RECLAMATION

Managing Water in the West

Draft Environmental Impact Statement

Navajo Generating Station-Kayenta Mine Complex Project

Volume 2 – Section 3.8 through Section 3.16

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Section 3.8

Vegetation Resources

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BMPs	Best Management Practices
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
O&M	Operations and Maintenance
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PFR	Partial Federal Replacement

PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
SWReGAP	Southwest Regional Gap Analysis Project
tpy	tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency
WTS	Western Transmission System

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3.8 Vegetation Resources

3.8.1 Regulatory Framework

Laws, regulations, and policies that directly influence vegetation management decisions for the project primarily are implemented by the Office of Surface Mining Reclamation and Enforcement (OSMRE), U.S. Fish and Wildlife Service, Navajo Nation, Hopi Tribe, Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), U.S. Forest Service, and Arizona Game and Fish Department. A summary of statutes, regulations, and policies relevant to the project are included in **Table 3.8-1**. Statues, regulations, and policies relevant to special status plant species are identified in Section 3.9, Special Status Vegetation Resources.

Table 3.8-1 Relevant Statutes, Regulations, and Policies for Plant Species

Statutes, Regulations, and Policies	Summary
Surface Mining Control and Reclamation Act of 1977	The Surface Mining Control and Reclamation Act of 1977 establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement. The law establishes minimum requirements for all coal surface mining on federal and state lands, including exploration activities and the surface effects of underground mining. Mine operators are required to minimize disturbance and adverse impacts to biological resources and achieve enhancement of these resources where practicable.
BLM Manual H-4180 and Code of Federal Regulations 4180.1	BLM Manual H-4180 sets forth policies for developing and implementing land health standards on the National System of Public Lands including technical assistance and guidance for vegetation and native and non-native plant communities.
Federal Noxious Weed Act of 1974 (7 United States Code 28909)	The Federal Noxious Weed Act of 1974 provides for the control and management of nonindigenous plant species that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. The Act requires that each federal agency develop a management program to control undesirable plants on federal lands under the agency's jurisdiction; establish and adequately fund the program; implement cooperative agreements with state agencies to coordinate management of undesirable plants on federal lands; and establish integrated management systems to control undesirable plants targeted under cooperative agreements.
Federal Plant Protection Act of 2000	The Federal Plant Protection Act of 2000 consolidates and modernizes all major statutes pertaining to plant protection and quarantine (Federal Noxious Weed Act, Plant Quarantine Act) and permits the Animal and Plant Health Inspection Service to address all types of weed issues. It also authorized the Animal and Plant Health Inspection Service to take both emergency and extraordinary emergency actions to address incursions of noxious weeds.
Arizona Revised Statute 3-201	Arizona Revised Statute 3-201 defines “noxious weed” as any species of plant that is, or is liable to be, detrimental or destructive and difficult to control or eradicate and shall include any species that the director, after investigation and hearing, shall determine to be a noxious weed.
Clean Water Act Section 404	Section 404 of the Clean Water Act regulates the discharge of dredged or fill materials into waters of the U.S., including wetlands.
Executive Order 13112	Executive Order 13112 requires federal agencies to prevent the introduction and spread of invasive species and prohibits their authorization of actions that would be likely to cause or promote the introduction or spread of invasive species.

Table 3.8-1 Relevant Statutes, Regulations, and Policies for Plant Species

Statutes, Regulations, and Policies	Summary
Executive Order 11988 Floodplain Management	Executive Order 11988 requires that federal agencies 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.
Executive Order 11990 Protection of Wetlands	Executive Order 11990 requires federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out an agency's responsibilities.
Nevada Revised Statutes, Chapter 555.05	Nevada Revised Statutes Chapter 555.05 defines "noxious weed" as any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate.

3.8.2 Study Area

3.8.2.1 Proposed Action and Action Alternatives

As described in Chapter 1.0, there are three main components of the Navajo Generating Station (NGS)-proposed Kayenta Mine Complex (KMC) Project: the NGS and associated facilities, the proposed KMC, and the transmission systems. To facilitate description of the affected environment and analysis of project effects, a total of six different study areas divided among the three project components have been identified to analyze impacts to general vegetation. Refer to Section 3.0 for a detailed description of these study areas. The areas are displayed on **Figure 3.8-1**. The project components and their associated study areas are listed below:

Navajo Generating Station:

- NGS Near-field study area; and
- Black Mesa & Lake Powell (BM&LP) Railroad study area.

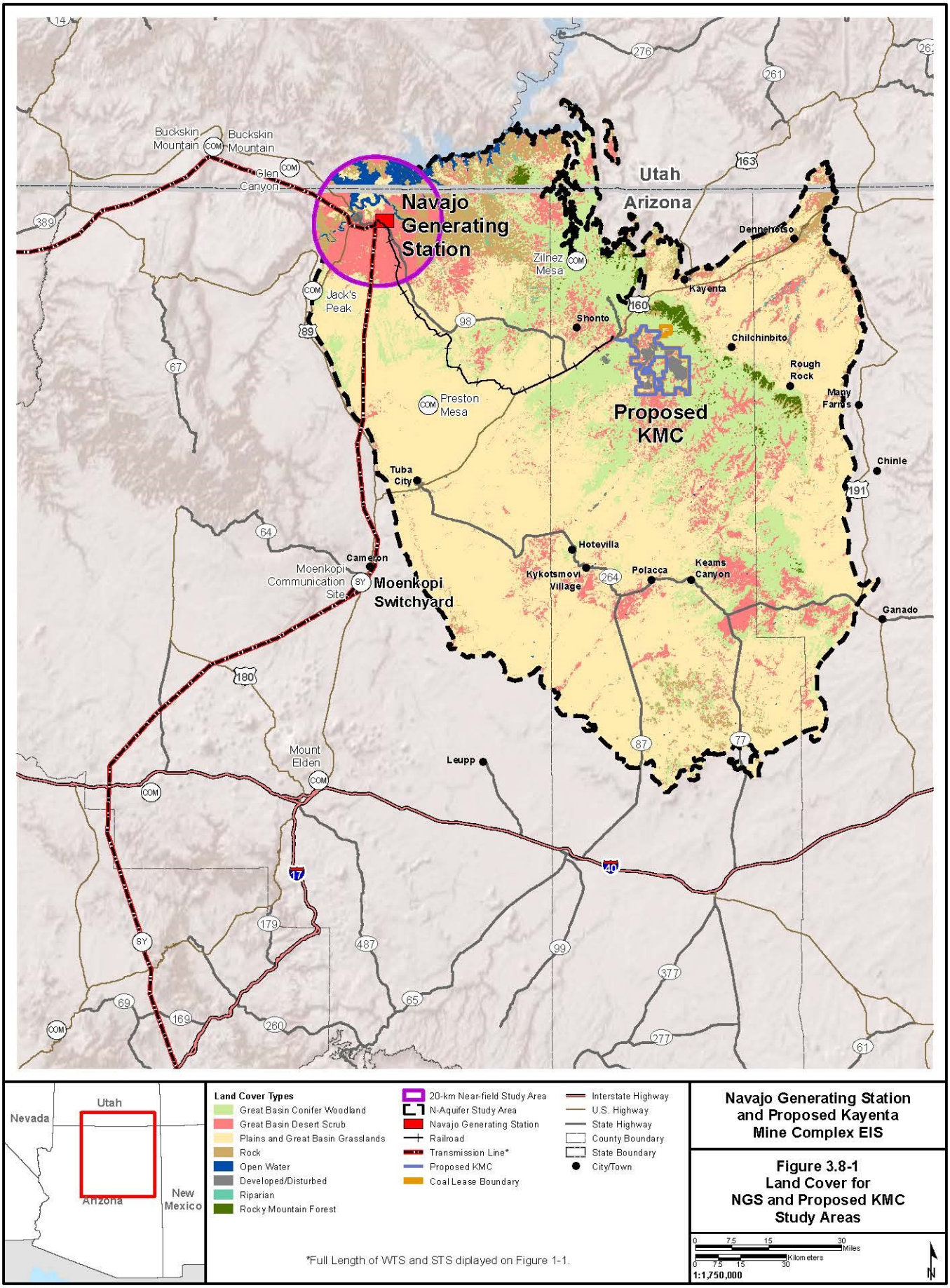
Proposed KMC:

- Proposed KMC study area; and
- Navajo Aquifer (N-Aquifer) study area.

Transmission Systems:

- Western Transmission System (WTS) study area; and
- Southern Transmission System (STS) study area.

As described in Section 3.0, potential water drawdown issues related to mine pumping at the proposed KMC was analyzed through hydrologic modeling. The study area for groundwater effects on riparian vegetation tied to seeps/springs is the same as the N-Aquifer study area as defined in Section 3.7.2, Water Resources. Because there is no new surface disturbance proposed within the N-Aquifer study area outside of the proposed KMC, impacts to upland vegetation were only analyzed in the proposed KMC disturbance area.



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.8-1
Land Cover for NGS and Proposed KMC Study Areas

7/20/2016

3.8.2.2 Cumulative

For general vegetation resources, the cumulative effects study areas are the same as those described for the Proposed Action and its alternatives. The cumulative effects analysis includes an assessment of total project affects across all study areas plus the effects of other past, present, and reasonably foreseeable actions affecting general vegetation within these areas. It should be noted that some actions assessed as part of the cumulative effects analysis may be located outside of the study areas listed above (e.g., mercury emissions associated with sources outside of the U.S.). However, to the extent that the effects of these actions combine with project-related effects to general vegetation within the six NGS-KMC study areas listed above, they are included in the cumulative effects analysis.

3.8.2.3 Ecological Risk Assessments – Role in Assessing Baseline Risk and Environmental Consequences

As detailed in Section 3.0, in order to evaluate total future risks associated with emissions from the NGS, the proposed KMC, plus other cumulative sources, it is necessary to consider the level of risk from chemicals currently present in the environment (baseline). Baseline conditions capture naturally occurring chemicals, past emission and deposition from the NGS, and past deposition from other local, regional, and global sources. The NGS Near-field ecological risk assessment (ERA) evaluated the potential risk to ecological receptors based on baseline conditions and concentrations of future NGS emission chemicals in soil, sediment, and surface water within a defined deposition area around NGS. The data used to evaluate the potential for risk to terrestrial plants was based on soil sampling results reported in the NGS Sampling Investigation Report (Ramboll Environ 2016f). Plant tissue samples were not collected or considered for the analysis. The KMC ERA prepared for the proposed KMC evaluated the potential for adverse effects to ecological receptors from exposure to chemical contaminants dispersed primarily from fugitive dust associated directly and indirectly with mining activities. Although the KMC ERA addressed risk for special status species, the potential for risk to general vegetation can be extrapolated based on the reported hazard quotients (HQs) for soils. The determination of the study area is summarized in Section 3.0.3, Ecological and Human Health Risk Assessment Approach and Study Area, and discussed in detail in **Appendix 3-RA**.

Representative species were evaluated for exposure to chemicals of potential ecological concern (COPECs). HQs were calculated for each COPEC. HQs are a ratio of estimated chemical concentrations and the appropriate ecological screening value at or below which impacts to a given species from exposure to a chemical are unlikely. The HQ is not a predictor of risk but rather is an indicator of whether or not there is a potential for risk. Detailed information on how HQs are calculated and how they are interpreted is described in **Appendix 3-RA**, Ecological and Human Health Risk Assessments. COPECs analyzed in the NGS Near-field study area analysis include inorganic chemicals (e.g., mercury and selenium) and organic chemicals, specifically dioxins/furans and polycyclic aromatic hydrocarbons.

3.8.3 Affected Environment

3.8.3.1 Region-wide Vegetation Resources

3.8.3.1.1 General Vegetation

The NGS and Kayenta Mine are located in the Colorado Plateau physiographic region. The vegetation in the Colorado Plateau is adapted to cold temperate and arid to semi-arid conditions. Major land cover types include Great Basin conifer woodland; dwarf woodland, dominated by pinyon-juniper; Great Basin desert scrub, dominated by a variety of arid land shrubs; and Plains and Great Basin grasslands, dominated by a mixture of perennial grasses and low shrubs. Other major cover types include exposed bedrock and developed/disturbed areas. Riparian/wetland areas cover only a small portion of the region and consist mostly of tamarisk shrub along major washes. Most of the region is dominated by native vegetation, with only a small portion being developed/ disturbed.

The descriptions of vegetation communities and land cover types for this analysis were based on the Southwest Regional Gap Analysis Project (SWReGAP) (U.S. Geological Survey 2005, 2004). For the purposes of SWReGAP, land cover can be characterized as natural or semi-natural vegetation and is defined by the dominant plant species. Mapping vegetation over large regions has commonly been done using imagery obtained from satellites and dividing the landscape into similar areas that correspond to land cover classes. Land cover types are divided into more detailed vegetative communities. No field verification has been performed to determine the accuracy of SWReGAP data within the project area, although approximately 93,000 field samples were collected within the region mapped by the SWReGAP project to assist the land cover modeling effort (Lowry et al. 2005).

3.8.3.1.2 Riparian/Wetlands

Riparian areas are transitional areas between aquatic and upland habitat. They have distinctive vegetation communities related to increased availability of water from occasional to regular flooding and elevated water tables. Typical riparian areas occupy lakeshores and streambanks and include vegetation such as cottonwood, tamarisk, and willow. In the arid west, these areas generally have greater vegetation cover and productivity than upland areas. Wetlands are defined under Clean Water Act Section 404 regulations as “those areas that are inundated or saturated by surface water 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.” To be identified as a wetland, areas must exhibit hydrophytic vegetation, hydric soils, and wetland hydrology (U.S. Army Corps of Engineers 1987). The Section 404 regulations also cover surface water features that have a defined bed and bank and that have connectivity to other waters of the U.S. Projects that directly affect waters of the U.S., including wetlands, require permitting under Section 404 of the Clean Water Act.

3.8.3.1.3 Noxious Weeds and Invasive Species

Legally, noxious weeds are defined as any plant designated by a federal, state, or county government as injurious to public health, agriculture, recreation, wildlife, or property. Invasive species have similar ecological effects as noxious weeds but are not covered by existing regulations in the NGS-KMC Project area. Both noxious weeds and invasive species can out-compete native vegetation in areas of disturbance and can spread quickly in a short timeframe.

The Federal Noxious Weed Act of 1974 (7 United States Code 28909) established a nationwide definition of noxious weeds. The Arizona Department of Agriculture, Nevada Department of Agriculture, Utah Department of Agriculture and Food, BIA, and federal land management agencies (BLM, U.S. Forest Service) all have requirements for management of noxious weeds.

The State of Arizona designates noxious weeds under Arizona Revised Statute 3-201. Weeds that are not indigenous to the state and likely to be detrimental, destructive, and difficult to control or eradicate may be listed as noxious by the state. Arizona-listed weeds are classified into prohibited, regulated, and restricted weeds. Prohibited species are quarantined from entry into the state. Regulated species means that any visible plant parts may be controlled to prevent further infestation. Restricted means that any viable plant parts found within the state shall be quarantined to prevent further infestation. The Arizona noxious weed list is included in **Appendix 3.8-A**.

The State of Nevada designates noxious weeds under the Nevada Revised Statute, Chapter 555.05. Nevada-listed weeds are classified into Category A, Category B, and Category C. Category A weeds are generally not found or are limited in distribution throughout the state. Category B weeds are generally established in scattered populations in some counties in the state. Category C weeds are generally established and widespread in many counties. Each category has guidelines for management and/or eradication. The Nevada noxious weed list is included in **Appendix 3.8-A**.

The State of Utah designates noxious weeds under Section 4.17-3, the Utah Noxious Weed Act. Utah-listed weeds are classified as Class A, Class B, and Class C. Class A weeds are “Early Detection Rapid

Response" declared weeds that are not native to Utah, pose a serious threat, and should be considered a high priority for treatment/removal. Class B weeds are not native to Utah, pose a threat to the state, and are considered a high priority for control. Class C weeds are not native to the state, are widely spread, and pose a threat to the agricultural industry. The focus on Class C weeds is to contain them, and thus help prevent spread. The Utah noxious weed list is included in **Appendix 3.8-A**.

The BIA Navajo Region currently is developing an integrated noxious weed management plan (BIA 2015) and the Navajo Region maintains a Noxious/Invasive Weed List, which is provided in **Appendix 3.8-A**.

Table 3.8-2 provides a list of noxious weeds that may occur within the area for each of the project components. Based on mapped distributions and habitats present, several species of noxious weeds and invasive plant species may occur at each of the facilities.

Table 3.8-2 Noxious Weeds and Invasive Plant Species

Species	Arizona Weed Category	Known or Potential Occurrence[1]				
		NGS and Associated Facilities	BM&LP Railroad	Proposed KMC	WTS	STS
Arizona Noxious Weeds						
Buffelgrass *Pennisetum ciliare*	Prohibited Regulated					Possible
Camelthorn *Alhagi pseudoalhagi*	Regulated Restricted		Possible		Possible	Likely
Common purslane *Portulaca oleracea*	Prohibited Regulated	Possible	Possible	Known	Possible	Possible
Dalmatian toadflax *Linaria genistifolia* var. *dalmatica*	Prohibited Restricted				Possible	
Diffuse knapweed *Centaurea diffusa*	Prohibited Restricted		Possible	Known		
Dodder *Cuscuta* spp.	Prohibited				Possible	Possible
Field bindweed *Convolvulus arvensis*	Prohibited Regulated	Possible	Known	Known	Likely	Likely
Halogeton *Halogeton glomeratus*	Prohibited Restricted	Possible	Possible	Known	Likely	Possible
Jointed goatgrass *Aegilops cylindrica*	Prohibited Restricted				Possible	
Puncture vine *Tribulus terrestris*	Prohibited Regulated	Possible	Known	Known	Possible	Possible
Quackgrass *Elytrigia repens*	Prohibited Restricted				Possible	Possible
Russian knapweed *Acroptilon repens*	Prohibited Restricted	Possible	Known	Known	Likely	Likely
Scotch thistle *Onorpordum acanthium*	Prohibited Restricted	Possible	Known	Known	Known	Possible

Table 3.8-2 Noxious Weeds and Invasive Plant Species

Species	Arizona Weed Category	Known or Potential Occurrence[1]				
		NGS and Associated Facilities	BM&LP Railroad	Proposed KMC	WTS	STS
Yellow starthistle *Centaurea solstialis*	Prohibited Restricted				Possible	Possible
Other Invasive Species						
African mustard *Brassica tournefortii*	NA				Known	Likely
Black henbane *Hyoscyamus niger*	NA				Likely	
Bull thistle *Cirsium vulgare*	NA		Known	Known	Possible	Possible
Cheatgrass *Bromus tectorum*	NA	Likely	Likely	Known	Known	Likely
Kochia *Bassia scoparia*	NA	Likely	Known	Known	Likely	Likely
Malta starthistle *Centaurea melitensis*	NA				Likely	
Musk thistle *Carduus nutans*	NA		Known	Known	Possible	
Red brome *Bromus rubens*	NA				Known	
Russian olive *Elaeagnus angustifolia*	NA			Possible	Possible	
Prickly Russian thistle *Salsola tragus*	NA	Likely	Likely	Known	Likely	Likely
Tamarisk (salt cedar) *Tamarix* spp.	NA	Possible	Likely	Known	Known	Likely

[1] Center for Invasive Species and Ecosystem Health 2015; Howery 2009; OSMRE 2011, 2008.

NA = Not applicable.

3.8.3.2 Navajo Generating Station

3.8.3.2.1 General Vegetation

Major land cover types and vegetative communities found within the NGS Near-field study area (i.e., within a 20-kilometer [km] radius of the power plant) are listed in **Table 3.8-3**. Those found along the existing BM&LP Railroad are provided in **Table 3.8-4**. The distribution of these land cover types is shown on **Figure 3.8-1**. Based on the NGS Near-field ERA results, the maximum HQs for baseline (current) conditions were all below 1, indicating that there would be no effect to vegetation communities under baseline conditions.

Table 3.8-3 Land Cover Types and Vegetative Communities within the NGS Near-field Study Area

Land Cover Types	Vegetative Communities Associated with Land Cover Types: SWReGAP	Acres	Percent
Great Basin Conifer Woodland	Colorado Plateau Pinyon-juniper Woodland Colorado Plateau Pinyon-juniper Shrubland	10,295	2.9
Great Basin Desert Scrub	Colorado Plateau Blackbrush-Mormon Tea Shrubland Intermountain Basins Big Sagebrush Shrubland Intermountain Basins Greasewood Flat Intermountain Basins Mixed Salt Desert Scrub	159,211	45.3
Plains and Great Basin Grasslands	Intermountain Basins Active and Stabilized Dunes Intermountain Basins Semi-desert Grassland Intermountain Basins Semi-desert Shrub Steppe Colorado Plateau Sand Shrubland	48,714	13.8
Riparian	Invasive Southwest Riparian Woodland and Shrubland North American Warm Desert Riparian Woodland and Shrubland	1,331	0.4
Rock	Colorado Plateau Mixed Bedrock Canyon and Tableland	83,324	23.7
Water	Open Water	43,774	12.5
Developed/Disturbed	Developed, Medium – High Intensity Developed, Open Space – Low Intensity	5,041	1.4
No data[1]		51	<0.1
Total[2]		**351,741**	**100**

[1] Small areas are present that were not mapped by SWReGAP.

[2] Totals may differ due to rounding.

Source: SWReGAP (U.S. Geological Survey 2004).

Table 3.8-4 Land Cover Types and Vegetative Communities along the BM&LP Railroad

Land Cover Types	Vegetative Communities Associated with Land Cover Types	Acres[1]	Percent
Great Basin Conifer Woodland	Colorado Plateau Pinyon-juniper Woodland Intermountain Basins Juniper Savanna	534	11.8
Great Basin Desert Scrub	Intermountain Basins Big Sagebrush Shrubland Colorado Plateau Blackbrush-Mormon Tea Shrubland	1,387	30.6
Plains and Great Basin Grasslands	Intermountain Basins Semi-desert Shrub Steppe Southern Colorado Plateau Sand Shrubland	2,377	52.4
Riparian	None	0	0.0
Rock	Colorado Plateau Mixed Bedrock Canyon and Tableland	50	1.1
Water	Open Water	0	0.0
Developed/Disturbed	Developed, Open Space – Low Intensity	188	4.1
Total[2]		**4,536**	**100.0**

[1] Based on a 250-foot buffer.

[2] Totals may differ due to rounding.

Source: SWReGAP (U.S. Geological Survey 2004).

Great Basin conifer woodland is found in approximately 2.9 percent of the NGS Near-field study area and includes two vegetative communities - Colorado Plateau pinyon-juniper woodland and pinyon-juniper shrubland. Great Basin conifer woodlands occur in Arizona at elevations of 3,400 to 8,800 feet above mean sea level (amsl) (Arizona Game and Fish Department 2012). Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) are the common tree species. Common understory shrubs include big sagebrush (*Artemisia tridentata*), four-wing saltbush (*Atriplex canescens*), Mexican cliffrose (*Purshia mexicana*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), and rubber rabbitbrush (*Ericameria nauseosa*) (Brown 1982). Grasses and forbs provide a small amount of cover with the most common of these being bottlebrush squirreltail (*Elymus elymoides* ssp. *elymoides*), Indian ricegrass (*Acnatherum hymenoides*), and muttongrass (*Poa fendleriana*) (Brown 1994).

Great Basin desert scrub is found in approximately 45.3 percent of the NGS Near-field study area and is the most common land cover type. It includes four vegetative communities - Colorado Plateau blackbrush-Mormon tea shrubland, intermountain basins big sagebrush shrubland, intermountain basins greasewood flat, and intermountain basins mixed salt desert scrub. Great Basin desert scrub occurs at elevations of 3,000 to 6,500 feet amsl in Arizona (Arizona Game and Fish Department 2012). Vegetation is dominated by low-growing, small-leaved grasses and shrubs including blue grama (*Bouteloua gracilis*), saltgrass (*Distichlis spicata*), needle-and-thread (*Hesperostipa comata*), big sagebrush, shadscale (*Atriplex confertifolia*), blackbrush (*Coleogyne ramosissima*), Mormon tea (*Ephedra viridis* and *E. torreyana*), greasewood (*Sarcobatus vermiculatus*), four-wing saltbush, and rubber rabbitbrush.

Plains and Great Basin grassland is found in approximately 13.8 percent of the NGS Near-field study area and includes four vegetative communities - intermountain basins active and stabilized dunes, intermountain basins semi-desert grassland, intermountain basins semi-desert shrub steppe, and Colorado Plateau sand shrubland. Plains and Great Basin grassland cover occur in Arizona from 5,000 to 7,000 feet amsl. This is a perennial grass-dominated landscape with short- or mid-height grasses, including blue grama, sideoats grama (*Bouteloua curtipendula*), buffalo-grass (*Buchloe dactyloides*), Indian rice grass, galletagrass (*Hilaria jamesii*), prairie junegrass (*Koeleria macrantha*), alkali sacaton (*Sporobolus airoides*), and others. Shrubs are common, including four-wing saltbush, big sagebrush, winterfat (*Krascheninnikovia lanata*), rabbitbrush, and prickly pear cactus (*Opuntia* spp.).

The rock land cover type is found within approximately 23.7 percent of the NGS-Near-field study area. The only vegetative community within this land cover type is Colorado Plateau mixed bedrock canyon and tableland. This cover type includes barren and sparsely vegetated landscapes on cliffs, canyons, and open tablelands of mostly sedimentary rocks. The vegetation includes scattered trees and shrubs with a sparse herbaceous layer. Common species include pinyon pine, ponderosa pine (*Pinus ponderosa*), Utah juniper, and dwarf mountain mahogany (*Cercocarpus intricatus*).

Open water is found within approximately 12.5 percent of the NGS Near-field study area and is largely comprised of Lake Powell and the Colorado River.

Developed/disturbed lands occupy approximately 1.4 percent of the NGS Near-field study area and include two communities - medium to high intensity development and low intensity open space development. The NGS plant site includes several associated facilities such as the ash disposal area and road, pump station, pump station road, and buried pipeline/powerline that contribute to this category. The town of Page also is included in this land cover type (U.S. Geological Survey 2004).

Land cover types and vegetative communities found along the existing BM&LP Railroad are provided in **Table 3.8-4**. More than half the land cover type found along the BM&LP Railroad consists of plains and Great Basin grassland. About 30 percent of the remaining land cover is Great Basin desert scrub.

3.8.3.2.2 Riparian/Wetlands

Riparian areas consist of vegetation along rivers and streams and around impoundments that are influenced by flooding and/or high groundwater levels. Riparian areas are found within approximately 0.4 percent of the NGS Near-field study area and include two vegetative communities - invasive southwest riparian woodland and shrubland and warm desert riparian woodland and shrubland. The invasive riparian woodland and shrubland is dominated by tamarisk. Warm desert riparian woodland and shrubland typically occurs as a tree-dominated community of cottonwoods and willows (*Salix* spp.) with a diverse shrub understory (U.S. Geological Survey 2005).

Based on available information, there are no riparian or wetland areas in the immediate vicinity of the NGS plant site or associated facilities. The lake pump station is located at the edge of Lake Powell, which is a water of the U.S. under the jurisdiction of Section 404 of the Clean Water Act. The drainage that crosses the northeast corner of the NGS plant site is a tributary of Lake Powell and also may be a water of the U.S.

Riparian vegetation is scarce at Lake Powell due to continuously fluctuating lake levels and upland desert vegetation extending to the water's edge (U.S. Bureau of Reclamation 2007). Below the dam, riparian communities are dominated by tamarisk, arrowweed (*Pluchea sericea*), Gooding willow (*Salix goodingii*), coyote willow (*Salix exigua*), bulrush (*Scirpus acutus*), and Emery seepwillow (*Baccharis emoryi*) (Reclamation 2007).

No riparian/wetlands are present along the BM&LP Railroad (U.S. Geological Survey 2004). However, aerial photographs show that 2 to 3 acres of tamarisk (Invasive Southwest Riparian Woodland and Shrubland) are present at the crossing of Begashibito Wash outside of the 250-foot analysis buffer.

3.8.3.2.3 Noxious Weeds and Invasive Species

No specific information is available on noxious weed occurrence at the NGS plant site and its facilities. Based on mapped distributions and habitats present, several species of noxious weeds and invasive plant species are possible or likely to occur at the NGS plant site and associated facilities as noted in **Table 3.8-2**.

A number of noxious weeds and invasive plant species are known or likely to occur along the BM&LP Railroad as noted in **Table 3.8-2**. Noxious weeds known along the rail corridor include puncture vine, Russian knapweed, and Scotch thistle. Invasive plant species known to occur along the railroad include bull thistle, kochia, and musk thistle.

3.8.3.3 Proposed Kayenta Mine Complex

3.8.3.3.1 General Vegetation

Vegetation communities within the proposed KMC are displayed on **Figure 3.8-2**. Detailed vegetation studies, including baseline vegetation sampling of the coal resource areas and reference areas, were conducted between 1979 and 1983, and supplemental baseline sampling has been performed at various times since then (ESCO Associates and Peabody Western Coal Company [PWCC] 2003; OSMRE 2011). A vegetation map used in the 2011 Kayenta Mine Environmental Assessment (OSMRE 2011) as well as aerial interpretation of 2014 GoogleEarth® imagery further refined the vegetative communities displayed within the proposed KMC.

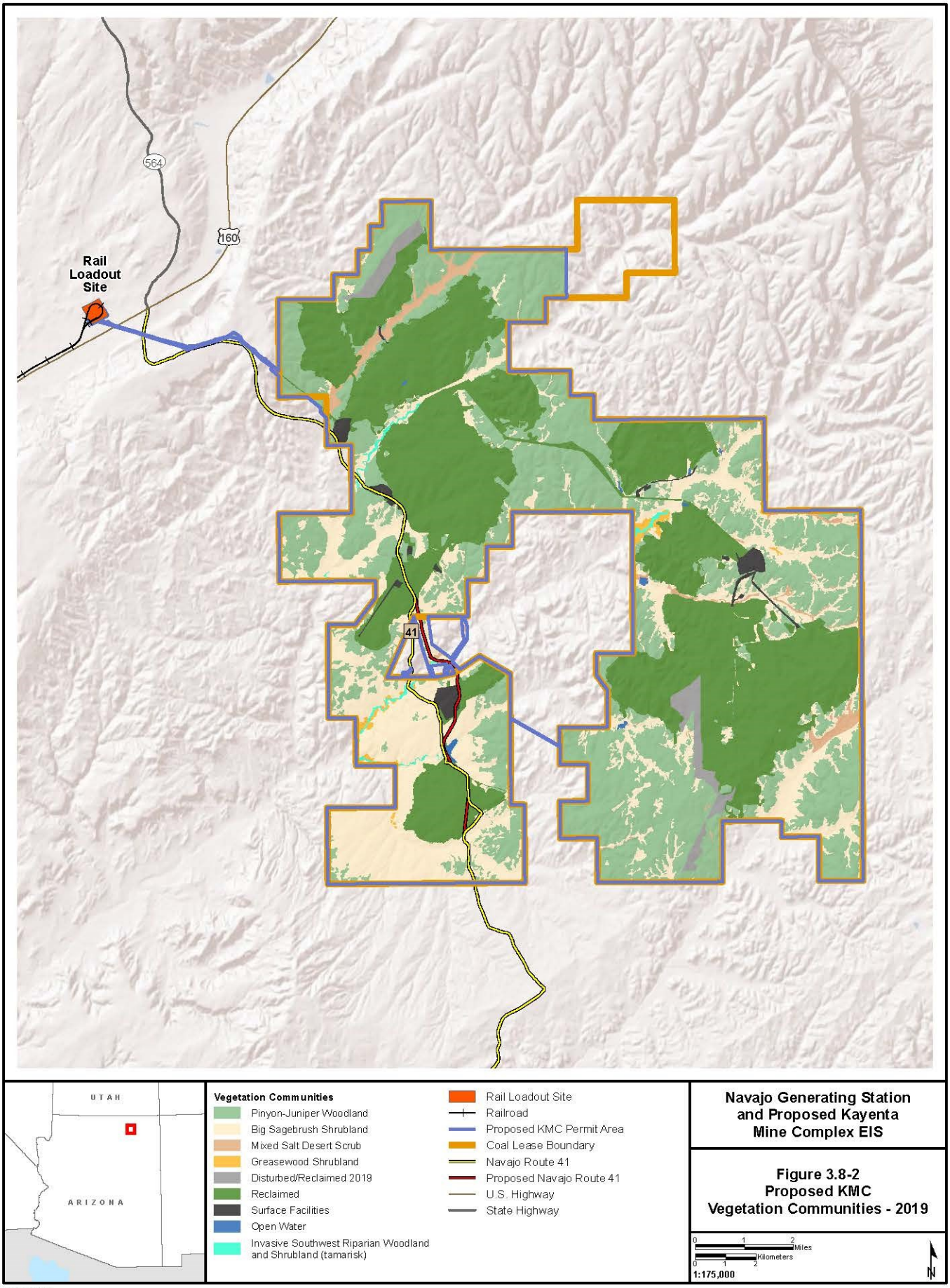


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Table 3.8-5 provides a summary of baseline (2019) acreages of the land cover types and vegetative communities within the proposed KMC. The land cover types of the proposed KMC are primarily Great Basin conifer woodland, Great Basin desert scrub, and recently mined areas. There are smaller areas of riparian and open water.

Table 3.8-5 Land Cover Types and Vegetative Communities within the Proposed KMC, 2019

Land Cover Types	Vegetative Communities Associated with Land Cover Types	Acres	Percent
Great Basin Conifer Woodland	Colorado Plateau Pinyon-juniper Woodland	23,557	37.5
Great Basin Desert Scrub	Intermountain Basins Big Sagebrush Shrubland	13,161	20.9
	Intermountain Basins Mixed Salt Desert Scrub	981	1.6
	Intermountain Basins Greasewood Shrubland	244	<1.0
Riparian	Invasive Southwest Riparian Woodland and Shrubland (tamarisk)	230	<1.0
Water	Open Water	87	<1.0
Developed/Disturbed	Disturbed/Reclaimed[1]	979	<1.0
	Reclaimed	22, 826	37.7
	Facilities	770	1.2
Total[2]		62,835	100.0

[1] Disturbed/reclaimed represents areas that are currently disturbed but likely to be reclaimed by 2019.

[2] Totals may differ due to rounding. Approximately 87 acres (0.1 percent) were not assigned a land cover type and are not included in table totals.

Source: U.S. Geological Survey 2004.

The Great Basin conifer woodland occurs on approximately 38 percent of the proposed KMC. The composition of this land cover type is described in Section 3.8.3.2, Navajo Generating Station.

Great Basin desert scrub occupies approximately 23 percent of the proposed KMC and more than 90 percent of this is sagebrush shrubland. This vegetative community occurs on deeper soils that develop in flatter areas and valley bottoms. Total vegetation cover is often less than 20 percent, with low rock cover and sparse understory vegetation. Sagebrush shrubland is the most prevalent vegetation type below 7,000 feet amsl on Black Mesa. Above that elevation, it is interspersed with pinyon-juniper woodland. Sagebrush shrubland is dominated by big sagebrush and blue grama. Common shrub species include four-wing saltbush, Douglas rabbitbrush, Greene's rabbitbrush (*Chrysothamnus greenei*), and rubber rabbitbrush. Common grasses include galletagrass, bottlebrush squirreltail, big squirreltail (*Sitanion jubatum*), needle-and-thread, Indian ricegrass, and western wheatgrass (*Elymus smithii*) (ESCO Associates, Inc. and PWCC 2003).

