).
c/ The increase in eelgrass impact is due largely to a natural expansion of one eelgrass bed within the pipeline right of way in Haynes Inlet that occurred since the 2008 survey.

Pacific Connector conducted a survey of eelgrass beds within Coos Bay along the pipeline route in 2008. Based on the survey of the route in 2008, there was about 1.0 acre of eelgrass beds that would be directly affected by the construction right-of-way (including TEWAs). A more recent survey found 5 acres of eelgrass scattered along the route, with total acres of estuarine habitat that would be affected little changed from earlier assessments (Ellis Ecological Services 2013).[99] Eelgrass beds were placed into three categories based on density: low, medium, and high. From the 2008 survey, most of the area affected would be low density, and no areas were categorized as high-density eelgrass. A total of 1,400 acres of eelgrass beds are present in Coos Bay (Ellis Ecological Services 2008), so less than 0.1 percent of this important habitat would be directly disturbed from construction with the new route. Overall, since the Coos Bay estuary is about 12,000 acres, construction disturbance would be less than 1 percent of the entire estuarine area.

Trench excavation to install the pipeline in the bay would bury, displace, or injure benthic organisms (e.g., worms, clams starfish and vegetation). Mobile organisms like crabs, shrimp, and fish would

[99] Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

move away from the trenching activities. Short-term impacts would occur to other benthic taxa in Coos Bay that include ribbon worms (*Nemertinea*), various burrowing segmented worms (*Polychaeta*), small crustaceans including amphipods, Dungeness crab, echinoderms, clams (i.e., *Macoma* sp.), and coral/anemone polyps (*Anthoszoa*) (Miller et al. 1990). However, benthic communities on mud substrates in Coos Bay that were disturbed by previous dredging activities recovered to pre-dredging levels in four weeks (Newell et al. 1998). Some impacts may be long-term if important habitat elements are affected, such as the effects of turbidity on eelgrass growth (Martin and Tyrrel 2002).

In addition, oyster beds near the construction right-of-way would be affected by turbidity (Couch and Hassler 1989) similar to potential effects to eelgrass. Pacific Connector has sited the pipeline route to be outside of all commercial oyster beds, so impacts on commercial beds would be limited to possibly short-term turbidity near the route (about 0.3 mile of the route where commercial beds are adjacent).

An overall estimate within the pipeline route is between 100 and 1,000 Olympia oysters along about 0.3 mile of the pipeline route based on surveys conducted in 2011 (Ellis Ecological Services 2011). Olympia oysters along the crossing of Haynes Inlet would be directly affected by construction activities. Additionally, some Olympia oyster spat would be settling to substrate to form their attached life stage during part of the allowed in-water construction window (October 1-February 15), with spat settling occurring from August through December, peaking in October (Sawyer 2011). The highest concentrations of Olympia oysters found during project surveys along the proposed route were between approximately MP 2.6 and 3.2. Generally, spat settle on hard substrates (e.g. shells, rock) so some disruption of spat settle success in this area could occur near the dredging area. To reduce this potential impact, the Coos County Planning Department, in their final approval of the land use permit for the construction of the route in Coos County including across Haynes Inlet, conditioned the approval on the applicant not dredging the pipeline route during October between MP 2.6 and 3.2 unless ODFW were to approve construction then (Coos County Planning Department 2012). This restriction would reduce the potential for unsuccessful spawning for Olympia oysters during the year of construction.

Pacific Connector has proposed an *Olympia Oyster Mitigation Plan.*[100] The plan includes moving any oysters present along the pipeline route just prior to construction to local areas that would be unaffected by project actions to prevent direct harm to these individuals. The applicant would also augment the region with suitable substrate for Olympia oysters after construction. The enhanced area would be monitored over several years to determine whether substrate was successfully colonized by Olympic oysters. If not, the applicant would consider other actions that may be proposed through consultation with resource agencies. The Coos County Planning Department (2012) placed additional conditions on the currently developed *Olympia Oyster Mitigation Plan* to meet their permit approval. Overall, this would result in no net substantial adverse effects to commercial or Olympia oysters from project actions.

<u>Sedimentation and Turbidity Resulting from Pipeline Installation Across Haynes Inlet</u>

Turbidity and increased suspended sediments would be generated during pipeline construction across the Haynes Inlet portion of the Coos Bay estuary. While the exact duration of pipeline

[100] Attachment 8 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

construction in the bay is unknown, if the typical construction rate of about 800 feet a day (CHE 2013b) occurs, it would be completed in a 2- to 3-week period.

Construction would occur during one season (i.e., less than the 4.5-month in-water work window). "Wet" crossing construction or open cutting (trench excavation, pipe installation, and backfilling the trench through flowing water) produces the highest downstream (or relative tidal flow direction) sediment loads of any construction technique (Mutrie and Scott 1984; Reid and Anderson 1999; Reid et al. 2004). The amount of sediment produced by open cutting depends on multiple characteristics at the construction site including depth and width of the waterbody (affects mixing of the sediment plume in the water column), current velocity and local turbulence at the site and downstream, concentrations of suspended sediment initially at the site and at some distance downstream, particle diameter, specific weight, and settling velocity of the excavated and backfilled materials (Ritter 1984; Reid et al. 2004). The general effects of increased turbidity and sediment on marine organisms and anadromous salmonids are presented in the earlier LNG impact discussion (section 4.6.2.2).

As discussed above for the LNG terminal (section 4.6.2.2), salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected (also see the discussion of suspended sediment effects below under Turbidity and Sedimentation – in Freshwater). Salmonids may avoid areas of increased turbidity based on some studies at about 70 mg/l (Lloyd et al. 1987) while some other studies suggest avoidance may occur at 20 mg/l suspended sediment, and possibly lower depending on length of exposure (Newcombe and Jensen 1996). The elevated suspended sediment conditions would be short-term during pipeline installation and would not be continuous at any one location. This would reduce the chances of continuous elevated exposure for fish that may move little. Concentrations as low as 17 mg/l have been noted to potentially have some adverse effects (e.g., gill irritation, respiration) for juvenile coho salmon (Wheeler 2008). Some other studies have found varied effects including lesser effects at these concentrations, with overall effects related to both duration as well as concentration (Newcomb and Jensen 1996). Additionally, estuarine environments often have moderately elevated suspended sediment concentrations (i.e., greater than 15 mg/l) and they are very productive (Gregory et al. 1993). As noted above, concentrations typically exceed this value (i.e., 17 mg/l) in Coos Bay in the winter (Moffat & Nichol 2006a), so fish present in Coos Bay in the winter are commonly present in regions with natural concentrations exceeding this value. The construction time would avoid periods of high abundance of salmonids in the construction area, with the possible exception of migrating coho salmon adults in the fall.

Sediment concentrations from pipeline trenching in the bay would be similar to winter background levels for much of the construction period and few fish would be near the highest plume concentration due to active avoidance. The applicant developed models to predict potential effects of dredging a pipeline route across Haynes Inlet on suspended sediment concentrations (CHE 2013b). Model results suggest that concentrations over 50 mg/l would be limited to a region likely less than 100 feet from actual trenching. Concentrations up to about 10 to 15 mg/l would be limited to likely less than 300 to 500 feet from actual trenching, which are normal for Coos Bay during the fall and winter construction period (Moffat & Nichol 2006a). Model results also indicated that suspended sediment concentrations would not exceed ambient suspended sediment concentrations by more than 10 percent within 350 feet or less of actual trenching. At an assumed construction rate of about 800 feet a day (CHE 2013b), this construction effect would likely occur over a 2- to 3-week period to traverse the 2.5 miles across Haynes Inlet. Therefore, some local, short-term avoidance of the actual construction area by fish may occur, but long-term or substantial effects on fish in the bay would be unlikely.

The composition of invertebrates inhabiting estuarine and tidal flats is likely to change seasonally (Higley and Holton 1981), and those invertebrate taxa most predominant at the time of construction would be affected. Estuarine benthic invertebrates including shellfish are likely to be affected by disturbed substrate and turbidity generated by pipeline construction. Construction within the estuary is scheduled from October 1 through mid-February to occur during the recommended in-water construction windows established by ODFW (2000b). Abundance of benthic invertebrates (except for shellfish) is expected to be minimal (Higley and Holton 1981). Similarly, impact from turbidity to local low salt marsh and high salt marsh would be during vegetation dormancy and low abundance of invertebrate inhabitants. Consequently, impact to those resources is expected to be limited.

Suspended sediment and turbidity resulting from construction may adversely affect filter feeding commercially and recreationally harvested clams and oysters near the pipeline route in Haynes Inlet. Adverse Project-related effects on clams and oysters from higher levels of TSS would be restricted to the short-term period of active construction across Haynes Inlet (maximum of 3 weeks).

Pacific Connector would minimize impacts by following the BMPs of its Haynes Inlet Water Route Construction Plan. These measures include:

- developing a turbidity monitoring and management plan;
- deploying turbidity curtains as practicable;
- where depth of water allows, keeping the excavation bucket below the water surface;
- placing the excavated spoil immediately adjacent to the trench;
- conducting fueling and maintenance of equipment more than 150 feet away from the pipeline trench, where practicable, and inspecting equipment for leaks; and
- backfilling the trench as quickly as possible after the pipeline is installed.

<u>Intertidal and Subtidal Habitat Removal and Modifications in Haynes Inlet</u>

During construction of the Pacific Connector pipeline across the Haynes Inlet portion of Coos Bay, various intertidal and subtidal habitats would be disturbed by trenching. Approximately 39 acres of intertidal mud flats and 32 acres of subtidal habitat would be affected by the construction right-of-way and TEWAs (table 4.6.2.3-3). Based on the distribution mapping of eelgrass, construction along the pipeline route could temporarily disturb about 5 acres of eelgrass (Ellis Ecological Services 2013).

Eelgrass can be adversely affected by turbidity because the depth and distribution of eelgrass is strongly associated with water clarity and depth of light penetration (Dennison and Orth 1993; Thom et al. 1998) as well as nutrient availability (Short et al. 1995), salinity, and water temperatures (Thom et al. 2003). Effects to eelgrass from turbidity generated during trenching would, in large part, depend on type of equipment utilized and strength and direction of currents within the estuary during construction. As noted above, model results suggest slightly elevated turbidity levels exceeding background would be limited to an area less than 350 feet from the actual dredging site for a period likely less than 3 weeks.

Generated turbidity could affect light penetration potential affecting primary production. This could affect overall production. The timing of the construction based on ODFW in-water work window requirements, October 1 through February 15, which would be reviewed by NMFS relative to listed and EFH fish species, is during most of the period when eelgrass in Coos Bay would be dormant, coinciding with low temperatures and short photoperiods (Fonseca et al. 1998). Therefore, light limitations would have minor effects on local patches of eelgrass beds proximate to construction sites and should not contribute additional indirect source of impact to eelgrass habitats or dependent aquatic species. Following pipeline installation, the pipeline trench would be backfilled with sediments removed during trenching, and the bottom elevation and flow conditions would be restored to pre-construction conditions. It is anticipated that following pipeline backfill, the areas disturbed by construction would be suitable for eelgrass to regrow. Pacific Connector has proposed a plan, its EWMP, to replant the disturbed areas with eelgrass.[101]

Construction within Coos Bay would also affect mud/sand flats, shallow subtidal, low and high salt marsh, and undifferentiated tidal marsh areas. Pacific Connector has prepared a plan to mitigate for a disturbance that would include, for marsh habitat, primarily retaining the rooted plants and top foot of soil, and planting them back after the pipeline has been backfilled and the pre-construction contours restored. For other habitat types, restoration would involve replacing excavated soils and recontouring sites. All areas of the estuary habitat, including the eelgrass restoration and marsh plant restoration, have monitoring and contingency plans to ensure habitat is restored along the route (see the EWMP). The plan includes details of how habitat would be restored, schedules, measures of success, monitoring, and contingency plans and schedule. Some of the main factors include:

- goal of 1:1 restoration of habitat with standard meeting or better than pre-project conditions specifically for eel grass bed, mud/sand flats, and salt marsh;
- on-site mitigation (restoring the habitat in place where it was disturbed);
- recontouring of pipeline route to pre-project conditions returning original covering substrate;
- pre-construction survey, physical and some biological, including references methods to resurvey same location;
- success criteria for eel grass is same acreage at equal or greater density;
- take no more than 10 percent of eel grass donor plants from other areas for replanting;
- contingency is if plants not established to pre-conditions within five years Pacific Connector would consult with agencies on next steps; and
- for mud/sand flats and shallow subtidal, success would be recontouring to pre-construction with natural substrate.

<u>Aquatic Nuisance Species in Coos Bay</u>

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. Non-indigenous aquatic species (NAS) are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Within the Coos Bay

[101] Attachment 7 of Pacific Connector's *Compensatory Mitigation Plan* filed with the FERC in September 2013.

estuary, over 67 NAS have been identified (Aquatic Nuisance Species Taskforce 2006). All of the invertebrate NAS in the Coos Bay estuary have been introduced by ship fouling or discharge from ballast water of ocean-going vessels.