Two other Great Basin desert scrub vegetative communities occur in the area. Mixed salt desert scrub and greasewood occupy relatively small, linear areas along washes in the proposed KMC and occur on the margins of terraces associated with the higher order drainages. The terraces typically lie 5 to 20 feet above wash channels where saline alluvial soil has accumulated. Four-wing saltbush dominates the saltbush community and greasewood dominates the greasewood community (Brown 1994). Annual forbs and grasses form sparse to dense understories (ESCO Associates, Inc. and PWCC 2003).

Developed/disturbed areas within the proposed KMC consist mostly of active and recently mined lands, reclaimed lands, and areas occupied by facilities. These areas comprise nearly 40 percent of the analysis area. Reclaimed areas are designed to achieve vegetation communities that support livestock

grazing, wildlife habitat, and cultural plants. Native and introduced grasses and native shrubs dominate reclaimed lands in the proposed KMC. Cool-season native grass species include western wheatgrass, thickspike wheatgrass (*Elymus lanceolatus*), Indian ricegrass, needle-and-thread, big squirreltail, and bottlebrush squirreltail; and common warm-season native grass species include blue grama, galletagrass, and alkali sacaton. The most abundant introduced perennial grass species is Russian wildrye (*Elymus junceus*). Crested wheatgrass (*Agropyron desertorum*) and intermediate wheatgrass (*Agropyron intermedium*) also are present. Four-wing saltbush is the dominant shrub species, but several other species are common. Several weedy annuals primarily occur in newer reclamation areas. These include kochia, prickly Russian thistle, and cheatgrass (ESCO Associates, Inc. and PWCC 2003; OSMRE 2011). The purpose of reclamation is to restore the affected lands to the approximate landforms that existed prior to mining and to establish an effective and permanent vegetative cover similar in seasonal variety, diversity, and plant composition to the native vegetation found on undisturbed lands surrounding the mining operation. PWCC has established the following reclamation goals: manage reclaimed areas to meet reclamation standards; use grazing to remove standing dead vegetative litter and promote new growth and aid in establishing new seedlings; and demonstrate the utility of reclaimed lands for various seasons of use. For more information concerning reclamation, see Section 3.14.2.3, Land Use, Proposed Kayenta Mine.

Approximately 87 acres within the proposed KMC is open water made up of water impoundments, many of which are permanent. Smaller impoundments including sediment ponds and internally draining ponds in reclaimed areas are not included in this acreage. Some of the larger impoundments have shrubs and emergent wetland plants along the margin, including tamarisk, coyote willow, bulrush, and cattail (*Typha latifolia*). Submergent aquatic plants include common poolmat (*Zanichellia palustris*), pondweeds (*Potamogeton filiformis* and *P. pectinata*), and holly-leafed water nymph (*Najas marina*). The only non-microscopic alga found in most ponds is green algae (*Chara* spp.).

Numerous species of native plants found in the proposed KMC have cultural significance to the Hopi and Navajo people for use as food or medicine, use in rituals, and other uses such as tools, construction, and baskets. Lists of these plants are kept by the Hopi and Navajo based on published information about such uses (Mayes and Lacy 2012). Approximately 475 acres of cultural plant sites have been established since 1994 on select sites within reclamation areas at the proposed KMC. These are developed in areas with a mesic aspect and on coarse-textured skeletal soils and rocky substrates similar to native areas supporting pinon-juniper woodland and historic cultural collection sites. These sites, combined with native shrubland and pinon-juniper planting areas, will comprise approximately 5 percent of the reclaimed lands (OSMRE 2011).

3.8.3.3.2 Riparian/Wetlands

Riparian vegetation is less than 1 percent of the proposed KMC and occurs along major drainages, forming linear bands of vegetation. Riparian areas are typically between 10 and 20 feet wide and from a few yards to more than 0.5-mile-long. This vegetation occurs on the bottoms of washes and typically occupies the depositional side of a channel. Within the proposed KMC, surface water in riparian areas usually is ephemeral (only exists for a short time after precipitation), but short reaches of intermittent streams are present. Tamarisk is the dominant species among the riparian vegetation. Small amounts of greasewood and four-wing saltbush are common with tamarisk in drier areas. Coyote willow occurs with tamarisk in wetter areas. Herbaceous understory vegetation is limited and often is composed of cheatgrass, European alkali grass (*Puccinellia distans*), stickseed (*Lappula occidentalis*), and desert seepweed (*Suaeda torreyana*) (ESCO Associates, Inc. and PWCC 2003; OSMRE 2011).

Small tamarisk-dominated riparian areas are present in the southwest portion of the proposed KMC along lower Moenkopi Wash, Red Peak Valley Wash, and Coal Mine Wash. Small areas of wetlands also are present at some ponds. The major drainages in the proposed KMC are waters of the U.S. under the jurisdiction of Section 404 of the Clean Water Act; however, the active mine areas are located outside these drainages.

Table 3.8-6 provides a summary of riparian vegetation underlain by the N-Aquifer. Most of the riparian woodland and shrubland communities are located along the lower portions of major washes, including Begashibito Wash, Moenkopi Wash, Dinnebito Wash, Oraibi Wash, Polacca Wash, Jeddito Wash, and Chinle Wash. Within the N-Aquifer, riparian/wetland areas were identified through a Geographic Information System analysis using SWReGAP data, LANDFIRE data, and aerial photo interpretation. Woodland riparian communities identified through aerial photo interpretation within Spring Groups that could be affected by water pumping (Spring Groups D, F1, and I) were prioritized and added to the total riparian acreage number within the N-Aquifer study area. Section 3.7, Water Resources, contains detailed information concerning the spring groups. Upland vegetation was not assessed within the N-Aquifer study area outside of the proposed KMC disturbance area.

Table 3.8-6 Riparian and Wetland Vegetation Cover Types Relative to Upland Areas Underlain by the N-Aquifer

Land Cover Types	Vegetative Communities Associated with Land Cover Types	Acres	Percent
Riparian	Invasive Southwest Riparian Woodland and Shrubland (SWReGAP)	2,708	0.04
	Rocky Mountain Lower Montane Woodland and Shrubland (SWReGAP)	133	less than 0.01
	Riparian (LANDFIRE)	22,209	0.33
	Riparian (desktop aerial interpretation)	555	less than 0.01
Water	Open water	24,560	0.37
Uplands	—	6,602,430	99.25
Total		6,652,595	100.00

Source: U.S. Geological Survey 2004.

3.8.3.3.3 Noxious Weeds and Invasive Species

A number of noxious weed or invasive plant species are known or expected to occur within the proposed KMC and are summarized in **Table 3.8-2**. Known noxious weeds include common purslane, diffuse knapweed, field bindweed, halogeton, puncture vine, Russian knapweed, tamarisk, and Scotch thistle. Weedy invasives known to occur in the proposed KMC include bull thistle, kochia, musk thistle, prickly Russian thistle, cheatgrass, and tamarisk (Center for Invasive Species and Ecosystem Health 2015; ESCO Associates and PWCC 2003; U.S. Geological Survey 2004). At the proposed KMC, several of the invasive species are early successional weedy species found in newly reclaimed and disturbed areas that diminish as perennial vegetation develops and out-competes these species (OSMRE 2011). The PWCC vegetation management program monitors and treats annual weeds.

3.8.3.4 Transmission Systems and Communication Sites

3.8.3.4.1 General Vegetation

The WTS extends from NGS west to the Mojave Desert and Great Basin in southern Nevada. The eastern portions of the WTS cross vegetation typical of the Colorado Plateau including Great Basin conifer woodland and desert scrub. The western portion crosses Mojave Desert scrub.

The STS extends south from the cold deserts of the Colorado Plateau to the northern part of the Sonoran Desert north of Phoenix, Arizona. Nearly 50 percent of the land cover present along the STS is conifer woodland and grasslands.

Tables 3.8-7 and **3.8-8** provide summaries of the land cover types and vegetation communities along the WTS and STS, respectively, based on SWReGAP (U.S. Geological Survey 2004). A buffer-width of

2 miles (1 mile on each side) was used to determine the major land cover types and vegetative communities near the transmission systems. This does not mean all of these areas were impacted. The WTS is less diverse and mostly crosses desert scrub habitat. The STS has a diverse range of vegetative communities because it crosses mountainous areas and mid-elevation areas in central Arizona before dropping down into the Sonoran Desert. The power line corridors were constructed and built approximately 40 years ago, and vegetation within the right-of-way (ROW) corridor has been maintained to support low growing grasses, herbaceous species, and shrubs.

Table 3.8-7 Major Land Cover Types and Vegetative Communities along the WTS

Land Cover Types	Vegetative Communities Associated with Land Cover Types	Acres[1]	Percent
Great Basin Conifer Woodland	Colorado Plateau Pinyon-juniper Woodland Colorado Plateau Pinyon-juniper Shrubland	23,191	6.6
Great Basin Desert Scrub	Colorado Plateau Blackbrush-Mormon tea Shrubland Intermountain Basins Big Sagebrush Shrubland Intermountain Basins Greasewood Flat Intermountain Basins Mixed Salt Desert Scrub	90,985	25.8
Plains and Great Basin Grasslands	Intermountain Basins Semi-desert Grassland Intermountain Basins Semi-desert Shrub Steppe Intermountain Basins Active and Stabilized Dune Invasive Annual Grassland Invasive Annual and Biennial Forbland Intermountain Basins Mat Saltbush Shrubland	27,716	7.8
Mohave Desert Scrub	Mojave Mid-elevation Mixed Desert Scrub	13,011	3.7
Sonoran-Mojave Desert Scrub	Sonoran-Mojave Creosotebush-White Bursage Desert Scrub Sonoran-Mojave Mixed Salt Desert Scrub North American Warm Desert Wash	166,237	47.0
Riparian	Invasive Southwest Riparian Woodland and Shrubland North American Warm Desert Playa	1,817	0.5
Rock	Colorado Plateau Mixed Bedrock Canyon and Tableland North American Warm Desert Badland North American Warm Desert Bedrock Cliff and Outcrop North American Warm Desert Pavement North American Warm Desert Volcanic Rockland	25,652	7.3
Water	Open Water	279	0.1
Developed/Disturbed	Agriculture Developed, Medium – High Intensity Developed, Open Space – Low Intensity	3,669	1.0
No Data[2]	—	755	0.2
Total[3]		353,342	100.0

[1] Acres based on 2-mile-wide corridor centered on transmission line.
[2] Small areas are present that were not mapped by SWReGAP.
[3] Totals may differ due to rounding.
Source: SWReGAP (U.S. Geological Survey 2004).

Table 3.8-8 Major Land Cover Types and Vegetative Communities along the STS

Land Cover Types	Vegetative Communities Associated with Land Cover Types	Acres[1]	Percent
Great Basin Conifer Woodland	Colorado Plateau Pinyon-juniper Woodland Intermountain Basins Juniper Savanna	73,809	21.9
Great Basin Desert Scrub	Colorado Plateau Blackbrush-Mormon Tea Shrubland Intermountain Basins Big Sagebrush Shrubland Intermountain Basins Greasewood Flat Intermountain Basins Mixed Salt Desert Scrub	51,749	15.4
Plains and Great Basin Grasslands	Intermountain Basins Semi-Desert Grassland Intermountain Basins Semi-Desert Shrub Steppe Intermountain Basins Shale Badland Southern Colorado Plateau Sand Shrubland Intermountain Basins Active and Stabilized Dune	80,301	23.9
Semi-desert Grassland	Apacherian-Chihuahuan Piedmont Semi-desert Grassland and Steppe	13,426	4.0
Mogollon Chaparral	Mogollon Chaparral	16,112	4.8
Madrean Conifer Woodland	Madrean Pinyon-Juniper Woodland Madrean Pine-oak Forest and Woodland Madrean Juniper Savanna	24,656	7.3
Upland Sonoran Desert Scrub	Sonoran Paloverde – Mixed Cacti Desert Scrub	33,933	10.1
Sonoran-Mojave Desert Scrub	Sonoran-Mojave Creosotebush-White Bursage Desert Scrub Sonoran Mid-Elevation Desert Scrub	9,110	2.7
Chihuahuan Desert Scrub	Apacherian-Chihuahuan Mesquite Upland Shrub	16,584	4.9
Rocky Mountain Forest	Rocky Mountain Ponderosa Pine Woodland	4,243	1.3
Riparian	Invasive Southwest Riparian Woodland and Shrubland North American Warm Desert Lower Montane Riparian Woodland and Shrubland North American Warm Desert Riparian Woodland and Shrubland	1,580	0.5
Rock	Colorado Plateau Mixed Bedrock Canyon and Tableland	7,077	2.1
Water	Open Water	26	0.0
Developed/Disturbed	Developed, Medium – High Intensity Developed, Open Space – Low Intensity Agriculture	3,275	1.0
No Data[2]		633	0.2
Total[3]		336,517	100.0

[1] Acres based on 2-mile-wide corridor centered on transmission line.

[2] Small areas are present that were not mapped by SWReGAP.

[3] Totals may differ due to rounding.

Source: SWReGAP (U.S. Geological Survey 2004).

Table 3.8-9 displays the communication sites and the surrounding land cover type. Past development of these communication sites likely impacted the general vegetation community that currently surrounds each site.

Table 3.8-9 Communication Sites and Surrounding Land Cover

Communication Site	Land Cover Type[1]
Preston Mesa	Great Basin Conifer Woodland
Jack's Peak	Great Basin Desert Scrub
Zilnez Mesa	Great Basin Conifer Woodland
Red Mountain	Rock
Apex to Crystal	Rock
Glendale	Great Basin Desert Scrub
Beaver Dam	Great Basin Conifer Woodland
Pipe Springs	Great Basin Conifer Woodland
Buckskin Mountain	Great Basin Desert Scrub
Glen Canyon	Great Basin Desert Scrub
Mt. Elden	Plains and Great Basin Grassland
Bill Williams	Rocky Mountain Forest
Mingus Mountain	Rocky Mountain Forest
Mt. Francis	Rocky Mountain Forest
West Wing	Developed/Disturbed
White Tank	Mogollon Chaparral
West Phoenix	Developed/Disturbed

[1] Based on SWReGAP data.

Descriptions of Great Basin conifer woodland, Great Basin desert scrub, and Plains and Great Basin grassland land cover types are provided under Section 3.8.3.2, Navajo Generating Station.

Mojave Desert scrub occurs along the WTS and represents approximately 3.7 percent of the land cover. The vegetative community represented by this land cover is Mojave mid-elevation mixed desert scrub. In the analysis area, it is a transitional habitat above the Sonoran-Mojave Desert scrub and below Lower Montane woodlands. It is a shrubland dominated by a variable group of species including blackbrush, eastern Mojave buckwheat (*Eriogonum fasciculatum*), Nevada jointfir (*Ephedra nevadensis*), spiny hopsage, and yuccas (*Yucca breviolia* and *Y. schidigera*).

Sonoran-Mojave Desert scrub represents approximately 47.0 percent of the WTS and 2.7 percent of the STS. Three vegetative communities are represented by this land cover along the WTS - Sonoran-Mojave creosotebush-white bursage desert scrub, mixed salt desert scrub, and warm desert wash. Two vegetative communities represent this land cover along the STS - Sonoran-Mojave creosotebush-white bursage desert scrub and Sonoran mid-elevation desert scrub. Sonoran-Mojave desert scrub is a low-growing, open shrubland dominated by creosote bush, white bursage, and burrobush (*Ambrosia dumosa*), with a number of other shrub species common including shadscale and brittlebush. Herbaceous plants are scarce during most seasons but may be locally abundant after rains. This community occurs in arid areas up to 5,500 feet amsl.

Rock is present as a land cover along the WTS and STS and can support a variety of vegetative communities including Colorado Plateau mixed bedrock canyon and tableland, North American warm desert badland, warm desert bedrock cliff and outcrop, warm desert pavement, and warm desert volcanic rockland. These communities occur along approximately 7.3 percent of the WTS and 2.1 percent of the STS. Along the STS, Colorado Plateau mixed bedrock canyon and tableland is represented.

Developed/disturbed land cover represents approximately 1.0 percent of both the WTS and the STS. Three communities are included within developed/disturbed - agriculture, medium to high intensity development, and low intensity (open space) development.

Semi-desert grassland is approximately 4.0 percent of the land cover types along the STS and includes Apacherian-Chihuahuan semi-desert grassland and steppe. This community is found on gently sloping bajadas that support frequent fire and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by diverse perennial grasses including several grama species (*Bouteloua* spp.), muhly (*Muhlenbergia* spp.), galleta (*Pleuraphis* spp.), and alkaline sacaton. Shrub and tree species also are found, in particular several oak (*Quercus* spp.) and mesquite (*Prosopis* spp.) species.

Mogollon chaparral represents approximately 4.8 percent of land cover along the STS. This community occurs in Arizona at elevations of 4,000 to 6,000 feet amsl (Arizona Game and Fish Department 2006). It typically grows as a dense thicket of evergreen shrubs, dominated manzanita (*Arctostaphylos* spp.), and shrub live oak (*Quercus turbinella*). A number of other shrub species as well as succulents (e.g., prickly pear cactus, agaves, and yuccas) are common. Forbs and grasses are not abundant because of the dense shrub cover.

Madrean conifer woodland represents approximately 7.3 percent of land cover along the STS and includes the vegetative communities of pinyon-juniper woodland, pine-oak forest and woodland, and juniper savanna. Dominate vegetation includes oaks, junipers, and pines. Other common species include oak, alligator bark juniper (*Juniperus deppeana*), one-seed juniper (*Juniperus monosperma*), and pinyon pine.

Upland Sonoran desert scrub is approximately 10.1 percent of land cover along the STS and is represented by Sonoran Paloverde - mixed cacti desert scrub. This community occurs in Arizona from 500 to 3,500 feet amsl (Arizona Game and Fish Department 2006). It has a mix of trees, shrubs, and cacti including blue and yellow palo verde (*Parkinsonia florida*, *P. microphylla*), desert ironwood (*Olneya tesota*), mesquites, catclaw acacia (*Senegalia greggii*), creosote bush (*Larrea tridentata*), brittlebush (*Encelia farinosa*), bursage (*Ambrosia* spp.), saguaro cactus (*Carnegiea gigantea*), and numerous other species.

Chihuahuan desert scrub is approximately 4.9 percent of land cover along the STS. This vegetative community occurs at elevations of 2,000 to 5,500 feet amsl. In the analysis area, this community is an upland shrubland dominated by mesquites and succulents with low grass cover. It typically occurs above the elevation range of creosote bush.

Rocky Mountain forest in the study area is represented by the ponderosa pine woodland community and makes up approximately 1.3 percent of the land cover along the STS. It is dominated by ponderosa pine, with Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and other species also present. It occurs at elevations of 6,000 to 9,000 feet amsl and many stands are relatively open woodlands.

3.8.3.4.2 Riparian/Wetlands

Riparian areas make up 0.5 percent of the land cover located along both transmission lines. Approximately one-third of the riparian habitat along the STS and most of the riparian habitat along the

WTS is dominated by tamarisk. Riparian vegetation along the WTS is present at the crossings of the Colorado River, Kanab Creek, Bitter Seeps Wash, Pipe Valley Wash, Sandridge Wash, Clayhole Wash, Meadow Valley Wash, Virgin River, Beaver Dam Wash, Muddy River, Las Vegas Wash, and some smaller unnamed washes and drainages.

Riparian land cover on the STS includes invasive southwest woodland and shrubland and warm desert woodland and shrubland. Dominate species include cottonwoods, Arizona sycamore (*Platanus wrightii*), Arizona walnut (*Juglans major*), velvet ash (*Fraxinus velutina*), and other species along perennial and intermittent streams. At lower elevations, box elder (*Acer negundo*), velvet ash, Gooding's willow, netleaf hackberry (*Celtis laevigata* var. *reticulata*), and Arizona walnut are common. Invasive southwest riparian woodland and shrubland are present at the crossing of the Little Colorado River. Riparian areas also occur at the crossing of the Verde and Agua Fria rivers.

3.8.3.4.3 Noxious Weeds and Invasive Species

A number of noxious weed and invasive plant species are likely to, or may possibly, occur along the transmission lines (**Table 3.8-2**). Noxious weed species likely to occur along the WTS include field bindweed, halogeton, Russian knapweed, and Scotch thistle. Noxious weeds that are likely to occur along the STS include camelthorn, field bindweed, Russian knapweed, cheatgrass, and red brome.

3.8.4 Environmental Consequences

3.8.4.1 Issues

The following issues related to vegetation resources were identified through public and agency scoping. Although there is overlap, issues vary somewhat by project component.

3.8.4.1.1 Navajo Generating Station

Issue 1 – Operations and Maintenance, including Surface Disturbance - effects of operations and maintenance of NGS and associated facilities, including the BM&LP Railroad.

Issue 2 – Emissions and Deposition - effects of NGS emissions and metals deposition on vegetation and reclamation potential.

3.8.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Operations and Reclamation - effects of mining operations and reclamation on vegetation resources.

Issue 2 – Emissions and Deposition - effects of combined emissions from the proposed KMC and NGS on vegetation resources.

Issue 3 – Groundwater Pumping - effects of mine-related groundwater pumping from the N-Aquifer on associated stream and spring baseflows that support aquatic, wetland, and/or riparian habitats.

3.8.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operations and Maintenance - effects of transmission line operations and maintenance on vegetation resources.

3.8.4.2 Assumptions and Impact Methodology

The following is a list of assumptions made and methodology used to assess impacts of the project as they relate to general vegetation. The impacts identified under the separate project components below are based on correspondence with federal and state agencies, tribal representatives, and public scoping comments.

- Non-native and invasive plants are present within the project area.
- Some NGS-associated facilities, including the BM&LP Railroad, and transmission lines have been in place for 40 years and areas have revegetated naturally within the project footprint.
- Impacts associated with decommissioning and reclaiming project facilities including the NGS plant, BM&LP Railroad, and proposed KMC in 2045 are assumed to have only beneficial effects for general vegetation. While there would be temporary disturbance associated with decommissioning activities, the overall effect would be to re-open and restore habitat. Effects of decommissioning are discussed under the No Action Alternative.

3.8.4.2.1 Navajo Generating Station

- Vegetation communities and dominant vegetation cover types for NGS and associated facilities as well as the 20-km deposition area were identified through review of SWReGAP data.
- COPECs in soil were used to identify potential impacts to general vegetation that may be growing within the NGS Near-field ERA study area and HQs were used to identify the potential for risk to plants.
- The results of the NGS Near-field ERA were analyzed to determine deposition impacts to vegetation.
- Vegetation along the BM&LP Railroad was qualitatively evaluated for coal dust deposition. No new surface disturbance is anticipated along the railroad. However, a 250-foot buffer was chosen to account for existing access roads and coal dust deposition from the train.

3.8.4.2.2 Proposed Kayenta Mine Complex

- Vegetative communities were evaluated within mining areas through review of SWReGAP data, previous baseline and field studies of the area, and aerial interpretation of satellite imagery.
- Acres of vegetation communities disturbed by mining were evaluated by overlaying coal lease areas over vegetation communities within a Geographic Information System.
- Within the Kayenta Mine, a 3-Unit Operation and 2-Unit Operation were analyzed to identify surface disturbance impacts.
- Groundwater model results were used to identify where baseflow to springs could be reduced as a result of mine groundwater pumping. The study area defined for surface water and groundwater impacts are referenced from the water resources section and groundwater model.
- No new surface disturbance is anticipated within the N-Aquifer study area outside of the proposed KMC. Only riparian/wetland vegetative communities tied to seeps/springs within this area would have potential to be affected by groundwater drawdown resulting from mine pumping.
- Riparian communities within the N-Aquifer were identified by assessing SWReGAP and LANDFIRE vegetation data, as well as aerial imagery interpretation to more accurately represent riparian areas.

3.8.4.2.3 Transmission Systems and Communication Sites

- General vegetation along the WTS and STS and the communication sites was evaluated qualitatively for Operations and Maintenance (O&M) activities. Substations and switchyards affiliated with the WTS and STS occur in or adjacent to the power line corridor and were included in the analysis.
- The plant communities and dominant vegetation cover types were identified within a 2-mile buffer of the transmission lines.

- Transmission line ROWs and infrastructure have been in place and maintained for 40 years and the proposed vegetation treatments would maintain the existing communities and vegetation types present in the ROWs (i.e., low growing shrub, herbaceous, and grass species).
- The indirect effects of potential introduction and spread of noxious weeds from vehicles or workers, as well as spread from infested areas, are evaluated qualitatively.

3.8.4.3 Proposed Action

3.8.4.3.1 Navajo Generating Station

3.8.4.3.1.1 NGS Operations and Maintenance, including Surface Disturbance

Under the Proposed Action, surface disturbance at the NGS would be approximately 239 acres for the 3-Unit Operation and 199 acres for the 2-Unit Operation. This would result in the direct removal of primarily desert scrub vegetation.

Following grading, where required, and redistribution of topsoil, the areas to be reclaimed would be revegetated with native plants in accordance with lease requirements. It is estimated that herbaceous species (e.g., grasses) would take 2 to 5 years to re-establish and achieve adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Re-establishment of woody shrub species (e.g., sagebrush) would require at least 10 to 25 years. Where soil constraints or presence of noxious and invasive weed species may affect reclamation success, additional measures (e.g., addition of soil amendments, noxious weed controls, etc.) would be implemented. Based on implementation of these measures, it is anticipated that impacts on the vegetation communities around the NGS site and associated facilities would be minor.

Coal delivery under the Proposed Action would be between 5.5 million tons per year (tpy) and 8.1 million tpy. Coal dust generated during coal transport (i.e., along the BM&LP Railroad), handling, and storage could settle on vegetation, potentially resulting in a localized effect to plant health. The potential for untreated or improperly loaded coal to be lost due to wind erosion is greatest during the initial transport near the mine (Winges and Steffel 2016).

Potential impacts from fugitive dust under the Proposed Action would be minimized through the implementation of fugitive dust control measures described in the NGS Operations and Maintenance Plan (**Appendix 1B**). Measures implemented to reduce coal blow-off during transport would include ensuring the coal remains below the top of the train cars during loading and enforcing slow train speeds. To further reduce the generation of coal dust, NGS developed a Dust Control Plan that would continue to be implemented at the plant and associated facilities. In addition, an annual Fugitive Dust Control Report that describes actions taken to control dust, records of citizen complaints, and any corrective measures taken for the Ash Disposal Area also would be generated as required under coal combustion residual regulations (40 Code of Federal Regulations 257.80). Based on implementation of these measures, dust-related effects to vegetation from O&M activities would be negligible.

Under the Proposed Action, the majority of the operating and support facilities at NGS would be dismantled and properly disposed and the area reclaimed at the end of operations, unless the Navajo Nation continues NGS operations beyond 2044. **Appendix 1B** provides an overview of the decommissioning sequence for the plant and associated facilities, including the coal ash landfill and BM&LP Railroad. Under this alternative, approximately 3,724 acres associated with the plant, coal ash landfill, and BML&LP Railroad, would be reclaimed.

3.8.4.3.1.2 Emissions and Deposition

For the NGS ERA terrestrial analysis, potential effects to vegetation were evaluated by comparison of soil concentrations for each COPEC to baseline soil concentrations plus air deposition (to soil) considering both the 3-Unit Operation and 2-Unit Operation. The 3-Unit Operation would result in the

highest rate of emission/deposition of COPECs to the environment and represents the maximum amount of deposition to soil within the NGS ERA study area. Based on the result of the NGS ERA, there would be negligible risk to the vegetation community from air emissions alone because maximum HQs for the 3-Unit Operation were determined to be below 1. Also, the contribution of the 3-Unit Operation emissions to overall soil concentrations in the NGS Near-field study area would be less than 6 percent (**Table 3.6-6**).

3.8.4.3.2 Proposed Kayenta Mine Complex

3.8.4.3.2.1 Operations and Reclamation

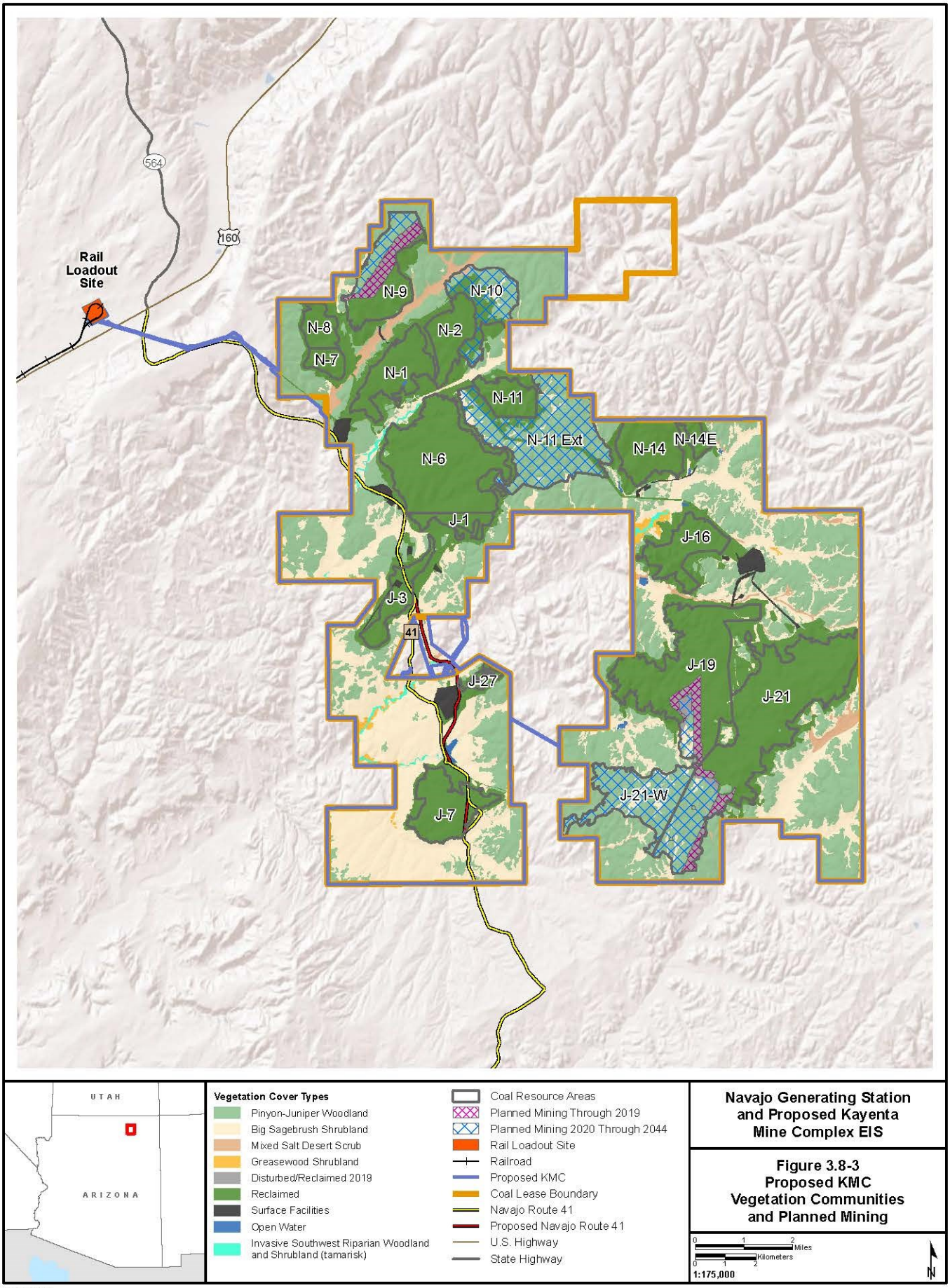
General Vegetation

Under the Proposed Action, mine pit locations and associated disturbance would be the same for both the 3-Unit Operation and 2-Unit Operation, with the following exceptions. Mining under the 2-Unit Operation would proceed at a slower rate, and no mining would occur in Mining Area N-10. Vegetation clearing, topsoil removal, and mining would continue under this alternative.

Estimated disturbance-related impacts to vegetation within the proposed KMC are provided in **Table 3.8-10**. **Figure 3.8-3** displays the baseline (2019) vegetation communities overlain by coal resource areas to display where impacts to native vegetation would occur. Under this alternative, mine-related surface disturbance at the proposed KMC would be approximately 5,230 acres for the 3-Unit Operation and 4,741 acres for the 2-Unit Operation. The three native vegetative communities that would be affected include pinyon-juniper woodlands, sagebrush shrublands, and mixed salt desert scrub. In addition, Navajo Route 41 would be realigned within the proposed KMC, directly impacting approximately 58 acres of upland vegetation. Forty-six acres of this impact would be within reclaimed areas and 10 acres would be within sagebrush shrublands.

Table 3.8-10 Impacts to Vegetation Communities within the Proposed KMC

Land Cover Type	Acres/Percent of Community Impacted	
	3-Unit Operation (2044)	2-Unit Operation (2044)
Pinyon-juniper Woodlands	4,738 / 20.1	4,306 / 18.3
Sagebrush Shrublands	456 / 3.5	427 / 3.2
Mixed Salt Desert Scrub	35 / 3.6	8 / <1.0
Greasewood Shrubland	0 / 0	0 / 0
Invasive Southwest Riparian Woodland and Shrubland (Tamarisk)	0 / 0	0 / 0
Open Water	0 / 0	0 / 0
Total Acres Impacted	5,230	4,741



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.8-3 Proposed KMC Vegetation Communities and Planned Mining

7/20/2016

Reclamation of mine pits would be conducted concurrent with operations. Upon decommissioning, no mining would occur in the proposed KMC after December 22, 2045, and final reclamation would be initiated. Facilities not requested to be kept by the tribes would be removed and recycled or properly disposed. The disturbance areas then would be recontoured to conform to the natural landform, covered with topsoil, and revegetated. Under the Proposed Action, approximately 9,000 to 10,000 acres of mining-related disturbance would be reclaimed.

Removal of pinyon-juniper and shrubland communities would represent a long-term impact (likely 25 to 50 years) until they are restored through mine reclamation efforts and natural re-establishment. It is likely that grassland communities on reclaimed lands would slowly be invaded by shrubs. The persistence of grasslands would depend on the post-reclamation livestock grazing regime and climatic variability over many years. Each of the various reclaimed plant community types has their own regulatory standards for success. For a discussion of reclamation success within the proposed KMC, see Section 3.14.4, Regulatory Framework, Land Use.

The Proposed Action would have moderate effects on the vegetation communities within the proposed KMC study area because approximately 27 percent of the native vegetation within the proposed KMC would be removed through mining operations; however, these areas would be reclaimed as grassland, rangeland, shrubland, or woodland communities. The resulting vegetative communities would increase the livestock carrying capacity and improve the potential for grazing (OSMRE 2011). With the inclusion of the various reclamation vegetative communities and cultural plant sites, long-term effects on plant species diversity are expected to be minor. The post-mining land uses of the reclaimed areas would be similar to pre-mining land uses, including production of forage for grazing, wildlife habitat, and collection of culturally important plants (OSMRE 2008).

Riparian/Wetlands

Small riparian areas are present in the southwest proposed KMC along lower Moenkopi Wash, Red Peak Valley Wash, and Coal Mine Wash. Small areas of wetlands also are present at some ponds. All of these areas are within the leasehold. They may be supported in part by releases from upstream ponds and impoundments and by seepage from those facilities.

Another riparian zone starts about 1.5 miles below the confluence of Coal Mine Wash with Moenkopi Wash and extends downstream for approximately 3 miles. Its greatest width is within the upper 1.5 miles. Downstream of that, a narrower belt of riparian vegetation occurs along the channel. This is the only extensive, downstream riparian area near the leasehold. It occurs in an eroded basin where the Mancos Shale is exposed at the surface. The less permeable nature of the shale forces groundwater to remain near the surface. In combination with inflows and local shale runoff, this groundwater supports the riparian zone downstream until evapotranspiration and channel migration limit the riparian areas expansion.

Under the Proposed Action, effects from reduced average runoff due to impoundments (including temporary sediment ponds and permanent impoundments) could occur at this riparian area but impacts could be too subtle to be detectable. The extent of riparian habitat varies with multi-year precipitation conditions and as Moenkopi Wash migrates within its floodplain and terrace system. These factors would make impacts indistinguishable from ongoing natural processes. Because of these factors, retained storage impacts to riparian areas in or near the leasehold would be negligible. See Section 3.7, Water Resources, for a description of flows and alluvial groundwater that support riparian vegetation downstream of the Kayenta Mine.

Noxious Weeds and Invasive Species

The Proposed Action would disturb between 4,741 and 5,230 acres of native vegetation. Surface disturbance such as those associated with mining have potential to provide pathways for further spread

of noxious and invasive species into adjacent undisturbed areas (Gelbard and Belnap 2003; Watkins et al. 2003) and serve as a source of propagules (D'Antonio et al. 2001). Localized surface disturbances could facilitate the invasion of noxious and invasive species by removing native vegetative cover, creating areas of bare ground (Burke and Grime 1996; Watkins et al. 2003), and increasing light and nutrient availability (Stohlgren et al. 2003, 1999). Noxious and invasive weed species would compete with native plants, degrade and modify native communities, and reduce resources for native species (e.g., moisture, soil nutrients, and light). Noxious and invasive weeds also could be spread by vehicles and workers.

In areas of existing noxious weed occurrence, noxious weed control during construction and O&M activities could be difficult due to a local seed source being present. Continuation of best management practices (BMPs) such as monitoring, herbicide use, and other activities listed within the NGS O&M plan would aid in decreasing the spread of these species. The effect of the Proposed Action on noxious weeds is expected to be minor based on continued implementation of BMPs.

3.8.4.3.2.2 Emissions and Deposition

For the KMC ERA emissions analysis, the potential for ecological risk was evaluated by comparison of soil concentrations for each COPEC to baseline soil concentrations plus air deposition (to soil) considering both the 3-Unit Operation and 2-Unit Operation. The resulting HQs were below 1 (Ramboll Environ 2016g) indicating that ecological risk is not likely. Therefore, it is anticipated that there would be negligible risk to the vegetation communities.

3.8.4.3.2.3 Groundwater Pumping

Groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. The model results predict that spring flow reduction from project groundwater pumping could occur in three of the spring groups (in locales near Tuba City, Chinle, and Dennehotso). The model analysis estimated small flow reductions from less than 0.001 to about 0.06 gallons per minute. For most spring groups, simulated changes in hydraulic head (water level at the ground surface) generally ranged from zero to about 0.02 feet. Immediately west of Chinle, the head change ranged up to about 0.1 foot. At the four U.S. Geological Survey-monitored springs, there would be no changes in flow as a result of project pumping under the Proposed Action. Based on the model results, it is expected the changes in water level at the ground surface would have negligible effects to riparian vegetation at seeps/springs.

The modeling study also indicated that the Proposed Action water supply pumping would reduce base flow by less than 1 percent after 2020 in major wash systems that drain across the proposed KMC. Due to past alterations of stream flows in the west, tamarisk has increased in abundance over native species and has been shown to have negative effects on riparian areas (Merritt and Poff 2010; Stromberg et al. 2007). Tamarisk is more drought tolerant than many natives because it is a facultative phreatophyte, meaning that it can use surface water from unsaturated soil as well as groundwater. It also has deep and extensive root systems (Di Tomaso 1998; Zouhar 2003). However, because base flow reduction is anticipated to be less than 1 percent, it is expected the Proposed Action would have negligible effects to riparian communities.

3.8.4.3.3 Transmission Systems and Communication Sites

3.8.4.3.3.1 Operations and Maintenance

Operation and maintenance of the transmission lines and associated facilities require periodic aerial and ground inspections, repair and maintenance of infrastructure, maintenance of access roads, and treatment of vegetation within the ROWs. The majority of all inspection and maintenance activities would occur along the existing ROWs, serviced by existing roads leading to the regional highway system, and would occur infrequently. Because of the infrequent need for vegetation treatments, NV Energy does not have an established periodic routine maintenance program for the WTS. Aerial, ground, and climbing

inspections of existing infrastructure is conducted at least once or twice a year for both the WTS and STS as needed. Low-growing species are desired, and vegetation along the ROWs has been treated to support and maintain low-growing species so dense brush does not grow, thereby reducing fire risk. It is anticipate that this type of future vegetation maintenance would continue to occur in previously treated areas and, therefore, would not contribute to vegetation impacts. Other potential effects to vegetation would include erosion and sedimentation caused by maintenance vehicles, fugitive dust generation, and the spread and establishment of noxious or invasive weeds into areas of lower vegetative cover. Because transmission line operators would continue to implement BMPs as described in the NGS Operation and Maintenance Report (**Appendix 1B**), the related effects to vegetation within the WTS and STS corridors would be negligible. The maintenance activities would continue to be coordinated with the land management agencies as required by ROW stipulations.

Riparian and wetland areas constitute a small proportion of the landscapes (less than 2 percent) crossed by the transmission lines. It is anticipated that the Proposed Action would have negligible effects on wetlands/riparian areas based on continued implementation of BMPs described in the NGS Operation and Maintenance Report (**Appendix 1B**).

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.8.4.3.4 Project Impact Summary – All Project Components

The total surface disturbance under the Proposed Action would be between 5,527 and 4,998 acres. The overall effects of the Proposed Action on general vegetation would be considered moderate, primarily due to the vegetation removal within the proposed KMC.

Up to 239 acres of vegetation would be removed at the NGS plant and ash disposal site, having a minor impact to general vegetation. Up to 5,230 acres of vegetation would be removed within the proposed KMC, mostly pinyon-juniper woodlands, having a moderate effect on general vegetation. The realignment of Navajo Nation Route 41 will remove 58 acres of vegetation. Effects of O&M activities at NGS and Associated Facilities, the BM&LP Railroad, and the transmission systems would have negligible effects to general vegetation. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities.

NGS emissions and deposition would represent a negligible risk to general vegetation in the NGS Near-field Study Area, as indicated by HQs that are less than 1. When combining NGS emissions with baseline conditions, there would be a negligible risk to general vegetation based on HQ values less than 1. The KMC ERA indicates emissions from the proposed KMC would pose a negligible risk to general vegetation based on HQ values which are less than 1.

Groundwater pumping in the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on riparian/wetland vegetation.

3.8.4.3.5 Cumulative Impacts

The vegetation cumulative effects study areas are the same as the direct indirect study areas. Refer to Section 3.0 for a detailed description of these study areas. The cumulative effects analysis includes an assessment of total project effects across all study areas plus the effects of other past and present actions and reasonably foreseeable actions affecting vegetation within these areas.

3.8.4.3.5.1 Operations and Maintenance, including Surface Disturbance

Reasonably foreseeable future actions are anticipated to impact 4,201 acres of vegetation, and past and present actions have impacted approximately 52,786 acres of vegetation. The Proposed Action

incrementally would contribute between 4,998 and 5,527 acres of vegetation disturbance to cumulative impacts, resulting in a total cumulative impact to vegetation on between 61,985 and 62,514 acres. It is anticipated that reclamation of portions of past and present actions and reasonably foreseeable future actions have been, or would be, completed in accordance with permit requirements or lease agreements, thereby reducing the cumulative impact to vegetation over time. Reclamation of Proposed Action disturbance areas would minimize the project's contribution to cumulative vegetation impacts.

3.8.4.3.5.2 Emissions and Deposition

Cumulative vegetation impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to vegetation is not likely under either scenario. Therefore, the project's contribution to cumulative ecological risk for vegetation would be negligible and would cease following completion of operations in 2044.

3.8.4.3.5.3 Proposed KMC Groundwater Pumping

Past and present and reasonably foreseeable future actions that could contribute to drawdown related effects to riparian/wetland vegetation within the N-Aquifer study area include groundwater pumping from community wells for local water use. Groundwater modeling indicates riparian/wetland communities associated with seeps and springs that have hydraulic connection to the N-Aquifer could experience negligible to minor effects as groundwater levels decline from community pumping in future years. The modeling also indicates that the Proposed Action's contribution to groundwater level declines and associated effects to riparian/wetland vegetation at seeps and springs would be negligible.

Figure 3.7-16 illustrates the drawdown cones associated with these community wells, and the proximity of these wells to major regional drainages. Areas of concern include lower Moenkopi Wash near Tuba City and Moenkopi; Pasture Canyon below Shonto and Red Lake; and Laguna Creek near Kayenta. At the Moenkopi Wash and Pasture Canyon locations, projected localized declines in groundwater levels from community groundwater pumping would not intersect with groundwater level changes projected from mine-related pumping as there is only a very small area of intersect (upper Laguna Creek) between the mining and community well pumping cones of depression. Additive cumulative drawdown impacts are anticipated to occur in this area of intersection, along upper Laguna Creek, where a small portion of the overall historic and predicted effects are attributed to mining activity. Based on aerial photo interpretation, site visits, and SWReGAP and LANDFIRE data analysis for Chinle Creek, Laguna Creek, and Polacca Wash, current conditions do not support native riparian vegetation. Therefore, cumulative impacts to riparian vegetation from baseflow changes are expected to be negligible.

3.8.4.4 Natural Gas Partial Federal Replacement Alternative

Under the Natural Gas Partial Federal Replacement (PFR) Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Under this alternative, the natural gas-fired power generating facility is assumed to exist. Therefore, prior disturbance impacts to general vegetation resources at the natural gas-fired facility are not evaluated in this Environmental Impact Statement. Key assumptions about vegetation resources related to such an existing natural gas site are listed below.

- The natural gas plant underwent National Environmental Policy Act evaluation, and state or local permitting.
- A combined-cycle natural gas-fired power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Native vegetation was removed from the site and would not be revegetated until after facility decommissioning.
- Natural gas combustion for power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the Study Area. The description of emissions calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

3.8.4.4.1 Navajo Generating Station

3.8.4.4.1.1 Operations and Maintenance, including Surface Disturbance

Coal delivery under the Proposed Action would range between 5.5 million tpy and 8.1 million tpy. Under the Natural Gas PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated at NGS. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use would be between 5 and 18 percent annually under the Natural Gas PFR Alternative. Overall, disturbance-related effects to vegetation under this alternative would be similar to the Proposed Action and, therefore, would be minor.

Due to lower coal use at NGS under the Natural Gas PFR Alternative, O&M activities at plant, associated facilities, and the BM&LP Railroad may occur less frequently. With ongoing implementation of fugitive dust control measures, dust-related effects to vegetation from O&M activities would be negligible.

3.8.4.4.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic, and mercury, associated with the Natural Gas PFR Alternative NGS stack emissions would be reduced relative to the Proposed Action as presented in **Table 3.8-11**.

Table 3.8-11 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Natural Gas PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Natural Gas PFR 100-MW Power Reduction (tpy / % change)	Natural Gas PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.127 / -5%	1.957 / -13%
Selenium	2-Unit	1.491	1.377 / -8%	1.208 / -19%
Mercury (total)	3-Unit	0.117	0.111 / -5%	0.102 / -13%
Mercury (total)	2-Unit	0.078	0.072 / -8%	0.063 / -19%
Arsenic	3-Unit	0.133	0.127 / -5%	0.117 / -13%
Arsenic	2-Unit	0.089	0.083 / -8%	0.073 / -19%

The 3-Unit and 2-Unit 100-MW and 250-MW Natural Gas PFR Alternative operations would result in approximately 5 to 19 percent less selenium, arsenic, and mercury deposition in the NGS Near-field study area than the Proposed Action. However, the emission/deposition-related impacts to general vegetation under the Natural Gas PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.4.2 Proposed Kayenta Mine Complex

3.8.4.4.2.1 Operations and Reclamation

Mining-related surface disturbance at the proposed KMC under the Natural Gas PFR Alternative would be proportionally reduced under this alternative as illustrated in **Table 3.0-7**. It is recognized that actual surface disturbance may not be directly proportional to coal mined because of differences in overburden and coal seam thickness across the coal resource areas. Actual reductions in coal production are displayed in **Table 3.0-6**.

Under the Proposed Action, mining-related disturbance would remove approximately 4,741 to 5,230 acres of native vegetation, resulting in a moderate impact. The disturbance areas would be reclaimed with grassland, rangeland, shrubland, or woodland communities. As displayed in **Table 3.0-7**, the Natural Gas PRF Alternative would result in a reduction in mine-related surface disturbance ranging from 5 to 12 percent for the 3-Unit Operation and from 7 to 18 percent for the 2-Unit Operation. However, similar to the Proposed Action, this would still result in a moderate impact to vegetation. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities. Overall, impacts to vegetation under this alternative would be similar to those discussed in Section 3.8.4.3.2.

3.8.4.4.2.2 Emissions and Deposition

Under the Natural Gas PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts to general vegetation under the Natural Gas PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.4.2.3 Groundwater Pumping

Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Because the same amount of water would be used under the Natural Gas PFR Alternative as under the Proposed Action, groundwater drawdown-related effects to riparian/wetland vegetation at seeps/springs and to riparian vegetation in drainages under this alternative also would be negligible. For more discussion, see Section 3.8.4.3.2.

3.8.4.4.3 Transmission Systems and Communication Sites

3.8.4.4.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

O&M activities along the WTS and STS and at communications sites would be the same as the Proposed Action. Because transmission line operators would continue to implement BMPs as described in the **Appendix 1B**, associated impacts to vegetation would be negligible. For more discussion describing impacts to general vegetation through O&M activities within transmission line ROWs, see Section 3.8.4.3.3.

3.8.4.4.4 Project Impact Summary – All Project Components

The total surface disturbance under the Natural Gas PFR Alternative would be between 5,265 and 4,145 acres. The overall effects of the Natural Gas PFR Alternative on vegetation would be considered moderate, primarily due to the vegetation removal within the proposed KMC. Potential vegetation

impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities.

The Natural Gas PFR Alternative would result in 5 to 19 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate 5 to 18 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to vegetation. The ecological risk to vegetation under the Natural Gas PFR Alternative also would be considered negligible.

Groundwater pumping at the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on riparian/wetland vegetation.

3.8.4.4.5 Cumulative Impacts

The cumulative vegetation impacts from surface disturbance under the Natural Gas PFR Alterative would be 0 to 1 percent less than those estimated for the Proposed Action. The surface disturbance contributed by the Natural Gas PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 62,252 to 61,132 acres. Reclamation of Natural Gas PFR Alternative disturbance areas would minimize the project's contribution to cumulative vegetation impacts over time.

Cumulative vegetation impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to vegetation is not likely under either scenario. Although the Natural Gas PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for vegetation would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to riparian/wetland vegetation as a result of groundwater pumping-related drawdown in the N-Aquifer under the Natural Gas PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. Therefore, cumulative impacts to riparian/wetland vegetation from baseflow changes are expected to be negligible.

3.8.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. Because the renewable energy power facility is assumed to exist, prior disturbance impacts to general vegetation resources from this facility are not evaluated in this Environmental Impact Statement. Key assumptions about vegetation resources related to such an existing site are detailed below.

- A renewable energy power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Vegetation was removed from the site and would not be revegetated until after facility decommissioning.
- The renewable energy operation underwent separate National Environmental Policy Act evaluation.

- Combustion emissions from associated firming power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the Study Area. The description of emissions calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

3.8.4.5.1 Navajo Generating Station

3.8.4.5.1.1 Operations and Maintenance, including Surface Disturbance

Under the Renewable PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated at NGS. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use would be 2 to 11 percent annually under the Renewable PFR Alternative. Overall, disturbance-related effects to vegetation under this alternative would be similar to the Proposed Action and, therefore, would be minor.

Due to lower coal use at NGS under the Renewable PFR Alternative, O&M activities at plant, associated facilities, and the BM&LP Railroad may occur less frequently. With ongoing implementation of fugitive dust control measures, dust-related effects to vegetation from O&M activities would be negligible.

3.8.4.5.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic, and mercury associated with the Renewable PFR Alternative NGS stack emissions would be reduced relative to the Proposed Action as presented in **Table 3.8-12**.

Table 3.8-12 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Renewable PFR Alternative

Trace Metals	Proposed Action (tpy)		Renewable PFR 100-MW Power Reduction (tpy / % change)	Renewable PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.174 / -3%	2.075 / -7%
Selenium	2-Unit	1.491	1.424 / -4%	1.325 / -11%
Mercury (total)	3-Unit	0.117	0.114 / -3%	0.108 / -7%
Mercury (total)	2-Unit	0.078	0.075 / -4%	0.069 / -11%
Arsenic	3-Unit	0.133	0.130 / -3%	0.124 / -7%
Arsenic	2-Unit	0.089	0.086 / -4%	0.080 / -11%

The 3-Unit and 2-Unit 100-MW and 250-MW Renewable PFR Alternative operations would result in approximately 3 to 11 percent less selenium, arsenic, and mercury deposition in the NGS Near-field study area than the Proposed Action. However, the emission/deposition-related impacts to general vegetation under the Renewable PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.5.2 Proposed Kayenta Mine Complex

3.8.4.5.2.1 Operations and Reclamation

Mining-related surface disturbance at the proposed KMC under the Renewable PFR Alternative would be proportionally reduced under this alternative as illustrated in **Table 3.0-7**. It is recognized that actual surface disturbance may not be directly proportional to coal mined because of differences in overburden and coal seam thickness across the coal resource areas. Actual reductions in coal production are displayed in **Table 3.0-6**.

Under the Proposed Action, mining-related disturbance would remove approximately 4,741 to 5,230 acres of native vegetation, resulting in a moderate impact. These areas would eventually be reclaimed with a grassland community. As displayed in **Table 3.0-7**, the Renewable PRF Alternative would result in a reduction in mine-related surface disturbance ranging from 3 to 7 percent for the 3-Unit Operation and from 4 to 10 percent for the 2-Unit Operation. However, similar to the Proposed Action, this would still result in a moderate impact to vegetation. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities. Overall, impacts to vegetation under this alternative would be the similar to those discussed in Section 3.8.4.3.2.

3.8.4.5.2.2 Emissions and Deposition

Under the Renewable PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts to general vegetation under the Renewable PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.5.2.3 Groundwater Pumping

Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Because the same amount of water would be used under the Renewable PFR Alternative as the Proposed Action, effects to riparian/wetland vegetation at seeps/springs and to riparian vegetation in drainages under this alternative also would be negligible.

3.8.4.5.3 Transmission Systems and Communication Sites

3.8.4.5.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

O&M activities along the WTS and STS and at communications sites would be the same as the Proposed Action. Because transmission line operators would continue to implement BMPs as described in the **Appendix 1B**, associated impacts to vegetation would be negligible. For more discussion describing impacts to general vegetation through O&M activities within transmission line ROWs, see Section 3.8.4.3.3.

3.8.4.5.4 Project Impact Summary – All Project Components

The total surface disturbance under the Renewable PFR is between 5,369 and 4,524 acres. The overall effects of the Renewable PFR Alternative on vegetation would be considered moderate, primarily due to the vegetation removal within the proposed KMC. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities.

The Renewable PFR Alternative would result in a 3 to 11 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate 3 to 10 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to vegetation. The ecological risk to vegetation under the Renewable PFR Alternative also would be considered negligible.

Groundwater pumping at the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on riparian/wetland vegetation.

3.8.4.5.5 Cumulative Impacts

The cumulative vegetation impacts from surface disturbance under the Renewable PFR Alterative would be 0 to 1 percent less than those estimated for the Proposed Action. The surface disturbance contributed by the Renewable PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 62,356 and 61,511 acres. Reclamation of Natural Gas PFR Alternative disturbance areas would minimize the project's contribution to cumulative vegetation impacts over time.

Cumulative vegetation impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to vegetation is not likely under either scenario. Although the Renewable PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for vegetation would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to riparian/wetland vegetation as a result of groundwater pumping-related drawdown in the N-Aquifer under the Natural Gas PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. Therefore, cumulative impacts to riparian/wetland vegetation from baseflow changes are expected to be negligible.

3.8.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate National Environmental Policy Act process once a facility location is identified. Key assumptions about vegetation resources related to the construction of a new photovoltaic facility are listed below.

- Vegetation would be removed from the entire site and would not be revegetated until after facility decommissioning.
- The emissions caused from construction of the solar facility (fugitive dust and vehicles) could be located in the NGS study area but would be very localized and temporary.
- Combustion emissions from firming power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the Study Area. The description of emissions calculations for the PFR is described in Chapter 2.0 and in Section 3.1, Air Quality.
- The duration of construction of a photovoltaic site would take between 1.5 and 3 years.

3.8.4.6.1 Navajo Generating Station

3.8.4.6.1.1 Operations and Maintenance, including Surface Disturbance

Under the Tribal PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use would be between 2 and 7 percent annually under the Natural Gas PFR Alternative. Overall, disturbance -related effects to vegetation under this alternative would be similar to the Proposed Action and, therefore, would be minor.

Due to lower coal use at NGS under the Tribal PFR Alternative, O&M activities at plant, associated facilities, and the BM&LP Railroad may occur less frequently. With ongoing implementation of fugitive dust control measures, dust-related effects to vegetation from O&M activities would be negligible.

3.8.4.6.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic, and mercury, associated with the Tribal PFR Alternative NGS stack emissions would be reduced relative to the Proposed Action as presented in **Table 3.8-13**.

Table 3.8-13 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Tribal PFR Alternative

Trace Metals	Proposed Action (tpy)		Tribal PFR 100-MW Power Reduction (tpy / % change)	Tribal PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.174 / -3%	2.153 / -4%
Selenium	2-Unit	1.491	1.447 / -3%	1.383 / -8%
Mercury (total)	3-Unit	0.117	0.114 / -3%	0.111 / -5%
Mercury (total)	2-Unit	0.078	0.076 / -3%	0.072 / -8%
Arsenic	3-Unit	0.133	0.130 / -2%	0.128 / -4%
Arsenic	2-Unit	0.089	0.087 / -3%	0.084 / -6%

The 3-Unit and 2-Unit 100-MW and 250-MW Tribal PFR Alternative operations would result in approximately 2 to 8 percent less selenium, arsenic, and mercury deposition in the NGS Near-field study area than the Proposed Action. However, the emission/deposition-related impacts to general vegetation under the Tribal PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.6.2 Proposed Kayenta Mine Complex

3.8.4.6.2.1 Operations and Reclamation

Mining-related surface disturbance at the proposed KMC under the Tribal PFR Alternative would be proportionally reduced as illustrated in **Table 3.0-7**. It is recognized that actual surface disturbance may not be directly proportional to coal mined because of differences in overburden and coal seam thickness across the coal resource areas. Actual reductions in coal production are displayed in **Table 3.0-6**.

Under the Proposed Action, mining-related disturbance would remove approximately 4,741 to 5,230 acres of native vegetation, resulting in a moderate impact. As displayed in **Table 3.0-7**, the Tribal PRF Alternative would result in a reduction in mine-related surface disturbance ranging from 2 to 5 percent for the 3-Unit Operation and from 3 to 7 percent for the 2-Unit Operation. However, similar to the Proposed Action, this would still result in a moderate impact to vegetation. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities. Overall, impacts to vegetation under this alternative would be similar to those discussed in Section 3.8.4.3.2.

3.8.4.6.2.2 Emissions and Deposition

Under the Tribal PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts to general vegetation under the Tribal PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.6.2.3 Groundwater Pumping

Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Because the same amount of water would be used under the Tribal PFR Alternative as under the Proposed Action, groundwater drawdown-related effects to riparian/wetland vegetation at seeps/springs and to riparian vegetation in drainages under this alternative also would be negligible. For more discussion, see Section 3.8.4.3.2.

3.8.4.6.3 Transmission Systems and Communication Sites

3.8.4.6.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

O&M activities along the WTS and STS and at communications sites would be the same as the Proposed Action. Because transmission line operators would continue to implement BMPs as described in the **Appendix 1B**, associated impacts to vegetation would be negligible. For more discussion describing impacts to general vegetation through O&M activities within transmission line ROWs, see Section 3.8.4.3.3.

3.8.4.6.4 Project Impact Summary – All Project Components

The total surface disturbance under the Tribal PFR Alternative would be between 5,421 and 4,666 acres. The overall effects of the Tribal PFR Alternative on vegetation would be considered moderate, primarily due to the vegetation removal within the proposed KMC. Potential vegetation impacts related to noxious weed invasion are anticipated to be minor with continued implementation of the current BMPs during O&M activities.

The Tribal PFR Alternative would result in 2 to 8 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate 2 to 7 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to vegetation. The ecological risk to vegetation under the Tribal PFR Alternative also would be considered negligible.

Groundwater pumping in the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on riparian/wetland vegetation.

3.8.4.6.5 Cumulative Impacts

The cumulative vegetation impacts from surface disturbance under the Tribal PFR Alterative would be 1 to 5 percent higher than those estimated for the Proposed Action. The surface disturbance contributed by the Tribal PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 65,408 and 62,853 acres. Reclamation of Natural Gas PFR Alternative disturbance areas would minimize the project's contribution to cumulative vegetation impacts over time.

Cumulative vegetation impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to vegetation is not likely under either scenario.

Although the Tribal PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for vegetation would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to riparian/wetland vegetation as a result of groundwater pumping-related drawdown in the N-Aquifer under the Natural Gas PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. Therefore, cumulative impacts to riparian/wetland vegetation from baseflow changes are expected to be negligible.

3.8.4.7 No Action

3.8.4.7.1 Navajo Generating Station

NGS and some associated facilities (including the BM&LP Railroad) would be decommissioned and reclaimed after 2019 as described in the NGS Operations and Maintenance Plan (**Appendix 1B**) and Chapter 2.0.

Under the No Action Alternative, activities affiliated with NGS would end 25 years before activities under the Proposed Action, and reclamation would take place sooner. This would result in a decrease in the temporal impacts to vegetation.

Reclamation of the NGS and associated facilities under the No Action Alternative would be the same as under the Proposed Action. Following grading, where required, and redistribution of topsoil, the areas to be reclaimed would be revegetated with native plants in accordance with lease requirements. It is estimated that herbaceous species (e.g., grasses) would take 2 to 5 years to re-establish and achieve adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Re-establishment of woody shrub species (e.g., sagebrush) would require at least 10 to 25 years. Where soil constraints or presence of noxious and invasive weed species may affect reclamation success, additional measures (e.g., addition of soil amendments, noxious weed controls, etc.) would be implemented. Based on implementation of these measures, it is anticipated that impacts on the vegetation communities around the NGS site and associated facilities would be minor.

The cessation of NGS emissions 25 years earlier than under the Proposed Action would reduce the total NGS-related contribution to COPEC deposition in the NGS Near-field ERA study area. However, the emission/deposition-related impacts to general vegetation under the No Action Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.8.4.7.2 Proposed Kayenta Mine Complex

Under the No Action Alternative, no mining would occur in the proposed KMC coal resource areas after 2019, thereby reducing the overall acreage of vegetation disturbance as compared to the Proposed Action. Based on SWReGAP data, this reduction would include up to approximately 4,738 acres of pinyon-juniper woodlands, 456 acres of sagebrush shrublands, and 35 acres of mixed salt desert scrub that would not be removed under the No Action Alternative.

Under this alternative, reclamation of disturbance areas, including ancillary facilities and remaining pit areas, would begin in 2019. The reclamation of ancillary areas would be initiated 25 years sooner than under the Proposed Action, resulting in a temporal decrease in vegetation impacts in these areas. However, impacts to vegetation would still be considered moderate due to the scale of affected acreage.

Under the No Action Alternative, groundwater pumping would continue for dust control and assistance with reclamation activities at the rate of approximately 500 acre-feet per year from 2020 through 2022 from the N-Aquifer. Groundwater withdrawals would continue at a rate of approximately 100 acre-feet per year from 2023 through 2032. Although pumping activities under the No Action Alternative would end

sooner than under the Proposed Action, the effects to groundwater levels and potential related impacts to riparian/wetland vegetation would be anticipated to be similar to the impacts under the Proposed Action. Therefore, the impacts would be negligible.

3.8.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

Impacts on vegetation as a result of O&M operations along the WTS and STS and at the communications sites through 2019 would be the same as under the Proposed Action and, therefore, would be negligible.

3.8.4.7.4 No Action Impact Summary – All Project Components

The overall effects of the No Action Alternative on vegetation would be considered moderate, primarily due to vegetation removal at KMC. There would be an overall temporal decrease in vegetation impacts as operations would cease and decommissioning implemented 25 years earlier than under the Proposed Action.

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Section 3.9

Special Status Vegetation Resources

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
OSMRE	Office of Surface Mining Reclamation and Enforcement
PFR	Partial Federal Replacement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation

ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
SWReGAP	Southwest Regional Gap Analysis Project
tpy	tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency
WTS	Western Transmission System

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3.9 Special Status Vegetation Resources

3.9.1 Regulatory Framework

Laws, regulations, and policies that directly influence vegetation management decisions for the Proposed Action are primarily implemented by the U.S. Fish and Wildlife Service (USFWS), Office of Surface Mining Reclamation and Enforcement, Navajo Nation, Hopi Tribe, Bureau of Indian Affairs, Bureau of Land Management (BLM), U.S. Forest Service (USFS), and National Park Service,. Statutes, regulations and policies relevant to the proposed project are included in **Table 3.9-1**. According to Arizona Statute ARS 3-915, existing electric utility projects are exempt from Arizona native plant law.

Table 3.9-1 Relevant Statutes, Regulations, and Policies for Plant Species

Statutes, Regulations, and Policies	Summary
Surface Mining Control and Reclamation Act of 1977	The Surface Mining Control and Reclamation Act of 1977 establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement. The law establishes minimum requirements for all coal surface mining on federal and state lands, including exploration activities and the surface effects of underground mining. Mine operators are required to minimize disturbance and adverse impacts to biological resources and achieve enhancement of these resources where practicable.
Endangered Species Act (ESA) of 1973 (16 USC 1531-1544)	The ESA provides broad protection for species of fish, wildlife, and plants listed as threatened or endangered by the USFWS. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. All federal agencies in consultation with and with the assistance of the USFWS, also must use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species. All federal agencies, in consultation with, and assistance of, the USFWS must ensure any action authorized, funded, or carried out by federal agency is not likely to jeopardize the continued existence of an endangered, threatened, or proposed listed species, or result in destruction or adverse modification of critical habitat of a species. Agencies are required to use the best scientific and commercial data available to fulfill this change.
Navajo Nation Code Title 17, Part 507 [1]	Part 507 of Title 17 of the Navajo Nation Code charges the Resources Committee of the Navajo Nation Council with the development of a list of endangered species and subspecies indigenous to the Navajo Nation and regulates take, possession, transport, export, processing, or sale of any of these species.
BLM Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6-125)	BLM Manual 6840 contains BLM's special status species management policy and guidance for the conservation of special status species and their habitats. Under this policy, special status species include animal and plant species listed as threatened or endangered, proposed for listing, and candidates for listing under the provisions of the ESA; those listed as sensitive species by a state; and those listed by the BLM State Director as sensitive. The objective of this policy is to ensure actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list any special status species, under provisions of the ESA.
USFS Manual 2670	USFS Manual 2670 established objectives for: managing Nation Forest System habitats and activities for threatened and endangered species to achieve recover objectives so that special protection measures provided under the ESA are no longer necessary: promoting species recovery efforts; developing and implementing management practices to ensure that species do not become threatened or endangered because of Forest Service actions; maintaining viable populations of all native and desired nonnative wildlife, fish , and plan species in habitats distributed throughout their geographic range on Nation Forest System lands; and developing and implementing management objectives for populations and /or habitat of sensitive species.

Table 3.9-1 Relevant Statutes, Regulations, and Policies for Plant Species

Statutes, Regulations, and Policies	Summary
National Park Service Management Policy (2006)	Section 4.2.3 "Management of Threatened and Endangered Plants and Animals" of the National Park Service Management Policy (2006) requires the National Park Service to survey for, protect, and strive to recover all species native to the national park system that are listed under the ESA. In addition, the National Park Service is required to inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federal listed species to the greatest extent possible.

[1] Applies to the Proposed KMC. Pursuant to the Lease Amendment No. 1, or any lease agreement the Nation enters into with the continuing NGS Participants, the Nation does not intend to regulate the NGS lease area.

3.9.2 Study Areas

3.9.2.1 Proposed Action and Action Alternatives

As described in Chapter 1.0, there are three main components of the NGS-KMC Project: the Navajo Generating Station (NGS) and associated facilities, the proposed Kayenta Mine Complex (KMC), and the transmission systems and communication sites. To facilitate description of the affected environment and analysis of Project effects on special status vegetation, a total of six different study areas divided among the three project components have been identified to analyze impacts to special status plants. Refer to Section 3.0 for a detailed description of these study areas. The project components and their associated study areas are listed below:

Navajo Generating Station:

- NGS Near-field study area; and
- Black Mesa & Lake Powell (BM&LP) Railroad study area.

Proposed KMC:

- Proposed KMC study area; and
- Navajo Aquifer (N-Aquifer) study area.

Transmission Systems:

- Western Transmission System (WTS) study area; and
- Southern Transmission System (STS) study area.

As described in Section 3.0, potential water drawdown issues related to mine pumping at the proposed KMC was analyzed through hydrologic modeling. The study area for groundwater effects on special status plants tied to seeps/springs was contained within the N-Aquifer. A detailed discussion of the groundwater study area is provided in Section 3.7.3, Water Resources.

3.9.2.2 Cumulative

For special status plants, the cumulative effects study areas are the same as those described for the Proposed Action and its alternatives. The cumulative effects analysis includes an assessment of total Project affects across all study areas plus the effects of other past and present actions and reasonably foreseeable actions affecting special status plants within these areas. It should be noted that the actions assessed as part of the cumulative effects analysis may be located outside of the study areas listed

above (e.g., mercury emissions associated with sources outside of the U.S.). However, to the extent that the effects of these actions combine with Project-related effects to special status plants within the six NGS-KMC study areas listed above, they are assessed as cumulative effects.

3.9.2.3 Ecological Risk Assessments Role in Assessing Baseline Risk and Environmental Consequences

In order to evaluate total future risks associated with future emissions from the NGS, the proposed KMC, and other cumulative sources, it is necessary to consider the level of risk from chemicals of potential ecological concern (COPECs) currently present in the environment (i.e., the environmental baseline). Baseline conditions capture naturally occurring chemicals; past and on-going emissions and deposition from the NGS and proposed KMC; and past and on-going deposition from other local, regional, global sources up to the year 2020. As described in Section 3.0.3, four Ecological Risk Assessments (ERAs) were performed to evaluate environmental conditions in the vicinity of the NGS and proposed KMC. The NGS Near-field ERA evaluated the potential risk to special status vegetation species based on concentrations of NGS emission chemicals in soil within a 20-kilometer (km) radius deposition area around the NGS plant. The proposed KMC ERA evaluated potential risk to special status vegetation resulting from baseline conditions, proposed future mine operations, NGS emissions, and other cumulative sources of COPECs within the proposed KMC. The Gap Regions and San Juan River ERAs evaluated potential risks associated with baseline conditions as well as future operations of NGS to aquatic species along the Colorado and San Juan Rivers outside of the NGS Near-field study area. No special status aquatic plant species live within these areas, so the NGS Near-field and proposed KMC ERAs were used to analyze special status vegetation. The determination of the ERA study areas is discussed in Section 3.0.2 and described in detail in **Appendix 3RA**, Ecological and Human Health Risk Assessments. Ecological risk for special status vegetation species that only have potential to occur along the transmission systems is not evaluated. It is assumed that, outside of the NGS Near-field study area, species occurring along the WTS and STS corridors would not be affected by NGS emissions.