Pacific Connector identified two NAS that may occur within the Coos Bay estuary: New Zealand mud snails (*Potamopyrgus antipodarum)* and brackish water snail *(Assiminea parasitologica)*. Pacific Connector did not specifically address how it would deal with encounters with NAS while crossing Haynes Inlet. The company did state that it would not obtain hydrostatic test water from either Coos Bay or the Coos River, to prevent the spread of NAS from the estuary to inland watersheds.

Construction Across Inland Stream Habitats

Construction of the pipeline would affect 106 perennial stream sites, 151 intermittent stream sites, five ponds, and one estuary channel[102] (table 4.6.2.3-4; Haynes Inlet crossing discussed above not included in the table). A total of 229 locations would be direct channel crossings, while 34 would be locations where the water body is in the right-of-way clearing area. Direct impacts to six perennial streams would be avoided by placing the pipeline beneath them by HDD, DP, or conventional boring.

TABLE 4.6.2.3-4

Number of Streams and Ponds (excluding Haynes Inlet) Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed

Fifth-Field Watershed (Fifth-Field HUC)	Ponds a/	Perennial Streams	Intermittent Streams	Fish-bearing Streams/channel with: Anadromous Species (assumed) b/	Resident Species (assumed) b/, c/	EFH Species and Habitat Present (assumed) b/	ESA Species or Habitat Present (assumed) b/
Coos County							
Coos Bay Frontal (1710030403)	1	41	20	15(2)	6(8)	12(7)	12(7)
Coquille River (1710030505)	0	5	1	2	1	0(2)	0(2)
North Fork Coquille River (1710030504)	0	3	9	2(1)	3	2(1)	2(1)
East Fork Coquille River (1710030503)	0	8	5	2(6)	5(2)	2(6)	2(6)
Middle Fork Coquille River (1710030501)	0	3	6	0(1)	0(3)	0(1)	0(1)
Douglas County							
Middle Fork Coquille River (1710030501)	0	3	3	0	0(3)	0	0
Olalla Creek-Lookingglass Cr (1710030212)	0	4	11	2(3)	3(1)	2(3)	2(3)
Myrtle Creek (1710030210)	0	5	5	3(2)	4(1)	3(2)	3(2)
Clark Branch-South Umpqua River (1710030211)	0	8	12	4	4	4	4
Days Cr. South Umpqua River (1710030205)	0	5	4	4	4	4	4

[102] Note that the values reported for stream crossings in this section (section 4.6) may differ from those reported in section 4.4 because this section does not include ditches in the analysis.

TABLE 4.6.2.3-4

Number of Streams and Ponds (excluding Haynes Inlet) Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed

Fifth-Field Watershed (Fifth-Field HUC)	Ponds a/	Perennial Streams	Intermittent Streams	Fish-bearing Streams/channel with: Anadromous Species (assumed) b/	Fish-bearing Streams/channel with: Resident Species (assumed) b/, c/	EFH Species and Habitat Present (assumed) b/	ESA Species or Habitat Present (assumed) b/
Upper Cow Creek (1710030206)	0	5	1	0	0(4)	0	0
Jackson County							
Upper Cow Creek (1710030206	0	0	1	0	0	0	0
Trail Creek (1710030706)	0	2	4	3	2	3	3
Rogue River-Shady Cove (1710030707)	0	4	13	1(1)	4	1(1)	1(1)
Big Butte Creek(1710030704)	0	3	6	2	2(1)	2	2
Little Butte Creek (1710030708)	2	4	31	3(3)	7(1)	2(4)	2(4)
Klamath County							
Spencer Creek (1801020601)	0	1	4	0	2(1)	0	0
Klamath R-John C Boyle (1801020602)	0	0	3	0	0	0	0
Lake Ewauna-Upper Klamath (1801020412)	1	1	1	0	1	0	1
Mills Creek-Lost River (1801020409)	2	1	11	0	0	0	1(7)
TOTAL	**6**	**106**	**151**	**43(19)**	**48(25)**	**37(27)**	**39(34)**

a/ All but one stock pond are not directly crossed but in ROW adjacent to direct pipeline locations.
b/ Known and assumed, possible or likely (value in parentheses) crossings or pipeline proximity with indicated fish category designation.
c/ Includes primarily cold water trout, but also estuarine species in lower Coos system, and endemic species in the Klamath Basin.

At one crossing of the South Umpqua River, Pacific Connector would use a diverted open cut. All other waterbody crossings that have flow at the time of construction would be crossed using dry open cut, which is designed to minimize activities directly in flowing water. Of streams that would be crossed using the dry open-cut method, about 36 are known to support anadromous salmon and/or steelhead and another 19 streams are assumed to also have anadromous species. Forty-two streams are known to support primarily coldwater resident fish, or important endemic species in the Klamath River Basin. Resident trout are mostly cutthroat trout. Twenty-three additional streams that would be crossed with dry open cut are assumed to support important resident fish. In all, about 87of the waterbodies that would be crossed by, or adjacent to, the pipeline are known or assumed to have fish. Pipeline construction could adversely affect EFH species in up to 63 streams, as well streams with numerous special status fish species crossings (see section 4.7 for ESA listed species). Our EFH assessment and BA (FERC 2015) describes impacts to those species occupying inland streams, and measures Pacific Connector would implement to avoid, minimize, or mitigate the impacts.

In-stream construction could interfere with essential life processes of aquatic species. The majority of the waterbodies identified as known, presumed, or classified as being fish bearing would be crossed using isolated or "dry" crossing construction techniques including the flume or dam-and-pump method if water is flowing in the waterbody at the time of construction. At one site on South Umpqua, the diverted open cut method used would require diversion of the flow to one side of the channel at a time. Potential effects of trapping fish from these methods are discussed under Entrainment and Entrapment subsection below.

Timing of Construction

The degree of impacts on aquatic resources associated with construction activities would depend on the timing of in-water construction. Construction during periods of sensitive fish activity (i.e., spawning, juvenile and adult rearing, and migration) can have a greater impact on fish than construction during other periods. Pacific Connector would cross fish-bearing waterways during the in-water work windows specified by the ODFW in consultation with NMFS.

The timing restrictions would prevent construction during periods of sensitive fish use and would typically allow construction only in periods of lower flow rates in streams. In general, construction of the pipeline would be timed to miss periods of major juvenile or adult anadromous salmonid migrations in freshwater based on allowed fishery construction windows, typically July 1 to mid-September for most streams, and some other dates for specific waterbodies. These are tentative dates and timing restrictions would be subject to change by the ODFW. Any modifications to the allowable construction windows would be dictated by stream and fish migration conditions in the year of construction, and would be stated as conditions of state water crossing permits.

Sedimentation and Turbidity Resulting from Pipeline Installation Across Inland Freshwater Streams and Impacts on Aquatic Resources

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and stream sediment characteristics can affect turbidity and suspended sediment in streams. Nearly all streams (96 percent) would be crossed using the dry open-cut method (flume and dam-and-pump) (table 4.6.2.3-5). Both "dry" techniques produce much less sediment in the water than alternative "wet" open cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004). While several factors affect the effectiveness of dry construction methods, dry open-cut construction across waterbodies, if properly installed and maintained during construction and restoration, would produce minor levels of sediment and turbidity. Pacific Connector would minimize impacts on surface waters and aquatic resources by implementing the waterbody crossing and erosion and sediment control measures as described in its project-specific ECRP, which would reduce the risk of sediment releases during construction.

TABLE 4.6.2.3-5

Proposed Waterbody Crossing Methods for All Waterbody Crossings (excluding Haynes Inlet), by Subbasins and Fifth-Field Watersheds

Subbasins and Fifth-Field Watersheds	Number of Waterbodies Crossed, by Construction Method: HDD or Direct Pipe	Bore	Wet Open-Cut	Diverted Open-Cut	Dry Open-Cut	Total Crossed	Adjacent Not Crossed a/	Bedrock b/
Coos Subbasin								
Coos Bay-Frontal Pacific Ocean	1	2	1		53	56	6	1
Coquille Subbasin								
Coquille River					6	6		2
North Fork Coquille River					10	10	2	2
East Fork Coquille River					12	12	1	4
Middle Fork Coquille River					14	14	1	6

TABLE 4.6.2.3-5

Proposed Waterbody Crossing Methods for All Waterbody Crossings (excluding Haynes Inlet), by Subbasins and Fifth-Field Watersheds

Subbasins and Fifth-Field Watersheds	**Number of Waterbodies Crossed, by Construction Method**							
	HDD or Direct Pipe	**Bore**	**Wet Open-Cut**	**Diverted Open-Cut**	**Dry Open-Cut**	**Total Crossed**	**Adjacent Not Crossed a/**	**Bedrock b/**
South Umpqua Subbasin								
Olalla Creek-Lookingglass Creek					15	15		5
Clark Branch-South Umpqua River	1				14	15	5	3
Myrtle Creek					8	8	2	3
Days Creek-South Umpqua River				1	8	9		5
Upper Cow Creek					6	6	1	1
Upper Rogue Subbasin								
Trail Creek					5	5	1	2
Shady Cove-Rogue River	1				10	11	6	2
Big Butte Creek		1			7	8	1	4
Little Butte Creek					34	34	3	5
Upper Klamath Subbasin								
Spencer Creek					5	5		
J.C. Boyle Reservoir-Klamath River					3	3		
Lost Subbasin								
Lake Ewauna-Klamath River	1				1	2	1	
Mills Creek-Lost River					10	10	4	1
TOTAL	**4**	**3**	**1**	**1**	**221**	**229**	**34**	**46**

a/ Waterbodies within the construction right-of-way that will not be crossed
b/ Bedrock streambeds will be crossed by dry open-cuts but may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained. Numbers are not in addition to Total Crossed as they are already included in the Dry-open cut counts shown.

Duration of crossing can ultimately affect downstream impacts of turbidity and suspended sediment to aquatic resources. If channels are dry during construction, small streams (less than 10 feet) are projected to be crossed in less than 24 hours, and intermediate streams (10 to 100 feet) usually in less than 48 hours. Reid et al. (2004) noted that, in flowing streams they monitored, instream work averaged 38 and 64 hours for dam-and-pump and flumed crossings, respectively. However, failure of flow sealing and other instream structures at upstream diversions structures can occur from a variety of malfunctions such as pump failure, dam and flume failure, poor dam seal and others. Reid et al. (2004) noted seal failures of monitored diverted open cut crossing in 1 of 23 dam-and-pump projects and 5 of 12 flumed projects. Should these occur, suspended sediment would be relatively elevated over those without failure, but immediate repair work could reduce magnitude and duration of elevated suspended sediment.

General Effects

Increased sediment loads associated with high turbidity can have effects on fish behavior and physiological processes (e.g., blood chemistry, gill trauma, immune system resistance), and can result in mortality. Salmonids (e.g., trout and salmon) are the most common, abundant, and important species within Project area streams and often the most sensitive of common freshwater fish species to elevated suspended sediment. Approximately 40 percent all streams crossed in the Project area contain salmonids that could be affected if TSS levels are elevated. Salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected. At high levels, turbidity and suspended sediment directly affects survival and growth of salmonids and other species and interferes with gill function (reviewed and compiled by Bash et al. 2001). Turbidity can also reduce aquatic plant cover (over the long-term) by limiting photosynthesis (Goldsborough and Kemp 1988), as well as adversely affecting fish vision, which is a requisite for social interactions (Berg and Northcote 1985), feeding (Vogel and Beauchamp 1999; Gregory and Northcote 1993), and predator avoidance (Meager et al. 2006; Miner and Stein 1996).

Sediment stirred into the water column can be redeposited on downstream substrates, which could bury aquatic macroinvertebrates (an important food source for salmonids, and other fish in estuarine areas). Additionally, downstream fine particle sedimentation could affect spawning substrate habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health (reviewed and compiled by Bash et al. 2001).

Some studies related specifically to pipeline stream crossing have found varied effects from sediment. For example, rapid recolonization of benthic organisms has been documented on 30 pipeline projects post-construction (Gartman 1984). One long-term study (during construction through three years post-construction) of multiple pipeline crossings of a coldwater streams found no measurable effect to fish or benthic resources or their habitat within two months to three years of construction (Blais and Simpson 1997).

Dry open-cut construction methods may have the potential to alter fish abundance over the short term. Reid et al. (2002) found that fish abundance downstream of dam-and-pump or flumed crossings reduced immediately after construction in two of four sampled sites, but concluded these reductions were likely not the result of sediment. Additionally, one year after construction, Reid et al. (2002) found no difference in fish abundance below these two sites from preconstruction levels.

Newcombe and Jensen (1996) compiled research from many sources that demonstrates effects to anadromous and resident salmonids by various levels of suspended sediment concentration and exposure duration. They used this information to develop models that estimated the severity of these effects based on sediment concentration and exposure duration.

Output from the model provides severity-of-ill-effects (SEV) scores that are summarized below. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

1) Behavioral Effects SEV scores
    - 1 = Alarm reaction
    - 2 = Abandonment of cover
    - 3 = Avoidance response

2) Sublethal Effects SEV scores
    - 4 = Short-term reduction in feeding rates and/or feeding success
    - 5 = Minor physiological stress (increase coughing rate and/or increased respiration rate)
    - 6 = Moderate physiological stress
    - 7 = Moderate habitat degradation; impact on homing

- 8 = Major physiological stress; long term reduction in feeding rate- feeding success; poor condition

3) Lethal and Paralethal Effects SEV scores
   - 9 = Reduced growth rate and/or delayed hatching and/or reduced fish density
   - 10 = 0 to 20 percent mortality and/or increased predation and/or moderate to severe habitat degradation
   - 11= >20 to 40 percent mortality (SEV scores exceeding 11 predict increased mortality rates)

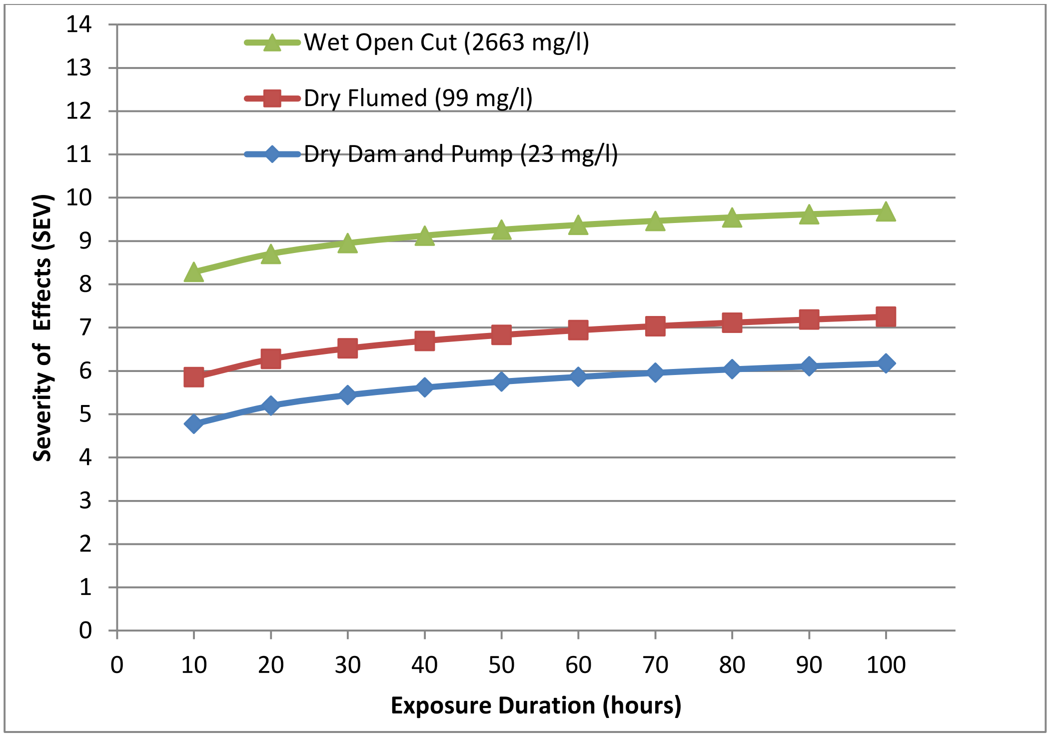
Newcombe and Jensen (1996) developed varied models for this assessment method. The one most relevant for this study is Model 1, which is used to estimate effects to both juvenile and adult salmonids and is based on 171 different study results.

Because of the uncertainty of both available site-specific information and the accuracy of models when applied to varied locations, two approaches were taken to estimate the concentration of suspended sediment and its effect on aquatic resources. One method used literature values from other stream pipeline studies concerning concentrations and durations of the activity to estimate reasonable approximations of likely sediment concentrations and effects to fish. The other was a detailed approach using models to predict sediment concentrations at Project stream pipeline-crossing sites based on known and assumed values, as presented in Pacific Connector's Resource Report 3.

Literature-Based Assessment of Sediment Effects

Application of the Newcombe and Jensen (1996) model to a collection of stream pipeline crossing locations supplies an approximation of what the likely range of effects may be to fish (primarily salmonid) resources in the project area. The Reid et al. (2004) data are the most complete set of literature information available on likely ranges of suspended sediment that may occur from various crossing methods and likely in-stream construction duration. Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry open-cut or isolated pipeline construction crossings) and 11 wet open-cut construction crossings. He noted that average suspended sediment concentrations near these 11 "wet cut" crossing sites were 2,663 mg/l, whereas values were much lower at "dry crossing" sites, which averaged 99 mg/l (12 sites) and 23 mg/l (23 sites) for flumed and dam-and-pump sites, respectively. Using the mean values from Reid et al. (2004) and the Newcombe and Jensen (1996) sensitivity Model 1, the effects to salmonid resources can be approximated (see figure 4.6-3).

Based on the estimate of likely average conditions of construction at a crossing assuming the average of the Reid et al. (2004) suspended sediment values, SEVs for dam-and-pump crossings would be most likely in the range of 5, which could include short-term reduced feeding rate or minor physiological stress, considering the likely construction time of less than 55 hours. Flumed crossing sites would on average have slightly greater effects, with SEVs mostly in the range of 7, which could result in habitat degradation, considering crossings could take up to 92 hours. If some failure occurred in crossing methods, short-term effects would be greater. SEV values would be similar to those of wet open-cuts, likely in the range of SEV 8, implying adverse



Note: Based on the Newcombe and Jensen (1996) effects model based on typical suspended sediment concentrations and duration of elevated levels (data from Reid et al.2004) by crossing type.

Figure 4.6-3. Effects of Pipeline Stream Crossing Suspended Sediment Concentrations on Salmonids

factors such as long-term reduction in feeding success, with wet open cut crossing time closer to 16 hours or less. All levels of impact would remain sublethal even with some short-term failure in crossing methods, based on the literature concentration and duration values.

Active monitoring of pipeline crossing construction of mostly coldwater fish streams in New Hampshire found similar SEV level results to those shown above. Trettel et al. (2002) monitored suspended sediment levels within 50 to 150 meters (160 to 500 feet) downstream of the active pipeline crossing constructions sites and used information from 75 perennial streams consisting 71 dry dam-and-pump or flumed crossings and 4 open-cut wet sites to estimate SEV levels. They found that the average SEV of the dry crossings was 6.5 with no measurable difference between types of dry crossing, while the four wet crossings averaged an SEV of 7.4. The SEV level of 6 corresponds to moderate stress while SEV 7 suggests the lowest level where some habitat impacts would occur. They found that about one-third of the dry crossings equaled or exceeded this SEV level (7) of potential adverse habitat effects. Additionally, 99 percent of all crossings were less than the designated paralethal or lethal range (SEV of 9 or above). The biggest factor affecting elevated SEV levels was the portion of fines in the sediment at the crossing. These results suggest a very low probability of any direct fish mortality from construction, with local crossing area impacts consisting of mostly sublethal effects (e.g., physiological stress, short-term reduction of feeding), and limited habitat degradation.

The distance downstream effects could occur is dependent on many factors (e.g., substrate composition, velocity, flow, channel width). Ritter (1984) estimated that for a minor perennial stream (likely average only half a foot deep, and less than 20 feet wide), suspended sediment concentrations may be near background levels in the range of 60 meters (200 feet) to 150 meters (500 feet) downstream during open-cut crossings. These stream sizes would be most typical of crossings along the pipeline route. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. However, at another crossing where some high suspended sediment concentrations occurred from leakage, values 340 meters (1,100 feet) downstream were reduced to 20 percent of those at 45 meters (150 feet) downstream. Low concentrations during construction of crossings appear to be more common when BMPs are closely followed. For example, according to Pacific Connector, a Williams Northwest pipeline completed in Washington State had only one state turbidity standard exceeded out of 67 waterbodies crossings. Pacific Connector's Resource Report 3 estimated the changes of suspended sediment concentrations based on the Ritter (1984) model downstream of 13 project area subwatersheds using estimates of substrate sediment composition and other physical conditions at the crossing sites (e.g., width, depth, and flow). For the project area streams, based on the models used in Resource Report 3, the average estimate of change in concentration from construction sites downstream was estimated to be reduced to 23 percent of the initial concentration within 10 meters (30 feet), and 17 percent within 100 meters (330 feet) (assuming low summer flow conditions). The results suggest typical suspended sediment concentrations are likely to be less than 20 percent of initial concentration within 100 meters (330 feet) downstream, greatly reducing the effect to aquatic resources.

Based on the Reid et al. (2004) average values, effects to salmonids would be low, other than when sealing failure events occur at the planned dry crossings; the effects would likely range from short-term behavioral to short-term sublethal effects. Trettel et al. (2002) monitoring suggests adverse effects may be somewhat greater but still sublethal, with occasional local habitat degradation.

Model Estimates of Effects of Suspended Sediment

Pacific Connector (Resource Report 3) incorporated site data, regional data, and available literature-based models to provide an estimate of both suspended sediment level and extent of effects to aquatic resources from pipeline stream crossing construction based on their estimates of sediment concentration and exposure duration. The parameters used in this model assessment are variable and are based on a combination of some data and professional judgment. Thus, the results may be considered an approximation, rather than the exact suspended sediment levels that would be observed.

The method for approximating the concentration of suspended sediment at the specific crossing sites and distance downstream that various concentrations travel relies on the use of two separate models and empirical suspended sediment value comparisons from typical crossing sites for each crossing method. The first is a regression model that estimates the concentration at or near the direct installation area (Reid et al. 2004) (see above) based on selected physical stream conditions. The second model estimates the distance various concentrations of suspended sediment travel downstream (Ritter 1984) based on selected physical site data (see Resource Report 3 in Pacific Connector's 2013 application to the FERC).

The Reid et al. (2004) model, which included site-specific physical parameters at crossings, was used to predict sediment concentrations from a wet open-cut crossing at a subset of project stream crossings. Since all project area crossings would be dry cut, these model estimates were adjusted downward to equal predicted dry cut crossing values based on the average relationship between wet cut and dry cut methods in the Reid et al. (2004) article. Mean suspended sediment concentrations generated during dry open-cut construction for dry fluming construction were 3.7 percent of the wet open-cut concentrations and 0.85 percent of the wet open-cut concentrations for dam-and-pump construction. Pacific Connector assumed in their model that if sealing of the site from stream flow failed during construction, the average suspended sediments levels at the crossing would be equal to wet cut crossing values.

All parameters used in this model (flow, stream width, velocity, percent silt and clay), except for median sediment size (this had an assumed value for all sites), were measured or estimated based on select crossings from fifth field watersheds in the project area. The details of how these values were estimated are presented in Pacific Connector's Resource Report 3.

The model by Ritter (1984) for small stream crossings was used to predict change in concentrations downstream of crossings based on stream characteristics (e.g., flow, depth, roughness). The details of how this model operates are provided in Pacific Connector's Resource Report 3. The distance concentrations would travel downstream at 10, 50, and 100 meters from the crossing site were estimated.

Estimates were made for 98 stream crossings for which sufficient data were available to conduct the analysis. These crossings were representative of the Project regions and ranges of stream width/gradient and would have normal dry open-cut crossings. Streams not modeled included the Upper Klamath River and Lost River subbasins, HDD or boring sites, and bedrock stream crossings (44 identified) that would have low sediment during crossings (see Resource Report 3 for details).

The resulting estimates of potential suspended sediment concentrations (without major crossing area sealing failures) indicate that suspended sediment concentrations would remain low in most project regions (Table 3.2-25 in Pacific Connector's Resource Report 3). Estimates of suspended sediment concentrations produced during pipeline construction under varied summer low-flow conditions may be highest for the six waterbodies crossed within the Coquille River fifth-field watershed, followed by crossings within the Coos Bay-Frontal Pacific Ocean fifth-field watershed, which is the result of assumed high fines concentrations at the crossings (see Table 3.2-21 in Pacific Connector's Resource Report 3). However, even for these streams, nearly all dry crossing estimates would be less than 100 mg/l within 10 meters (33 feet) downstream of the crossing site. For the other fifth-field watershed crossings where estimates could be made, the average suspended sediment concentrations produced during fluming and dam-and pump construction would be near background suspended sediment levels (about 2 mg/l). Nearly all estimates were less than 10 mg/l between 10 and 100 meters (33 and 328 feet, respectively) downstream from construction sites. However, as noted above, levels as low as about 17 mg/l may cause some short-term adverse effects to salmonids such as gill irritation and respiration issues for juvenile coho salmon.

If there is a failure of isolation structures during either type of dry open-cut construction, it is assumed that the suspended sediment generated during the failure would be similar to suspended sediment generated during wet open-cut construction. Suspended sediment concentrations assumed to occur during failure of isolation structures could be substantial. In waterbodies within the Coos Bay-Frontal Pacific Ocean and Coquille River fifth-field watersheds, peak modeled suspended sediment might be as high as 2,110 mg/l only 10 meters (33 feet) downstream from construction and as high as 1,389 mg/l 100 meters (328 feet) downstream. However, the values are based on a single point estimate without consideration of how precise the model value is or how the variability of input parameters may affect the model output.

As noted above, Newcombe and Jensen (1996) developed models that estimate severity of effects on fish (primarily salmonids) based on the suspended sediment concentration and the amount of exposure time (i.e., assumed in-water construction period length) for various fish life stages. We used the results from Model 1 (effects to juvenile and adults salmonids) for the analysis in this EIS because those are the primary life stages and species of concern.

The duration of exposure to suspended sediment generated during dry open-cut construction at each of the 98 waterbodies is assumed to be similar to the empirical values presented in Reid et al. (2004) for all aspects of in-water construction (e.g., dam-and-flume placement and removal, and channel trenching).