The exposure pathway evaluated for terrestrial special status vegetation included direct contact with COPECs in surface soil. Special status plant tissue samples were not collected or considered for the analysis. Data used to characterize baseline conditions for the ERA study areas around the NGS was obtained from a combination of literature reviews, available data, and field sampling.

Hazard quotients (HQs) are calculated for each COPEC for each species considered. HQs are a unitless ratio of known or predicted COPEC concentrations and the appropriate ecological screening value below which impacts to a given species from exposure to a given constituent are unlikely. The HQ is not a predictor of risk but rather is an indicator of whether or not there is a potential for risk. More information on how HQs are calculated and what the HQ result means is provided in Section 3.0.3 and in **Appendix 3RA**, Ecological and Human Health Risk Assessments. The HQ valued calculated for exposure to maximum concentrations of COPECs, denoted herein as HQ_{max}, is considered a screening-level HQ. It provides a very conservative indicator of risk because receptors would practically never be exposed to maximum concentrations of COPECs in the wild. The HQ value calculated for refined concentrations of COPECs, denoted herein as $HQ_{refined}$, is considered to be a more realistic indicator of ecological risk than HQ_{max}.

If the maximum value of HQ_{max} at the no adverse effects level across all COPECs is less than 1 or equal to (≤) 1, risk to the species is considered unlikely and negligible. If HQ_{max} is greater than (>) 1, ecological risk is evaluated further using $HQ_{refined}$ for the particular chemical of concern. If $HQ_{refined}$ is less than (<) 1, risk is considered negligible. Conversely, if $HQ_{refined}$ is greater than or equal to (≥) 1 there is a potential risk to that species from one or more COPECs (**Appendix 3RA**, Ecological and Human Health Risk Assessments). Risks to special status vegetation associated with baseline conditions are discussed in the Affected Environment section. Risks associated with the Proposed Action, and the Proposed Action when added to baseline conditions, are disclosed in the Environmental Consequence section. It should be noted that all HQs presented for the Proposed Action are associated with the 3-Unit Operation and

are considered a worst-case scenario. HQs for the 2-Unit Operation are slightly lower than those for the 3-Unit Operation but, given that ecological risk to special status vegetation is primarily a factor of baseline conditions and, in one case, other cumulative sources, implementation of the 2-Unit Operation would provide only incremental benefits to special status vegetation relative to the 3-Unit Operation.

3.9.3 Affected Environment

The lists of special status plant species from the USFWS, Navajo Natural Heritage Program, USFS (Kaibab and Prescott National Forest), and BLM Arizona (Arizona Strip Field Office), Utah (Grand Staircase-Escalante National Monument, St. George Field Office), and Nevada were combined to create a consolidated list of species. The study areas were evaluated for each plant species based on known distribution and potential habitat. Consultation was held with the individual agencies to assist in the selection of the special status plant species to be carried forward for detailed study.

3.9.3.1 Navajo Generating Station

Two federally listed species have known occurrences within the NGS Near-field study area: Brady pincushion cactus (*Pediocactus bradyi*) and Welsh's milkweed (*Asclepias welshii*). Based on distribution and habitat, one other federally listed species, Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*), has the potential to occur in the NGS Near-field study area (i.e., 20-km-radius) deposition area. **Table 3.9-2** provides a list of all special status plant species with known occurrence or potential habitat in the NGS study areas. Information on life history, habitat association, conservation status, and recovery for federally listed species is provided in the following sections.

Table 3.9-2 Special Status Plant Species Occurrence in the NGS Study Areas

Species	Status[1]	NGS Area[2]	BM&LP Railroad
Federally Listed Special Status Plant Species			
Brady pincushion cactus (*Pediocactus bradyi*)	FE, NESL G2	K	--
Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*)	FE, FS, NESL G3	P	--
Welsh's milkweed (*Asclepias welshii*)	FT, NESL G3	K	P
Other Special Status Plant Species			
Alcove death camas (*Zigadenus vaginatus*)	NESL G3	P	--
Kaibab plains cactus (*Pediocactus paradinei*)	FS; BLMS (CCA)	P	P
Marble Canyon milk-vetch (*Astragalus cremnophylax* var. *hevronii*)	FS; BLMS	P	--
Mojave indigo bush (*Psorothamnus arborescens* var. *pubescens*)	BLMS	K	K

[1] Status: FE = Federal Endangered, FT = Federal Threatened, NESL = Navajo Endangered List, G2 = Group 2, G3 = Group 3, FS = Forest Sensitive, BLMS = BLM Sensitive, CCA = Candidate Conservation Agreement.

[2] Occurrence Categories: K = Known occurrence based on Natural Heritage Program data, Navajo data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, the USFWS IPaC system; SW = occurs in the Southwest Gap Region only.

Potential habitat exists within the BM&LP Railroad 250-foot analysis buffer for Welsh's milkweed among several stabilized dune habitats (Mikesic and Roth 2008).

3.9.3.1.1 Brady Pincushion Cactus

3.9.3.1.1.1 Species Occurrence

Brady pincushion cactus is found on plateaus beside the Colorado River, including both rims of Marble Canyon, which lies approximately 12 to 48 miles southwest of NGS (Navajo Nation Department of Fish and Wildlife 2014). Potential habitat does exist in the NGS Near-field study area.

3.9.3.1.1.2 Life History and Habitat Association

Brady pincushion cactus grows sporadically within sparsely vegetated desert scrub communities dominated by shadscale, snakeweed, Mormon tea, and desert trumpet (*Eriogonum inflatum*). It occurs as sporadic, dense populations along sloped benches in sunny locations (USFWS 2012) and is restricted to habitat composed of Kaibab limestone chips over soil derived from sandstone outcrops and Moenkopi shale. The species occurs between 3,861 to 4,488 feet above mean sea level (amsl) and flowers between March and April (USFWS 2012).

3.9.3.1.1.3 Listing and Conservation Status

Brady pincushion cactus is a small succulent listed as endangered pursuant to the ESA in October 1979. Current threats to this species include invasive species, collection, off-road vehicle use, mining, and livestock grazing (USFWS 2012). Because there are known occurrences of this species within the NGS Near-field study area, past activities related to NGS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to activities related to NGS. On the Navajo Nation, it is hypothesized that there were more thriving populations, but human foot and vehicle traffic may have killed many of these cacti (Hazelton 2014). No critical habitat has been designated for Brady pincushion cactus. A recovery plan was completed in 1985 and a 5-year status review was completed in 2012. It was recommended that the species classification remain endangered and the recovery priority number be changed from a 2 (high degree of threat and high recovery potential) to a 5 (high degree of threat and low recovery potential) (USFWS 2012). This is based on evidence the cactus is long-lived and exhibits low fecundity. The only criterion for down-listing contained within the recovery plan is permanent protection of at least 75 percent of the known habitat. Other criteria could not be evaluated due to inadequate information on its population numbers (USFWS 2012).

3.9.3.1.1.4 Factors Affected Species

The NGS Near-field study area includes an evaluation of representative plant species expected to occur in the area. Risk calculations were not performed for all special status plants because of the similarity of habitat and exposure patterns among closely related species. Representative species were selected based on multiple discussions with stakeholders and the USFWS. Brady pincushion cactus was one of the special status plants selected as a representative species within the NGS Near-field study area ERA analysis. Field sampling of soil conditions was conducted in 2014 near known locations of the cactus to assess baseline risk from COPECs. HQs for all COPECs using maximum soil concentrations were below 1. Because HQs were below 1 using maximum concentrations, baseline soil conditions are negligible and unlikely to pose a risk to Brady pincushion cactus.

3.9.3.1.2 Fickeisen Plains Cactus

3.9.3.1.2.1 Species Occurrence

Potential habitat for Fickeisen plains cactus exists within the NGS Near-field study area. Habitat for this species includes shrubland and desert scrub communities, but is restricted to specific soils and geological substrates. It is known to occur in Coconino and Mohave counties in Arizona. In Coconino County, they are scattered from House Rock Valley and Gray Mountain, as well as the canyons of the Little Colorado and Colorado rivers. Populations in Mohave County have been found as far west as Dutchman Draw and Grandstand (Mikesic and Roth 2008).

3.9.3.1.2.2 Life History and Habitat Association

Fickeisen plains cactus is a narrow endemic restricted to exposed layers of Kaibab limestone within the Colorado Plateau. They are found in well-drained, shallow, gravelly loam soils formed from alluvium, colluvium, or Aeolian deposits derived from limestone of the Harrisburg Member of the Kaibab and Toroweap Formations. Most populations occur on the margins of canyon rims, flat terraces and benches, or toes of well-drained hills having less than 20 percent slope within the plains and Great Basin grasslands and desert scrub communities. Populations are widely scattered and found at approximately 4,200 and 5,959 feet amsl (USFWS 2015g). The species flowers in late April and produces fruit from May to June (Mikesic and Roth 2008).

3.9.3.1.2.3 Listing and Conservation Status

Fickeisen plains cactus was listed as endangered pursuant to the ESA in October 2013. It also is a Navajo endangered and USFS-listed sensitive plant. Because there are known occurrences within the NGS Near-field study area, past activities related to NGS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to activities related to NGS. Past and current threats to this small succulent include habitat destruction, modification, and degradation from livestock grazing, predation by small mammals, natural environmental variability, and effects of climate such as drought. Small population size likely exacerbates the effects of these threats (USFWS 2013a). In 2013, the USFWS reopened the comment period concerning the proposed critical habitat for this species (USFWS 2013a). The proposed critical habitat for this species is discussed more thoroughly under the WTS and STS sections of this chapter. No recovery information is available for the Fickeisen plains cactus (USFWS 2015g).

3.9.3.1.2.4 Factors Affecting Species

Fickeisen plains cactus has not been confirmed within the NGS Near-field study area, but was chosen as a representative plant species for analysis. HQs for all COPECs using maximum soil concentrations were below 1. Because HQs were below 1 using maximum concentrations, baseline soil conditions are negligible and unlikely to pose a risk to Fickeisen plains cactus.

3.9.3.1.3 Welsh's Milkweed

3.9.3.1.3.1 Species Occurrence

Known occurrences of Welsh's milkweed exist within the NGS Near-field study area within a BLM Wilderness Area. Potential habitat occurs along the BM&LP Railroad among stabilized sand dune communities (Navajo Nation Department of Fish And Wildlife 2014). Known occurrences occur within the WTS and potential habitat along the STS.

3.9.3.1.3.2 Life History and Habitat Association

Welsh's milkweed grows on open, sparsely vegetated, semi-stabilized sand dunes and the lee slopes of actively drifting sand dunes (USFWS 2015e). These active sand dunes are found within sagebrush, juniper, and ponderosa pine communities and occur from 4,700 to 6,200 feet amsl (USFWS 2015h). Flowering occurs from June to July (Mikesic and Roth 2008).

There are eight known populations of Welsh's milkweed (USFWS 2015h). They occur in the Coral Pink Sand Dunes and the Sand Hills, both in Kane County, Utah, as well as in northern Arizona (Mikesic and Roth 2008; USFWS 2015e,h). On the Navajo Nation, Welsh's milkweed occurs near Tuba City and Comb Ridge. Potential habitat also exists on tribal land on active sand dunes between Page and Tuba City, east to the Chinle Creek drainage (Mikesic and Roth 2008). At the time of listing, the population was estimated to be 11,000 individuals, now considered stems, many of which can be connected underground as part of one individual plant. Currently, there are an estimated 72,000 stems distributed over 8,000 acres among the eight populations, with 98 percent of the stems in Coral Pink Sand Dunes, which is jointly managed by the BLM and the State of Utah (USFWS 2015h).

3.9.3.1.3.3 Listing and Conservation Status

Welsh's milkweed is an herbaceous perennial forb listed as threatened in October 1987. It also is a Navajo Endangered G3 species. Primary threats to the species include off-highway vehicle use and oil and gas development, with cattle grazing named as a potential threat (USFWS 1987b). Past activities, especially, off-highway vehicle use, may have impacted this species, but there is no available information concerning population numbers prior to activities related to NGS. Critical habitat has been designated for this species on BLM lands within the Sand Hills and Coral Pink Sand Dunes, approximately 65 to 75 miles west-northwest of NGS. A recovery plan was completed in 1992 (USFWS 1992). In 2011, Welsh's milkweed was recommended for a 5-year review with 11 other Mountain-Prairie Region species to revisit listing status (USFWS 2011). The results of this review were published in 2015 with a recommendation to revise the recovery plan due to insufficient measureable recovery criteria (USFWS 2015h).

3.9.3.1.3.4 Factors Affecting Species

Welsh's milkweed was chosen as a representative plant species for NGS Near-field study area ERA analysis. HQs for all COPECs using maximum soil concentrations were below 1 for representative plants. Because HQs were below 1 using maximum concentrations, baseline soil conditions are negligible and unlikely to pose a risk to Welsh's milkweed.

3.9.3.2 Proposed Kayenta Mine Complex

No known occurrences or potential habitat exists within the proposed KMC for any special status species, including federally listed species. Potential habitat does exist within the N-Aquifer study area for the federally listed Navajo sedge, which is adapted to the hanging garden communities in seeps and springs and was analyzed for impacts due to water drawdown from pumping for the mine. Alcove bog orchid and alcove death camas, NESL G3 species, also have potential habitat in the N-Aquifer among seeps/springs. Life history, habitat association, conservation status, and recovery information for Navajo sedge is presented below. Other special status plant species known to occur or to have the potential to occur within the N-Aquifer study area potentially affected by mining activities are listed in **Table 3.9-3**.

3.9.3.2.1 Navajo Sedge

3.9.3.2.1.1 Species Occurrence

No known occurrences or potential habitat exist for Navajo sedge within the proposed KMC (Peabody Western Coal Company [PWCC] 2012 et seq.), but there are known occurrences within the N-Aquifer study area. The range of Navajo sedge on the Navajo Nation is from the Lukachukai Mountains, south to Canyon de Chelly and north to the San Juan River. The N-Aquifer study area falls within the range of this species.

3.9.3.2.1.2 Life History and Habitat Association

Navajo sedge is a wetland obligate of seeps/springs and typically is found in hanging gardens within alcoves of sandstone cliffs of varying height and slope between 4,200 and 7,600 feet amsl (USFWS 2014). Hanging gardens occur on nearly inaccessible cliff faces to accessible alcoves. It is associated with other hanging garden plants such as Eastwood's monkey flower (*Mimulus eastwoodiae*), giant helleborine (*Epipactis gigantae*), sand bluestem (*Andropogon hallii*), thistles (*Cirsium* sp.), foxtail barley (*Hordeum jubatum*), and common reed (*Phragmites communis*) (USFWS 2015d). Navajo sedge flowers between late June and September (USFWS 2014).

Table 3.9-3 Special Status Plant Species Occurrence within the N-Aquifer Study Area

Species	Status[1]	N-Aquifer Study Area[2]
Federally Listed Special Status Plant Species		
Navajo sedge (*Carex specuicola*)	FT, NESL G3	K (CH)
Other Special Status Plant Species		
Alcove Bog-orchid (*Platanthera zothecina*)	NESL G3	P
Alcove Death Camas (*Zigadenus vaginatus*)	NESL G3	P

[1] Status: FE = Federal Endangered, FT = Federal Threatened, NESL = Navajo Endangered Species List, G3 = Group 3, FS = Forest Service Sensitive, BLMS = BLM Sensitive.

[2] Occurrence Categories: K = Known occurrence based on Natural Heritage Program data, Navajo Nation data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, and the USFWS IPaC system; (CH) = Critical Habitat.

At the time of federal listing, Navajo sedge was only known from three springs, all within a 1-mile stretch along a trail within the Navajo Nation in Coconino County, Arizona. These three sites are now considered one population by the Navajo Natural Heritage Program. At this writing, there are 57 known populations across the range of this species managed by the Navajo Nation, Hopi Tribe, National Park Service, and BLM. This increase in number most likely is based on increased survey effort rather than an increase in abundance. Based on geologic characteristics, the species has the potential to extend farther north and west into Utah (USFWS 2014).

The proposed KMC is located on the Wepo Aquifer with the N-Aquifer underlain approximately 2,000 feet below. It appears that Navajo sedge is supported by seeps/springs on the edge of the N-Aquifer rather than the Wepo Aquifer. This assertion is supported by vegetation surveys within the proposed KMC that were conducted in 2003. These surveys were focused on the J28 and N10 coal lease areas and no Navajo sedge occurrences or potential habitat was located during the survey (ESCO and PWCC 2003).

3.9.3.2.1.3 Listing and Conservation Status

Navajo sedge is a perennial forb listed as threatened pursuant to the ESA in May 1985. It also is a Navajo Endangered G3 species. Threats to this species include livestock trampling, habitat loss from groundwater development, and climate change. It is likely that livestock trampling and habitat loss from cattle grazing has affected this species prior to NGS development, but there is no available information concerning population numbers prior to activities related to NGS. The Navajo Nation has now been monitoring this species for 30 years (Roth 2004). It was found that 80 percent of the hanging gardens visited was accessible to livestock, some heavily impacted by trampling (Roth 2004). For projects that may affect groundwater development, evaluation is recommended by the USFWS (USFWS 2014). It is not possible to predict at this time how the local climate may change to the extent that it would affect Navajo sedge habitat. Weather events are likely to become more extreme with periods of drought and flood, which could affect seeps and springs.

Critical habitat has been designated for this species and is located approximately 20 miles northwest of the proposed KMC. A recovery plan was completed in 1987, and at the time of publication, no criteria for delisting had been established. Studies implemented due to the recovery plan were to provide the necessary data from which quantifiable delisting criteria could be established (USFWS 1987a). In 2014, Navajo sedge underwent its latest 5-year review by the USFWS to revisit its listing status. The results of this review deemed that no change is necessary for the status of the species and that it should remain

threatened (USFWS 2014). As of this last review, delisting criteria still had not been established, although it does identify recovery actions intended to protect the sedge while information is collected to create criteria.

3.9.3.2.1.4 Factors Affecting Species

The Proposed Action groundwater model analysis takes into account historical effects (baseline) through the end of 2019. For more information, see Section 3.7.4.2, under *Proposed Kayenta Mine Complex* and historical mine withdrawals are provided in **Appendix WR-7, Table WR-7.1**. Maximum N-Aquifer withdrawals for the mine were 4,740 acre-feet per year in 1982. More recently, in 1982, N-Aquifer water use at the mine was 4,480 acre-feet per year. The mean annual pumping for 2006 through 2012 was about 1,273 acre-feet per year. It is unknown how these past withdrawals affected the seep and spring habitats of Navajo sedge.

Due to known locations of Navajo sedge around the proposed KMC, it was evaluated as a special status plant within the proposed KMC ERA analysis. Results showed baseline soil conditions are negligible and unlikely to pose a risk to Navajo sedge based on HQ_{max} <1.

3.9.3.3 Transmission Systems and Communication Sites

The WTS extends west from NGS to the Mojave Desert and Great Basin in southern Nevada. The eastern portions of the WTS cross vegetation typical of the Colorado Plateau including Great Basin conifer woodland and Great Basin desert scrub. The western portion crosses Mojave Desert scrub, with nearly half of the transmission line crossing desert scrub habitat (U.S. Geological Survey 2004).

The STS extends south from the cold deserts of the Colorado Plateau to the northern part of the Sonoran Desert north of Phoenix, Arizona. Major biotic communities include Great Basin conifer woodland, Great Basin desert scrub, Plains and Great Basin grasslands, and upland Sonoran desert scrub.

As listed in **Table 3.9-4**, potential habitat exists within the WTS 2-mile corridor and communication sites analysis area for the following federally listed species: Brady pincushion cactus, dwarf bear-poppy, and Jones cycladenia. Siler pincushion cactus, Fickeisen plains cactus (proposed critical habitat), Holmgren milkvetch (critical habitat), Gierisch mallow, and Welsh's milkweed have known occurrences along the WTS. Fickeisen plains cactus also has proposed critical habitat along the STS with known occurrences. Potential habitat for Welsh's milkweed occurs along the STS. Life history, habitat association, conservation status, and recovery information for dwarf bear-poppy, Gierisch mallow, Holmgren milkvetch, Jones cycladenia, and Siler pincushion cactus is presented in the sections that follow. For information on the other federally listed species, see Section 3.9.2.2, NGS and Associated Facilities and Section 3.9.2.3, Proposed KMC. Other special status plant species with potential to occur along the transmission lines and communication sites that may be affected by maintenance operations are listed in **Table 3.9-4**.

Table 3.9-4 Special Status Plant Species Occurrence along the Transmission Systems

Species	Status[1]	Transmission System[2]	
		WTS	STS
Federally Listed Special Status Plant Species			
Brady pincushion cactus (*Pediocactus bradyi*)	FE, NESL G2	P	U
Dwarf bear-poppy (*Arctomecon humilis*)	FE	P	U
Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*)	FE, FS, NESL G3	K (PCH)	K (CH)
Gierisch mallow (*Sphaeralcea gierischii*)	FE	K (CH)	U
Holmgren milk-vetch (*Astragalus holmgreniorum*)	FE	K (CH)	U
Jones cycladenia (*Cycladenia humilis* var. *jonesii*)	FT	P	U
Siler pincushion cactus (*Pediocactus sileri*)	FT, BLMS	K	U
Welsh's milkweed (*Asclepias welshii*)	FT, NESL G3	K	P
Other Special Status Plant Species			
Arizona Bugbane (*Cimicifuga arizonica*)	CAS	--	P
Atwood's pretty phacelia (*Phacelia pulchella* var. *atwoodii*)	BLMS	P	U
Baird camissonia (*Camissonia bairdii*)	BLMS	P	U
Barneby breadroot (*Pediomelum aromaticum* var. *barnebyi*)	BLMS	P	U
Beaver Dam Milk-vetch (*Astragalus geyeri* var. *triquetrus*)	BLMS	K	U
Chinle chia (*Salvia columbariae* var. *argillacea*)	BLMS	P	U
Chinle evening primrose (*Oenothera murdockii*)	BLMS	P	U
Cronquist's phacelia (*Phacelia cronquistiana*)	BLMS	P	U
Cutler lupine (*Lupinus caudatus* var. *cutleri*)	BLMS	P	U
Escarpment milkvetch (*Astragalus striatiflorus*)	BLMS	P	U
Gooseberryleaf globemallow (*Sphaeralcea grossulariifolia* var. *fumariensis*)	BLMS	P	U
Gould camissonia (*Camissonia gouldii*)	BLMS	P	U
Gumbo milkvetch (*Astragalus ampullarius*)	BLMS	P	U

Table 3.9-4 Special Status Plant Species Occurrence along the Transmission Systems

Species	Status[1]	Transmission System[2]	
		WTS	STS
Kaibab Plains Cactus (*Pediocactus paradinei*)	CAS, FS, BLMS	P	U
Kanab thelypody (*Thelypodiopsis ambigua* var. *erecta*)	BLMS	P	U
Kane breadroot (*Pediomelum megalanthum* var. *epipsilum*)	BLMS	P	U
Las Vegas Buckwheat (*Eriogonum corymbosum* var. *nilesil*)	BLMS	K	U
Nevada willowherb (*Epilobium nevadense*)	BLMS	P	U
Parry's petalonyx (*Petalonyx parryi*)	BLMS	P	U
Silverleaf sunray (*Enceliopsis argophylla*)	BLMS	P	U
Sticky wild buckwheat (*Eriogonum viscidulum*)	BLMS	K	U
Utah spurge (*Euphorbia nephradenia*)	BLMS	P	U
Whitetip clover (*Trifolium variegatum* var. *parunuweapensis*)	BLMS	P	U
Wirestem buckwheat (*Eriogonum pharnaceoides* var. *cervinum*)	BLMS	P	U

[1] Status: FE = Federal Endangered, FT = Federal Threatened, NESL = Navajo Endangered Species List, G2 = Group 2, G3 = Group 3, FS = Forest Service Sensitive, BLMS = BLM Sensitive, CAS = Conservation Agreement Species.

[2] Occurrence Categories: K = Known occurrence based on Natural Heritage Program data, Navajo Nation data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, and the USFWS IPaC system; CH = Critical Habitat; U = occurrence unknown.

3.9.3.3.1 Dwarf Bear-poppy

3.9.3.3.1.1 Species Occurrence

Potential habitat for dwarf bear-poppy exists along the WTS, restricted to the southwestern corner of Utah near St. George in Washington County (Tilley et al. 2010; USFWS 2015a). This species inhabits desert shrub communities, but is restricted to specific substrates.

3.9.3.3.1.2 Life History and Habitat Association

Dwarf bear-poppy is endemic to specific substrates derived from the Moenkopi Formation with soils slightly basic and high in gypsum and calcium carbonate (USFWS 2015a). There are approximately 12 populations within 10 miles of St. George, with the largest near Red Bluff, Webb Hill, White Dome, Punchbowl Dome and Atkinville (Tilley et al. 2010).

Dwarf bear-poppy grows within mixed desert shrub communities between 2,500 and 3,400 feet amsl dominated by Fremont indigo bush (*Psorothamnus fremontii*), cheesebush (*Hymenoclea salsola*), Mormon tea, shadscale, shrubby buckwheat (*Eriogonum corymbosum*), and Fremont pepperweed

(*Lepidium fremontii*). The species flowers in April and May with peak flowering occurring in early May (USFWS 2015a).

3.9.3.3.1.3 Listing and Conservation Status

Dwarf bear-poppy is a perennial herb listed as endangered pursuant to the ESA in December 1979. When the species was listed, primary threats were urban development, lack of regulatory mechanisms, and collection for home gardens. Current threats still include urban development, but collection is no longer considered a threat. Additional threats include habitat fragmentation, strip mining, grazing. Off-highway vehicle use, prolonged droughts, and climate change effects such as increased competition from invasive species and increased fire frequency and altered fire behavior (USFWS 2013d, 1979). Because potential habitat exists within the WTS, past activities related to WTS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to activities related to the construction of the WTS. Critical habitat has not been designated for this species. In 2011, dwarf bear-poppy was recommended for a 5-year review with 11 other Mountain-Prairie Region species to revisit listing status (USFWS 2011). A recovery plan was completed in 1985 (USFWS 1985).The results of the 5-year review have not been published. The primary objective of the recovery plan is to restore the dwarf bear-poppy to a non-endangered status by protecting existing populations from threats and ensuring they are maintained as self-sustaining populations in their natural habitat (USFWS 1985).

3.9.3.3.2 Gierisch Mallow

3.9.3.3.2.1 Species Occurrence

Critical habitat for Gierisch mallow exists along the WTS, but it is unknown if occurrences are within the analysis area of the WTS. Habitat for this species is limited to desert scrub communities, on gypsum outcrops associated with the Harrisburg Member of the Kaibab Formation in northern Mohave County, Arizona, and closely adjacent Washington County, Utah. The species known range has not changed since it was described by the USFWS in 2002 (USFWS 2013b).

3.9.3.3.2.2 Life History and Habitat Association

Gierisch mallow grows within Mojave Desert scrub communities restricted by certain gypsum soils. The USFWS examined locations to identify commonalities such as slope, aspect, and occurrence locations. However, no correlation was determined. Populations are found between 2,477 and 3,766 feet amsl (USFWS 2013b). Very little is known about the species including pollination system, seed dispersal mechanisms, or conditions under which seeds germinate (USFWS 2015b).

3.9.3.3.2.3 Listing and Conservation Status

Gierisch mallow is a perennial listed as endangered pursuant to the ESA in September 2013. Threats to this species include livestock grazing, habitat loss and degradation from mining, recreational activities, and invasive plant species (USFWS 2013b). Because known locations and critical habitat exist within the WTS, past activities related to WTS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to these activities. Small population size and a restricted range make this species increasingly susceptible to further declines (USFWS 2013c). No recovery information or conservation plans are available for Gierisch mallow (USFWS 2015b).

3.9.3.3.3 Holmgren Milk-vetch

3.9.3.3.3.1 Species Occurrence

Holmgren milk-vetch is an herbaceous perennial having known occurrences within critical habitat along the WTS in three small populations in Washington County, Utah, and Mohave County, Arizona. Individual plant numbers vary considerably from year-to-year (USFWS 2015c). These populations all

occur within approximately 10 miles of St. George, Utah, with the largest concentration along the Utah-Arizona border. While this represents the known historic distribution, it is likely that due to human-induced impacts, Holmgren milk-vetch occupied more habitat in the past (USFWS 2006).

3.9.3.3.3.2 Life History and Habitat Association

The species grows within warm-desert shrub communities among small and large hill and plateau formations, above or at the edge of intermittent drainages. They are found on bare soils with less than 20 percent vegetated cover. Associated species include desert goldenhead (*Acamptopappus sphaerocephalus*), white burrobush (*Ambrosia dumosa*), Nevada jointfir (*Ephedra nevadensis*), threadleaf snakeweed (*Gutierrezia microcephala*), small flowered milk-vetch (*Astragalus nuttallianus*), and big galleta (*Hilaria rigida*). Approximately 95 percent of these plants occur on slopes of 20 percent or less. The soil surface for Holmgren milk-vetch is characterized by small stone and gravel deposits between 2,480 and 3,000 feet amsl (USFWS 2006). The species flowers between March and April (USFWS 2015c). Approximately half of the areas inhabited by this species are owned and managed by the State of Utah (USFWS 2006).

3.9.3.3.3.3 Listing and Conservation Status

Holmgren milk-vetch was listed as endangered pursuant to the ESA in September 2001. Threats to this species include urban development, off-road vehicle use, invasive plants, and mineral development (USFWS 2006). Past disturbance was shown to increase invasive weeds within habitat occupied by the species (USFWS 2006). Because known locations and critical habitat exist within the WTS, past activities related to WTS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to these activities. Critical habitat exists for Holmgren milk-vetch (USFWS 2015c) and a recovery plan was completed in 2006 (USFWS 2006). Recovery for this species would hinge on conservation of extant populations as well as the establishment of additional populations to ensure demographic and genetic viability. Delisting potentially would occur when all of the recovery goals and criteria listed in the recovery plan are met (USFWS 2006).

3.9.3.3.4 Jones Cycladenia

3.9.3.3.4.1 Species Occurrence

Potential habitat for Jones cycladenia exists along the WTS. Jones cycladenia is known from 26 sites located in 5 areas in southern Utah (Kane, Grand, Garfield, and Emery counties) and northern Arizona (Mohave County) (USFWS 2008a).

3.9.3.3.4.2 Life History and Habitat Association

Jones cycladenia is a long-lived herbaceous perennial adapted to harsh soil conditions that are easily degraded by surface disturbance and is slow to recover (USFWS 1986a). The species grows within desert shrub and pinyon-juniper communities often associated with buckwheat and Mormon tea. It is found on gypsiferous, saline soils of the Cutler, Chinle, and Summerville Formations between 4,390 and 6,000 feet amsl. The species flowers from mid-April to early June (USFWS 2010).

3.9.3.3.4.3 Listing and Conservation Status

Jones cycladenia was listed as threatened pursuant to the ESA in May 1986. Threats to this species include cattle grazing, habitat disturbance from oil and gas development, tar sand and minerals exploration, and recreational or other off-road vehicle use. Habitat disturbance was thought to be reducing seedling establishment (USFWS 2008a). Because potential habitat exists within the WTS, past activities related to WTS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to these activities. Designated critical habitat does not exist for Jones cycladenia. No recovery plan has been written, but a recovery plan is being prepared and recovery efforts are in progress. A recovery outline was created for the species

which lays out the preliminary course of action for recovery (USFWS 2015f, 2008a). This species has been assigned a recovery priority of 12C, which indicates it faces a moderate degree of threat, has a low potential for recovery, and is in conflict with development or other economic activities. The initial action plan includes surveys and monitoring, threats abatement, and research (USFWS 2008a).

3.9.3.3.5 Siler Pincushion Cactus

3.9.3.3.5.1 Species Occurrence

Siler pincushion cactus has potential habitat along the WTS. The range of Siler pincushion cactus extends from extreme northwestern Coconino County, Arizona, west for approximately 70 miles into north-central Mohave County, Arizona. The range also includes approximately 3 miles within southern Utah in both Washington and Kane counties. The majority occur on BLM lands (Arizona Strip and Cedar City Districts). A smaller amount of land where the cactus is found is managed by the Kaibab-Paiute Indian Tribe, Arizona, Utah State trust lands, and privately owned lands (USFWS 2008b).

3.9.3.3.5.2 Life History and Habitat Association

Siler pincushion cactus grows in a variety of plant communities from 2,800 to 5,400 feet amsl, with low elevation sites within Mojave Desert scrub to the highest elevation sites within the Great Basin conifer woodland and Plains and Great Basin grassland communities (USFWS 1993). The majority are found in the Great Basin desert shrub community. The majority of plants are associated with the Shnabkaib Member of the Moenkopi Formation, which is composed of siltstone, gypsum, limestone, and dolomite. They also are found scattered on the Middle Red Member of the Moenkopi Formation, which is a reddish siltstone with thin to thick layers of gypsum (USFWS 2008b). Flowers appear in the spring (USFWS 1993).

3.9.3.3.5.3 Listing and Conservation Status

Siler pincushion cactus was listed as endangered in 1979 and reclassified as threatened pursuant to the ESA in 1993. It also is a BLM sensitive plant. Threats to this species include gypsum mining, off-road vehicle use, road construction, collection, livestock grazing, and inadequacy of regulatory mechanisms. Because known occurrences exist within the WTS, past activities related to WTS construction and surface disturbance may have impacted this species, but there is no available information concerning population numbers prior to these activities. Specialized soil types, small populations, and population disjunction could have intensified impacts to the species and its habitat (USFWS 1993). At the time of listing, there was thought to be less than 1,000 individuals. Since then, the BLM has performed extensive surveys as well as habitat delineation. As of 2008, it was estimated that over 34,000 acres of habitat exist and over 10,000 individuals have been recorded (USFWS 2008b). This is most likely a reflection of increased survey rather than increased individual plants. Based on USFWS monitoring data, populations are decreasing and showing evidence of reduced recruitment (USFWS 2008b). Critical habitat has not been designated for this species. A recovery plan was completed in 1986 (USFWS 1986b) and a 5-year review occurred in 2008 (USFWS 2008b).

3.9.4 Environmental Consequences

3.9.4.1 Issues

The following issues related to vegetation resources were identified through public and agency scoping. Although there is overlap, issues vary somewhat by project component.

3.9.4.1.1 Navajo Generating Station

Issue 1 – Operations and Maintenance, including Surface Disturbance - effects of operations and maintenance of NGS and associated facilities, including the BM&LP Railroad, on special status plants.

Issue 2 – Emissions and Deposition - effects of NGS emissions and metals deposition on special status plants.