The models were run for the two types of dry crossings (flume and dam-and-pump) that would be used for all stream crossing sites (except the HDD sites and one site on South Umpqua River). An additional set of models were run to estimate higher suspended sediment in water passing downstream if sealing methods used for dry crossings failed.

Exposures of juvenile and adult salmonids to suspended sediment concentrations estimated at flumed crossings range from 5 to 90 mg/l (Table 3.2-25 in Pacific Connector's Resource Report 3). These estimates are based on the range of suspended sediment concentrations during low flows, the period when in-stream construction would occur at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites. Exposures to suspended sediment concentrations from 10 to 105 mg/l at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites are expected during peak low flows. All flumed construction is assumed to be completed between 36 and 96 hours.

The highest suspended sediment concentrations would be expected during flume crossings within the Coquille River fifth-field watershed because of assumed high substrate fines (see Pacific Connector's Resource Report 3, Table 3.2-21). Some of the 42 dry open-cut crossings in this watershed would be by fluming. High concentrations would also be expected during flumed construction across waterbodies in the Coos Bay-Frontal Pacific Ocean fifth-field watershed, which is also assumed to have high substrate fines at the crossings. This watershed has 55 dry open-cut crossings, some of which would be by fluming. Results of Model 1 for juvenile and adult salmonids indicate most SEV scores for durations of exposure to the suspended sediment concentrations range from 6 (moderate physiological stress) to 7 (moderate habitat degradation and/or impaired homing) (Table 3.2-26 in Pacific Connector's Resource Report 3). Based on model uncertainties (inclusion of the upper 95 percent confidence intervals from Newcombe and Jensen 1996), SEV scores could be as high as 8 (indications of major physiological stress). All expected responses by adult and juvenile salmonids, to suspended sediment produced during fluming 10 meters or more downstream, would be classified as sublethal. For most waterbodies crossed, estimated suspended sediment concentrations produced by fluming are 5 mg/l or less between 10 and 50 meters downstream from construction during low flows or peak low flows. For that concentration, Model 1 SEV scores range from 4 (short-term reduction in feeding rates and/or feeding success) to 5 (minor physiological stress), and possibly to 6 (moderate physiological stress). Overall, these effects would be short term, with most lasting less than 3 days. As noted above for value estimates of suspended sediment, the SEV estimates should be considered approximate because the range of accuracy and variability of the input parameters is not directly included in the model estimates. However, the results are reasonable considering that typical dry crossing methods have relatively low concentrations of suspended sediment of short duration (Reid et al. 2004).

Where dam-and-pump crossing methods are used, exposures of fish to modeled average suspended sediment concentrations would range from less than 5 to 22 mg/l during low flows at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites (Table 3.2-25 in Pacific Connector's Resource Report 3). Exposures to modeled average suspended sediment concentrations may be slightly higher (less than 5 up to 26 mg/l) during peak low flows at 10, 50, or 100 meters (33, 164, or 328 feet) downstream from construction sites. All dam-and-pump construction is assumed to be completed within 20 to 56 hours. Values in this range of suspended sediment and expected exposure periods are used to estimate the SEV values shown in Table 3.2-27 in Pacific Connector's Resource Report 3.

The highest suspended sediment concentrations would be expected during dam-and-pump construction across streams within the Coquille River and Coos Bay-Frontal Pacific Ocean fifth-field watersheds for the same reasons as discussed for fluming. Results of Model 1 for juvenile and adult salmonids indicate most SEV scores for durations of exposure to the suspended sediment concentrations would be 5 (minor physiological stress with increased coughing rate and/or increased respiration rate) or 6 (moderate physiological stress). Similar to flume crossing, overall effects would be very short term, with most less than 2 days.

Failures of isolation dams/structures to exclude streamflow during fluming or dam-and-pump could result in increased suspended sediment entrained downstream, assumed to be the same as concentrations generated during wet open-cut construction (Table 3.2-25 in Pacific Connector Resource Report 3). Scenarios of exposures of 1 hour and 6 hours could occur while work crews repair the failed isolation dam structures. Longer exposures of 12 and 24 hours are assumed to occur if dry open-cut construction (flume or dam-and-pump) is abandoned and the waterbody crossing is completed using wet open-cut construction. The mean time required for wet open-cut crossings was 13.7 hours with standard error of 2.0 hours (Reid et al. 2004). Therefore, durations of 12 and 24 hours are reasonable to complete a crossing if a dry open-cut fails. With the high suspended sediment concentrations expected during wet open cuts of waterbodies in the Coquille River and Coos Bay Frontal fifth-field watersheds, durations of 1 and 6 hours during low flows and peak low flows would generally result in sublethal effects to salmonids, with SEV scores ranging from 5 (minor physiological stress) to 8 (major stress, such as long-term reduced feeding success) (Table 3.2-28 in Pacific Connector's Resource Report 3). Wet open-cut construction lasting from 12 to 24 hours would also result in SEV scores of 8 or lower. The effect under likely scenarios if failure occurred would remain at sublethal levels. The only exception may be in the estimated highest concentrations and longest possible durations for the two high substrate fines watershed where paralethal effects may occur with SEV levels of 9 (e.g., reduced growth/reduced fish density). Even under failure, effects would be very short term, likely a day or less, although some redistribution of sediment may occur over time with these higher concentrations.

No open-cut or dry-cut crossings would occur when any known salmonid resource, including spring Chinook salmon, would be spawning near a crossing during the designated approved construction window, so direct effects to spawning are unlikely. Overall, the potential effect of suspended sediment on spawning activities of spring Chinook salmon would be limited to close proximity to the South Umpqua River diverted open-cut crossing.

Summary of Suspended Sediment Effects

While the modeled results supply a reasonable estimate of likely level of effects to primarily salmonid fish resources, the models rely on multiple input parameters (e.g., substrate composition and size distribution of fines, median substrate size (d_{50}), and water velocity at each crossing) that are predicted. Therefore, overall summary assessment of effects considered both literature results from other pipeline crossings and the modeled results of project area streams. For both modeled and literature-based assessments, effects would be mostly short term (less than 1 to 4 days) and remain near the crossing location (downstream distance a few hundred feet).

Overall model results are based on regional watershed averages; however, some site-specific conditions may vary from these averages. However, the literature-based values of typical project-wide effects provide similar results, suggesting more specific model estimated effects are reasonable. The results for either method are that crossings would cause at least some short-term adverse effects, primarily avoidance, short-term feeding reduction, and likely minor stress. No long-term adverse effect would likely occur unless some major failure occurred during construction. However, if failure occurred under certain conditions, some marked effects could occur including reduced fish density of salmonids in a limited stream area.

Because of the linear nature of the Project, the number of stream crossings and ultimately total area of stream habitat and individual streams that would be affected in any watershed would be extremely small. There would be from zero to 56 crossings per fifth-field watershed, which totals 211 actual stream channel crossings in 231 miles of pipeline route over 19 fifth-field watersheds. Since almost no individual stream would have more than one crossing, effects to each stream would be limited to the crossing location. As an example of the relative portion of streams that may be affected in the short term by stream crossings, we examined the potential stream area affected in the four fifth-field watersheds of the Coquille subbasin, a route area with a high number of stream crossings. Those four watersheds have 3,093 miles of stream (Ecotrust 2015). The Project would cross 42 stream channels in that length. Assuming an effect area from sediment of 400 feet per stream crossing, about 0.1 percent of all stream length in these four watersheds would have some short-term effect from sediment during construction. Overall cumulative effects would be unsubstantial based on the dispersed distribution of crossings and magnitude of effects at each and lengths of stream channel potentially affected.

Inadvertent Release of Drilling Mud from HDDs

Pacific Connector proposes to use the HDD method to cross under the Coos, Rogue, and Klamath Rivers. Generally, an HDD would avoid direct impacts on a river and its associated aquatic resources. However, an HDD requires the use of drilling mud as a lubricant during the process. This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface (also referred to as a frac-out).

Drilling mud primarily consists of water mixed with bentonite, which is a naturally occurring clay material. Bentonite by itself is essentially non-toxic (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979). However, bentonite, can act like a fine particulate sediment in water, which could affect aquatic resources. The dispersal of drilling mud from a frac-out in a stream could interfere with oxygen exchange by clogging the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Sediments in high concentrations can clog gills, impair vision, make it difficult to feed, and increase the chance of predation. Drilling mud that accumulates on the stream bottom could cover over food sources and eggs. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from the affected area. Other less mobile or immobile organisms, such as mussels and other macroinvertebrates, would incur direct mortality if smothered by the drilling mud. Impacts would be localized and short term, limited to species in the immediate vicinity of the frac-out, and ameliorated by river volume.

The effects of an in-stream frac-out on spawning habitat, eggs, and juvenile survival depend on the timing of the release. If spawning habitat is nearby, redds could be affected near a frac-out (Reid and Anderson 1999). During establishment of the spawning bed, the female as part of the normal preparation behavior would likely clean out a minor addition of sediment. However, a heavy sediment load dispersing downstream could settle into spawning beds and clog interstitial spaces, reducing the amount of available spawning habitat, which could be a limiting factor in areas of already reduced habitat. When redds are active, eggs could be buried, disrupting the normal exchange of gases and metabolic wastes between the egg and water (Anderson 1996). The impacts of sediment intrusion into the redd on larval survival are more severe during the earlier embryonic stages than following development of the circulatory system of larvae, possible because of a higher efficiency in oxygen uptake by the older fish (Shaw and Maga 1942; Wickett 1954). Clogging of interstitial spaces also reduces cover and food availability for juvenile salmonids (Cordone and Kelley 1961). Benthic organisms could also be affected by burial. However, bentonite is more likely to stay in suspension and less likely to immediately settle than common bottom sediment so, in flowing water effects on benthic organisms from burial under a release of drilling mud are likely to be low and unsubstantial.

To prevent a frac-out or deal with an occurrence, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[103] As also discussed in section 4.4, the plan outlined measures that would be implemented in the case of a frac-out into an aquatic environment. These measures include, but are not limited to:

- temporarily halting the HDD, and sealing the source of the leak in the fractured zone;
- contacting agencies and developing a site-specific treatment plan;
- deploying containment structures, if feasible;
- monitoring locations downstream of the HDD to identify areas of drilling mud accumulation; and
- removing the drilling mud from substrate and streambanks, if possible.

[103] This plan was attached as Appendix 2H of Resource Report 2, in Pacific Connector's June 2013 application to the FERC.

At the site of any frac-out, the amount of drilling mud released into a waterbody would be low. The HDD locations are all under major rivers, with large volumes of water and swift flows, where the drilling mud would be diluted. We conclude that an inadvertent release of drilling mud from an HDD would have minor short-term adverse effects to aquatic resources.

Streambank Erosion and Stream Bed Stability

The clearing and grading of vegetation during construction could increase erosion along streambanks, resulting in sedimentation and higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Erosion, sedimentation, and higher turbidity levels related to the Project could affect aquatic resources, as discussed above. The degree of impact on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

The rootwad network of trees adjacent to stream supplies bank stability. Those within 25 feet of the stream are considered most important at providing the root source aiding in bank stability (WDNR 1997). To aid in maintaining this bank stability, Pacific Connector would cut most trees near the bank, except those in the trench line, at ground level leaving the root systems in place helping to maintain short-term bank stability. Roots would be removed over the trench line or from any steam banks that would need to be cut down or graded to accomplish the pipeline crossing. To minimize these impacts, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way.

The pipeline would be designed to ensure it does not become exposed from potential occurrence of bed scour and channel migration, which may include increasing the depth of cover to more than the 5-foot minimum to accommodate the potential for long-term channel changes. At a minimum, Pacific Connector would design all waterbody crossings to meet DOT CFR 49 Part 192 standards. For perennial crossings on federal lands, the site-specific crossing restoration plans (appendix J, 2014 Supplement) would be used in lieu of previously submitted approaches by the applicant. Additional depth would be evaluated and considered based on GeoEngineers (2013f, 2015) channel migration and scour analysis methods or other site-specific investigations, considering the final route alignment. The channel migration and scour analysis rated crossings as to their risk of pipe exposure. The analysis screened sites initially with available data (e.g., aerial photos, LiDAR) and rated them for potential risk. Those sites considered to have potential risk of pipe exposure were evaluated in more detail including site-specific data and, where deemed necessary, would have additional procedures taken to ensure that likelihood of pipe exposure is eliminated. From the results of the channel migration and scour analysis, Pacific Connector would design all crossings that were assessed in detail to bury the pipe below the 100-year scour depth and, for streams likely to have channel migration, outside and below the 50-year channel migration zone. Additional analysis prior to construction would be needed for sites that were not accessible due to property rights. All crossing sites would have pre- and post-construction surveys conducted in order to document (by post-construction conditions monitoring) that each crossing has been restored to pre-construction conditions (or better) after project construction. Crossing of various risk categories will have additional BMPs as described below.

In addition to a FERC permit, local, state, and federal permits approvals would be sought for final designs and installation procedures before construction would occur. These would help ensure that the pipeline would not become exposed and reduce potential for contribution to bed and bank scour and prevent impedance to fish passage from pipe exposure.