3.9.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Operations and Reclamation - effects of mining operations and reclamation on special status plants.

Issue 2 – Emissions and Deposition - effects of combined emissions from the proposed KMC and NGS on special status plants.

Issue 3 – Groundwater Pumping - effects of mine-related groundwater pumping from the N-Aquifer on associated stream and spring baseflows that support special status plants.

3.9.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operations and Maintenance - effects of transmission line operations and maintenance on special status plants.

3.9.4.2 Assumptions and Impact Methodology

The following is a list of assumptions made and methodology used to assess impacts of the project as they relate to special status plant species.

- Potential habitat for special status plants was derived based on life history information and input from cooperating agencies.
- Species were considered as having the potential to occur within the study area if recent occurrence has been documented or the current range exists within the study area with suitable habitat present.
- There would be no construction disturbance for the BM&LP Railroad, transmission lines, and communication site. The analysis of impacts to special status plants from these components would be limited to O&M activities.
- Non-native and invasive plants are present within the project area.

3.9.4.2.1 Navajo Generating Station

- The NGS Near-field study area ERA (Ramboll Environ 2016a) evaluated risks to species within the 20-km deposition area of the NGS. Exposure of special status plants to COPECs (metals, dioxins/furans, and polycyclic aromatic hydrocarbons) was evaluated based on concentrations present in soil. Other cumulative sources, as well as future emissions from the NGS, also were modeled and evaluated from 2020 to 2074 to address future emissions deposition-related impacts from the Proposed Action and other sources.
- Only aquatic receptors along the Colorado and San Juan rivers were analyzed. No special status plants are riverine aquatic species; therefore, special status plants were not analyzed in the Gap Regions and San Juan River ERAs.
- HQs were used to identify risk effects to soil resources where special status plants potentially occur.
- Prior to vegetation treatments within the BM&LP railroad, potentially suitable habitat for special status plants would be surveyed and any occurrence locations marked to avoid impacts. Vegetation treatment would include activities such as mowing and weed control as outlined in the O&M plan.

3.9.4.2.2 Proposed Kayenta Mine Complex

- Known and potential special status plant occurrence was based on input from the Navajo Nation Department of Fish and Wildlife, USFWS, and PWCC.
- Waterbodies including seeps/springs within the N-Aquifer study area could be potential habitat for some special status plants. Groundwater modeling results were used to identify waterbodies where baseflow to springs could be reduced as a result of mine pumping.

3.9.4.2.3 Transmission Systems and Communication Sites

- Potential impacts from O&M activities to known or potential habitat occurrence of special status plants along the WTS and STS were evaluated qualitatively. Potential habitat locations were determined based on life history information and consultation with cooperating agencies.
- The indirect effects of introduction and spread of noxious weeds from vehicles or workers from infested areas into undisturbed areas were evaluated qualitatively. BMPs to reduce the spread of invasive plants are in place and would continue to be implemented to minimize impacts.
- Prior to vegetation treatments within the rights-of-way (ROWs) or other ground-disturbing maintenance activities, potentially suitable habitat for special status plants would be surveyed and any occurrences locations marked to avoid impacts. Vegetation treatment would include activities such as mowing and weed control as outlined in the O&M plan.

3.9.4.3 Proposed Action

3.9.4.3.1 Navajo Generating Station

3.9.4.3.1.1 Operations and Maintenance, including Surface Disturbance

<u>Federally Listed Species</u>

At the NGS, the Proposed Action would result in approximately 199 to 239 acres of surface disturbance (depending on 3-Unit Operation or 2-Unit Operation), resulting in the direct removal of primarily desert scrub vegetation. Of the three federally listed plants found within the NGS Near-field study area, Fickeisen plains cactus inhabits desert scrub communities, but is restricted to certain soils. As a result, this species is not likely to be found in the future NGS disturbance areas. However, special status plant species surveys would be conducted in these areas prior to disturbance to determine presence/absence of special status species. If special status plants are found, consultation would occur with the U.S. Fish and Wildlife Service.

Welsh's milkweed, a federally threatened species, has the potential to occur along the BM&LP Railroad. Coal dust generated during coal transport (i.e., along the BM&LP Railroad), handling, and storage could settle on vegetation, potentially resulting in a localized effect to plant health including Welsh's milkweed. The potential for untreated or improperly loaded coal to be lost due to wind erosion is greatest during the initial transport near the mine (Winges and Steffel 2016).

Potential impacts from fugitive dust under the Proposed Action would be minimized through the implementation of fugitive dust control measures described in the NGS Operations and Maintenance Plan (**Appendix 1B**). Measures implemented to reduce coal blow-off during transport would include ensuring the coal remains below the top of the train cars during loading and enforcing slow train speeds. To further reduce the generation of coal dust, NGS developed a Dust Control Plan that would continue to be implemented at the plant and associated facilities. In addition, an annual Fugitive Dust Control Report that describes actions taken to control dust, records of citizen complaints, and any corrective measures taken for the Ash Disposal Area also would be generated as required under coal combustion residual regulations (40 Code of Federal Regulations 257.80). Based on implementation of these measures, dust-related effects to Welsh's milkweed from O&M activities would be negligible.

Under the Proposed Action, the majority of the operating and support facilities at NGS would be dismantled and properly disposed and the area reclaimed at the end of operations, unless the Navajo Nation continues NGS operations beyond 2044. **Appendix 1B** provides an overview of the decommissioning sequence for the plant and associated facilities, including the coal ash landfill and BM&LP Railroad. Under this alternative, approximately 3,724 acres associated with the plant, coal ash landfill, and BML&LP Railroad, would be reclaimed.

Potential Welsh's milkweed habitat near the BM&LP Railroad Welsh's milkweed would be marked and avoided to minimize any impacts to special status plants during decommissioning and abandonment of the railroad. The implementation of additional reclamation techniques such as minimization of surface disturbance, soil amendments, and noxious weed control may be required along the BM&LP Railroad to further minimize impacts to special status plants or potential habitat. Decommissioning and abandonment of the railroad should have negligible effects to special status plants.

Other Special Status Plant Species

Kaibab plains cactus and Mojave indigo bush have the potential to occur along the BM&LP Railroad and are listed on **Table 3.9-2**. As discussed above for the Welsh's milkweed, there would be negligible dust-related effects to these species as a result of O&M activities. Also, decommissioning and abandonment of the railroad should have negligible effects on these species with implementation of the measures discussed above for federally listed plants.

3.9.4.3.1.2 Emissions and Deposition

Federally Listed Species

Federally listed plants found within the NGS Near-field study area are listed in **Table 3.9-2**. For the NGS ERA emissions analysis, potential emissions/deposition-related effects to special status plants were evaluated by comparison of soil concentrations for each COPEC to baseline soil concentrations plus air deposition (to soil) considering both the 3-Unit Operation and 2-Unit Operation (see Section 3.9.3.1 for further detail). Based on the results of the NGS ERA analysis, the 3-Unit Operation and 2-Unit Operation would result in HQs below 1 from emission deposition (Ramboll Environ 2016a). Therefore, the Proposed Action would have negligible effects on special status plant species.

Other Special Status Plant Species

Other special status plant species having known locations or potential habitat within the NGS Near-field study area are listed in **Table 3.9-2**. Potential emissions/deposition-related effects to other special status plant species were evaluated based on the soil concentrations for each COPEC reported in the NGS ERA. Based on the results of the NGS ERA, the 3-Unit Operation and 2-Unit Operation would result in HQs below 1 (Ramboll Environ 2016a). Therefore, the Proposed Action would have negligible effects to alcove death camas, Mojave indigo bush, Kaibab plains cactus, and Marble Canyon milk-vetch from future operations of NGS.

3.9.4.3.2 Proposed Kayenta Mine Complex

3.9.4.3.2.1 Operations and Reclamation

Federally Listed Species

No federally listed plants have known locations or potential habitat within the proposed KMC study area. Surveys were conducted in lease areas N-10 and J-28 which support no occurrences or potential habitat of federally listed plants (ESCO and PWCC 2003). Suitable habitat was not identified in the other lease areas based on examination of aerial imagery and baseline vegetation data (ESCO and PWCC 2003).

Therefore, there would be no disturbance-related impacts to federally listed plants in the KMC study area.

Other Special Status Plant Species

No other special status plant species have known occurrences or potential habitat within the proposed KMC study area. Therefore, there would be no disturbance-related impacts on other special status plants.

3.9.4.3.2.2 Emissions and Deposition

The KMC ERA study area encompasses areas within and outside of the KMC study area (**Figure 3.0-8**). For the KMC ERA emissions analysis, the potential for ecological risk was evaluated by comparison of soil concentrations for each COPEC to baseline soil concentrations plus air deposition (to soil) considering both the 3-Unit Operation and 2-Unit Operation. The resulting HQs were below 1 (Ramboll Environ 2016g) indicating that ecological risk in the KMC ERA study area is not likely. Therefore, it is anticipated there would be negligible risk to federally listed and other special status plant species.

3.9.4.3.2.3 Groundwater Pumping

Federally Listed Species

Critical habitat as well as potentially suitable habitat for the Navajo sedge exists within the N-Aquifer study area. This species occurs among hanging garden communities affiliated with seeps/springs. Due to potential drawdown effects from mine pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details of this analysis are provided in Section 3.7, Water Resources. The model results predict that spring flow reduction from project groundwater pumping could occur in three of the spring groups in the N-Aquifer study area (i.e., near Tuba City/Moenkopi Wash, Chinle, and Dennehotso). There are known locations and potential habitat of Navajo sedge located within two of the three spring groups, including the F1 spring group near Dennehotso and the I spring group near Chinle. The model analysis estimated small flow reductions from less than 0.001 to approximately 0.06 gallons per minute. For most spring groups, simulated changes in hydraulic head (water level at the ground surface) generally ranged from zero to approximately 0.02 feet. Immediately west of Chinle, the head change ranged up to about 0.1 foot. At the four U.S. Geological Survey-monitored springs, there would be no change in flow as a result of project pumping under the Proposed Action. Based on the groundwater model results, it is expected the changes in water level at the ground surface from mine pumping would have negligible effects to the Navajo sedge at seeps/springs in the N-Aquifer study area.

The occurrence of Navajo sedge near Tsegi Canyon is likely supported by recharge to exposed Navajo sandstone from the north, as opposed to groundwater discharge from the N-aquifer to the south (OSMRE 2011). When precipitation falls on the exposed Navajo sandstone in the Tsegi Canyon, some water travels through cracks and discharges from the canyon walls. These water discharges are enough to support hanging garden communities. Groundwater pumping cannot occur above the Laguna Creek saturated alluvium and, therefore, would not have an effect on the population of Navajo sedge at Tsegi Canyon (OSMRE 2011).

Other Special Status Species

Alcove bog orchid and alcove death camas have potential habitat within the N-Aquifer study area. These species occur in hanging garden communities associated with seeps/springs. Potential reduction in groundwater baseflows to seep/spring habitats for these species would be the same as those described above for the Navajo sedge. Based on the groundwater model results, it is expected the changes in water level at the ground surface as a result of mine pumping would have negligible effects to the alcove bog orchid and alcove death camas at seeps/springs in the N-Aquifer study area.

3.9.4.3.3 Transmission Systems and Communication Sites

3.9.4.3.3.1 Operations and Maintenance

Federally Listed Species

Federally listed plants with known or potential habitat along the WTS and STS are displayed in **Table 3.9-4**.

The majority of inspection and maintenance activities would occur along the existing ROWs, serviced by existing roads leading to the regional highway system. Potential impacts to federally listed plants as a result of O&M activities would include erosion and sedimentation caused by maintenance vehicles, fugitive dust generation, and the spread and establishment of noxious or invasive weeds into areas of lower vegetative cover. Special status species surveys and avoidance measures would be required prior to any new surface disturbance (excluding emergency maintenance activities). Further discussion outlining specific vegetation maintenance within the WTS and STS are described in the NGS Operations and Maintenance Plan (**Appendix 1B**). There would be negligible effects to dwarf-bear poppy, Fickeisen plains cactus, Jones cycladenia, Siler pincushion cactus, and Welsh's milkweed from O&M activities based on continued implementation of BMPs.

Gierisch mallow critical habitat is crossed by the WTS ROW approximately 9 miles southeast of St. George, Utah. It is not known if individual plants are within the critical habitat crossed by the WTS study area or ROW. Several access roads affiliated with the WTS also are within this critical habitat. Conservation measures for this species would reduce the likelihood of direct impacts to this species by requiring that biologically sensitive areas be marked and avoided, and that pre-activity surveys be conducted prior to vegetation management occurring in the ROW in these areas. In addition, vehicle use would be restricted to existing roads in areas of suitable habitat.

Although suitable or critical habitat for Gierisch mallow may be affected by the introduction and spread of noxious weeds or invasive plant species, ongoing conservation measures require clean vehicle practices during O&M activities. Also, the WTS ROW has been altered and exhibits disturbance due to ongoing maintenance and vegetation management activities. Therefore, it is anticipated that continued O&M activities would have negligible effects on suitable or critical habitat for the Gierisch mallow.

Holmgren milk-vetch is known to occur within designated critical habitat approximately 0.7 to 3.5 miles from the WTS ROW in both Washington County, Utah, and Mohave County, Arizona. Suitable habitat is present within the WTS study area and critical habitat for this species is crossed by the WTS study area; however, it is not known if individual plants are present in these locations. One WTS ROW access road goes through Holmgren milk-vetch critical habitat, while one access road is immediately adjacent and shares a boundary with critical habitat. Conservation measures for this species would reduce the likelihood of direct impact to this species by requiring that biologically sensitive areas be marked and avoided, and that pre-activity surveys are conducted prior to vegetation management occurring in the ROW in these areas. In addition, vehicle use would be restricted to existing roads in areas of suitable habitat.

Although suitable and critical habitat for Holmgren milk-vetch may be affected by the introduction and spread of noxious weeds or invasive plant species, ongoing conservation measures require clean vehicle practices during O&M activities. Also, the WTS ROW is altered and exhibits disturbance due to ongoing maintenance and vegetation management activities. Therefore, it is anticipated that continued O&M activities would have negligible effects on suitable or critical habitat for Holmgren milk-vetch.

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Other Special Status Plant Species

Other special status plant species with known locations or potential habitat along the WTS and STS are listed in **Table 3.9-4**. Potential impacts to these species resulting from transmission line O&M activities would be the same as those described above for federally listed species. It is anticipated that the Proposed Action would result in negligible effects to other special status plants with continued implementation of conservation measures during O&M activities.

3.9.4.3.4 Project Impact Summary – All Project Components

The total surface disturbance under the Proposed Action would be between 5,527 and 4,998 acres. The overall effects of the Proposed Action on special status plants would be considered negligible.

Up to 239 acres of vegetation will be removed at the NGS plant and ash disposal site. However, due to the unlikely occurrence of special status plants within the future disturbance areas and the conduct of pre-disturbance surveys, no disturbance-related impacts to special status plants are anticipated at the NGS plant site. Effects to special status plants as a result of O&M activities at NGS and along the BM&LP Railroad and transmission systems are expected to be negligible.

NGS emissions and deposition by itself would represent a negligible risk to special status plants in the NGS Near-field study area, as indicated by HQs less than 1. When combining NGS emissions with baseline conditions, there would be a negligible risk to special status plants based on HQ values less than 1. The KMC ERA indicates emissions from the proposed KMC would pose a negligible risk to special status plants in the KMC ERA study area based on HQ values that are less than 1.

Water pumping in the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible impacts to special status plants and habitat.

3.9.4.3.5 Cumulative Impacts

The special status plants cumulative effects study areas are the same as the direct indirect study areas. Refer to Section 3.0 for a detailed description of these study areas. Cumulative impacts occur when the incremental effects of an action are added with the effects of other past and present actions and reasonably foreseeable future actions.

3.9.4.3.5.1 Operations and Maintenance, including Surface Disturbance

Reasonably foreseeable future actions are anticipated to impact 4,201 acres of vegetation, and past and present actions have impacted approximately 52,786 acres of vegetation. It is not known if special status plants were impacted, or would be impacted, by these actions. The Proposed Action incrementally would contribute between 4,998 and 5,527 acres of vegetation disturbance to cumulative impacts, resulting in a total cumulative impact to vegetation on between 61,985 and 62,514 acres. The Proposed Action's contribution to cumulative impacts to special status plants, critical habitat, and potentially suitable habitat within the project disturbance area would be considered negligible with implementation of conservation measures and BMPs. It is anticipated that reclamation of portions of past and present actions and reasonably foreseeable future actions have been, or would be, completed in accordance with permit requirements or lease agreements, thereby reducing the cumulative impact to vegetation (and potentially special status plant species and habitat, if present) over time. Reclamation of Proposed Action disturbance areas would further minimize the project's contribution to cumulative special status species impacts.

3.9.4.3.5.2 Emissions and Deposition

Cumulative special status species impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and

deposition. Based on the ERA results, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to special status species is not likely under either scenario. Therefore, the project's contribution to cumulative ecological risk for special status plants would be negligible and would cease following completion of operations in 2044.

3.9.4.3.5.3 Groundwater Pumping

Past and present and reasonably foreseeable future actions that could contribute to drawdown related effects to seeps/springs that support Navajo sedge, alcove bog orchid, or alcove death camas or provide habitat for these species within the N-Aquifer study area include groundwater pumping from community wells for local water use. Groundwater modeling indicates special status plants associated with seeps and springs that have hydraulic connection to the N-Aquifer could experience negligible to minor effects as groundwater levels decline from community pumping in future years. The modeling also indicates that the Proposed Action's contribution to groundwater level declines and associated effects to seeps and springs that support, or may support, these species would be negligible.

3.9.4.4 Natural Gas Partial Federal Replacement Alternative

Under the Natural Gas Partial Federal Replacement (PFR) Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to exist, prior disturbance impacts to special status plants at the existing facility are not evaluated in this Environmental Impact Statement (EIS). Key assumptions about special status plants related to such an existing natural gas site are listed below.

- The natural gas plant underwent National Environmental Policy Act (NEPA) evaluation.
- A combined-cycle natural gas power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Native vegetation and possibly special status plants were removed from the site and would not be revegetated until after facility decommissioning.
- Natural gas combustion for power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the study area. The description of emission calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

3.9.4.4.1 Navajo Generating Station

3.9.4.4.1.1 Operations and Maintenance, including Surface Disturbance

Federally listed and other special status plants that have occurrences or potential habitat are listed in **Table 3.9-2**. Coal delivery under the Proposed Action would range between 5.5 million tons per year (tpy) and 8.1 million tpy. Under the Natural Gas PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use would be between 5 and 18 percent annually under the Natural Gas PFR Alternative. Overall, impacts to special status plants as a result of surface disturbance and O&M activities under this alternative would be similar to the Proposed Action and, therefore, would be negligible.

3.9.4.4.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic and mercury, associated with the Natural Gas PFR Alternative NGS stack emissions would be reduced relative to the Proposed Action as presented in **Table 3.9-5.**

Table 3.9-5 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Natural Gas PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Natural Gas PFR 100-MW Power Reduction (tpy / %change)	Natural Gas PFR 250-MW Power Reduction (tpy / %change)
Selenium	3-Unit	2.237	2.127 / -5%	1.957 / -13%
Selenium	2-Unit	1.491	1.377 / -8%	1.208 / -19%
Mercury (total)	3-Unit	0.117	0.111 / -5%	0.102 / -13%
Mercury (total)	2-Unit	0.078	0.072 / -8%	0.063 / -19%
Arsenic	3-Unit	0.133	0.127 / -5%	0.117 / -13%
Arsenic	2-Unit	0.089	0.083 / -8%	0.073 / -19%

The 3-Unit Operation and 2-Unit Operation 100-MW and 250-MW Natural Gas PFR Alternative operations would result in approximately 5 to 19 percent less selenium, arsenic, and mercury than the Proposed Action. Based on modeling for the Proposed Action, maximum deposition from the NGS stacks combined with background soil concentrations would be below U.S. Environmental Protection Agency ERA screening levels as described under the Proposed Action.

Federally listed and other special status plants that have known occurrences or potential habitat within the NGS Near-field study area are listed in **Table 3.9-2**. The emission/deposition-related impacts on these species under the Natural Gas PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.4.2 Proposed Kayenta Mine Complex

3.9.4.4.2.1 Operations and Reclamation

There are no special status plants that have known occurrences or potential habitat within the proposed KMC study area. Therefore, there would be no disturbance-related impacts to special status plants under this alternative.

3.9.4.4.2.2 Emissions and Deposition

Under the Natural Gas PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts on federally listed and other special status species under the Natural Gas PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.4.2.3 Groundwater Pumping

Navajo sedge is a federally listed plant having known occurrences and critical habitat within the N-Aquifer study area. Other special status plants (i.e., alcove bog orchid and alcove death camas) listed in **Table 3.9-3** have potential habitat in the N-Aquifer study area. These species are present among the hanging garden communities affiliated with seeps/springs. Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Water use would be the same under both the Natural Gas PFR Alternative and the Proposed Action; therefore, effects to special status plants and habitat at the seeps and springs in the N-Aquifer study area under this alternative also would be negligible. For more discussion, see Section 3.9.4.3, Proposed Action, *Proposed Kayenta Mine Complex*.

3.9.4.4.3 Transmission Systems and Communication Sites

3.9.4.4.3.1 Operations and Maintenance

Federal and other special status plants found within the WTS and STS are listed in **Table 3.9-4**. O&M activities along the WTS and STS and at the communications sites would be the same as the Proposed Action (Section 3.9.4.3). There would be negligible effects to dwarf-bear poppy, Fickeisen plains cactus, Jones cycladenia, Siler pincushion cactus, and Welsh's milkweed within the WTS and STS ROWs under the Natural Gas PFR Alternative from O&M activities based on continued implementation of BMPs. There would be negligible effects to Gierisch mallow and Holmgren milk-vetch, as well as their respective critical habitats, with implementation of conservation measures and BMPs.

3.9.4.4.4 Project Impact Summary – All Project Components

The overall effects of the Natural Gas PFR Alternative on special status plant species is expected to be negligible due to the overall effect of the various impact issues.

The Natural Gas PFR Alternative would result in a 5 to 19 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate 5 to 18 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to special status plants. The ecological risk to vegetation under the Natural Gas PFR Alternative also would be considered negligible.

O&M activities for the BM&LP Railroad and transmission systems also would result in negligible impacts to special status plants as well as Gierisch mallow and Holmgren milk-vetch critical habitat.

Groundwater pumping at the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on special status species and habitat.

3.9.4.4.5 Cumulative Impacts

The cumulative impacts of surface disturbance under the Natural Gas PFR Alternative would be 0 to 1 percent less than those estimated for the Proposed Action. The surface disturbance contributed by the Natural Gas PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 62,252 to 61,132 acres. Reclamation of Natural Gas PFR Alternative disturbance areas would minimize the project's contribution to cumulative special status species impacts over time.

Cumulative special status plants impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to special status plants is not likely under either scenario. Although the Natural Gas PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for special status plants would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to special status plants as a result of groundwater pumping-related drawdown in the N-Aquifer under the Natural Gas PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. As discussed, groundwater modeling indicates special status species associated with seeps and springs that have hydraulic connection to the N-Aquifer could experience negligible to minor effects as groundwater levels decline from community pumping in future years. The modeling also indicates that the Proposed Action's contribution to groundwater level declines and associated effects to seeps and springs that support, or may support, these species would be negligible. As the water usage would be the same under both the Natural Gas PFR Alternative and the

Proposed Action, the project's contribution to cumulative groundwater level declines under the Natural Gas PFR Alternative also would be negligible.

3.9.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to exist, prior disturbance impacts to special status plants are not evaluated in this EIS. Key assumptions about special status plants related to such an existing site are listed below.

- The renewable energy operation underwent NEPA evaluation.
- A renewable energy power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Native vegetation and possibly special status plants were removed from the site and would not be revegetated until after facility decommissioning.
- Combustion and emissions for power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the study area. The description of emission calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

3.9.4.5.1 Navajo Generating Station

3.9.4.5.1.1 Operations and Maintenance, including Surface Disturbance

Federally listed and other special status plants that have occurrences or potential habitat are listed in **Table 3.9-2**. Under the Renewable PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated at NGS. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use are between 2 and 11 percent annually under the Renewable PFR Alternative. Overall, impacts to special status plants as a result of surface disturbance and O&M activities under this alternative would be similar to the Proposed Action and, therefore, would be negligible.

3.9.4.5.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic and mercury for the Renewable PFR Alternative NGS stack emissions, would be reduced relative to the Proposed Action as presented in **Table 3.9-6**.

The 3-Unit Operation and 2-Unit Operation 100-MW and 250-MW Renewable PFR Alternative operations would result in approximately 3 to 11 percent less selenium, arsenic, and mercury than the Proposed Action. Based on modeling for the Proposed Action, maximum deposition from the NGS stacks combined with background soil concentrations would be below U.S. Environmental Protection Agency ERA screening levels.

Federally listed and other special status plants that have known occurrences or potential habitat within the NGS Near-field study area are listed in **Table 3.9-2**. The emission/deposition-related impacts on these species under the Renewable PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

Table 3.9-6 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Renewable PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Renewable PFR 100-MW Power Reduction (tpy / %change)	Renewable PFR 250-MW Power Reduction (tpy / %change)
Selenium	3-Unit	2.237	2.174 / -3%	2.075 / -7%
Selenium	2-Unit	1.491	1.424 / -4%	1.325 / -11%
Mercury (total)	3-Unit	0.117	0.114 / -3%	0.108 / -7%
Mercury (total)	2-Unit	0.078	0.075 / -4%	0.069 / -11%
Arsenic	3-Unit	0.133	0.130 / -3%	0.124 / -7%
Arsenic	2-Unit	0.089	0.086 / -4%	0.080 / -11%

3.9.4.5.2 Proposed Kayenta Mine Complex

3.9.4.5.2.1 Operations and Reclamation

There are no special status plants that have known occurrences or potential habitat within the proposed KMC study area. Therefore, there would be no disturbance-related impacts to special status plants under this alternative.

3.9.4.5.2.2 Emissions and Deposition

Under the Renewable PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts on federally listed and other special status species under the Renewable PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.5.2.3 Groundwater Pumping

Navajo sedge is a federally listed plant having known occurrences and critical habitat within the N-Aquifer study area. Other special status plants (i.e., alcove bog orchid and alcove death camas) listed in **Table 3.9-3** have potential habitat in the N-Aquifer study area. These species are present among the hanging garden communities affiliated with seeps/springs. Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Water use would be the same under both the Renewable PFR Alternative and the Proposed Action; therefore, effects to special status plants and habitat at the seeps and springs in the N-Aquifer study area under this alternative also would be negligible. For more discussion, see Section 3.9.4.3, Proposed Action, *Proposed Kayenta Mine Complex*.

3.9.4.5.3 Transmission Systems and Communication Sites

3.9.4.5.3.1 Operations and Maintenance

Federal and other special status plants found within the WTS and STS are listed in **Table 3.9-4**. O&M activities along the WTS and STS and at the communications sites would be the same as the Proposed Action (Section 3.9.4.3). There would be negligible effects to dwarf-bear poppy, Fickeisen plains cactus, Jones cycladenia, Siler pincushion cactus, and Welsh's milkweed within the WTS and STS ROWs under the Natural Gas PFR Alternative from O&M activities based on continued implementation of BMPs. There would be negligible effects to Gierisch mallow and Holmgren milk-vetch, as well as their respective critical habitats, with implementation of conservation measures and BMPs.

3.9.4.5.4 Project Impact Summary – All Project Components

The overall effects of the Renewable PFR Alternative on special status plants would be considered negligible due to the overall effect of the various impact issues.

The Renewable PFR Alternative would result in a 3 to 11 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate 3 to 10 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to special status plants. The ecological risk to vegetation under the Renewable PFR Alternative also would be considered negligible.

O&M activities for the BM&LP Railroad and transmission systems also would result in negligible impacts to special status plants as well as Gierisch mallow and Holmgren milk-vetch critical habitat.

Groundwater pumping at the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on special status species and habitat.

3.9.4.5.5 Cumulative Impacts

The cumulative impacts of surface disturbance under the Renewable PFR would be 0 to 1 percent less than those estimated for the Proposed Action. The surface disturbance contributed by the Renewable PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 62,356 and 61,511 acres. Reclamation of Renewable PFR Alternative disturbance areas would minimize the project's contribution to cumulative special status species impacts over time.

Cumulative special status species impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to special status plants is not likely under either scenario. Although the Renewable PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for special status plants would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to special status plants as a result of groundwater pumping-related drawdown in the N-Aquifer under the Renewable PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. As discussed, groundwater modeling indicates that special status plants associated with seeps and springs that have hydraulic connection to the N-Aquifer could experience negligible to minor effects as groundwater levels decline from community pumping in future years. The modeling also indicates that the Proposed Action's contribution to groundwater level declines and associated effects to seeps and springs that support, or may support, these species would be negligible. As the water usage would be the same under both the Renewable PFR Alternative and the Proposed Action, the project's contribution to cumulative groundwater level declines under the Renewable PFR Alternative also would be negligible.

3.9.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate NEPA process once a facility

location is identified. Key assumptions about special status plants related to the construction of a new photovoltaic facility are listed below.

- Combustion emissions from firming power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS in the study area. The description of emissions calculations for the PFR is described in Chapter 2.0 and in Section 3.1, Air Quality.
- The duration of construction of a photovoltaic site would take between 1.5 and 3 years.
- The emissions caused from construction of the solar facility (fugitive dust and vehicles) could be located in the NGS study area but would be very localized and temporary.
- The construction of a photovoltaic site would be subject to subsequent evaluation through NEPA and ESA, where impacts to any special status plants would be analyzed.

3.9.4.6.1 Navajo Generating Station

3.9.4.6.1.1 Operations and Maintenance, including Surface Disturbance

Federally listed and other special status plants that have occurrences or potential habitat are listed in **Table 3.9-2**. Coal delivery under the Proposed Action would range between 5.5 million tpy and 8.1 million tpy. Under the Renewable PFR Alternative, less coal would be handled and transported on the BM&LP Railroad because less power would be generated. **Table 3.0-6** shows the difference in annual coal production and use. The reductions in coal use would be between 2 and 7 percent annually under the Tribal PFR Alternative. Overall, impacts to special status plants as a result of surface disturbance and O&M activities under this alternative would be similar to the Proposed Action and, therefore, would be negligible.

3.9.4.6.1.2 Emissions and Deposition

COPECs, specifically selenium, arsenic and mercury for the Tribal PFR Alternative NGS stack emissions would be reduced relative to the Proposed Action as presented in **Table 3.9-7**.

Table 3.9-7 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Tribal PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Tribal PFR 100-MW Power Reduction (tpy / %change)	Tribal PFR 250-MW Power Reduction (tpy / %change)
Selenium	3-Unit	2.237	2.174 / -3%	2.153 / -4%
Selenium	2-Unit	1.491	1.447 / -3%	1.383 / -8%
Mercury (total)	3-Unit	0.117	0.114 / -3%	0.111 / -5%
Mercury (total)	2-Unit	0.078	0.076 / -3%	0.072 / -8%
Arsenic	3-Unit	0.133	0.130 / -2%	0.128 / -4%
Arsenic	2-Unit	0.089	0.087 / -3%	0.084 / -6%

The 3-Unit Operation and 2-Unit Operation 100-MW and 250-MW Tribal PFR Alternative operations would result in approximately 2 to 8 percent less selenium, arsenic, and mercury than the Proposed Action. Based on modeling for the Proposed Action, maximum deposition from the NGS stacks combined with background soil concentrations would be below U.S. Environmental Protection Agency ERA screening levels since HQ values were less than 1.

Federally listed and other special status plants that have known occurrences or potential habitat within the NGS Near-field Area are listed in **Table 3.9-2**. The emission/deposition-related impacts on these species under the Tribal PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.6.2 Proposed Kayenta Mine Complex

3.9.4.6.2.1 Operations and Reclamation

There are no special status plants that have known occurrences or potential habitat within the proposed KMC. Therefore, there would be no impacts to special status plants as a result of surface disturbance from construction and mining operations.

3.9.4.6.2.2 Emissions and Deposition

Under the Tribal PFR Alternative, less coal would be produced than under the Proposed Action, resulting in a reduction in mining-related emissions deposition. However, the emission/deposition-related impacts on federally listed and other special status species under the Tribal PFR Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.6.2.3 Groundwater Pumping

Navajo sedge is a federally listed plant having known occurrences and critical habitat within the N-Aquifer study area. Other special status plants (i.e., alcove bog orchid and alcove death camas) listed in **Table 3.9-3** have potential habitat in the N-Aquifer study area. These species are present among the hanging garden communities affiliated with seeps/springs. Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. Water use would be the same under both the Tribal PFR Alternative and the Proposed Action; therefore, effects to special status plants and habitat at the seeps and springs in the N-Aquifer study area under this alternative also would be negligible. For more discussion, see Section 3.9.4.3.2, *Proposed Kayenta Mine Complex*.

3.9.4.6.3 Transmission Systems and Communication Sites

3.9.4.6.3.1 Operations and Maintenance

Federal and other special status plants found within the WTS and STS are listed in **Table 3.9-4**. O&M activities along the WTS and STS and at the communications sites would be the same as the Proposed Action (Section 3.9.4.3). There would be negligible effects to dwarf-bear poppy, Fickeisen plains cactus, Jones cycladenia, Siler pincushion cactus, and Welsh's milkweed within the WTS and STS ROWs under the Natural Gas PFR Alternative from O&M activities based on continued implementation of BMPs. There would be negligible effects to Gierisch mallow and Holmgren milk-vetch, as well as their respective critical habitats, with implementation of conservation measures and BMPs.

Additional disturbance could occur related to connecting a new photovoltaic generation site on tribal land to the existing transmission system and would be evaluated in a subsequent NEPA action and ESA compliance. The exact acres of disturbance are unknown at this time.

3.9.4.6.4 Project Impact Summary – All Project Components

The overall impact of the Tribal PFR Alternative on special status vegetation is expected to be negligible due to the overall effect of the various impact issues.

The Tribal PFR Alternative would result in a 2 to 8 percent power reduction at NGS compared to the Proposed Action, and reductions in coal production at the proposed KMC would result in an approximate

2 to 7 percent reduction in surface disturbance. These reductions would result in lower emissions and deposition of COPECs within the study area and an anticipated slight reduction in the HQs. Based on the NGS Near-field ERA and KMC ERA evaluations, the HQs under the Proposed Action were determined to be less than 1, indicating a negligible risk to special status plants. The ecological risk to vegetation under the Tribal PFR Alternative also would be considered negligible.

O&M activities for the BM&LP Railroad and transmission systems also would result in negligible impacts to special status plants as well as Gierisch mallow and Holmgren milk-vetch critical habitat.

Groundwater pumping at the proposed KMC would result in small baseflow reductions to seeps and springs, representing negligible effects on special status species and habitat.

3.9.4.6.5 Cumulative Impacts

The cumulative impacts of surface disturbance under the Tribal PFR Alternative would be 1 to 5 percent higher than those estimated for the Proposed Action. The surface disturbance contributed by the Tribal PFR Alternative, past and present actions, and foreseeable future actions is estimated to be between 65,408 to 62,853 acres. Reclamation of Tribal PFR Alternative disturbance areas would minimize the project's contribution to cumulative special status species impacts over time.

Cumulative special status species impacts resulting from past and present emissions and deposition in the cumulative effects study area are reflected in the NGS Near-field ERA and KCM ERA baseline COPECs analyses. The ERAs also evaluated future ecological risk from ongoing emissions and deposition. Based on the ERA results for the Proposed Action, the HQs for both baseline and future conditions indicate an ecological risk below 1, indicating that ecological risk to special status plants is not likely under either scenario. Although the Tribal PFR Alternative would result in a slight reduction in emissions deposition, the project's contribution to cumulative ecological risk for special status plants would be considered negligible and would cease following completion of operations in 2044.

Cumulative impacts to special status plants as a result of groundwater pumping-related drawdown in the N-Aquifer under the Tribal PFR Alternative would be the same as discussed in the Proposed Action cumulative impacts sections. As discussed, groundwater modeling indicates that special status plants associated with seeps and springs that have hydraulic connection to the N-Aquifer could experience negligible to minor effects as groundwater levels decline from community pumping in future years. The modeling also indicates that the Proposed Action's contribution to groundwater level declines and associated effects to seeps and springs that support, or may support, these species would be negligible. As the water usage would be the same under both the Tribal PFR Alternative and the Proposed Action, the project's contribution to cumulative groundwater level declines under the Tribal PFR Alternative also would be negligible.

3.9.4.7 No Action

3.9.4.7.1 Navajo Generating Station

3.9.4.7.1.1 Operations and Maintenance, including Surface Disturbance

NGS and some associated facilities (including the BM&LP Railroad) would be decommissioned and reclaimed after 2019 as described in the NGS Operations and Maintenance Plan (**Appendix 1B**) and Chapter 2.0.

Under the No Action Alternative, activities affiliated with NGS would end 25 years before activities under the Proposed Action, and reclamation would take place sooner. This would result in earlier establishment of native vegetative communities that may support special status plants and a temporal decrease in the likelihood of noxious and invasive weeds affecting special status plants.

3.9.4.7.1.2 Emissions and Deposition

The cessation of NGS emissions 25 years earlier than under the Proposed Action would reduce the total NGS-related contribution to COPEC deposition in the NGS Near-field ERA study area. However, the emission/deposition-related impacts to federally listed and other special status species under the No Action Alternative and the Proposed Action would be similar because the Proposed Action ERA analysis indicates HQ numbers less than 1, indicating negligible risk.

3.9.4.7.2 Proposed Kayenta Mine Complex

3.9.4.7.2.1 Operations and Reclamation

Under the No Action Alternative, no mining would occur in the proposed KMC coal resource areas after 2019. However, there are no special status plants that have known occurrences or potential habitat within the proposed KMC and, therefore, no related impacts.

3.9.4.7.2.2 Groundwater Pumping

Federal and other special status plants found within the N-Aquifer study area are listed in **Table 3.9-3**. Under the No Action Alternative, water would continue to be pumped from groundwater wells for dust control and assistance with reclamation activities at the rate of approximately 500 acre-feet per year from 2020 through 2022. Groundwater withdrawals would continue at a rate of approximately 100 acre-feet per year from 2023 through 2032. This minimal groundwater use is anticipated to have negligible effect on special status vegetation resources.

3.9.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.9.4.7.3.1 Operations and Maintenance

Federal and other special status plants found within the WTS and STS are listed in **Table 3.9-4.** Impacts on special status plant species as a result of O&M operations along the WTS and STS and at the communications sites through 2019 would be the same as under the Proposed Action and, therefore, would be negligible.

3.9.4.7.4 No Action Impact Summary – All Project Components

The overall effects of the No Action Alternative on special status plants are expected to be negligible. There would be a potential overall temporal decrease in impacts as operations and reclamation would be completed 25 years earlier than under the Proposed Action.

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Section 3.10

Terrestrial Wildlife Resources

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
AGFD	Arizona Game and Fish Department
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
MOU	Memorandum of Understanding
MBTA	Migratory Bird Treaty Act
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
OSMRE	Office of Surface Mining Reclamation and Enforcement
PFR	Partial Federal Replacement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less

$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
tpy	tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WTS	Western Transmission System

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3.10 Terrestrial Wildlife Resources

3.10.1 Regulatory Framework

Statutes, regulations, and policies that directly influence wildlife management decisions for the project primarily are implemented by the U.S. Fish and Wildlife Service (USFWS), Navajo Nation, Hopi Tribe, Bureau of Land Management (BLM), U.S. Forest Service, Arizona Game and Fish Department (AGFD), Utah Division of Wildlife Resources, Office of Surface Mining Reclamation and Enforcement (OSMRE), and Nevada Department of Wildlife. Prominent laws, regulations, directives, and agreements relevant to the proposed project are included in **Table 3.10-1**.

Table 3.10-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
Arizona Revised Statutes Title 17	The State of Arizona's Title 17 – Game and Fish Revised Statutes establish policies and programs for the management, preservation, and harvest of wildlife including aquatic species. Policies directed at managing and conserving aquatic species including invasive species programs and lists, funding/fiscal provisions, rules regarding taking and handling wildlife, and other prohibitions
National Park Service Statutes, Regulations and Policies	National Park Service Organic Act of 1916 (now 54 USC 100101 et. seq.). Glen Canyon National Recreation Area Enabling Legislation (Public Law 92-593). National Park Service Management Policies, Section 4.4 (2006) Glen Canyon National Recreation Area General Management Plan.
BLM Resource Management Plans	The Arizona Strip Field Office, Safford District, Bradshaw-Harquahala, Kanab Field Office, Las Vegas and Pahrump Field Office, Ely District, Phoenix, and the St. George Resource Management Plans specify regulations and goals for management of BLM-administered lands and set restrictions to protect fish and wildlife and the habitats on which they depend.
U.S. Forest Service Land and Resource Management Plans	The Coconino and Tonto National Forest Land and Resource Management Plans identify goals for forest health and constraints on resource uses to meet these goals. Land and Resource Management Plans also identify project restrictions to protect fish and wildlife and management indicator species for each forest.
Navajo Nation Title 17 and 23[1]	The Navajo Nation's Title 17 (Subchapter 21) and 23 classifies terrestrial wildlife species as big game animals, waterfowl, small game animals fur-bearing animals, game birds, raptors, invasive species, and endangered species. These criminal and civil codes also established regulations on unlawful take of these species. This title includes additional species specific regulations such as the Golden and Bald Eagle Protection Regulations and Raptor Electrocution Prevention Regulations.
Navajo Nation Biological Resource Land Use Clearance Policies and Procedures, RCS-44-08[1]	The purpose of the Navajo Nation Biological Resource Land Use Clearance Policies and Procedures is to assist the Navajo Nation government and chapters ensure compliance with federal and Navajo laws which protect, wildlife resources, including plants, and their habitat resulting in an expedited land use clearance process. The Navajo Nation Biological Resource Land Use Clearance Policies and Procedures assists in directing development to areas where impacts to wildlife and/or their habitat will be less significant. Development includes but is not limited to human activities that result in permanent structures, temporary, long-term, or repetitive disturbance to wildlife or habitat as defined by Navajo Nation Code 17 NNC 500 et. Seq.
Utah Code 23-14-1, 23-16, 23-20-3 , and Administrative Rules R657-3, R657-5, R657-6, R657-9, R657-10, R657-11 , R657-19, R657-33, R657-33-3, R657-53, and	Section 23-14-1 of the Utah State Code directs the Utah Division of Wildlife Resources to protect, propagate, manage, conserve, and distribute protected wildlife throughout the state. This statute also authorizes Utah Division of Wildlife Resources to identify and delineate crucial seasonal wildlife habitats. Section 23-20-3 establishes penalties for taking, transporting, selling, or purchasing protected wildlife. Section 23-16 establishes regulations for big game animals.

Table 3.10-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
R657-54	Utah Administrative Rule R657-3 establishes regulations for collection, transportation and possession of animalsR657-5 and R657-6 establish regulations for taking of big game and upland game. R657-9, R657-10, and R657-11 establish regulations for taking waterfowl, common snipe and coot, taking cougar, and taking furbearers. R657-19 establishes regulations for taking nongame animals. R657-33 established regulations for taking bear. R657-53 establishes rules for amphibian and reptile collection, importation, transportation, and possession.R657-54 establishes regulations for taking wild turkey.
Nevada Revised Statutes Title 45 – Wildlife Chapter 501	Nevada Revised Statutes provide definitions for: big game mammals (501.005), fur-bearing mammals (501.35), game mammals, migratory game birds (501.055), and upland game birds (501.95) and classifications for wildlife (501.110) including wild mammals, wild birds, reptiles, and protected wildlife.
BLM Manual 6500	The BLM Manual 6500 declares that it is the BLM policy to manage habitat with emphasis on ecosystems to ensure self-sustaining populations and a natural abundance and diversity of wildlife, fish, and plant resources on public lands. The Manual further states that to carry out the above policy, the BLM will do inventory, planning, research, monitoring, and maintenance; will communicate, cooperate, and automate; and will hire professional staff.
Migratory Bird Treaty Act (MBTA) (16 United States Code [USC] 703 et seq.)	The MBTA, originally passed in 1918, implements the U.S. commitment to four bilateral treaties [with Canada, Mexico, Japan, and Russia], or conventions, for the protection of a shared migratory bird resource (16 USC 703-712). The MBTA applies only to migratory bird species that are native to the U.S. or its territories. A native migratory bird is defined as one that is present as a result of natural biological or ecological processes. Excluded are species whose presence in the U.S. is solely the result of intentional or unintentional human-assisted introductions. The list of migratory bird species protected by the MBTA appears in 50 Code of Federal Regulations 10.13. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. “Take” is defined in regulations as: “pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt.” Nongame species that are excluded from protection under the MBTA include the rock pigeon, Eurasian collared-dove, European starling, and house sparrow. For all other native migratory bird species, the MBTA includes, but is not limited to, the following protections: • A total of 1,007 species of migratory birds and their parts, including eggs, feathers, and nests, are protected. • Proof of intent to violate the MBTA is not required for prosecution. • The MBTA has no consultation process such as Section 7 consultation under the Endangered Species Act. The MBTA does not permit incidental or unintentional take, such as that provided by Sections 7 and 10 of the Endangered Species Act.
Bald and Golden Eagle Protection Act (16 USC 668 et seq.)	The Bald and Golden Eagle Protection Act (16 USC 668-668c), enacted in 1940 and amended several times since enactment, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that

Table 3.10-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
	interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment (USFWS 2016). Eagle breeding activities and nesting locations are afforded legal protection under the act.
Executive Order 13186 (66 Federal Register 3853)	Executive Order 13186 directs federal agencies that take actions that either directly or indirectly effect on migratory birds to develop a Memorandum of Understanding (MOU), and to work with the USFWS, and other federal agencies to promote the conservation of migratory bird populations. So far, nine agencies have completed a MOU with the USFWS under the Executive Order, and several other MOUs are in progress.
BLM MOU WO-230-2010-04	In accordance with Executive Order 13186, this MOU outlines a collaborative approach to promote the conservation of migratory bird populations. The MOU is intended to strengthen migratory bird conservation efforts by identifying and implementing strategies to promote conservation and reduce or eliminate adverse impacts on migratory birds through enhanced collaboration between the BLM and the USFWS, in coordination with State, tribal, and local governments. The MOU also identifies migratory bird conservation as a significant part of the BLM National Environmental Policy Act and planning process. Strategic planning for migratory bird conservation is a key element to the MOU implementations.
U.S. Forest Service Agreement # 08-MU-1113-2400-264	In accordance with Executive Order 13186, this MOU outlines a collaborative approach between the U.S. Forest Service and USFWS to promote the conservation and reduce the take of migratory birds. The Executive Order directs agencies to take certain actions to further comply with the migratory bird conventions, the MBTA, the Bald and Golden Eagle Protection Act, and other pertinent statutes. The purpose of this MOU is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds through enhanced collaboration between the Parties, in coordination with State, Tribal, and local governments. This MOU identifies specific activities where cooperation between Parties will contribute to the conservation of migratory birds and their habitats. These activities are intended to complement and support existing, and facilitate new, collaborative migratory bird conservation partnerships and comprehensive planning efforts for migratory birds.
Avian Power Line Interaction Committee (APLIC) Guidance	APLIC was formed in 1989 to address whooping crane collisions with power lines. Since its inception, the organization has expanded to address a variety of avian/power line interactions including electrocutions, collisions, and nests. APLIC was originally comprised of 10 utilities, the Edison Electric Institute, the USFWS, and the National Audubon Society. The membership now includes over 50 utilities, the Edison Electric Institute, the USFWS, the Electric Power Research Institute, the National Rural Electrical Cooperative Association, and the Rural Utilities Service. APLIC has developed guidance documents identifying causes and minimization methods for avian electrocutions and collisions and released national Avian Protection Plan Guidelines in conjunction with the USFWS in 2005 (APLIC 2016). APLIC also published *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* and *Reducing Avian Collisions with Power Lines*: The State of the Art in 2012.
Navajo Nation Department of Fish and Wildlife Raptor Electrocution Prevention Regulations	It is the Navajo Nation Policy to have electrical power companies reduce the likelihood of electrocution of raptors on the Navajo Nation by enforcing raptor-safe power pole design standards for new power line constructions within Raptor Sensitive Areas to protect Golden Eagles, Bald Eagles and Ferruginous Hawks. These regulations apply to projects involving repairs or upgrades to existing power lines within Raptor Sensitive Areas, by requiring raptor-safe power pole designs when poles are replaced, and retrofitting of existing power poles on a case-by-case basis, with techniques to minimize the risk of raptor electrocution. The Department of

Table 3.10-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
	Fish and Wildlife has identified Raptor Sensitive Areas for these regulations from its knowledge of raptor breeding areas and wintering concentrations. Breeding Area R.S.A.s are depicted as circular areas, centered on nests, that are equal to the average home range size for that species. Breeding Area R.S.A.s are depicted for Golden Eagles (*Aquila chrysaeots*), Bald Eagles (*Haliaeetus leucocephalus*) and Ferruginous Hawks (*Buteo regalis*) because these are native breeding species of the Navajo Nation, susceptible to electrocution, and are listed as "endangered" on the Navajo Endangered Species List. Wintering Concentration R.S.A.s are depicted by the outline of areas known to harbor aggregations of raptors during the winter.

[1] Applies to the Proposed KMC. Pursuant to the Lease Amendment No. 1(or a leasing agreement with the Navajo Nation having similar terms as the 1969 Lease and Lease Amendment No. 1), the Nation does not intend to regulate the NGS lease area.

MBTA = Migratory Bird Treaty Act.

MOU = Memorandum of Understanding.

USC = United States Code.

3.10.2 Study Areas

3.10.2.1 Proposed Action and Action Alternatives

As described in Chapter 1.0, there are three main components of the Navajo Generating Station (NGS) and the proposed Kayenta Mine Complex (KMC) Project: the NGS and associated facilities, the proposed KMC, and the transmission systems and communication sites. To facilitate description of the affected environment and analysis of project effects, a total of nine different study areas divided among the three project components have been identified. Refer to Section 3.0 for a more detailed description of these study areas as they pertain to the Ecological Risk Assessments (ERAs). The project components and their associated study areas are listed below and described in detail in subsequent sections:

Navajo Generating Station:

- NGS Near-field Study Area;
- Northeast Gap Region Study Area;
- Southwest Gap Region Study Area;
- San Juan River Study Area; and
- Black Mesa & Lake Powell (BM&LP) Railroad Study Area.

Proposed KMC:

- Proposed KMC Study Area; and
- N-Aquifer Study Area.

Transmission Systems:

- WTS (Western Transmission System) Study Area; and
- STS (Southern Transmission System) Study Area.

3.10.2.2 Cumulative

For terrestrial wildlife resources, the cumulative effects study areas are the same as those described for the Proposed Action and its alternatives. The cumulative effects analysis includes an assessment of total project affects across all study areas plus the effects of other past, present, and reasonably foreseeable actions affecting terrestrial wildlife species within these areas. It should be noted that the actions assessed as part of the cumulative effects analysis may be caused by activities located outside of the study areas listed above (e.g., mercury emissions associated with sources outside of the U.S.). However, to the extent that the effects of these actions combine with project-related effects to terrestrial wildlife within the nine NGS-KMC study areas, they are assessed as cumulative effects.

3.10.2.3 Ecological Risk Assessment – Role in Assessing Baseline Risk and Environmental Consequences

As detailed in Section 3.0, in order to evaluate total future risks associated with emissions from the NGS, the proposed KMC, plus other cumulative sources, it is necessary to consider the level of risk from chemicals currently present in the environment (baseline). Baseline conditions capture naturally occurring chemicals, past emission and deposition from the NGS, and past deposition from other local, regional, and global sources. Four ERAs were performed to evaluate environmental conditions in the vicinity of the NGS and the proposed KMC. The NGS Near-field ERA evaluated the potential risk to terrestrial ecological receptors based on concentrations of future NGS emission chemicals in soil, sediment, and surface water within a defined deposition area around NGS. The NGS Gap Regions ERA evaluated potential risks of future operations of NGS to terrestrial ecological receptors in the riparian corridor of the Colorado River above and below Lake Powell. The NGS San Juan River ERA evaluated potential risk from NGS stack emissions on aquatic oriented wildlife within the San Juan River watershed based on sediment, surface water, and fish tissue concentrations. The KMC ERA evaluated potential risk to special status wildlife species resulting from baseline conditions, proposed future mine operations, NGS emissions, and other cumulative sources of chemicals of potential ecological concern (COPECs) within the proposed KMC. The determination of the study areas are summarized in Section 3.0.2, Ecological and Human Health Risk Assessments, and discussed in detail in **Appendix 3RA**.

Exposure of terrestrial receptors (terrestrial invertebrates, mammals, and birds) was considered for the terrestrial habitat within the study area of each ERA. The exposure pathway evaluated for terrestrial invertebrates included direct contact with COPECs in surface soil. The potential exposure of avian and mammalian receptors to COPECs in surface soil and food items was evaluated by modeling the ingestion of prey items (i.e., terrestrial invertebrates and small mammals), terrestrial plants, inadvertent ingestion of soil, and drinking (surface) water. Data used to characterize baseline conditions for the ERA study areas associated with NGS included a combination of data available in regionally relevant literature and from field sampling.

For each of the ERAs, identification of receptors initially relies on the identification of functional groups or feeding “guilds” that are representative of, or essential to, habitat function. These receptors are representative of entire classes of organisms (i.e., functional groups). Selection criteria for receptors include sensitivity, exposure potential, and expected presence in the study area, ecological relevance, trophic level, feeding habits, and the availability of life history information. Based on the ecological conceptual site models for each ERA study area, both terrestrial receptors (that obtain all food resources from terrestrial sources) and aquatic-oriented receptors (that obtain all or a portion of food resources from aquatic habitats) were evaluated. The representative terrestrial wildlife receptors evaluated included:

- **Terrestrial wildlife receptors:** These receptors were evaluated for exposure to soil, terrestrial food and drinking water and included the terrestrial invertebrate community, and red-tailed hawk (*Buteo jamaicensis*), mourning dove (*Zenaida macroura*), American robin (*Turdus migratorius*),

meadow vole (*Microtus pennsylvanicus*), dusky shrew (*Sorex monticolus*),and red fox (*Vulpes vulpes*). Special status terrestrial species evaluated are discussed further in Section 3.11.

- **Aquatic-oriented receptors:** These receptors were evaluated for exposure to sediment, aquatic food, and drinking water and included canvasback duck (*Aythya valisineria*), mallard duck (*Anas platyrhynchos*), muskrat (*Ondatra zibethicus*), little brown bat (*Myotis lucifugus*) and raccoon (*Procyon lotor*). Special status aquatic species evaluated are discussed further in Section 3.13.

Representative species were evaluated for exposure to COPECs identified for each specific risk assessment. For terrestrial wildlife, the hazard quotient (HQ) was based on food web modeling of dietary intake (i.e., exposure estimate based on intake of food and surface water and incidental soil ingestion) and comparison to chemical-specific toxicity values. Information regarding how HQs were calculated and interpretation of the HQ is summarized in Section 3.0.2, Ecological and Human Health Risk Assessments, and is detailed in **Appendix 3RA**. A refined HQ greater than or equal to 1 indicates that there is a potential for adverse effects and other lines of information are used to further evaluate risk.

3.10.2.3.1 NGS Near-field ERA

The deposition area for the Near-field ERA was the 20-kilometer (km) radius from NGS. In the screening level terrestrial food web, terrestrial wildlife receptors (carnivores, insectivores, and herbivores) were assumed to be continually exposed to the maximum baseline soil and surface (drinking) water concentrations. The screening step assumed that receptors feed exclusively within the portion of Lake Powell and the Colorado River within the 20-km NGS Near-field ERA study area. This represents a conservative assumption for those receptors with larger home ranges or those receptors that are known to be only seasonally present within the study area. Also in the screening step, the dietary dose using the food web model is based on maximum COPEC concentrations that are then compared to a no-observed-effect level toxicity value (versus a lowest-observed-effect level) to estimate risk. Use of the no-observed-effect level ensured the highly conservative requirement of the screening step.

3.10.2.3.2 Gap Regions ERA

The study area for the NGS Gap Region ERA includes the Colorado River upstream and downstream of Lake Powell that were not captured in the NGS Near-field or San Juan River ERAs in order to ascertain whether NGS emissions could potentially impact sensitive species directly adjacent to the defined NGS Near-Field Study Area. The determination of the study area and the effects of metals on terrestrial wildlife species are discussed in Section 3.0.2, Ecological and Human Health Risk Assessments. The two Gap Regions that are outside of the 20-km NGS Near-field study area are defined as follows:

- **Southwest Gap Region**: This area includes the lower Colorado River beyond the 20-km NGS Near-field ERA study area below Lees Ferry downstream to the confluence of the Colorado and Little Colorado rivers, approximately 100 km downstream of the Glen Canyon Dam. This reach of river was selected to assure the study area captured humpback chub habitat.
- **Northeast Gap Region**: This area includes the portion of Lake Powell beyond the 20-km NGS Near-field ERA study area and the Colorado River northeast of Lake Powell upstream to the confluence of the Colorado and Green rivers, approximately 274 km upstream of the Glen Canyon Dam.

Based on these study areas, the Gap Regions ERA focused on evaluating impacts to aquatic-oriented receptors only from exposure to key COPECs (i.e., arsenic, mercury, and selenium). The data used to characterize baseline conditions in the Gap Regions was based on available data in the literature for COPECs and existing data developed during the development of the Near-field ERA. Representative terrestrial wildlife species selected for evaluation in the food web model included the bald eagle *(Haliaeetus leucocephalus)*, muskrat, raccoon, little brown bat, mallard duck, and canvasback duck. Special status terrestrial wildlife species analyzed are discussed in Section 3.11.

3.10.2.3.3 San Juan River ERA

The San Juan River ERA study area encompasses the San Juan River from the State Route 371 bridge in Farmington, New Mexico, downstream to the San Juan arm of Lake Powell. The NGS San Juan River ERA evaluated the potential risk to ecological receptors primarily based on data compiled from the literature, input from Reclamation and USFWS, and the results of the NGS Near-field ERA, Gap Region ERA, and the Electric Power Research Institute San Juan River Study (Electric Power Research Institute 2016) to establish baseline conditions. Evaluation of wildlife risk in the San Juan River was focused to evaluation of key COPECs (arsenic, mercury, and selenium).

Similar to the Gap Regions ERA, the San Juan River ERA focused on evaluating potential risk to aquatic-oriented receptors only. Special status terrestrial wildlife species analyzed are discussed in Section 3.11.

3.10.2.3.4 KMC ERA

The KMC ERA was prepared for the proposed KMC to evaluate the potential for adverse effects to ecological receptors from exposure to chemical contaminants dispersed primarily from fugitive dust associated directly and indirectly with mining activities. The proposed KMC ERA Study Area was based on consideration of the Lease Area boundaries (i.e., the areas leased from the Navajo Nation and Hopi Tribes, as shown in **Figure 1-1**), the influence of mining activities, and the presence and locations of special status species (i.e., Mexican Spotted owl and Navajo Sedge).

3.10.3 Affected Environment

3.10.3.1 Region-wide Terrestrial Wildlife

As detailed under Section 3.8, Vegetation, the project is located within the Colorado Plateau physiographic region. Major biotic communities include Great Basin Conifer woodland, a dwarf woodland dominated by pinyon and juniper trees; Great Basin Desert scrub, dominated by a variety of arid land shrubs; Plains and Great Basin grasslands, dominated by a mixture of perennial grasses and low shrubs; Riparian communities dominated by riparian woodlands and shrublands; and Colorado Plateau Mixed Bedrock Canyon and Tableland (**Table 3.8-3**). These biotic communities represent the habitats for terrestrial wildlife species potentially occurring in the region. A variety of wildlife species are associated with these habitats, with greater species diversity occurring in areas exhibiting greater vegetation structure, soil moisture, and open water such as wetlands and riparian areas. Throughout the region, aquatic systems and associated riparian areas play a major role in maintaining biodiversity. Riparian communities provide migratory birds and pollinating insects and bats with vital travel corridors for their migrations between North and South America (AGFD 2012).

Terrestrial wildlife (i.e., big game species, small game species, nongame species, and migratory birds) baseline discussions include descriptions of both resident and migratory species that may occur within the region based on habitat associations. Amphibians and fish are addressed in Section 3.12, Aquatic Biological Resources.

3.10.3.1.1 Big Game Species

Big game species that occur within the region include pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus canadensis*), desert bighorn sheep (*Ovis canadensis nelson*), javelina (*Tayassu tajacu*), and carnivores including black bear (*Ursus americanus*) and mountain lion (*Puma concolor*) (AGFD 2015a; Nevada Department of Wildlife 2015). Occurrence of these big game species by project component is presented in **Table 3.10-2**.

Table 3.10-2 Big Game Species Presence for the Project Components

Species	NGS [1]	Proposed KMC	N-Aquifer Area	WTS	STS
Pronghorn	X		X	X	X
Mule Deer	X	X	X	X	X
White-tailed Deer		X	X		X
Elk	X	X	X		X
Desert Bighorn Sheep	X			X	
Javelina					X
Black Bear	X			X	X
Mountain Lion	X	X	X	X	X

[1] Includes the NGS Near-field (20-km) study area and the BM&LP Railroad.

N-Aquifer = Navajo Aquifer.

NGS = Navajo Generating Station.

WTS = Western Transmission System.

STS = Southern Transmission System.

Source: AGFD 2015a-h; BLM 2000, 2008a,b; Ecosystem Management, Inc. 2015; OSMRE 2011; Reclamation 2002.

3.10.3.1.1.1 Pronghorn

Pronghorn inhabit grassland, desert shrubland, and sagebrush shrubland in flat to rolling topography and browse on grass, forbs, and shrubs, especially sagebrush, throughout the year. In pronghorn habitat, understory vegetation provides cover for fawning. For example, where they occur, pronghorn typically benefit from habitat with grasses and shrubs greater than 11 inches in height to provide fawns protection from predators during the fawning season; however, this habitat is dependent in large part on weather (e.g., winter snow fall and spring precipitation) (U.S. Forest Service 2014). Fawning typically occurs from May through mid-June. During the winter, pronghorn generally utilize areas of relatively high sagebrush densities and overall low snow accumulations on south- and west-facing slopes. Pronghorn also are considered a Navajo Endangered Species (Mikesic and Roth 2008) and a Management Indicator Species for the Kaibab National Forest. According to the Navajo Nation Department of Fish and Wildlife, occupied habitat is located within the vicinity of Cameron Mountain and Gray Mountain, which are located in close proximity to the southern transmission line system (Smith and Hazelton 2014). Additionally, occupied habitat occurs on the lands managed by the Arizona Strip Field Office crossed by the WTS and crucial year-long habitat is crossed by the WTS on lands managed by the Kanab Field Office in Utah (BLM 2008a). The STS crosses portions of designated Pronghorn Movement Corridors and Fawning Habitat Wildlife Habitat Areas on lands managed by the BLM within the Agua Fria National Monument (BLM 2010).

3.10.3.1.1.2 Mule Deer

The most numerous, widespread, and popular of the big-game animals are deer, with the most abundant in the region being mule deer (AGFD 2015b). Mule deer occupy a variety of habitats from sparse, low deserts to high forested mountains and have a preference for the more rugged country (AGFD 2015b). Although their diet varies somewhat by season, mule deer primarily are browsers, feeding on a wide variety of woody vegetation including shoots, leaves, and twigs of shrubs and trees. Like pronghorn, winter habitat for mule deer occurs in areas of relatively high sagebrush densities and overall low snow accumulation on south- and west-facing slopes. Crucial winter range is crossed by the WTS on lands managed by the BLM Arizona Strip Field Office within the Buckskin Mountains east of Fredonia (BLM 2008b).

3.10.3.1.1.3 White-tailed Deer

White-tailed deer are less common than mule deer in the region but do occur within oak-grasslands, chaparral, and pine forests of central and southeastern Arizona (AGFD 2015c; NatureServe 2015). Within the region, white-tailed deer feed on a variety of vegetation including weeds, shrubs, mast, grass, mistletoe, and cacti fruits in season (AGFD 2015c). This species has been observed within the proposed KMC (Ecosystem Management, Inc. 2015) and has the potential to occur within the N-Aquifer area and along the STS (**Table 3.10-2**).

3.10.3.1.1.4 Elk

Elk may occur within the region in Arizona along all of the project components with the exception of the WTS (**Table 3.10-2**). Elk populations in Arizona are a result of transplanted animals from Yellowstone National Park between 1912 and 1967 (AGFD 2015d). As a result, the Arizona elk population has grown to nearly 35,000 animals. Elk typically are found in forested habitats, specifically fir-aspen and pine-juniper forests. Summer elk range varies from elevations of 7,000 feet in the mixed conifers to 10,000 feet and greater in the spruce fir-sub-alpine belt. Elk populations typically occur within 0.5 mile of water (AGFD 2015d). Elk prefer the summer range, moving to high elevations early and staying until forced down by snow depth (AGFD 2015d). Like other big game species in the region, winter range often is the limiting factor for elk herds as only about 10 percent of their total habitat is winter range. Winter range varies from 5,500 to 6,500 feet in Arizona in the pinyon-juniper zone (AGFD 2015d). Elk feed on a variety of vegetation with food preference including weeds, grasses, sedges, shrubs, willow, and trees in season (AGFD 2015d).

3.10.3.1.1.5 Desert Bighorn Sheep

Desert bighorn sheep occur within the region in Arizona, Utah, and Nevada (AGFD 2015e; Nevada Department of Wildlife 2001; Utah Division of Wildlife Resources 2008).This species is found in desert shrubland and barren/sparsely vegetated habitats and is most common in steep, rocky terrain with abundant grass and browse (Nevada Department of Wildlife 2001; Utah Division of Wildlife Resources 2008). Water sources often are limited in desert bighorn sheep habitat; therefore, this species may occupy habitats near streams, springs, and man-made water sources (i.e., guzzlers) during the summer months (Nevada Department of Wildlife 2001). The diet of the desert bighorn sheep is similar to that of the Rocky Mountain bighorn sheep and primarily consists of grasses, shrubs, and forbs (Nevada Department of Wildlife 2001; Utah Division of Wildlife Resources 2008). Due to the geographic range of the desert bighorn sheep, use of seasonal habitats primarily is determined by water and forage availability rather than weather patterns and snow depth (Utah Division of Wildlife Resources 2008). The desert bighorn sheep also is considered a Navajo Endangered Species (Mikesic and Roth 2008) and BLM sensitive in Nevada. Known occurrence of this species within the region includes the San Juan River in Utah, rare sightings in Marble Canyon along the Colorado River (U.S. Bureau of Reclamation [Reclamation] 2002), and along Kanab Creek and Paria Canyon crossed by the WTS.

3.10.3.1.1.6 Javelina

Javelina, also known as the collared peccary, is considered a big game species that occurs within central and southeastern portions of the region in Arizona. This species occupies a wide variety of habitats including desert, chaparral, and oak-grasslands and are considered opportunistic feeders eating flowers, fruits, nuts, berries, bulbs, and most succulent plants. Prickly pear cactus makes up the major portion of their diet (AGFD 2015f).

3.10.3.1.1.7 Carnivores

Black bear and mountain lions are classified as big game carnivore species in Arizona and Nevada. In Utah, black bear and mountain lions are managed under the furbearer program, which provides certain protections. The distribution for both of these species is dependent on existing and ongoing disturbance and available food sources. Within the region, the black bear is found in most woodland habitats,

including pinyon-juniper, oak woodland, coniferous forest, and chaparral (AGFD 2012). Black bears are omnivores, with vegetation (e.g., roots, grass, cactus fruits, and berries) making up the majority of their diet. A small percentage of their diet includes insects, fish, small mammals, reptiles, and amphibians (AGFD 2015g; Utah Division of Wildlife Resources 2010). Mountain lions occupy a variety of habitats within the region. Mountain lions are strongly tied to the distribution of deer, their major prey species (AGFD 2015h).

3.10.3.1.2 Small Game Species

Small game species that occur within the wildlife study area include upland game birds, small mammals, furbearers, and waterfowl. Potential habitat for small game species (except waterfowl) within the region includes all of the vegetative communities present. Potential habitat for waterfowl includes herbaceous wetland, open water, riparian, and woody riparian and wetlands vegetation communities.

3.10.3.1.2.1 Upland Game Birds

Upland game bird species that occur within the region include Merriam's turkey (*Meleagris gallopavo*), band-tailed pigeon (*Patagioenas fasciata*), and mourning dove. Merriam's turkeys are found throughout the western U.S. and primarily within the ponderosa pine forests and oak-brush habitats within the region. They also may be found in riparian and agricultural areas with suitable trees for roosting (AGFD 2015i; Boyle 1998; Utah Division of Wildlife Resources 2011). Band-tailed pigeons occur in Arizona and Utah in forests and mountain shrub habitats; primarily ponderosa pine and oakbrush (AGFD 2015j). The mourning dove is the most widely distributed game bird in North America (George 1988). Mourning doves are capable of traveling long distances to fulfill all of their habitat needs and occupy open prairies, brushlands, and woodlands within the Sonoran Desert (AGFD 2015k).

3.10.3.1.2.2 Small Game Mammals

Based on known ranges and habitat preferences, a variety of small game species, mammalian predators, and furbearers are likely to be present in the region because most of these species are relatively widespread and common. Small game mammals that are likely to occur within the region include desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), white-tailed jackrabbit (*Lepus townsendii*), and tree squirrels (*Sciurus* spp.) (AGFD 2015l; BLM 2014; Nevada Department of Wildlife 2015).

3.10.3.1.2.3 Furbearers

Furbearers likely to occur within the region include beaver (*Castor canadensis*), muskrat, raccoon, otter (*Lontra canadensis*), ringtail (*Bassariscus astutus*), long-tailed weasel (*Mustela frenata*), short-tailed weasel (*Mustela ermine*), mink (*Neovison vison*), American badger (*Taxidea taxus*), bobcat (*Lynx rufus*), red fox, and coyote (*Canis latrans*) (AGFD 2015m; BLM 2014; Utah Division of Wildlife Resources 2010). Typically, the distribution of furbearers within the region is determined by available food sources (e.g., small rodents, fish, insects, waste grain, and human food waste).