The FWS expressed concerns that more detailed site-specific information on bank material, streambed composition, shoreline vegetation and other information is needed to adequately ensure that actions occurring at a stream crossing do not significantly increase streambank erosion and streambed instability. Pacific Connector, in response to these requests, has conducted an initial assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2013c). GeoEngineers, using a combination of field and GIS data, rated the 215 pipeline stream crossings based on the matrix. The matrix has two axes rating the crossing based on the potential project effects to the crossing and the relative stream response at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, Medium–High).

No crossing was rated as having both high risk of project impact potential (i.e., high risk of project impacts and high risk of site response potential) and high risk of stream and site response potential. If any crossing had been in this category, Pacific Connector indicated a site-specific crossing plan, similar to that required by FERC for stream crossings over 100 feet wide, would be developed. Should later assessment of the crossings (see below) find that a crossing is in this category, a site-specific plan would be developed prior to construction.

GeoEngineers (2013c) grouped the nine risk categories into five categories based on generally similar risk of streams being affected, with all but one containing two risk categories, and labeled these as color management categories (Blue, Green, Yellow, Orange, and Red). Those stream crossings with the lowest stream response potential and a low or moderate project impact potential (96 total), designated as the Blue category, would be crossed using project-typical BMPs. These project-typical BMPs would be applied to all streams while additional BMPs would be applied to the other crossings depending on their rated category of risk. The remaining stream crossings, which include 119 crossing (Green 15, Yellow 85, Orange 19, Green 15 categories), were originally designated in the 2013 report to have a variety of additional BMP actions taken to reduce the probability of stream bank and bed erosion or instability from project actions (see pre-construction surveys below). The Green category had streams with high project impact potential but low and moderate stream response. The Yellow category included all other streams with moderate stream response potential and Orange those with high stream response potential. Stream crossings that are unstable can ultimately adversely affect aquatic resources from such factors as loss of local habitat and impacts to downstream habitat from addition of high unstable sediment addition and overall increase in recovery time of the specific site to stable conditions. The Orange category crossing includes crossings with the highest stream response potential and were therefore considered of greatest risk from project actions on bank and bed stability. Those in the Yellow category contained all of the crossings with moderate stream crossing risk potential and therefore of lower potential risk for channel and bank effects. The Red category had no crossings.

Additional follow-up surveys of selected accessible sites, analysis, and modification of recommended crossing BMPs, and some sited specific crossing designs occurred in 2014 (GeoEngineers 2015). The applicant directly surveyed 60 proposed crossing sites and representative streams of another 11 sites in 2014, including about half of the Orange category sites (access was not available for the other Orange sites) which includes two crossing not included in the original analysis for a total of 217 crossing assessed. These surveys resulted in some changes in categories with final category distribution of Blue (125), Green (14), Yellow (61), Orange (19), and Red (0). GeoEngineers (2015) developed more specific BMPs of bed and bank restoration that would be applied to project-induced disturbed areas of streams on a case-by-case basis (determined at the time of construction). These would be applied to streams in at least the Yellow category. Additionally, for eight surveyed Orange crossings (Middle Creek [MP 27.04], Tributary to East Fork Coquille [MP 29.49], Elk Creek [MP 32.40], Tributary to Big Creek [MP 37.35], Upper Rock Creek [MP 44.21], East Fork Cow Creek [MP 109.47], West Fork Trail Creek [MP 118.89], and South Fork Little Butte Creek [MP 162.45]), GeoEngineers developed specific crossing plans that designate the types of bed and bank restoration that would occur at each of these sites, primarily from the list of those to be used at Yellow category sites. Also there would be eight crossing sites (Middle Creek [MP 27.04], Tributary to Big Creek [MP 37.35], Deep Creek [MP 48.27], Tributary to East Fork Cow Creek [MP 109.17], East Fork Cow Creek [MP 109.47], Tributary to East Fork Cow Creek [MP 109.69], Tributary to East Fork Cow Creek [MP 109.78], and South Fork Little Butte Creek [MP 162.45]) that are on federal lands and at which the BLM and Forest Service have developed specific BMPs they want implemented. GeoEngineers (2015) indicated those specific BMPs would be followed at those sites using the direction included in the appendix J 2014 Supplement.

In addition, substrate characteristics and physical habitat features would be determined through pre-construction surveys, and the upper 1 foot of existing substrate would be replaced and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate and composition would be based on pebble counts or other appropriate methods on a site-specific basis – on federal lands, this would require review and approval by agency staff and line officers prior to implementation. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI specifically trained to determine proper restoration actions to implement based on river channel processes or a suitably trained professional. On non-federal lands, this person would have the authority to select appropriate additional BMP construction methods, bank stability actions, revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2013c, 2015).

A pre-construction survey would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This would include surveys of sites currently not accessible due to property ownership issues. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If any crossing is moved into the "high" project impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Following the final surveys, special additional BMPs, as described in GeoEngineers (2013c, 2015), would be implemented depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, type of bed and bank restoration structure and various other actions.

The approach described above, which would include more site-specific information and possibly more site-specific designs based on the pre-construction survey, is expected to be suitable for the protection of aquatic resources at waterbody crossings. The final procedures would ultimately need to obtain state and other federal permit-process approval before construction is conducted (if approved) at specific sites.

As a measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector, as part of their pipeline integrity monitoring, would observe all stream crossings, regardless of risk, annually and note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Where any problems were noted during this annual assessment, a follow-up visit by geo-professionals would occur (GeoEngineers 2015). On a quarterly basis, over two years after construction at all perennial crossings on federal lands as well as the highest risk sites identified on non-federal lands (Orange category) monitoring of vegetation success, stability of restoration elements, fish passage status, channel migration, erosion, head cutting, and other channel characteristics would be monitored. Additional forms of monitoring (e.g. vegetation, animal browse, and continued channel/restoration status) would occur at varied sites over varied intermittent periods over a 10-year period, with highest frequency and intensity of monitoring effort at sites of greatest risk of channel and bank instability. Frequency and type of monitoring may be adjusted based on site-specific conditions. In addition, flow and rainfall events would be recorded to understand the response of sites to flow events. Unscheduled monitoring may occur at crossings on BLM and NFS lands following 25-year rainfall events to assess channel, bank, restoration structure, and vegetation conditions including field measurements. Remediation of adverse conditions with channel stability or habitat found during the monitoring would occur. Reports of the monitoring would be developed for years 1, 2, 3, 5, 7, and 10 after construction describing observations made and any remedial actions taken.

Crossing Unstable Slopes

Slope failure near the waterbody during pipeline operation could result in soil and sedimentation falling into the waterbody. Pacific Connector evaluated all likely unstable areas during selection of the proposed pipeline route, and moved the route as necessary to areas considered to have low risk. Only one field-surveyed moderate risk area approximately between MPs 18.14 and 18.20 just upslope from a small (2-foot-wide) stream, a tributary to Cunningham Creek, is known to remain along the route. The known landslide risk areas have thus been all but eliminated from the route.

Resuspension of Potentially Contaminated Sediments

Elevated heavy metals in water and sediment can have adverse effects on aquatic organisms. Fish and other aquatic organisms are sensitive to mercury levels even at very low concentrations. Because of concerns about hazardous waste from historic mining activities in the vicinity of the crossing of the East Fork Cow Creek (approximately MPs 109 to 110), Pacific Connector evaluated the currently proposed route in the area for mercury-contaminated soils and stream sediment. Examination of the underlying rock type (volcanic) of the proposed route indicates it is unlikely to contain elevated mercury in the bedrock (GeoEngineers 2009b). Broeker (2010b) examined this route and sampled soil and stream samples near the proposed stream crossings. Of the three crossing measurements, one value (0.29 milligram per kilogram [mg/kg]) exceeded the ODEQ Level II screening value for freshwater (0.2 mg/kg). The other two were less than the freshwater value but two of the three were equal to or exceeded the bioaccumulation value of 0.07 mg/kg. The six soils samples were considered low in mercury, although they were slightly higher than the ambient background levels. Two intermittent stream channels occur up slope in this region that theoretically could carry sediment and related mercury downslope. However, Broeker (2010b) concluded that these intermittent streams would stop on upslope benches and not reach the stream. He concluded upslope delivery to streams was not likely unless erosion was not controlled. Special erosion control provisions, in addition to what usually are implemented, were agreed to by Pacific Connector for this region to reduce possibly elevated mercury levels reaching the stream (Pacific Connector 2013).

Additionally while levels of mercury in the East Fork Cow Creek are sometimes over ODEQ Level II screening levels, little sediment would be disturbed or suspended from the crossing activity since the crossing would be done in the dry. With adjacent upland disturbance following the standard ECRP and supplement erosion control actions, upslope potential sediment entry into the stream would be eliminated. Overall, adverse effects to fish from mercury would not occur from Pacific Connector Pipeline Project actions despite occasional elevated mercury levels that naturally occur, because upslope soil erosion would be controlled and dry crossing methods would be used in East Fork Cow Creek, limiting sediment disturbance.

Vegetation and Habitat Removal and Modification

Section 4.5 and the wildlife portion of 4.6 (see above) lists the acres of riparian habitat that would be directly affected by all construction-related activities. Much of this habitat is in forested areas, where stream shading and organic input are most prominent. This area is within one site potential tree height of the stream, the area near streams with the greatest potential effects to stream. Federal lands have additional areas called Riparian Reserves, which are different than the riparian areas shown here (see section 4.1.3.5 and table 4.1.3.5-1a for Riparian Reserve acres). Table 4.6.2.3-6 lists riparian areas disturbed by construction adjacent to perennial and intermittent waterbodies crossed by the pipeline. Removal or alterations in other habitats (e.g., clearcut/regenerating forest, shrub and grasslands, and wetlands) would also contribute to effects on aquatic resources, but to a lesser degree because riparian influence (e.g., shade, organic input, sediment and nutrient filtration) on stream conditions would be less.

Pacific Connector would minimize impacts on riparian vegetation by narrowing the width of its standard construction right-of-way at waterbody crossings, and by maintaining a setback between waterbody banks and TEWAs in forested areas. A riparian strip at least 25 feet wide on private lands and 100 feet wide on federally managed lands, as measured from the edge of the waterbody, would be permanently revegetated. Pacific Connector would plant native tree and shrub species along all fish-bearing streams. Within a 30-foot-wide corridor centered on the pipeline, plants would be kept less than 15 feet high. Overall, about 82 acres (19 percent) of former riparian habitat cleared by pipeline construction would be maintained long term in an herbaceous state. The management of vegetation including the riparian areas is presented in detail in section 4.5. Restricting the low-growth vegetation area to a small portion of the total right-of-way clearing would allow much of the ecological function of the riparian conditions relative to fish needs (e.g., shade, future LWD, and organic input) to more quickly return. This would limit the overall long-term impacts of loss of riparian habitat to a small portion of each stream crossed, reducing future negative effects to fish resources.

TABLE 4.6.2.3-6

Total Riparian Area (acres within one site-potential tree height distance) Disturbed (a/) by Construction Activities Adjacent to Perennial and Intermittent Waterbodies Crossed/Near by the Pacific Connector Pipeline

	Forest Habitat b/					**Other Habitat b/**						
Landowner	**Late Successional Old-Growth Forest**	**Mid-Seral Forest**	**Forest Regenerating**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland c/**	**Wetland Nonforested c/**	**Nonforested Habitat Unaltered**	**Agriculture**	**Altered Habitat**	**Other**	**Total Riparian Area Impact (acres)**
BLM-Coos Bay District	4	8	6	2	20	0.0	0.0	0	1	2	0	**23**
BLM-Roseburg District	3	2	<1	0	5	0.0	0.0	0	0	<1	<1	**5**
BLM-Medford District	9	3	0	0	12	0.0	0.0	5	0	<1	<1	**18**
BLM-Lakeview District	1	0	0	0	1	0.0	0.0	<1	0	<1	<1	**1**
Forest Service–Umpqua National Forest	2	4	2	0	8	0.1	<0.1	0	0	3	<1	**12**
Forest Service–Rogue River National Forest	<1	<1	1	0	2	0.0	0.0	<!	0	0	<1	**2**
Forest Service–Winema National Forest	2	<1	2	0	5	0.3	0.0	<1	0	<1	<1	**5**
Federal Subtotal	**22**	**17**	**11**	**2**	**52**	**0.4**	**<0.1**	**5**	**<1**	**6**	**1**	**66**
Non-Federal Subtotal	**10**	**60**	**70**	**8**	**147**	**2.0**	**36.9**	**64**	**57**	**23**	**85**	**415**
Overall Total	**32**	**77**	**81**	**10**	**199**	**2.4**	**40.0**	**69**	**58**	**29**	**86**	**481**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre; acreages less than 1 are shown as <1.

a/ Project components considered in calculation of habitat "Removed": Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads. Note that federal lands have "riparian reserve" areas along streams that differ in size than those areas shown here.

b/ Habitat Types within Riparian areas generally categorized as: Late Successional (Mature) or Old-Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Wetland Forested, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

c/ Acreages for wetlands and estuarine areas are rounded to the nearest tenth of an acre.