3.10.3.1.2.4 Waterfowl

Waterfowl species are considered game birds, and are protected under the MBTA. The region is located within the Pacific Flyway for migratory birds. Common waterfowl species that may occur within the region include Canada Geese (*Branta canadensis*), mallard, green-winged teal (*Anas crecca*), northern pintail (*Anas acuta*), bufflehead (*Bucephala albeola*), American widgeon (*Anas americana*), common merganser (*Mergus merganser*), common goldeneye (*Bucephala clangula*), and lesser scaup (*Aythya affini*) (AGFD 2015n; Floyd et al. 2007; Stokes and Stokes 1996; Reclamation 2007). These species distributions are limited to the rivers, streams, lakes, reservoirs, ponds, and wetlands found within the region.

3.10.3.1.3 Nongame Species

A diversity of nongame species (e.g., mammals, reptiles, raptors, and passerines) occupy a variety of habitat types within the wildlife analysis area. Common nongame wildlife species discussed include small mammals (e.g., bats, voles, chipmunks, gophers, woodrats, ground squirrels, and mice) and reptiles (e.g., lizards and snakes).

3.10.3.1.4 Migratory Birds

Migratory birds, including passerine and raptors species inhabit all of the vegetation communities/habitat types present throughout the region. The MBTA applies only to migratory bird species that are native to the U.S. or its territories. A native migratory bird is one that is present as a result of natural biological or ecological processes. Excluded are species whose presence in the U.S. is solely the result of intentional or unintentional human-assisted introductions. Nongame species that are excluded from protection under the MBTA include the rock pigeon, Eurasian collared-dove, European starling, and Old World sparrows including the house sparrow. On Navajo Nation lands, these species are protected under Navajo Nation Title 17 (Subchapter 21) and 23, which includes the protection of songbirds, or species of perching birds that feed entirely or chiefly on insects. Further, The Navajo Nation Department of Fish and Wildlife has identified Raptor Sensitive Areas (RSAs) for these regulations from its knowledge of raptor breeding areas and wintering concentrations. Breeding Area RSAs are depicted as circular areas, centered on nests that are equal to the average home range size for that species. Breeding Area RSAs are depicted for Golden Eagles (*Aquila chrysaeots*), Bald Eagles (*Haliaeetus leucocephalus*) and Ferruginous Hawks (*Buteo regalis*) because these are native breeding species of the Navajo Nation, susceptible to electrocution, and are listed as “endangered” on the Navajo Endangered Species List (see Section 3.11.3). Wintering Concentration RSAs are depicted by the outline of areas known to harbor aggregations of raptors during the winter (Navajo Nation Department of Fish and Wildlife 2008).

A wide variety of migratory bird species are found within the region. As documented above for waterfowl, the project lies within the Pacific Flyway for migratory birds. A variety of passerine species occur within the region. Representative species include horned lark (*Eremophila alpestris*), barn swallow (*Hirundo rustica*, black-billed magpie (*Pica hudsonia*), common raven (*Corvus corax*), western meadowlark (*Sturnella neglecta*), American goldfinch (*Carduelis tristis*), and red-winged blackbird (*Agelaius phoeniceus*) (Floyd et al. 2007; Stokes and Stokes 1996). Raptor species that potentially could occur as residents or migrants within the region include eagles (i.e., bald and golden eagles), buteos (i.e., red-tailed hawk, Swainson’s hawk, ferruginous hawk, and rough-legged hawk), falcons (i.e., prairie falcon, peregrine falcon, American kestrel, and merlin), accipiters (i.e., northern goshawk, Cooper’s hawk, sharp-shinned hawk), owls (i.e., barn owl, great horned owl, burrowing owl, long-eared owl, short-eared owl, flammulated owl, western screech owl, and Mexican spotted owl), northern harrier, and osprey (Floyd et al. 2007; Herron et al. 1985; Stokes and Stokes 1996). Migratory bird species, including raptors that are further classified as federally listed, candidate, proposed, state-listed, Navajo Nation endangered, Hopi endangered, BLM sensitive, or U.S. Forest Service sensitive, are identified under Special Status Wildlife Species in Section 3.11.

A list of Birds of Conservation Concern was developed by the USFWS as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This Act mandated that the USFWS “identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973.” The goal of the Birds of Conservation Concern list is to prevent or remove the need for additional Endangered Species Act bird listings by implementing proactive management and conservation actions, and to assure that these species would be consulted on in accordance with Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (USFWS 2008). These species are presented by project component in **Table 3.10-3**.

Table 3.10-3 Birds of Conservation Concern for the Project Components

Species Common Name (*Scientific Name*)	Potential Occurrence and Season					
	NGS Deposition Area	BM&LP Railroad	Proposed KMC	N-Aquifer Area	WTS	STS
American Bittern (*Botaurus lentiginosus*)					Wintering	
Bald Eagle (*Haliaeetus leucocephalus*)	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering
Bell's Vireo (*Vireo bellii*)					Breeding	Breeding
Bendire's Thrasher (*Toxostoma bendirei*)	Breeding	Breeding	Breeding	Breeding	Breeding	Year-round
Black-chinned Sparrow (*Spizella atrogularis*)					Breeding	Wintering, Breeding
Black-throated Gray Warbler (*Dendroica nigrescens*)						Breeding, Migrating
Brewer's Sparrow (*Spizella breweri*)	Breeding	Breeding	Breeding	Breeding, Migrating	Breeding, Migrating	Breeding, Wintering, Migrating
Burrowing Owl (*Athene cunicularia*)	Breeding	Breeding	Breeding	Breeding	Year-round	Year-round
Canyon Towhee (*Pipilo fuscus*)						Year-round
Cassin's Finch (*Carpodacus cassinii*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Common Black-hawk (*Buteogallus anthracinus*)						Breeding
Costa's Hummingbird (*Calypte costae*)				Breeding	Breeding	Breeding
Elf Owl (*Micrathene whitneyi*)						Breeding
Ferruginous Hawk (*Buteo regalis*)	Year-round				Year-round	

Table 3.10-3 Birds of Conservation Concern for the Project Components

Species Common Name (*Scientific Name*)	Potential Occurrence and Season					
	NGS Deposition Area	BM&LP Railroad	Proposed KMC	N-Aquifer Area	WTS	STS
Flammulated Owl (*Otus flammeolus*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding
Fox Sparrow (*Passerella iliaca*)						Wintering
Gila Woodpecker (*Melanerpes uropygialis*)						Year-round
Gilded Flicker (*Colaptes chrysoides*)					Year-round	Year-round
Golden Eagle (*Aquila chrysaetos*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Grace's Warbler (*Dendroica graciae*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding
Gray Vireo (*Vireo vicinior*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding
Green-tailed Towhee (*Pipilo chlorurus*)					Breeding, Wintering	
Juniper Titmouse (*Baeolophus ridgwayi*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Lark Bunting (*Calamospiza melanocorys*)						Wintering
LeConte's Thrasher (*Toxostoma lecontei*)					Breeding	Breeding
Least Bittern (*Ixobrychus exilis*)						Year-round
Lewis's Woodpecker (*Melanerpes lewis*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Loggerhead Shrike (*Lanius ludovicianus*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round

Table 3.10-3 Birds of Conservation Concern for the Project Components

Species Common Name (*Scientific Name*)	Potential Occurrence and Season					
	NGS Deposition Area	BM&LP Railroad	Proposed KMC	N-Aquifer Area	WTS	STS
Lucy's Warbler (*Vermivora luciae*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding
Mountain Plover (*Charadrius montanus*)						Wintering
Olive Warbler (*Peucedramus taeniatus*)						Breeding
Olive-sided Flycatcher (*Contopus cooperi*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding
Peregrine Falcon (*Falco peregrinus*)	Breeding	Breeding	Breeding	Breeding	Year-round	Year-round
Phainopepla (*Phainopepla nitens*)						Breeding
Pinyon Jay (*Gymnorhinus cyanocephalus*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Prairie Falcon (*Falco mexicanus*)	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round
Red-faced Warbler (*Cardellina rubrifrons*)						Breeding
Sage Thrasher (*Oreoscoptes montanus*)	Breeding				Breeding, Wintering	
Short-eared Owl (*Asio flammeus*)						Wintering
Sonoran Yellow Warbler (*Dendroica petechia sonorana*)					Breeding, Migrating	Breeding
Swainson's Hawk (*Buteo swainsoni*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding

Table 3.10-3 Birds of Conservation Concern for the Project Components

Species Common Name (*Scientific Name*)	Potential Occurrence and Season					
	NGS Deposition Area	BM&LP Railroad	Proposed KMC	N-Aquifer Area	WTS	STS
Williamson's Sapsucker (*Sphyrapicus thyroideus*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding, Wintering
Willow Flycatcher (*Empidonax traillii*)	Breeding	Breeding	Breeding	Breeding	Breeding	Breeding

Source: USFWS 2015a,b,c,d,e,f.

3.10.3.2 Navajo Generating Station

The study area for the NGS and associated facilities includes the 250-foot corridor for the BM&LP Railroad and four deposition impact areas delineated within the ERAs. The areas were delineated based on an iterative process during the development of the risk assessments and in coordination with the USFWS and cooperating agencies. Coordination for the emission study areas was completed as part of the process for defining sampling location, data review, and methodologies for the ERAs (Ramboll Environ 2016a,b,c,d).

Wildlife habitat types associated with NGS and its associated facilities are detailed under Section 3.8, Vegetation. Important wildlife habitat found within this study area of the project includes associated aquatic habitats of Lake Powell and the Colorado River analyzed for the Gap Regions. There are approximately 80 species of mammals, 35 species of reptiles and amphibians, and 200 species of birds in the Lake Powell area (National Park Service 2005). The NGS Gap Regions were analyzed for potential risks to aquatic and aquatic-oriented wildlife; risks to terrestrial receptors in the Gap Regions are based on results of the NGS Near-field ERA and the potential to be affected by consumption of food obtained from aquatic sources. The Southwest Gap Region includes the lower Colorado River below Lees Ferry downstream to the confluence of the Colorado and Little Colorado rivers. The Northeast Gap Region includes the portion of the Colorado River northeast of Lake Powell upstream to the confluence of the Colorado and Green rivers.

Big game species occurring within the NGS study area include mule deer, desert bighorn sheep, and mountain lion, although uncommon. White-tailed deer have the potential to occur within the Northeast Gap Region along the Colorado River. Common small game species found in the area include dove, turkey, beaver, coyotes, and bobcats (AGFD 2015l; Reclamation 2007). Common waterfowl of Lake Powell and the Colorado River include American widgeon, northern pintail, bufflehead, common goldeneye, common merganser, green-winged teal, lesser scaup, eared grebe (*Podiceps nigricollis*), and mallard (Reclamation 2007). The majority of these are winter residents or spring and fall migrants.

Common nongame species occurring within the NGS study area include small mammals and reptiles. Small mammals found within the NGS study area include ringtail, western spotted skunks (*Spilogale gracilis*) and numerous bat species including the little brown bat, fringed myotis (*Myotis thysanodes*), western pipistrelle (*Pipistrellus hesperus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and pallid bat (*Antrozous pallidus*) (National Park Service 2016; Reclamation 2007). Other common small mammals include jackrabbit, Ord kangaroo rat (*Dipodomys ordi*), deer mouse (*Peromyscus maniculatus*), pocket mouse (*Chaetodipus* spp. and *Perognathus* spp.), and woodrat (*Neotoma* spp.) (National Park Service 2005). Common reptiles include the Plateau striped whiptail lizard (*Cnemidophorus velox*), gopher snake (*Pituophis catenifer*), Western rattlesnake (*Crotalus viridis*), desert spiny lizard (*Sceloporus magister*), and side-blotched lizard (*Uta stansburiana*) (National Park Service 2005).

The Colorado River corridor provides important habitat for migratory birds (both neotropical songbirds and waterfowl and other wetland dependent species) as well as habitat for resident species. Waterfowl species are described above under nongame species. Migratory songbird species include humming birds, cuckoos, flycatchers, vireos, warblers, tanagers, orioles, and buntings (Reclamation 2007).

Raptors species associated with the NGS study area include sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), northern harrier (*Circus cyaneus*), red-tailed hawk, Ferruginous Hawk, zone-tailed hawk (*Buteo albonotatus*), common black hawk (*Buteogallus anthracinus),* Harris' hawk *(Parabuteo unicinctus),* bald eagle, golden eagle (*Aquila chrysaetos*), white-tailed kite (*Elanus leucurus*), American kestrel (*Falco sparverius*), peregrine falcon (*Falco peregrinus*), and osprey (*Pandion haliaetus*) (Reclamation 2007). No raptor breeding or wintering RSAs as designated by the Navajo Nation Department of Fish and Wildlife have been identified within the study area on Navajo Nation lands.

Lake Powell and the Colorado River provide important aquatic habitats for migratory bird species in the region. Within the Lake Powell area, most shorebirds are summer residents (Reclamation 2007). Common shorebird species include western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), American avocet (*Recurvirostra americana*), long-billed dowitcher (*Limnodromus scolopaceus*), snowy egret (*Egretta thula*), and great blue heron (*Ardrea herodias*) (Reclamation 2007). Along the Colorado River corridor, the aquatic bird community is almost exclusively made up of winter residents (Reclamation 2007). Thirty-four species of wintering waterfowl along with loons, cormorants, grebes, herons, rails, and sandpipers utilize the Colorado River corridor (Reclamation 2007).

Birds of Conservation Concern species identified by the USFWS (2015a,b,c,d,e,f) as occurring within the NGS study area are listed above in **Table 3.10-3**.

The COPECs for evaluation for the project were defined in each of the ERAs (Ramboll Environ 2016a,b,c,d) and were identified based on two previous studies conducted by Electric Power Research Institute (2009, 2011) and input by cooperating agencies regarding project scope in development of the ERAs. These chemicals are associated with coal and coal-fired power plants and included 24 metals (inorganic chemicals), two broad chemical classes of organic compounds (polycyclic aromatic hydrocarbons, or PAHs, and dioxins/furans), and two other organic compounds, benzene and acrolein. This section describes the potential risk to non-special status terrestrial wildlife species from COPEC baseline (current) conditions within the NGS study areas that included ERAs conducted for the NGS Near-field (terrestrial habitats surrounding NGS, and Lake Powell), Colorado River (Gap Regions), and the San Juan River (Ramboll Environ 2016a,b,c). Details regarding the effects of these chemicals on terrestrial wildlife species are provided in the Ecological and Human Health Risk Assessment Summary, **Appendix 3RA**, and summarized in Section 3.0.

3.10.3.2.1 NGS Near-field ERA

Overall, key chemicals are detected at low concentrations and are dispersed throughout the NGS study area with no distinct patterns of occurrence. The complete results are provided in the NGS Near-field Sampling Investigation Report (Ramboll Environ 2016e). Based on evaluation of risk, refined HQs for all of the terrestrial wildlife receptors were less than 1 for all COPECs for baseline conditions within the NGS Near-field study area, indicating that risks to terrestrial wildlife species from baseline conditions are negligible.

3.10.3.2.2 Gap Regions ERA

The study areas for the Gap Regions ERA included the Colorado River upstream and downstream of Lake Powell that were not captured in the NGS Near-field or San Juan River ERAs. Within the Northeast Gap Region, the results of the indicated COPECs (including selenium, mercury, and arsenic) for baseline conditions within the existing environment would pose negligible risk to aquatic-oriented terrestrial wildlife. Within the Southwest Gap Region, HQs exceeded one for bald eagle, canvasback duck, mallard, muskrat, and raccoon exposed to refined methyl mercury concentrations and lowest observed adverse effect level TRVs (HQs ranged from 2-4). HQs exceeded 1 for the muskrat, raccoon and little brown bat exposed to refined concentrations of selenium. HQs exceeded 1 for the muskrat, raccoon and little brown bat exposed to selenium using refined COPEC concentrations and lowest observed adverse effect level TRVs (HQs=2) (**Appendix 3RA**). The results for wildlife were influenced by the results of the Walters et al. (2015) study as data for fish and aquatic invertebrates from that study was used in the Southwest Gap food web model as these organisms are prey items for the representative wildlife species. The high concentrations reported in the Waters et al. (2015) study, which were incorporated and used in this ERA per the recommendation of Reclamation and U.S. Fish and Wildlife Service, significantly influenced the results of the ERA and elevated the perceived risk to representative wildlife species.

3.10.3.2.3 San Juan River ERA

As detailed in the San Juan River ERA (Ramboll Environ 2016c), the risk characterization results showed that the refined HQs for all COPEC/receptor combinations were below 1, indicating that NGS COPECs (selenium, mercury, and arsenic) for baseline conditions within the San Juan River study would pose a negligible risk to non-special status aquatic-oriented wildlife under baseline conditions.

3.10.3.3 Proposed Kayenta Mine Complex

Wildlife habitat within the proposed KMC is dominated by Great Basin conifer woodlands, Big Sagebrush shrublands, reclaimed lands, and lands impacted by human uses/disturbance (**Table 3.8-5**). Aquatic habitats within the proposed KMC are detailed in Section 3.12, Aquatic Biological Resources, and mainly consist of intermittent and ephemeral streams, springs, and artificial sediment ponds within the mine boundary. Important aquatic habitats used by terrestrial wildlife species are found within the N-Aquifer (groundwater) study area (see Section 3.7, Water Resources) and include numerous intermittent streams and washes that support riparian habitats.

According to the 2010 Permit Application Package prepared for the OSMRE, the Surface Mining Control and Reclamation Act of 1977 (30 United States Code 1201-1328), the Surface Mining Control and Reclamation Act amendments, and the Endangered Species Act of 1973 (16 United States Code 1531-1544, 87 Stat. 884), as amended (Ecosystem Management, Inc. 2015), Peabody Western Coal Company (PWCC) is required to monitor wildlife populations during the course of active surface mining activities and after mining activities have been completed. Wildlife-monitoring activities are required to assess impacts of active mining and to demonstrate the suitability of reclamation for wildlife post-mining either before or after bond release.

Big game species within the mine area are present, but uncommon. A 1979-1980 census for game species recorded two observations of mule deer, both north of the PWCC lease area (OSMRE 2011). In 2003, 10 mule deer and numerous pellet groups of mule deer and elk were observed during biological surveys for birds and threatened and endangered species (OSMRE 2011). More recent monitoring has documented the presence of elk, mule deer, and white-tailed deer coinciding with the increased reclaimed lands (OSMRE 2011). Areas of important seasonal use for big game species have not been identified within the proposed KMC. Small game species are similar to those described for the region with documented occurrence of bobcat, red fox, and coyote within the mine area (OSMRE 2011). Upland game birds with potential to occur include dove and turkey (AGFD 2015l). Waterfowl observed in ponds and flooded parts of reclaimed and other areas of the mine included 10 species of ducks, Canada geese, 2 species of grebes, double-crested cormorant (*Phalacrocorax auritus*), white-faced Ibis (*Plegadis chihi*), and American coot (*Fulica americana*) (Ecosystem Management, Inc. 2015).

Deer mice are one of the most common nongame species observed in the mine area, both in native and reclaimed lands. Other common nongame small mammals include ground squirrels (*Ammospermophilus* spp.), brush mice (*Peromyscus boylii*), Ord's kangaroo rat, Stephen's woodrat (*Neotoma stephensi*), black-tailed jackrabbits, desert cottontails, and Colorado chipmunk (*Tamias quadrivittatus*). Gunnison's prairie dogs (*Cynomys gunnisoni*) occur and are being monitored on the mine based on their role as keystone species for other wildlife species (Ecosystem Management, Inc. 2015). Bat studies were conducted in 1999 in reclaimed lands and piñon-juniper within and adjacent to the proposed KMC (OSMRE 2011). Nine bat species were identified including the big brown bat (*Eptesicus fuscus*), long-legged myotis (*Myotis volans*), silver haired bat (*Lasionyctris noctivagans*), pallid bat, fringed myotis, Brazilian free-tailed bat, big free-tailed bat (*Nyctinomops macrotis*), canyon bat (*Parastrellus hesperus*), and an unknown myotis species. Only the first six species were found in the pinyon-juniper habitat, but all nine species were found in the reclaimed lands (OSMRE 2011).

Reptile species, both common and observed, within the proposed KMC include whiptail lizard (*Aspidoscelis* spp.), collared lizard (*Crotaphytus collaris*), sagebrush lizard (*Sceloporus graciosus*), fence

lizard (*Sceloporus undulatus*), short-horned lizard (*Phyrnosoma douglassi)*, side-blotched lizard, gopher snake, and western rattlesnake (AGFD 2012; OSMRE 2011).

Bird surveys have recorded 235 bird species in the mine area, more than half of which are known to or potentially nest in the area (OSMRE 2011). Common songbirds recorded during recent wildlife monitoring include the horned lark, western meadowlark, mountain bluebird (*Sialia currucoides*), house finch (*Carpodacus mexicanus*), and multiple species of shrub-nesting sparrows in older reclaimed areas with shrub cover (Ecosystem Management, Inc. 2015). Shorebirds observed within of the mine area include killdeer (*Charadrius vociferus*) and spotted sandpiper (*Actitis macularius*) (Ecosystem Management, Inc. 2015).

Raptor studies in the mine area have recorded raptor species including red-tailed hawks, Cooper's hawks, sharp-shinned hawks, and American kestrels (Ecosystem Management, Inc. 2015; OSMRE 2011). Other less common species that may breed in the mine area include northern goshawk (*Accipiter gentilis*), prairie falcon (*Falco mexicanus*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), northern pygmy owl (*Glaucidium gnoma*), and long-eared owl (*Asio otus*) (OSMRE 2011). Historically, the Mexican spotted owl (*Strix occidentalis lucida*) was observed near the proposed KMC, but annual surveys beginning in 2011 have not documented this species within the vicinity. This species is discussed further in Section 3.11.3.2 due to its special status. Additionally, No raptor breeding or wintering RSAs as designated by the Navajo Nation Department of Fish and Wildlife have been identified within the study area on Navajo Nation lands.

Birds of Conservation Concern species identified by the USFWS (2015b,c) as occurring within the proposed KMC and groundwater drawdown portions of the project are listed in **Table 3.10-3**. Important migratory routes have not been identified within the proposed KMC.

3.10.3.3.1 Baseline Ecological Risk

Based on risk estimates from the KMC ERA, the refined (and average) HQs are less than 1 for terrestrial receptors, indicating negligible risks to terrestrial wildlife (**Appendix 3RA**, Ecological and Human Health Risk Assessments; Ramboll Environ 2016d). Therefore, effects from baseline conditions on terrestrial wildlife species would be negligible (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

3.10.3.4 Transmission Lines and Communication Sites

Big game species within the region of the WTS right-of-way (ROW) include mule deer, pronghorn, desert bighorn sheep, and mountain lion. In addition to the small game species described for the NGS and the proposed KMC project components, the chukar (*Alectoris chukar*), Gambel's quail (*Callipepla gambelii*), and California quail (*Callipepla californica*) are found along the WTS ROW. Chukars are found in central and western Arizona, Utah, and Nevada in dry, rocky terrain with abundant cheatgrass (BLM 2014; Utah Division of Wildlife Resources 2003). Gambel's quail are found along the WTS in Arizona, Utah and Nevada and California quail are found along the WTS in Utah and Nevada (Stokes and Stokes 1996; Utah Division of Wildlife Resources 2011). These two species of quail occupy similar brushy habitats near riparian areas (Stokes and Stokes 1996). Nongame species would be similar to those described for the NGS and proposed KMC project components.

Representative game and nongame terrestrial wildlife species along the STS ROW would be the same as those described for the NGS and proposed KMC project components above, with the addition of javelina and Gambel's quail.

Migratory bird species would be similar to those described for the NGS and proposed KMC project components. A list of Birds of Conservation Concern species potentially occurring along both the WTS and STS ROWs is found in **Table 3.10-3**.

Outside of the NGS Near-field study area, baseline ecological risk has not been evaluated for terrestrial wildlife species as these portions of the study areas occur outside of the area affected by emissions from NGS and the proposed KMC.

3.10.4 Environmental Consequences

3.10.4.1 Issues

The following issues related to terrestrial wildlife species were identified through public and agency scoping. Although there is overlap, issues vary somewhat by project component.

3.10.4.1.1 Navajo Generating Station

Issue 1 – Emissions and Deposition - effects of NGS emissions on terrestrial wildlife species.

Issue 2 – Operations and Maintenance - effects of operations and maintenance of NGS and associated facilities, including the BM&LP Railroad, on terrestrial wildlife species.

3.10.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Operations and Reclamation - effects of mining operations and reclamation on terrestrial wildlife species.

Issue 2 – Emissions and Deposition - effects of combined emissions from the proposed KMC and NGS on terrestrial wildlife species within the proposed KMC study area.

Issue 3 – Groundwater Pumping - effects of mine-related groundwater pumping from the N-Aquifer on associated stream and spring baseflows that support aquatic, wetland, and/or riparian habitats that may be used by terrestrial wildlife species.

3.10.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operations and Maintenance - effects of transmission line operations and maintenance on terrestrial wildlife species.

3.10.4.2 Assumptions and Impact Methodology

The following is a list of assumptions made and methodology used to assess impacts of the project as they relate to terrestrial wildlife species. The impacts identified under the separate project components below are based on correspondence with federal and state agencies and, tribal representatives, and based on public scoping comments.

- Terrestrial wildlife species composition and associated habitat within each of the project components was determined by:
  - Consultation and review of existing published data sources from federal and state agencies, as well as PWCC, Navajo Nation, and Hopi Tribe.
  - Identifying the types of terrestrial wildlife habitats (e.g., grasslands, forested lands, riparian areas, etc.) located within the study area using data from the vegetation analysis.
- Species was considered as having the potential to occur within the study area if:
  - Occurrence has been documented for the species; and
  - The current species range exists within the study area and suitable habitat is present.
- There would be no construction disturbance for the NGS, BM&LP Railroad, transmission systems, and communication sites components of the project. The analysis of impacts to terrestrial wildlife species from these components would be limited to operation and maintenance activities.

- Human activity, noise, and surface disturbance associated with decommissioning and reclaiming project facilities including the NGS plant, BM&LP Railroad, and proposed KMC in 2045 may result in short-term impacts on terrestrial wildlife species and their habitats known or with potential to occur in proximity to these facilities. Following completion of these activities, it is assumed that there would be beneficial effects to wildlife.

3.10.4.2.1 Navajo Generating Station

- Utilize the results of the NGS Near-field ERA, Gap Regions ERA, and San Juan River ERA to determine impacts to terrestrial wildlife species resulting from NGS emissions.
- Terrestrial wildlife habitat located within the NGS Near-field ERA, Gap Regions ERA, and the San Juan River ERA, and proposed KMC study areas were analyzed for emission effects on wildlife habitat and representative species. The Gap Regions and San Juan River ERAs apply only to aquatic-oriented terrestrial wildlife.
- Surrogate species identified in the three ERAs are representative of terrestrial wildlife species that occur in the analysis area.
- As detailed in the four ERAs, the risk characterization for future scenarios is conducted in the same way as the risk characterization for baseline conditions.
- As identified in the ERAs, potential exposure routes for wildlife receptors include incidental ingestion of sediment, surface water, or soil, as well as ingestion of food items containing COPECs. The actual amount of exposure by wildlife species as the result of ingestion depends on a number of factors including concentrations of COPECs in food items, size of the receptor, and bioavailability of the COPEC once consumed by the receptor.
- Known or potential occurrence of terrestrial wildlife species were evaluated for the BM&LP Railroad in a qualitative analysis.

3.10.4.2.2 Proposed Kayenta Mine Complex

- Utilize the results of the proposed KMC ERA to determine impacts to terrestrial wildlife species.
- Surrogate species identified in the ERA are representative of terrestrial wildlife species that occur in the analysis area.
- Identify game and nongame terrestrial wildlife species and associated wildlife habitat within project components using published information and internet sites from the Navajo Nation, Hopi Tribe, the state, and PWCC.
- The study area defined for surface water and groundwater impacts are referenced from the water resources section and groundwater model.
- No new surface disturbance is anticipated within the N-Aquifer Study Area outside of the proposed KMC. Only riparian/wetland vegetative communities tied to seeps/springs within this area would have potential to be affected by groundwater drawdown resulting from mine pumping.

3.10.4.2.3 Transmission Systems and Communication Sites

- Known or potential occurrence of terrestrial wildlife species were evaluated for the transmission lines and communication sites in a qualitative analysis.
- The impact analysis for terrestrial wildlife species focuses on O&M activities associated with the transmission line and communication site component of the project. Substations and switchyards affiliated with the WTS and STS occur in or adjacent to the powerline corridor and were included in the analysis.

- Transmission line ROWs and infrastructure have been in place and maintained for 40 years and the proposed vegetation treatments would maintain the existing communities and vegetation types present in the ROWs (i.e., low growing low shrub, herbaceous, and grass species).

3.10.4.3 Proposed Action

3.10.4.3.1 Navajo Generating Station

3.10.4.3.1.1 Emissions and Deposition

The effects of emission of metals on terrestrial wildlife species along with detailed support information are discussed in **Appendix 3RA**, Ecological and Human Health Risk Assessment. The appendix was prepared based on the Near-field, Gap Regions, and San Juan River ERAs (Ramboll Environ 2016a,b,c). The future operations (i.e., 3-Unit Operation and 2-Unit Operation) were analyzed to estimate the potential for adverse impacts to ecological receptors from potential future exposure to chemical contaminants dispersed from stack emissions and other sources at the NGS within the same defined deposition areas as for the baseline evaluation.

NGS Near-field

The determination of the study area and a detailed analysis on the effects of metals on terrestrial wildlife species are discussed in Section 3.0.2, Ecological and Human Health Risk Assessments. The refined HQs for all of the representative terrestrial wildlife receptors were less than 1 for all metals when using refined values for both the 3-Unit Operation and 2-Unit Operation. Therefore, the conclusion of the near-field analysis is that risk to terrestrial wildlife communities as a result of the NGS emissions from the Proposed Action would be negligible.

Gap Regions

The contribution in the Northeast Gap Region from future maximum NGS emissions (3-Unit Operation and 2-Unit Operation) is negligible, resulting in refined risk HQs of less than 1. In the Southwest Gap Region, HQs were well below 1 for each of the representative wildlife receptors included in the ERA and ranged from three to eight orders of magnitude below an HQ of 1 (**Appendix 3RA**). As detailed above in Section 3.10.3.2, baseline conditions are the cause of HQs greater than 1 for total contributions from the Proposed Action plus baseline conditions for methylmercury for each of the six representative wildlife receptors and for selenium among the mammals. Thus, future NGS emissions when combined with baseline conditions may pose risk to the aquatic oriented wildlife species in this region. As discussed in Section 3.10.3.2, baseline mercury levels in the Southwest Gap Region may be overestimated due to the use of questionable baseline mercury data (Ramboll Environ 2016 [3/23/16 Gap Region ERA]). Nonetheless, based on current data, the Proposed Action when combined with potentially degraded baseline conditions may have a minor impact on terrestrial wildlife species.

San Juan River

Based on the results of the refined HQ values all being less than 1 for aquatic-oriented wildlife species under both the 3-Unit Operation and 2-Unit Operation, risks from future project contributions would be negligible to terrestrial wildlife species.

3.10.4.3.1.2 Operations and Maintenance

The Operations and Maintenance Plan (**Appendix 1B**) provides a list of operation, maintenance, and improvement activities that would occur at NGS and associated facilities and along the BM&LP Railroad. Under the Proposed Action, the majority of the operating and support facilities at the plant site would be dismantled and demolished to ground level by December 22, 2045, unless the Navajo Nation continues NGS operations beyond 2044. Details on decommissioning and closure of the NGS and associated facilities are found in **Appendix 1B**.

Potential impacts as a result of proposed NGS operations would include wildlife mortalities that could occur as a result of collisions with trains, the overhead catenary system, and other vehicles used during operation and maintenance activities, increased risk of wildland fires, habitat degradation resulting from surface disturbance, and increased noise and human activity. Impacts to wildlife from operations, maintenance, improvement, and decommissioning activities could include:

- Increased human/wildlife interactions within the ROWs that have the potential to result indirectly in wildlife harassment and accidental mortality.
- An increase in human presence, noise, and traffic levels resulting in an increased potential for wildlife/vehicle collisions.
- Artificial light would likely be used in the case of repairs. Artificial light at night introduced to areas currently without lighting could adversely impact wildlife behaviors including mating, foraging, sleeping, and migratory behaviors (International Dark-sky Association 2008). These behaviors would be determined by the length of nighttime lighting. For example, birds could become disoriented by artificial light, disrupting migration routes and causing additional energy expenditure by staying near light sources. Crepuscular and nocturnal mammals such as raccoons, bats, deer, coyotes, and mice could lose the nighttime ecosystem they depend on for food and protection against predators.
- Wildlife mortality could occur as a consequence of electrocution or collision with powerlines associated with the plant site and the pump powerline to the Lake Pump; and components of the 50-kilovolt (kV) overhead catenary system. However, according to Salt River Project Agricultural Improvement and Power District (personal communication, June 24, 2016) the pump powerline to the Lake Pump has recently been replaced and built to APLIC standards. Components associated with the 50-kV overhead catenary system that is nearing the end of its service life would be replaced in the long term. The replacement catenary design would help avoid and/or mitigate electrical hazards to birds including large raptors and condors (APLIC 2006). Other catenary components and hardware would be replaced on an as-needed basis (**Appendix 1B**).
- Avoidance of otherwise suitable habitat due to increased predation from perching raptors.
- Nest abandonment or loss of eggs or young. These temporary losses would reduce productivity for that breeding season, given the duration of these activities.
- Habitat loss or alteration would result in direct losses of smaller, less mobile wildlife species such as small mammals and reptiles. It also would result in displacement of more mobile species into adjacent habitats during operations, maintenance, improvement, and decommissioning activities.

Impacts from the continued operation of NGS and its associated facilities on terrestrial wildlife within the lease boundary are expected to be minor. Because NGS and its associated facilities have been in operation for approximately 40 years, it is anticipated that most of the terrestrial wildlife species known to occur in the vicinity of the existing NGS and associated facilities, and BM&LP Railroad already are acclimated to the operation of the railroad and the human presence associated with it on some level.

All activities would remain within existing defined boundaries and ROWs and be limited to operation, maintenance, and improvement activities associated with NGS and associated facilities, known disturbance to associated vegetation communities would be limited to the ash disposal site. According to the Operations and Maintenance Plan (**Appendix 1B**), under the 3-Unit Operation, the current footprint of the existing ash disposal area would be expanded by approximately 40 acres (Section 3.8.4.3) within the existing lease area. The existing footprint would not change under the 2-Unit Operation. As initially discussed in Section 3.8.4, revegetation measures are in place to re-establish vegetation cover on the ash landfill (NGS Operations and Maintenance Plan, **Appendix 1B**).

As detailed in Section 2.3.1.2, under the 3-Unit Operation and 2-Unit Operation, the BM&LP Railroad would continue operations; however, the volume of coal delivered could decrease by approximately one-third for the 2-Unit Operation. Thus, instead of three trainloads of 8,000 tons of coal each day, the railroad would operate with a different schedule or capacity to meet NGS fuel demand. Fewer train trips or smaller trains hauling less coal would not substantially change maintenance requirements or potential impacts.