Water Temperature

The effects of water temperature on salmonid life stages have been extensively reviewed by McCullough (1999) and others. Maximum water temperatures ranging from 71.6 to 75.2°F (22 to 24°C) limit distribution of many salmonid species. For spring Chinook salmon, for example, the optimum temperature for growth is 60.1°F (15.6°C) and higher temperatures during summer could reduce growth and lead to increased mortality rates (McCullough 1999). Vegetative cover that provides shade, especially during summer, is one factor that regulates water temperature (WDNR 1997). If sufficient loss of shade occurs, temperatures in streams are known to increase. Increasing stream temperatures can result in reduced fish production and spawning success, and, if high enough, reduced fish survival also, especially for important northwest salmon and trout species found in many project area streams. The current Oregon state water quality temperature standards, which are addressed in section 4.4 of this EIS, include provisions to limit anthropogenic increases in stream temperature especially in salmon- and trout-bearing streams. Construction of the pipeline across waterbodies would necessitate removal of trees and riparian shrubs at the crossing locations that may influence these stream temperatures. Pacific Connector has proposed to mitigate potential temperature increases on waterbodies through riparian plantings at selected sites and project-wide depending on landowner approval (appendix S). This would include, as mitigation for loss of riparian shade vegetation, replanting the equivalent of 1:1 ratio for construction or 2:1 for permanent riparian vegetation loss impacts (GeoEngineers 2013i).

Available information on the effects of pipeline construction in other regions on water temperature has found no or immeasurable change. The total width of riparian area affected by shade tree removal would be small (less than 100 feet) relative to the length of any stream crossed. In one study, construction across two coldwater, fish-bearing streams in Alberta required removing forested riparian vegetation; water temperatures at construction sites and downstream did not increase above temperatures at control sites upstream from construction (Brown et al. 2002). Similarly, water temperatures measured at four coldwater streams in New York before and during pipeline construction and for three years following construction showed no short-term or long-term effects on water quality parameters, including water temperature, even though such effects were expected because streambank vegetation had to be cleared, which reduced shading (Blais and Simpson 1997). In the Alberta study, the highest water temperature recorded was 66°F (19°C in August). In the New York study, the highest temperature was 79°F (26°C during sometime between August and October). Long-term average water temperatures recorded during July-August in Elk Creek (a tributary to the Umpqua River) at USGS gauge 14338000 are 72 to 73ºF, intermediate to water temperatures in the Alberta and New York studies. Conditions in Oregon appear comparable to those in the cited studies.

Another recent right-of-way clearing study in Oregon found little to no effect from existing and proposed right of clearing on coldwater Cascade mountain streams (Tetra Tech 2013). Monitoring of 22 existing cleared right-of-ways for transmission lines in the Cascade region along the upper North Santiam River averaging 244 feet wide found no significant temperature (peak daily average, and daily maximum) change across the clearings compared to existing uncleared areas on each of these streams. While temperature changes did occur across the clearing (average of peak daily maximum change 0.19°F/100 feet of stream), these increases were no different from the temperature changes in the uncleared wooded areas just upstream of these clearing. While these streams did retain some vegetation in the right-of-way, they were kept relatively low to ensure no issues with the power lines. Modeling of these streams using the SSTEMP (Bartholow 2002) estimated some relatively small increases, which were generally greatest for smallest streams. The model assumed all or most vegetation would be removed from banks over a 150-foot-wide projected clearing. The results for both existing (summer 2012) and projected worst-case (likely maximum summer air temperature) environmental conditions with very conservative shade assumptions (0 and 25 percent for entire 150-foot clearings) showed an average increase of about 1.1°F (median of about 0.4°F) in the modeled maximum and maximum daily mean temperature across the assumed future clearing of these 22 streams. The small size of the streams in this study affected the model results. All but three of the streams had flow less than 1 cfs and width less than 10 feet. The three larger streams had modeled maximum temperature changes ranging from 0.0 to 0.2°F. Most of these streams had relatively low to moderate temperatures (mean maximum about 55°F); therefore, these low temperature increases were generally not expected to affect fish resources.

An additional model analysis for the Pacific Connector project effects on stream temperature was completed by GeoEngineers (2013i). This analysis also used the SSTEMP model by Bartholow (2002) to estimate potential temperature effects at 15 pipeline crossing locations (each a 75-foot-wide clearing) along the whole route. The streams selected varied in size from 2- to 85-foot-wide (average 29 feet), moderately large streams, with only eight of these having a less than 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010 and did not consider maximum potential air temperatures though they were likely representative of summer conditions. The average modeled increased for these 15 streams was 0.03°F, and the maximum increase among the streams was 0.3°F. Overall, these estimated changes are relatively low. They are lower than the North State Resources (2009) estimates for one comparable stream, but model conditions were slightly different.

Additional project-specific temperature modeling was also conducted on federal lands stream crossings. Temperature modeling, again using SSTEMP (Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek Deep Creek and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009 and again in 2013 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015a,b). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing streams' actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015a,b), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams.

Model analysis completed in 2014 for perennial stream crossings on BLM and NFS lands of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek (0.1 °F) and higher increase on a small tributary to Big Creek (1.1°F). Limited temperature changes likely were due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations (NSR 2015a). During the drought conditions of 2013, modeled 7-day maximum stream temperature just below in the multiple East Fork Cow Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015b). Measured stream volumes ranged from

0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16 °C (61 °F) in small perennial channels in the East Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the rare conditions that occurred in 2013 and the potential to overestimate temperature in low-flow channels from the SSTEMP model as noted above. The 2015 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole et al. 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. Results from field measurements of existing conditions on the Umpqua National Forest showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015b). The presence numerous of small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. These data also support the NSR (2009) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides significant shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the project, all LWD and boulders removed from the crossing area would be replaced during site restoration and low-growing brush would be retained where possible. Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Site-specific modeling on BLM and NFS perennial stream crossings suggests temperature increases would over natural pre-project levels. The site-specific stream restoration plans prepared by the BLM and Forest Service will be implemented to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the revegetation of shading brush on small channels, the placement of LWD, and the replanting of willows, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009, 2014).

Over the whole pipeline project region, plantings and regrowth in riparian areas, as suggested by these modeling results, would help moderate potential temperature increases in the short term (a few years). Much of the riparian area would be allowed to regrow from plantings with herbaceous plants (only 10 feet wide would be maintained without some growth) and conifer and other trees (all but 30-foot width). On small streams and to a lesser extent on larger streams, even 10- to 15-foot-high trees would supply shade, reducing solar heating effects on streams. Thus, the slight effects of solar heating from clearing would gradually be reduced or completely eliminated over time, based on the model, most between 5 and 10 years.

Potential cumulative watershed temperature increases from project riparian clearing would be unlikely. The number of crossings resulting in riparian shade area cleared in any watershed would be slight. Other than the Coos Bay-Frontal watershed (with 41 perennial crossings), no more than eight perennial streams would be crossed in any one of the other 18 watersheds crossed by the pipeline route. Primarily perennial stream clearings are likely to have effects on temperature during the warmest part of the year, because many intermittent streams would be dry during the peak temperature periods (July–September). Thus, peak seasonal temperatures would be unlikely to affect many intermittent streams. Even considering the total number of streams crossed in watersheds, which ranges from zero to 56 crossings per watershed, most watersheds would have less than 15 crossings (table 4.6.2.3-4). The riparian area lost that could affect watershed stream temperature relative to all available riparian areas in the watershed would be slight. About 9.5 linear stream miles of streambank could be affected along the whole project route (GeoEngineers 2013i; note this counts both banks separately so stream length affected would be half of this value). A likely relative change in cumulative watershed stream temperature from project clearing can be approximated through an estimate of increased heat budget from clearing. An example of this estimate is based on three fifth-field watersheds in the South Umpqua subbasin. These watersheds have an estimated total daily thermal load of about 50,592 million kcal/day. The estimate of the increased thermal load from the project due to initial construction clearing in these watersheds is about 11.0 million kcal/day, or about 0.022 percent. The relative change would likely be 0.004 percent to load once vegetation is allowed to grow back outside of the 30-foot permanently maintained right-of-way clearing (GeoEngineers 2013i). Considering the very small portion of total watershed riparian stream cover removed and low estimates of thermal increase, streamside clearing would not result in any measurable cumulative watershed-level changes in water temperature.

Based on available information, we conclude that any changes in water temperature, related to 75-foot-wide right-of-way vegetation clearing at waterbody crossings, are likely to be very small and undetectable through measurements, except for possibly the very smallest and often intermittent flowing streams, that also generally contain limited fish populations. Any temperature changes that may occur would gradually be reduced or eliminated over time as most riparian vegetation, from plantings and natural vegetation growth, increases in size increasing stream shading. Adverse effects on fish resources along the route would be unsubstantial due to limited distribution of any measurable changes to regions with minimal or no fish resources.

Large Woody Debris

A potential effect on fisheries that would result from forest clearing at pipeline crossings of waterbodies is the reduction of LWD in streams and on adjacent uplands (Harmon et al. 1986; Sedell et al. 1988). Large logs provide in-stream channel structures (i.e., pools and riffles), which are critical to salmon spawning and rearing. As the size of individual logs or accumulations of logs increases, the size and stability of pools that are created also increase (Beschta 1983). Riparian forests that undergo harvesting of large trees take on secondary-growth characteristics and contribute lower quantities of woody debris than unmanaged, old-growth forests (Bisson et al. 1987). However, sufficiently wide, carefully managed riparian buffers that retain a full complement of ages, sizes, and species of native trees and vegetation can ensure adequate recruitment of LWD to streams (Bisson et al. 1987; Murphy and Koski 1989; Morman 1993).

Pacific Connector has proposed to mitigate for impacts on waterbodies by installing LWD at agency- and landowner-approved and appropriate areas within the construction right-of-way across certain waterbodies. The use of LWD as a mitigation measure for impacts associated with in-stream construction has been documented as an effective means of creating in-stream habitat heterogeneity, reducing streambank erosion, reducing sediment mobilization (Bethel and Neal 2003), and enhancing local fish abundance (Scarborough and Robertson 2002). Placement of LWD on the streambanks and in the streams can provide slight shade and increase bank stability, while vegetation is maturing following construction. Additionally, placement of LWD in streams or on streambanks can provide habitat for benthic invertebrates and important food source for salmonids, and also increase habitat for forage species with the creation of pools and enhancement of the salmonid rearing potential of an area (Cederholm et al. 1997; Slaney et al. 1997).

To mitigate for short-term losses of LWD from riparian clearing and in-stream removal of wood during construction, Pacific Connector has proposed to install 521 pieces of LWD over several fifth-field watersheds along the pipeline route where the two ESA-listed coho salmon ESUs are present. The plan includes placing from 1 to 4 pieces of LWD per stream crossed in the stream or on the bank, depending on forest conditions, stream flow, and landowner approval. This number of pieces, if no other LWD were present in the stream reach affected by clearing, would be in the range of what is considered "desirable" by ODFW (Foster et al. 2001) for forested streams. Foster et al. (2001) noted that more than 20 LWD pieces/100 meters of stream length (i.e., 4.6 pieces/75 feet of right-of-way clearing) with more than 3 "key" pieces/100 meters (i.e., 0.7 "key" pieces/75 feet right-of-way clearing) is considered "desirable" in forested streams in Oregon. The sizes of LWD pieces to be installed are based on ODF and ODFW (1995) guidelines for sizes of LWD pieces to be present in streams to meet habitat needs for specific stream sizes and number of streams crossed. These final numbers would be developed as part of Pacific Connector's Mitigation Plan, which may have some modification prior to construction.

Specific streams for LWD installation have been identified by Pacific Connector; however, the specific locations within the streams would be determined through discussion with ODFW and agencies as appropriate, and in consideration of the BMPs outlined in the *Stream Crossing Risk*

Analysis Addendum (GeoEngineers 2015). The size of LWD installed would follow ODF and ODFW (1995) suggested guidelines for size of LWD based on stream size. Depending on private landholder approval, some pieces may be installed at different times and locations, but in general, LWD would be placed at waterbody crossings during the last phases of pipeline construction and right-of-way restoration. Pacific Connector has proposed that, if for some reason not all pieces proposed are actually installed, they would be donated to local water conservation groups for installation locally.

Long-term losses of LWD input would largely be mitigated through riparian replanting of conifers in the right-of-way.

Entrainment and Entrapment

Waterbody crossings using the dry crossing methods, either flume or dam–and-pump, may result in some fish being trapped in streams. Flumes and dams would be completely installed and functioning before any in-stream trenching disturbance occurs. Construction across a waterbody would take up to 4 days using dry open-cut methods, but less for small and intermediate streams. At one crossing of the South Umpqua River, a diverted open-cut crossing would be used. This is similar to a dry open cut in that all in channel construction would be done in the "dry" but would require diversion of the flow to one side of the channel at a time. This method could take about 14 days to complete. Because one channel would be open during the entire crossing, no passage of fish would be impeded and no fish removal would be required.

For typical crossings, once streamflow is diverted through the flume pipe, but before pipeline trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released using the methods in Pacific Connector's *Fish Salvage Plan*.[104] Adult Pacific lamprey, and possibly lamprey ammocoete larvae, are expected to be captured during fish salvaging by seining. However, salvage techniques for salmonids may not be effective for salvaging lamprey ammocoete larvae, which may remain in dewatered sediments. Electrofishing procedures to sample Pacific lamprey larvae have been recommended (see Appendix A in FWS 2010a) but seining and use of dip-nets may also be effective once the workspace has been dewatered, depending on substrate conditions at the time of construction. Pacific Connector would contract with either the ODFW or a qualified consultant to capture the fish.

Because the flume would maintain streamflow, fish may move upstream through the flume. With the dam-and-pump method, the fish would not be able to move upstream or downstream through the work area until the dams have been removed. Flumes and dams would be removed as soon as possible following backfilling of the trench.

Aquatic Nuisance Species

Currently, there are 180 reported NAS in Oregon, of which 134 are documented within the USGS hydrologic basins crossed by the Pacific Connector pipeline (USGS 2005). Not all non-indigenous species pose a threat to native species and their habitat in Oregon. For example, the largemouth bass provide economic and recreational benefits. Some of the major potential aquatic invasive species are mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*), and New Zealand mud snail (*Potamopyrgus*

[104] See Appendix L to the POD, which was included in Pacific Connector's application to the FERC.

antipodarumis) as well as Cyanobacteria (blue-green algae), and freshwater mold (Saprolegnia). Invasive species can have multiple adverse effects when introduced to their non-native environment. The most common impact is competition with native species for habitat and resources, often with the reduction or elimination of the native species. They also may cause impacts to human uses of the water. For example, zebra mussels have been found to multiply to such great numbers that they effectively block water intakes, such as drinking water supplies. Additionally, invasive species may crossbreed with native stocks of organisms indirectly causing the reduction of viable native pure species. Some invasives may directly kill other native species that have no natural defenses against them.

Pacific Connector's *Hydrostatic Test Plan*[105] includes measures that would prevent the spread of invasive species from one water basin to another. However, Pacific Connector did not address how it would deal with aquatic nuisance species encountered during pipeline construction. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and approval by the Director of OEP, a Project-specific *Aquatic Species Nuisance Treatment Plan*, and documentation that the plan was developed in consultation with ODFW and appropriate resource agencies.**

<u>Blasting</u>

Blasting in stream channels can have adverse effects to fish, especially for fish with swim bladders. Explosives detonated near water produces shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Explosives detonated underground produce two modes of seismic wave (Alaska Department of Fish and Game 1991). Shock waves propagated from ground to water are less lethal to fish than those in-water explosions since some energy is reflected or lost at the ground-water interface (Alaska Department of Fish and Game 1991). Peak overpressures as low as 7.2 pounds per square inch (psi) produced by blasting on a gravel/boulder beach caused 40 percent mortality in coho smolts and other studies revealed 50 percent mortality in smolts with peak overpressures ranging from 19.3 to 21.0 psi (Alaska Department of Fish and Game 1991).

The best way to reduce or eliminate effects to fish is to keep fish out of regions where pressure waves are harmful. The Alaska Department of Fish and Game (1991) reported that a pressure change of 2.7 psi is the level for which no fish mortality occurs and is from 1.7 to 4.5 psi below any level where mortality would be expected. Based on normal charges used in trenching (about 1 to 2 pounds at 8-millisecond delay) the zone of the above pressure wave would extend 34 to 49 feet, depending on substrate near the charge (Alaska Department of Fish and Game 1991). Typically the dry area (where fish could not be) would be at least 25 feet wide during construction. If blasting were to occur with only a 25-foot-wide dry working space buffer between the blast and the stream, the potentially hazardous pressure wave (i.e., greater than 2.7 psi) would extend no more than an additional 25 feet. In all likelihood, the effects would be felt over a much smaller distance. Pacific Connector developed a *Blasting Plan* that outlined measures to reduce impacts on resources. The plan stated that Pacific Connector does not anticipate conducting any in-water blasting in any streams crossed by the pipeline. However,

[105] See Appendix M to the POD, which was included in Pacific Connector's application to the FERC.

blasting may occur in uplands adjacent to streams, or within dry streambeds. In those situations, Pacific Connector would attempt to minimize shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. In addition, bubble curtains may be used. Lastly, fish may be removed from the crossing area, in accordance with Pacific Connector's *Fish Salvage Plan*.

Hydrostatic Testing

After the pipeline is installed, Pacific Connector would fill it with water under pressure to test it (see section 2.4.2.1). Total water used for hydrostatic testing would be about 62 million gallons. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners to lakes, impoundments, and streams from possibly 11 different locations. About half of the water would be from impoundments or lakes, and the rest from streams, including South Umpqua River, Rogue River, North Fork Little Butte Creek, and Klamath River. All of the streams identified as potential test water sources include anadromous salmonids or resident trout. About 75 potential discharge locations for the test water have been identified (see Table 2 in the *Hydrostatic Test Plan*). During the test, it may be necessary to discharge water at each of the sites; however, discharges would be minimized and water would be conserved as much as practical by cascading water between test sections when feasible (pumping from one segment to the next).

Potential impacts on aquatic resources associated with hydrostatic testing include entrainment of organisms including fish, reduced downstream flows, erosion and scouring at release points, and the transfer of aquatic nuisance species through the test water from one water basin to another. Pacific Connector has developed a *Hydrostatic Test Plan* to minimize impacts from hydrostatic testing on resources. This plan is discussed in more detail in section 4.4.2, Surface Waters, of this EIS.

To prevent the entrainment of most aquatic species, the pumps and intake hoses for hydrostatic test water removal would be screened, in accordance with NMFS screening criteria. To ensure water withdrawal does not cause downstream water level issues (ramping rate), Pacific Connector would submit their withdrawal plans to ODFW for review prior hydrostatic testing. To prevent the transfer of organisms from one water basin to another, Pacific Connector would try to return hydrostatic test water to its basin of origin. However, given the linear nature of the pipeline and the need to cascade test water from one section to another, such a return may not always be possible. Therefore, Pacific Connector would treat the test water after withdrawal (most likely with chlorine) to prevent the spread of invasive species and pathogens. To prevent erosion or scour at discharge locations, the hydrostatic test water would be discharged at low head into energy dissipating devices and dewatering structures in uplands. Volume and flow rates would be controlled to prevent overland flows directly to waterbodies.

Fuel and Chemical Spills

For any large construction project, there is the potential for spills of fuel or other hazardous liquids from storage containers, equipment working in or near streams, and fuel transfers. Any spill of fuel or other hazardous liquid that reaches a waterbody would be detrimental to water quality. The chemicals released during spills could have acute, direct effects on fish, or could have indirect effects such as altered behavior, changes in physiological processes, or changes in food sources. Fish could also be killed if a large volume of hazardous liquid is spilled into a waterbody. Ingestion of large numbers of contaminated fish could affect primary and secondary fish predators in the food chain.

To minimize the potential for spills, Pacific Connector has developed an SPCCP. Pacific Connector's implementation of this SPCCP would minimize the potential for and the impact of any spill near surface waters. The SPCCP would be updated with site-specific information prior to construction. Specific measures in this plan include prohibiting liquid transfer, vehicle and equipment washing, and refueling within 100 feet of waterbodies and specific steps to be followed to control, contain, and clean up any spill that occurs. The SPCCP is further described in section 4.4.2.2. Pacific Connector's implementation of this SPCCP would minimize the potential for and the impact of any spill near surface water on aquatic resources.

Benthic and Sessile Organisms

Benthic and sessile organisms including benthic invertebrates and freshwater mussels would be affected by most of the same factors noted primarily for fish discussed above. This would include impacts from elevated turbidity and suspended sediments, release of drilling muds, herbicide application, blasting, fuel and chemical spills, and habitat modification. Risk of adverse impact to relatively sessile species, such as mollusks, could extend downstream from construction sites if degradation of water quality affects downstream habitats. However, because they are relatively immobile, the trenched crossing would have the greatest effect and would directly kill many at the trenching site because most would unable to actively move from the area. In the case of many aquatic invertebrates, including insect larvae, these areas would be rapidly (weeks/months) recolonized from upstream drift and new egg deposition from adults. In some cases for longer-lived organism, such as mussels, recolonization would take longer as they are immobile and most take years to grow to full size. The largest impact to benthic and sessile organisms would be directly at the crossing location and the impact would be short term. In the case of mussels, local affects may be long term. However, the overall area affected for any given stream would be small so adverse effects to local populations would be slight.

Operation and Maintenance Activities

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, and visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies. All of the maintenance activities would be outlined in the *Operations and Maintenance Plan* that would be prepared according to operating regulations in DOT 49 CFR Subpart L, Part 192 and would be completed prior to going in-service. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

Potential estuarine or stream channel disturbance would occur if an integrity issue with the pipeline occurred. If this happened, the pipeline would be unearthed within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered. Impacts would be similar to those discussed above for initial installation except on a much smaller scale, because they would only involve one crossing compared to many streams and, in the case of the estuary, just a portion of whole route would be disturbed not the whole 2.4-mile route. However, should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects to key fish resources at the specific site. The actions would include similar BMPs and mitigation. Any future repairs would require additional permit approval from appropriate state and federal agencies, which would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state. In addition, trees that are located within 15 feet of the pipeline and that are greater than 15 feet in height would be cut and removed from the right-of-way. We analyzed riparian and forest clearing and revegetation adjacent to waterbodies above, and found those impacts on aquatic resources related to removal of stream shade and increases in water temperature would be unsubstantial.

Herbicide Application

Pacific Connector would not use herbicides for routine vegetation maintenance; however, Pacific Connector would implement an *Integrated Pest Management Plan* that addresses control of noxious weeds. The plan would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. Pacific Connector would only use agency-approved herbicides authorized in current planning documents to control noxious weeds where infestations occur in the right-of-way after construction and during operation. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zones.

Herbicides can have toxic or other adverse effects on fish and other aquatic organisms. In general, most impacts to aquatic systems occur from direct spray of herbicides, and possibly drift when herbicides are sprayed, and leaching through soils and groundwater (Tu et al. 2001). Pacific Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground. The six different types of potential herbicides that could be used have various levels of toxicity to aquatic organisms. However, the restriction to selective applications outside of riparian zones would greatly reduce the potential of adverse effects to fish by keeping herbicides outside of riparian zones and preventing herbicides from reaching streams.

Essential Fish Habitat – Pipeline Route

EFH and species present in Coos Bay are described in detail above in section 4.6.2.1. In Coos Bay, the amount of EFH habitat that would be directly disturbed in the estuarine environment from either right-of-way construction or TEWAs is estimated to be about 73 acres (table 4.6.2.3-3). Additional areas would be affected from sediment and turbidity from pipeline installation. The directly disturbed areas would include approximately 5 acre of aquatic eelgrass, an additional 36 acres of intertidal mudflat, and about 33 acres of subtidal habitat. All are important habitat components for estuarine food webs, especially the eelgrass beds. The characteristics and life history of PFMC EFH species that may be in the pipeline area at waterbody crossings are summarized in table 4.6.2.3-4 and described in our BA and EFH Assessment (FERC 2015) prepared for the Project. Construction-related impacts on the estuarine region of Coos Bay and its EFH would be reduced by Pacific Connector following its *Haynes Inlet Water Route Plan*, which includes the in-water work window developed by ODFW and other measures discussed above.

A list of the waterbodies crossed by the proposed pipeline route and EFH assumed or known for coho and Chinook salmon species is shown in appendix O, table O-2. Sixty-five of the stream and estuary crossing areas (either directly crossed or near the pipeline) contain or are assumed to contain EFH for either one or both of these species. The Haynes Inlet crossing would be wet open cut during the designated in-water work window for Coos Bay. All streams that would be directly crossed would have all construction work done in the dry (three would be passed by HDD, three with conventional bore, and one using a diverted open cut [South Umpqua River]). In-water work for the pipeline crossings would temporarily affect EFH in approximately 59 streams that would be crossed using dry open-cut methods that are potentially designated as EFH for Chinook and/or coho salmon. Waterbody crossings that involve open trenching would be constructed during established in-water work windows. However, some streams may have spawning Chinook salmon present during the crossing period, which would increase the risk of spawning effects from turbidity and sediment.

In freshwater, EFH for Chinook and coho salmon includes habitats for spawning, rearing, and migration corridors (PFMC 2003). Components of the pipeline with the potential to adversely affect designated EFH include removal of terrestrial and riparian vegetation, in-water pipeline construction increasing turbidity and sediment, accidental spills and leaks of hazardous materials, and hydrostatic testing. Construction adjacent to EFH could also result in increased stormwater runoff and/or an inadvertent spill of hazardous materials, either of which could result in substantial adverse effects on EFH. A detailed discussion of measures that would be implemented to avoid or minimize impacts on aquatic resources (including EFH) because of pipeline construction is presented above.

The determinations of effect on EFH resulting from the Pacific Connector Pipeline Project are described below. For actions within the estuary, effects to EFH would be similar to those described for the LNG terminal slip. Additional adverse effects would occur at freshwater crossings that would affect Pacific Coast salmon. For coastal pelagic, groundfish, and Pacific coast salmon, effects would be similar although magnitude would vary (table 4.6.2.3-7).

TABLE 4.6.2.3-7

Potential Impacts to EFH due to Pipeline Construction and Operation

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Groundfish	All waters from the extent of the high tide line (and parts of estuaries) to offshore to the 3,500 meter (1,914 fathoms) depth.	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances	Substantial adverse effects to multiple groundfish species (e.g., rockfish, English sole, Starry flounder) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50 °F and 79 °F	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances	Substantial adverse effects to coastal pelagic species (northern anchovy, Pacific sardine) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)

TABLE 4.6.2.3-7

Potential Impacts to EFH due to Pipeline Construction and Operation

EFH	Description of EFH a/	Project Actions and Potential Impacts	Determination of Effects
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon. Estuaries and marine areas extending to the EEZ and beyond.	• Dredging of 2.4-mile pipeline route in Coos Bay • Accidental spills of hazardous substances • Pipeline construction at waterbody crossings • Water withdrawal • Loss of riparian habitat along streams • Short-term disruptions of Chinook salmon active spawning	Substantial adverse effects to Pacific coastal salmon species (coho and Chinook salmon) EFH (see sections 4.6.2.2 and 4.6.2.3 for impacts and mitigation)

a/ PFMC 2006 (update version 7/24/2006)

FERC, as the lead federal agency, is consolidating the EFH and the ESA process for all portions of the Project. This includes development of an EFH Assessment and BA together for submittal to NMFS and FWS with a request to initiate formal consultation.

4.6.2.4 Aquatic Resources on Federal Lands

The Pacific Connector pipeline would have some effect on 47 waterbodies and associated riparian areas within the approximately 71 miles of federal lands that would be crossed by the pipeline. This includes 13 known or assumed fish-bearing stream crossings (table 4.6.2.4-1). The effects to federal lands and resources from the proposed action are addressed fully in section 4.1. Watersheds crossed on federal lands and characteristics of those watersheds are discussed in section 4.1.3.5. Aquatic species present on federal lands would be similar to those discussed in section 4.6.2.3, except no marine and estuarine fish and shellfish are present within the waterbodies crossed on federal lands. Aquatic species found on federal lands would be mostly the same as those on non-federal lands with freshwater habitat. Commercial and recreational fisheries of importance in waterbodies crossed include primarily anadromous salmon and steelhead and resident trout. Specials status species present in some stream segments crossed include federally listed Oregon coastal coho salmon and Southern Oregon/Northern California coastal coho salmon ESU. EFH habitat is also present along the route for coho and Chinook salmon stocks. Other state and federal fish species of special status are discussed in section 4.7. Aquatic habitats that would be affected by the pipeline on federal lands are primarily coldwater and anadromous streams, with a few warmwater ponds adjacent to the construction areas. Much of the stream riparian areas crossed on BLM and NFS lands is heavily forested and shaded by coniferous trees.

The general impacts on aquatic resources, and mitigation for those effects, would be similar on federal lands to those discussed above in section 4.6.2.3 for the entire pipeline. Crossing techniques for most waterbodies would include dry-open cut methods. Fourteen perennial and 29 intermittent streams would be directly crossed by the pipeline construction on federal lands (table 4.6.2.4-1). Of these streams, 5 are known or assumed to contain anadromous fish, and 15 known or assumed to contain resident fish species. ESA species and EFH habitat for salmon may be present in up to 5 stream disturbance areas (table 4.6.2.4-1).

TABLE 4.6.2.4-1

Number of Streams Crossed by the Pacific Connector Pipeline Route on Federal Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project

Fifth Field Watershed (Fifth Field HUC)	Federal Land Agency	Perennial Streams	Intermittent Streams	Fish-bearing Streams with (a/): Anadromous Species (assumed) b/	Fish-bearing Streams with (a/): Resident Species (assumed) a/,b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Coos County							
Coos Bay Frontal-Pacific Ocean	BLM Coos Bay Dist.	0	1	0	0	0	0
North Fork Coquille River (1710030504)	BLM Coos Bay Dist.	1	5	1	1	1	1
East Fork Coquille River (1710030503)	BLM Coos Bay Dist.	0	2	0	0	0	0
Middle Fork Coquille River (1710030501)	BLM Coos Bay Dist.	1	6	(1)	(2)	(1)	(1)
Middle Fork Coquille River (1710030501)	BLM Roseburg District	1	0	0	0	0	0
Douglas County							
Middle Fork Coquille River (1710030501)	BLM Roseburg Dist.	1	1	0	(1)	0	0
Days Creek-South Umpqua (1710030205)	BLM Coos Bay Dist.	0	1	0	0	0	0
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	5	1	0	(4)	0	0
Jackson County							
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	0	1	0	0	0	0
Trail Creek (1710030501)	Forest Service Umpqua NF	0	1	0	0	0	0
Trail Creek (1710030501)	BLM Medford Dist.	1	0	1	1	1	1
Shady Cove-Rogue River (1710030707)	BLM Medford Dist.	0	5	0	0	0	0
Big Butte Creek(1710030704)	BLM Medford Dist.	2	1	(1)	(1)	(1)	(1)
Little Butte Creek (1710030708)	BLM Medford Dist.	0	5	(1)	1	(1)	(1)
Little Butte Creek (1710030708)	Forest Service Rogue River NF	1	1	0	2	0	0
Klamath County							
Spencer Creek (1801020601)	Forest Service Winema NF	1	2	0	1	0	0
Spencer Creek (1801020601)	BLM Lakeview NF	0	1	0	(1)	0	0
TOTAL		**14**	**36**	**2(3)**	**6(9)**	**2(3)**	**2(3)**

a/ Known and assumed (value in parentheses) crossings by the pipeline with indicated fish category designation
b/ Trout
Note: Based on Pacific Connector's analysis, numbers may differ from federal agency analysis of streams, in some watersheds.

Riparian Reserve Areas

A unique land allocation specific to BLM and NFS lands is Riparian Reserve. This allocation was developed in conjunction with the ACS that is incorporated into each of the BLM and Forest Service LMPs for management of areas associated with streams, lakes, and potentially unstable areas. The ACS was developed as part of the NWFP *Standards and Guidelines* to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within NFS lands

(Forest Service and BLM 1994b) for a variety of species. Major components of the ACS are Riparian Reserves and Key Watersheds (see section 4.1). Riparian Reserves are intended to serve as corridors in the matrix and enable BLM and Forest Service to manage these land allocations to maintain and restore riparian structures and functions of these unique and important features. As described in section 4.1, Riparian Reserves have a unique set of Standards and Guidelines that are applicable wherever these occur. While the ACS places an emphasis on efforts to maintain and restore aquatic and riparian habitat that is necessary to support anadromous salmonids, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones in general to support invertebrate and vertebrate species dependent on those habitats. The description of these nine objectives and how they will be maintained under the proposed actions is presented fully in section 4.1.

The Pacific Connector pipeline would cross Riparian Reserves areas along the route on federal lands. Direct and indirect impacts on Riparian Reserves affected by all construction activities (e.g., pipeline right-of-way, TEWAs, permanent and temporary access roads) are discussed in section 4.1.

Key Watersheds on NFS Lands

Key watersheds on NFS land, as designated by the NWFP (Forest Service and BLM 1994a), provide high water quality and are crucial to at-risk fish species and stocks. They are the highest priority for watershed restoration. Tier 1 Key Watersheds consist primarily of watersheds directly contributing to anadromous salmonid, bull trout, and resident fish species conservation. Tier 2 watersheds do not necessarily contain at-risk fish stocks, but are important sources of high quality water (Forest Service and BLM 1994a). The Key Watersheds include three Tier 1 (Days Creek – South Umpqua River [formerly named South Umpqua River], North and South Forks Little Butte, Spencer Creek) and one Tier 2 (Clover Creek) watershed. Potential effects to these Key Watersheds and actions that would be taken by the project to ensure Key Watershed functions are maintained are discussed in section 4.1.

Measures That Would Mitigate Impacts on Aquatic Resources on Federal Lands

Pacific Connector would develop project design, construction, and operation measures to avoid or minimize impacts on aquatic resources to the extent practicable, and to meet long-term consistency with the ACS on NFS and BLM lands. To compensate for unavoidable impacts along streams from loss of upslope and riparian vegetation and LWD input that do not meet the objectives of the ACS, Pacific Connector has developed a CMP.[106] Actions that would be taken on NFS and BLM lands to help meet ACS objectives on those lands are included in appendix F. These additional actions and mitigation measures are summarized in table 2.1.4-1; the effects of implementation of these measures on meeting the ACS objectives by watershed are discussed in section 4.1.

To ensure that the Pacific Connector Pipeline Project is consistent with the objectives of the ACS on NFS and BLM lands, which would in turn aid fish populations on federal land, Pacific Connector would (1) donate LWD to agencies/conservation groups to perform in-stream restoration projects; and/or (2) relocate large boulders greater than 24 inches in diameter for use

[106] Filed with the FERC in September 2013.

as fish habitat structures. To mitigate for Project actions that, even with site-specific actions, may impede maintaining ACS objectives on each watershed (e.g., pipeline crossing LWD placement and riparian vegetation plantings), Pacific Connector would fund the following types of projects that would be implemented on federal land areas not directly affected by Project activity:

- add LWD to several miles of streams outside of the project area;
- restore degraded riparian habitats through off-site revegetation projects;
- conduct off-site in-stream habitat improvement and fish passage projects;
- improve stream road crossings and replace or stabilize culverts that may contribute sediment from fill failure to streams;
- acquire conservation easements on private land to protect or improve important riparian habitats, particularly targeting streams containing listed fish, 303(d) streams, and key watersheds;
- conduct pre-commercial thinning projects where feasible to improve riparian habitats;
- install fences in allotments to improve riparian habitats;
- decommission roads and waterbody features (e.g., culverts, crossings, bridges) identified by the BLM and Forest Service that are no longer needed for resource management to provide numerous benefits including lower road density, minimization of channel extensions, minimization of sedimentation, improvement of fish passage through culvert removal, and reduction of riparian habitat fragmentation;
- close roads that are not in use, which would reduce sediment runoff to streams; and
- stormproof roads (such as adding water bars, ditch cleaning, culvert bypass) to also reduce fine sediment to streams and reduce the risk of road blow out, which could contribute heavy sediment loads to streams.

The list of mitigation measures noted above is not all that would be in place (see table 2.1.4-1), but identifies some of the major efforts that would be undertaken to reduce and mitigate impacts from the proposed action to aquatic resources. Following project construction, habitat and ecosystem function would be restored in-place as much as possible. However, although mitigation actions would restore habitat and have long-term benefits to wetlands, estuarine ecosystems, and habitat for salmonids in general, there would be effects on some non-target species. The goal of additional mitigation would be to restore habitat with similar ecological function for the remaining impacts to aquatic resources to ensure project actions meet the ACS objectives at multiple scales. All of these actions would reduce impacts to fish resources on federal lands by reducing factors known to be harmful or limiting to fish species including elevated suspended sediment and sediment in the stream channel, which affects fish production and survival; loss of LWD in streams, which reduces habitat quality; loss of future riparian LWD and other vegetation supplying input of organic matter; and loss or restriction of fish movement (passage) in streams. Specific sites and actions for the mitigation measures were identified through meetings with the BLM and Forest Service. These are provided in the *Mitigation Plan for Federal Lands* included in appendix F of this EIS. The details of these mitigation actions and how they relate to ensuring the ACS is being met in each of the affected watersheds are discussed in section 4.1.

4.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Federal agencies are required by Section 7 of the ESA (Title 19 U.S.C. Part 1536[c]), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. The action agency (e.g., the FERC) is required to consult with the FWS and/or the NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a BO as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

Jordan Cove and Pacific Connector filed an applicant-prepared draft BA in September 2013, and a revised applicant-prepared draft BA in April 2014. We prepared a BA and EFH Assessment (FERC 2015) that was submitted to the FWS and NMFS in February 2015. The effects determination summaries included in this FEIS are based on FERC's February 2015 BA and EFH Assessment (FERC 2015), as well as updated information provided by Jordan Cove and Pacific Connector since we submitted our BA. Based on this updated information and ongoing consultation with FWS and NMFS, our effects determinations for two species, fisher (*Pekania pennanti*; West Coast DPS) and Pacific eulachon (*Thaleichthys pacificus*; Southern DPS), have changed from "not likely to adversely affect" to "likely to adversely affect" since we submitted our BA in February 2015; these updates are reflected in this FEIS. Because consultation with FWS and NMFS is ongoing, additional analysis may be incorporated into the Project's BA in the future, which may result in data or analysis in the BA that is not reflected in this FEIS.

This section analyzes the effects of the Project on special status species. In addition to species listed as threatened or endangered under the federal ESA and Oregon ESA, agencies and organizations such as the FWS, BLM, Forest Service, ODA, and ODFW maintain lists of species that are considered special concern, sensitive, rare, or are otherwise offered protections under agency planning documents. These species are broadly defined in this assessment as "special status species."[107] Although the term "special status species" is used differently by various agencies, for the purposes of this assessment, the term "special status species" includes:

[107] The term "special status species" is also used by the BLM, but in a narrower agency-specific definition than in this assessment. BLM "special status species" include species listed as threatened or endangered under the ESA, species that are proposed for listing under the ESA, species that are candidates for listing under the ESA, and species designated by the BLM as "sensitive" under criteria in BLM Manual 6840. The Forest Service uses similar designations. For both the BLM and Forest Service, "S&M" are managed under specific criteria provided in the Northwest Forest Plan rather than the agency "special status species" programs. Fifteen species are designated as both "special status species" for the BLM and Forest Service and "S&M species." Those species are noted in the assessment and are analyzed here under criteria for both programs.