Finally, the following best management practices and protection measures that are part of the NGS-KMC Project (**Appendix 1B**) and correspondence with the Navajo Nation would be implemented to avoid or reduce impacts to terrestrial wildlife species and associated habitats:

- For routine vegetation maintenance (mechanical and hand clearing) and ground-disturbing maintenance activities, workers will watch for nesting birds. If an active nest is found, the vegetation containing the active nest will be avoided until after the nesting season. If the active nest is in vegetation that is causing a safety or system reliably risk, the utility will coordinate with the USFWS and the federal or tribal land manager to determine the appropriate removal procedures and assure compliance with the MBTA and the Navajo Nation Title 17 and 23 regarding songbirds.
- If raptor nests are found on system infrastructure and nest removal or repair work is necessary, the necessary coordination with the USFWS would be conducted to assure compliance with the MBTA, Bald and Golden Eagle Act, and within the Navajo Nation Title 17 and 23 under Golden and Bald Eagle Nest Protection Regulations, as appropriate.
- As transmission and lower voltage power lines are replaced and maintained, installed equipment will meet the most current Avian Power Line Interaction Committee (APLIC) design standards, as well as the Navajo Nation raptor electrocution prevention regulations where applicable to prevent bird electrocutions.
- Speed limits would minimize vehicular collisions with wildlife and decrease fugitive dust emissions.
- Excavation sites would be monitored or covered to avoid trapping wildlife, and routes of escape for wildlife would be maintained. The construction site would be inspected daily for appropriate covering and flagging of excavation sites. Each morning the construction site would be inspected for wildlife trapped in excavation pits.
- While working in riparian areas, workers will reduce the number of trips in and out, use hand crews if possible, minimize time spent working within the riparian area, and/or stage vehicles and materials outside riparian areas, if possible.

3.10.4.3.1.3 Decommissioning and Abandonment

Under the Proposed Action, the majority of the operating and support facilities at the plant site would be dismantled and demolished to ground level by December 22, 2045, unless the Navajo Nation continues NGS operations beyond 2044. Most of the 3,724 acres comprising the plant site and coal ash landfill would be capped, contoured, and revegetated. **Appendix 1B** provides an overview of the decommissioning sequence, including equipment required, and management of residual materials such as fuel oils, sludges, and recyclable materials. Following decommissioning of the plant site, several buildings and other facilities would remain for use by the Navajo Nation and fences around the site and along the railroad would be left in place. Decommissioning of the BM&LP Railroad would involve removal of rails, ties, and overhead power lines. Railroad embankments would be abandoned in place and revegetated.

As required in the 1969 Lease and Lease Amendment (or a leasing agreement with the Navajo Nation having similar terms as the 1969 Lease and Lease Amendment No. 1), the land would be restored as

closely as possible to original condition where the surface of any leased land has been modified or improved.

It is estimated that herb-dominated habitats such as grasslands would take a minimum of 2 to 5 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species. Woody habitats like sagebrush shrublands would require at least 10 to 25 years for shrubs to recolonize the area.

Although there would be short-term impacts to wildlife associated with increased levels of noise and activity associated with decommissioning activities are expected to re-open and restore wildlife habitat over the long term. Wildlife groups expected to benefit from decommissioning of NGS and associated facilities include small game and non-game species, particularly migratory birds, small mammals, and reptiles that are known or with potential to occur in the area. Because fences would be left in place, big game species such as pronghorn and desert bighorn sheep would not benefit from restoration of the plant site, and the railroad ROW would remain a barrier to the movement of these species.

3.10.4.3.2 Proposed Kayenta Mine Complex

3.10.4.3.2.1 Operations and Reclamation

Potential impacts to wildlife during the proposed KMC operations could include incremental habitat loss and fragmentation, direct mortalities from construction and operation activities, animal displacement and disruption from additional human presence and associated increased noise and light, and the potential for transmission line collisions.

There would be potential for incremental long-term and short-term habitat loss throughout the life-of-mine that would affect big game, small mammals, upland game birds, waterfowl, raptors, songbirds, and reptiles. Impacts to big game species would most likely include the incremental, short-term reduction of potential foraging habitat during the life of the mines. However, because big game species are uncommon within the proposed KMC, individuals temporarily displaced by mining-related activities would be able to relocate to surrounding habitats and would re-inhabit the mining-related disturbed areas following the reestablishment of vegetation. Impacts to small game, migratory bird, and non-game species would be similar to those for big game species and would include the loss of potentially suitable breeding, nesting, and foraging habitat; habitat fragmentation; and displacement of species. Direct impacts also may include nest or burrow abandonment or the loss of eggs or young, resulting in reduced productivity for that breeding season. However, based on the availability of potentially suitable breeding and foraging habitat in the areas adjacent to mining operations, the adverse effects to local populations are anticipated to be low.

Estimated impacts to general vegetation based on the 3-Unit Operation and 2-Unit Operation would be as discussed in Section 3.8 and Section 3.14. For the 3-Unit Operation and 2-Unit Operation, the majority of the impacts would occur within pinyon-juniper woodlands and sagebrush shrublands (**Table 3.10-4**). Loss of these vegetation communities would result in a long-term (greater than 25 years) impact to terrestrial wildlife species associated with these habitats. As discussed in Section 3.14.4.3, most of the reclaimed areas now provide a greater amount of forage vegetation than was available under pre-mine conditions to benefit grazing rights. However, this does not benefit wildlife species associated with the initial loss of woody shrub landcover types such as mule deer, golden eagles, cottontails, and numerous migratory bird and rodent species, as woody vegetation requires long-term time periods (i.e., greater than 25 years) to reestablish. Benefits of reclamation to wildlife species associated with these habitats would only be realized if future reclamation is successful and grazing is managed appropriately. This will require ongoing monitoring and possible reseeding in areas that are less responsive to reclamation. The reclaimed areas will provide habitat for species adapted to habitat edges, early successional environments, and grassland habitats. Species that are highly adaptable could increase in abundance in reclaimed areas. These species include deer, elk, deer mice, Ord's kangaroo rats, Gunnison's prairie dogs, Navajo mountain vole, black-tailed jackrabbits, desert cottontails, red foxes,

coyotes, some bats, eastern fence izards, prairie falcons, and red-tailed hawks. In the long term, the breeding potential for most raptors could increase as trees develop in portions of the reclamation (OSMRE 2011).

Table 3.10-4 Impacts to Associated Wildlife Habitat within the Proposed KMC

	3-Unit Operation (2044)	2-Unit Operation (2044)
Total Acres Impacted	**5,230**	**4,741**
Landcover Type	**Percent of Impacts within the Proposed KMC Analysis Area**	
Pinyon-juniper Woodlands	20	18
Mixed Salt Desert Scrub	4	<1
Sagebrush Shrublands	4	3.2
Open Water	0	0
Greasewood Shrubland	0	0
Invasive Southwest Riparian Woodland and Shrubland (Tamarisk)	0	0

As detailed in Section 3.8, pit locations proposed for mining would be the same between the 3-Unit Operation and 2-Unit Operation except that under the 2-Unit Operation the rate of mining would proceed more slowly and no mining would occur in the N-10 area. Thus, the 3-Unit Operation would directly impact approximately 489 more acres of pinyon-juniper woodlands, sagebrush shrublands, and mixed salt desert scrub through vegetation removal than the 2-Unit Operation.

Activity at the mine would result in adverse impacts to terrestrial wildlife species from disruptions due to increased human presence, noise, and light. The most common wildlife responses to noise and human presence are avoidance or acclimation. It is not possible to predict the total extent of habitat lost or affected as a result of wildlife avoidance response because the degree of this response would vary from species to species and even between individuals of the same species. However, it is anticipated that most of the terrestrial wildlife species known to occur in the vicinity of existing mines already are acclimated to human presence on some level, or that they have the ability to acclimate, reducing impacts from human avoidance response (Ward 1976). During initial development stages, many species likely would disperse from the area; however, as species become acclimated to human presence and noise, the majority likely would return to reoccupy undisturbed habitats within and surrounding the disturbance areas (Ward 1976).

Increased human/wildlife interactions during the construction and operation phases of mine development would have the potential to indirectly affect wildlife via harassment, poaching, and illegal harvest or accidental mortality. Increased human presence and related increases in traffic levels on mine access routes would increase the potential for wildlife/vehicle collisions, with the greatest potential occurring during peak operations. If construction or ground-clearing activities were to occur during the migratory bird breeding season, direct impacts to breeding birds could include the loss of active nest sites or abandonment of a nest site due to increased human presence and noise in proximity to a nest site. Loss of active nest sites of migratory birds, incubating adults, eggs, or young would be in violation of the MBTA.

Similar to the NGS and associated facilities component of the study area, artificial light would be used at the proposed KMC complex during mining construction and operations. The effects of artificial light would be the same as those listed under for the BM&LP Railroad under NGS and associated facilities in Section 3.10.4.3. To reduce impacts from the use of artificial light, lighting at the proposed KMC would be similar to the lighting currently used at the Kayenta Mine where full-cutoff lighting is used on the dragline booms and at parking lots. Full cutoff lighting directs lighting downward and does not emit any

light past 90 degrees of horizontal so there is no upward lighting which would create diffuse lighting effects away from these areas. In addition, full-cutoff lighting requires that at 80 degrees from horizontal the visible light is less than 10 percent of the candlepower of the light source, minimizing the potential for glare related lighting effects away from the area. For safety, in areas where combustible dusts may be present such as coal handling areas different types of lighting are used to reduce the potential for the light to act as an ignition source. Depending on the model, the luminaires are either full-cutoff or semi-cutoff (with 3 percent of the total candlepower emitted at greater than 90° from horizontal). While general lighting provides even, overall illumination for a work area, directional lighting highlights a specific portion of the work area. PWCC uses directional lighting for areas where additional light is needed for a specific area or project.

As a result of the impacts discussed above, impacts to terrestrial wildlife species as a result of mining construction and operations at the proposed KMC complex would be moderate to terrestrial wildlife species.

3.10.4.3.2.2 Emissions and Deposition

The study area for the proposed KMC includes the current Kayenta Mine lease property boundary and proposed expansions. In addition, several locations adjacent but outside of the lease boundary associated with special status species occurrence also are included in the overall study area. A summary of the KMC ERA is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment and detailed methods and results are provided in the ERA report (Ramboll Environ 2016d). The results consider the contribution from surface disturbance from mining activities associated with coal resource yields of 8.1 million tons per year (tpy) and 5.5 million tpy, which represent the quantity of coal needed to support NGS 3-Unit Operation and 2-Unit Operation, respectively.

The results of the proposed KMC ERA indicated that HQs in the refined evaluation for COPEC/receptor combinations were below 1. As a result, the proposed KMC ERA indicates that impacts from emissions resulting from the operation of NGS and the proposed KMC from 2020 to 2044 from the contribution of the 8.1 million tpy and 5.5 million tpy operations would be negligible to terrestrial wildlife species within the KMC Study Area.

3.10.4.3.2.3 Groundwater Pumping

The habitats associated with naturally occurring groundwater-fed intermittent and ephemeral stream reaches and associated perennial seeps and springs support riparian vegetation (both woody and herbaceous plant species) and wetland areas. Reduction or loss of riparian and wetland habitats supported by these water sources would adversely impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structures.

Due to potential drawdown effects from water pumping within the N-Aquifer, groundwater modeling was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Continued groundwater pumping to support mine operations would result in no measurable decreases in flow in the four U.S. Geological Survey-monitored springs in the N-Aquifer study area (Section 3.7). Moreover, based on groundwater modeling, no change in spring flows would be expected in 95 of 98 non-monitored springs. One spring in each of Spring Groups D (Pasture Canyon/Tuba City/Moenkopi Wash area), F1 (Dennehotso area), and I (Tselani Valley area west of Chinle) would be expected to experience small decreases in flow as a result of mine pumping and associated drawdown of the N-Aquifer (Section 3.7). Surface mining activities such as pit excavations and backfills are predicted to have localized effects on spring flows associated with the shallower Wepo Formation (Section 3.7, Water Resources and Section 3.8). The anticipated flow reductions would be incremental and occur within an over-riding trend of declining springflows due to natural variations including region-wide drought.

Groundwater modeling was conducted to evaluate the effects of mine well pumping on groundwater and connected surface water sources. Details on the groundwater modeling analysis and results are provided in Section 3.7, Water Resources. The modeling analysis investigated potential changes in groundwater contributions to seven streams including Begashibito, Chinle, Dennebito, Jeddito, Moenkopi, and Polacca washes and Laguna Creek. When comparing the simulated stream baseflows for 1956 to those of 2019, modeling results estimated that the maximum decrease in 2019 simulated baseflow would be less than 0.04 cubic feet per second from all previous project groundwater pumping. Over the projected 2020 through 2057 pumping period, the total 3-Unit Operation pumping would be approximately 1,200 acre-feet per year through 2044 and approximately 100 to 500 acre-feet per year through 2057, which is reduced from previous rates, comprising 20 percent of the historic PWCC pumping volume. It is important to note that the pumping analysis extends until 2110 so that the maximum drawdown effect is determined. There is a continued effect beyond the end of pumping. Refer to Section Water Resources in Section 3.7 for additional detail on the groundwater pumping analysis. Based on the future total withdrawal due to proposed project pumping, no measurable change in 2019 stream baseflows are predicted by the model from pumping for either Proposed Action operation (3-Unit Operation and 2-Unit Operation). Therefore, the proposed KMC pumping for operations from 2020-2054 would not result in effects to aquatic habitat with connections to groundwater.

As detailed in Section 3.8.4.3, information concerning how much groundwater levels need to drop before there are effects to seeps/springs and associated riparian habitats is limited. It is expected the changes in water level at the ground surface would have negligible effects to riparian vegetation at seeps/springs because of their small volume. Therefore, the Proposed Action would have negligible effects on the associated aquatic habitat and water sources utilized by terrestrial wildlife species based on drawdown effects within the N-Aquifer because the impact to the resource would be at or below the levels of detection.

3.10.4.3.2.4 Decommissioning and Abandonment

Under the Proposed Action, no mining would occur in the proposed KMC after December 21, 2044. Facilities such as buildings, parking lots, roads, wells, and utilities that are requested to be kept by the tribes would be turned over to them. Other materials having economic value (such as structures and equipment) would be salvaged or recycled. All other materials would be disposed of using approved procedures and in accordance applicable regulations. All sites would be re-contoured to conform to the natural landform, covered with topsoil, and revegetated, using the same post-mining techniques as those proposed for areas disturbed by mining.

The effects of mine decommissioning on terrestrial wildlife species are expected to be beneficial over the long term. Reclamation and re-vegetation of disturbed lands would restore wildlife habitat. The first species to benefit would be those associated with herbaceous habitats. Over time, as shrubs and eventually forest cover returns to the site, other terrestrial wildlife species would benefit as well.

3.10.4.3.3 Transmission Systems and Communication Sites

3.10.4.3.3.1 Operations and Maintenance

Operation and maintenance of the transmission lines and associated facilities would result in no new surface disturbance, but would require periodic aerial and ground inspections, repair and maintenance of infrastructure, maintenance of access routes, and treatment of vegetation within the ROW. The majority of all inspection and maintenance activities would occur along the existing ROWs, serviced by existing roads leading to the regional highway system, and would occur infrequently.

Potential impacts to terrestrial wildlife species would be similar to those discussed above for the operation and maintenance activities occurring at the NGS and associated facilities and along the BM&LP Railroad, with the exception of surface disturbance; a reduction in the amount of acclimation to human presence associated with the operation and maintenance of the ROWs; and the potential for

electrocution or collision with electrical components found on the railroad. In comparison between the two transmission systems, due to the low growing and sparsely vegetated land cover, the WTS receives very light human use for maintenance activities (two full length inspections per year) compared to the STS that conducts more routine vegetation maintenance to comply with industry line clearance standards.

Regarding the potential for raptor electrocution or collision, transmission line configurations greater than 69 kV typically do not present a high risk of avian electrocution based on conductor placement and orientation (Avian Power Line Interaction Committee 2006). The STS and WTS are Avian Power Line Interaction Committee compliant or, as replaced or maintained would be compliant with Avian Power Line Interaction Committee design standards to minimize these impacts.

Similar to the determination for operation, maintenance, and improvement activities that would occur at NGS, impacts from the continued operation of the two transmission systems and communication sites on terrestrial wildlife are expected to be minor. To reduce impacts from these activities, line operators would coordinate ongoing periodic line repair and maintenance and vegetation treatments with the appropriate land and wildlife management agencies and incorporate the following best management practices and mitigation measures from the Operations and Maintenance Plan (**Appendix 1B**) and correspondence with the Navajo Nation and BLM as detailed below.

- For routine vegetation maintenance (mechanical and hand clearing) and ground-disturbing maintenance activities, workers will watch for nesting birds. If an active nest is found, the vegetation containing the active nest will be avoided until after the nesting season. If the active nest is in vegetation that is causing a safety or system reliably risk, the utility will coordinate with the USFWS and the federal or tribal land manager to determine the appropriate removal procedures and assure compliance with the MBTA and the Navajo Nation Title 17 and 23 regarding songbirds.
- If raptor nests are found on system infrastructure and nest removal or repair work is necessary, the utility (i.e., Salt River Project Agricultural Improvement and Power District, Arizona Public Service Company, NV Energy) would coordinate with the USFWS, the federal land manager, and/or the tribal land manager to assure compliance with the MBTA, Bald and Golden Eagle Act, and under the Navajo Nation Title 17 and 23 within the Golden and Bald Eagle Nest Protection Regulations, as appropriate.
- Speed limits would minimize vehicular collisions with wildlife and decrease fugitive dust emissions.
- Excavation sites would be monitored or covered to avoid trapping wildlife, and routes of escape for wildlife would be maintained. The construction site would be inspected daily for appropriate covering and flagging of excavation sites. Each morning the construction site would be inspected for wildlife trapped in excavation pits.
- While working in riparian areas, workers will reduce the number of trips in and out, use hand crews if possible, minimize time spent working within the riparian area, and/or stage vehicles and materials outside riparian areas, if possible.
- For the STS, herbicide treatments best management practices would include:
  - Between April 15 and August 15, the spray vehicle will watch for ground nesting birds. If any are seen, the operation will be stopped and the area completed utilizing handheld or backpack sprayers.
  - At any location where the vegetation density is sufficient to provide adequate cover for nest sites, for example dense stands in riparian areas, the area to be treated will be surveyed by the utility (or their contractor) for nests prior to spraying. If nests are found during the survey

or encountered during the course of the application, spraying in the area at and surrounding the nest will cease and be postponed until after August 15 or until the nest is inactive.

- All vehicles will be operated in a safe and prudent manner during daylight hours, maintaining speeds of 15 to 20 miles per hours within the ROW.

- Along the STS on BLM lands, non-emergency maintenance activity should not be conducted in identified pronghorn fawning areas during the fawning season (April 1 and June 1) (BLM 2010).

3.10.4.3.3.2 Decommissioning and Abandonment

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.10.4.3.4 Project Impact Summary – All Project Components

The overall effects of the Proposed Action on terrestrial wildlife species would vary from negligible to moderate depending on the activities conducted within each study area.

The overall effects of the Proposed Action's emissions on special status wildlife species would range from negligible to minor when considered in aggregate over the various study areas. With the exception of the aquatic oriented terrestrial receptors within the Southwest Gap Region, NGS and proposed KMC emissions combined with baseline conditions would pose negligible risk to terrestrial wildlife species within the NGS Near-field, Northeast Gap Region, Southwest Gap Region, San Juan River, and proposed KMC study areas as indicated by refined HQs less than 1 for maximum exposure and no adverse effects levels for all species and COPEC combinations. Aquatic oriented terrestrial wildlife in the Southwest Gap Region study area, due to seemingly elevated levels of methylmercury in their diet, are at risk of mercury toxicity under baseline conditions.

Impacts to terrestrial wildlife species resulting from operation and maintenance of NGS and associated facilities and the two transmission systems, as well as the construction and operation of the proposed KMC, would range from minor to moderate depending on species present, the timing of these activities, and the associated habitat disturbed. Impacts to terrestrial wildlife based on operation and maintenance activities associated with human presence, noise, traffic, and artificial lighting is expected to be minor based on wildlife acclimation to these disturbances associated with the historic existence and operation of the NGS and associated facilities, transmission line system, and portions of the proposed KMC. Direct loss of individuals or breeding areas due to vehicle, transmission line, and the overhead catenary system would be considered moderate. Construction activities at the proposed KMC would be considered a moderate impact based on the resulting short-term and long-term habitat loss and fragmentation; and increased human presence, noise, traffic, and artificial lighting in areas of the proposed KMC considered undisturbed. Implementation of general and species-specific best management practices would ensure that impacts to terrestrial wildlife resulting from mine operations and transmission line operation and maintenance activities are avoided and minimized to the extent practicable.

Mine-related groundwater pumping under the 3-Unit Operation is predicted to result in small reductions (0.0004 – 0.0027 cfs) in baseflow in four different washes and at three springs in three different spring groups (0.008 – 0.06 gallons per minute flow reduction) associated with the N-Aquifer. These predicted reductions in spring flows are expected to have negligible effects on riparian habitats with potential to support terrestrial wildlife species.

3.10.4.3.5 Cumulative Impacts

For terrestrial wildlife resources, the Cumulative Effects study areas are the same as those described for the Proposed Action. Refer to Section 3.0 for a detailed description of these study areas. The cumulative

effects analysis includes an assessment of total project effects across all study areas plus the effects of other past, present, and reasonably foreseeable actions affecting terrestrial wildlife species within these areas.

3.10.4.3.5.1 Navajo Generating Station

The following discussion is divided into emission and deposition effects followed by other cumulative effects on terrestrial wildlife species for the portions of the overall study area related to each of the study areas.

Other than climate change, no reasonably foreseeable future actions are anticipated at the NGS plant site that would result in cumulative impacts to terrestrial wildlife habitat. All surface disturbances would be confined to the existing NGS plant site, associated facilities, and the existing railroad ROW as a continuation of operations that started in the late 1960s and 1970s. Reclamation measures are in place for the l ash landfill to promote wildlife habitat will recover over the long term. Additionally, no overlapping use of the plant site, associated facilities, and the existing railroad ROW (with the exception of railroad crossings) are permitted. Therefore, no cumulative impacts caused by overlapping on-the-ground activities in the NGS and associated facilities area are foreseen.

The total cumulative impacts from emissions were calculated by considering risks from COPECs currently present in the environment (baseline), as well as COPECs associated with future emissions from the NGS plus other cumulative sources modeled and evaluated from 2020 to 2044. Other cumulative sources addressed impacts from sources other than NGS and proposed KMC including non-U.S. sources added to NGS impacts to estimate the cumulative effects for the ERA study areas. The evaluation is carried through to 2074 to capture the lag period between closure of NGS and movement of COPECs through the watershed and food web.

As described in previous sections, emissions from future operation of NGS under the Proposed Action would result in negligible impacts to terrestrial wildlife. However, when the minute amounts of some trace metals emitted by NGS combine with elevated baseline concentrations and/or other cumulative sources of these metals, they could result in risk to some species.

The NGS Near-field and San Juan ERAs indicate that baseline risk for trace metals, when evaluated together with the Proposed Action and other cumulative sources, would pose negligible risk to terrestrial wildlife species. The cumulative analysis showed that the NGS 3-Unit Operation and 2-Unit Operation combined with baseline conditions and other cumulative emissions resulted in HQs less than 1 for all COPECs, indicating negligible risk to terrestrial wildlife based on cumulative emissions in these study areas.

Within the Gap Regions, results of the ERA indicated that all total cumulative risk HQs using refined concentrations of COPECs were below one for all COPEC/wildlife combinations within the Northeast Gap Region study area. For the Southwest Gap Region study area, total cumulative risk HQs for representative wildlife receptors using refined modeled concentrations of methylmercury and lowest observed adverse effect level TRVs exceeded 1 for each receptor in the food web model with HQs ranging from 2 to 5. In addition, HQs = 2 for muskrat, raccoon, and little brown bat exposed to selenium. As detailed in **Appendix 3RA**, these HQs exceedances are due to baseline contributions to the HQs rather than from future operations. Overall, baseline concentrations, the Proposed Action, and other cumulative sources future contributions from NGS do not pose an unacceptable risk to fish, bird and mammal populations, but risk from other cumulative sources to piscivorous birds cannot be ruled out based on the results of the analysis for the bald eagle discussed in detail in Section 3.11.4.3. Whereas the bald eagle may be at risk of mercury toxicity in the Southwest Gap Region, it should be noted that the contribution of the Proposed Action to that risk is only 0.06 percent.

3.10.4.3.5.2 Proposed Kayenta Mine Complex

The results of the proposed KMC ERA baseline, future emission scenarios, and other cumulative sources indicated that HQs in the refined evaluation for COPEC/receptor combinations were below 1. Therefore, cumulative impacts from emissions and mine activity from 2020-2044 would be negligible to terrestrial wildlife species.

The overall cumulative effect of groundwater pumping in the N-Aquifer area through 2110 would be moderate in Polacca and Chinle washes and Laguna Creek with reductions in annual flow of 32 to 48 percent from 2020 rates (Section 3.7, Water Resources). These reductions result in moderate reductions in the amount of aquatic habitat in these washes where surface water is present and cause reductions in the abundance and diversity of aquatic invertebrates and plants used as food and cover by terrestrial wildlife resources. The cumulative effect is caused by pumping activities other than the proposed project. The project would contribute to a future reduction in base flows of less than 1 percent in these drainages after 2020, based on the results of the groundwater modeling.

3.10.4.3.5.3 Transmission Systems and Communication Sites

The reasonably foreseeable future actions that could result in cumulative impacts to this component of the Proposed Action include the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines, and the Lake Powell water pipeline and transmission line. The TransWest Express, Southern Nevada Intertie Project, and Eastern Nevada transmission lines may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada (**Figure 3.0-2**). Segments of the Lake Powell water pipeline and transmission line are proposed to overlap with the WTS utility corridor in Coconino County, Arizona, west of Lake Powell (**Figure 3.0-3**).

The primary potential impacts to wildlife would be attributed to vehicle/wildlife collisions along access roads for project construction and maintenance. These impacts would be reduced by best management practices including controlling vehicle speeds and implementing environmental compliance programs that protect susceptible species. Because of the rural setting of these transmission lines, and lack of fencing or other controls, off-road vehicle disturbance to wildlife would occur throughout the length of these transmission lines resulting in short-term impacts.

3.10.4.4 Natural Gas Partial Federal Replacement Alternative

This discussion is divided into two parts. The first part describes the alternative site and operational characteristics and primary terrestrial wildlife species impacts that have occurred, or would occur. The second part addresses the impacts to terrestrial wildlife species from reducing the power generated at NGS with consequent reductions in coal production at the Kayenta Mine.

Under the Natural Gas Partial Federal Replacement (PFR) Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to currently exist, prior disturbance impacts to terrestrial biological resources are not evaluated. Key assumptions about terrestrial biological resources related to such an existing site are listed below.

- A combined-cycle natural gas power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time and the existing plant would have undergone previous National Environmental Policy Act (NEPA) evaluation.
- Potential surface disturbance could occur at scattered locations within the entire site.
- Wildlife habitat would be removed during surface disturbing activities and would not be replaced and revegetated until after facility decommissioning.

- Terrestrial wildlife habitat associated with perennial waterbodies is assumed to be limited within the alternative site due to the arid characteristics of the general region.
- Natural combustion for power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS; therefore, there would be no deposition from natural gas combustion to surface water in the study area. The description of emission calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

The focus of this discussion is to distinguish differences in impacts within the replacement alternative operational range to provide a basis for comparison with the Proposed Action.

3.10.4.4.1 Navajo Generating Station

3.10.4.4.1.1 Emissions and Deposition

The Natural Gas PFR Alternative would result in the following reductions in emissions of trace metals for the 100-MW and 250-MW replacements in comparison to the Proposed Action (**Table 3.10-5**).

Table 3.10-5 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Natural Gas PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Natural Gas PFR 100-MW Power Reduction (tpy / % change)	Natural Gas PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.127 / -5%	1.957 / -13%
Selenium	2-Unit	1.491	1.377 / -8%	1.208 / -19%
Mercury (total)	3-Unit	0.117	0.111 / -5%	0.102 / -13%
Mercury (total)	2-Unit	0.078	0.072 / -8%	0.063 / -19%
Arsenic	3-Unit	0.133	0.127 / -5%	0.117 / -13%
Arsenic	2-Unit	0.089	0.083 / -8%	0.073 / -19%

The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. The 3-Unit and 2-Unit 100-MW and 250-MW Natural Gas PFR Alternative operations would result in approximately 5 to 19 percent less selenium, arsenic, and mercury than the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for terrestrial species would be slightly reduced in each of the study areas. The difference in impacts to terrestrial wildlife species between the Natural Gas PFR Alternative and the Proposed Action would be negligible because the Proposed Action ERA analysis indicates refined HQ numbers less than 1, indicating no risk of effect. Because emissions from NGS are less under the Natural Gas PFR Alternative, COPEC deposition also would have less impact on terrestrial wildlife than the proposed action and, therefore, the impacts are considered negligible.

3.10.4.4.1.2 Operations and Maintenance

Impacts to terrestrial wildlife species as a result of operation, maintenance, and improvement activities occurring at NGS and along the BM&LP Railroad as a result of the Natural Gas PFR would be the same as the Proposed Action. All activities would remain within existing defined boundaries and ROWs and known disturbance to associated vegetation communities would be limited to the ash disposal site. As previously described in Section 3.8.4.4, coal delivery under the Proposed Action would range between 8.1 million tpy and 5.5 million tpy for the 3-Unit Operation or 2-Unit Operation, respectively. Under the Natural Gas PFR Alternative, less coal would be handled and transported on the BM&LP Railroad

because less power would be generated. **Table 3.0-6** shows the difference in annual coal production and use. Because coal use is less under the Natural Gas PFR Alternative, O&M activities which occur at NGS, associated facilities, and the BM&LP Railroad may occur less frequently. The reductions in coal use are between 5 and 18 percent annually under the Natural Gas PFR Alternative and because effects from disturbance under the Proposed Action were considered minor, they are considered minor under the Natural Gas PFR Alternative.

According to the Operations and Maintenance Plan (**Appendix 1B**), under the 3-Unit Operation, the current footprint of the existing ash disposal area would be expanded. The existing footprint would not change under the 2-Unit Operation. As initially discussed, revegetation measures are in place to re-establish vegetation cover on the coal ash landfill; successful revegetation prevents soil loss from wind or water erosion at the plant site and coal ash landfill (NGS Operations and Maintenance Plan, **Appendix 1B**).

No new surface disturbance would be required to operate the BM&LP Railroad under both the 3-Unit Operation and 2-Unit Operation. As detailed in Chapter 2.0, under the 3-Unit Operation and 2-Unit Operation, the BM&LP Railroad would continue operations; however, the volume of coal delivered could decrease by approximately one-third for the 2-Unit Operation. Thus, instead of three trainloads of 8,000 tons of coal each day, the railroad would operate with a different schedule or capacity to meet NGS fuel demand. Fewer train trips or smaller trains hauling less coal would not substantially change maintenance requirements or potential impacts from the proposed action and thus the same level of impacts are anticipated.

Under the Natural Gas PFR Alternative, decommissioning and final reclamation of the NGS and BM&LP Railroad would be the same as described for the Proposed Action.

3.10.4.4.2 Proposed Kayenta Mine Complex

3.10.4.4.2.1 Operations and Reclamation

The impacts of mining surface disturbance would be the same as the Proposed Action and considered moderate for terrestrial wildlife species. Mining surface disturbance under this PFR alternative would be proportionally reduced as illustrated in **Table 3.0-7**. It is recognized that actual surface disturbance may not be directly proportional to coal mined because of differences in overburden and coal seam thickness across the coal resource areas.

The impacts of surface coal mining would be moderate because approximately 3,888 to 4,968 acres of new surface disturbance utilized by terrestrial wildlife species are subject to mining activities that include existing intensive surface management programs for soil salvage, soil erosion control, sedimentation control, and revegetation (**Appendix 1B**) that could result in the loss of associated terrestrial wildlife habitat as discussed for the Proposed Action. No permanent ponds that provide habitat for waterfowls and shorebirds would be modified by this alternative. Smaller detention ponds associated with ongoing mining may be closed and filled in as reclamation proceeds. All surface disturbance is subject to a soil stabilization and revegetation adequacy standard prior to release back to the surface owner, the Navajo Nation.

3.10.4.4.2.2 Emissions and Deposition

KMC emissions under the Natural Gas PFR Alternative would be reduced as a result of less coal being burned. There would be a slight reduction in risks to terrestrial wildlife species as indicated by slightly lower HQs. The combination of KMC emissions under this alternative with baseline conditions would represent negligible risks, as HQs would still be less than 1. The impact level would be considered negligible and the effects from this alternative would be the same as described for the Proposed Action.

3.10.4.4.2.3 Groundwater Pumping

Groundwater pumping would be the same as the Proposed Action, with less than 1 percent potential reduction in stream and spring flows. The small anticipated changes in riparian community structure, composition and occupied surface area are not expected to noticeably reduce wildlife habitat values. Therefore, impacts from groundwater pumping would be negligible to terrestrial wildlife species and associated habitat.

3.10.4.4.3 Transmission Systems and Communication Sites

3.10.4.4.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Impacts to terrestrial wildlife species do not differ from the Proposed Action and would be considered minor under the Natural Gas PFR Alternative.

3.10.4.4.4 Project Impact Summary – All Project Components

The overall effects of the Natural Gas PFR Alternative on wildlife species and associated habitats would be similar to the Proposed Action and would vary from negligible to moderate depending on the activities conducted within each study area.

The Natural Gas PFR Alternative would result in 5 to 19 percent power reduction compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS and proposed KMC emissions under this alternative by themselves represent a negligible risk on all species.

Impacts to wildlife and associated habitat from surface disturbance and human presence would be moderate due to loss of habitat the potential wildlife mortality and disturbance as indicated under the Proposed Action. The combined new land disturbance at NGS and proposed KMC under the Natural Gas PFR Alternative would range from a high of 4,968 acres to a low of 3,888 acres. This habitat disturbance compares to a Proposed Action range of mining disturbance between a high of 5,429 acres to a low of 5,181 acres, or an overall 5 to 18 percent reduction in new land disturbance for this PFR alternative. The effects from groundwater pumping would be the same as the Proposed Action and considered negligible due to the predicted reductions in spring flows expected to have negligible effects on riparian habitats with potential to support terrestrial wildlife species.

The impacts associated with the operation and maintenance of the transmission systems would be the same as the Proposed Alternative and result in minor effects on terrestrial wildlife.

3.10.4.4.5 Cumulative Impacts

The cumulative impacts of surface disturbance would be 5 to 18 percent less than those estimated for the Proposed Action. However, similar to the Proposed Action, no cumulative impacts caused by overlapping on-the-ground activities in the NGS and associated facilities area are foreseen. In addition, no foreseeable actions would increase the area of disturbance, or the level of human activity. Therefore, cumulative impacts from mine activity from 2020-2044 would be negligible to terrestrial wildlife species.

The combination of NGS and Proposed KMC emissions under the Natural Gas PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs.

However, the project risk and contribution is so small that it does not change the overall effects to terrestrial wildlife species. Risks and effects would negligible as indicated by HQs below 1.

All other cumulative actions in the NGS, proposed KMC, and transmission systems areas that would adversely affect terrestrial wildlife species and their habitat would be the same as discussed in the Proposed Action cumulative impact discussion.

3.10.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. Prior disturbance impacts to terrestrial wildlife resources from the renewable source are not evaluated. Key assumptions about terrestrial wildlife related to such an existing site are listed below.

- A combined-cycle natural gas power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time and the existing plant would have undergone previous NEPA evaluation.
- Wildlife habitat was likely removed from the site and would not be revegetated until after facility decommissioning.
- Combustion and emissions for power generation from this alternative would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS; therefore, there would be no deposition from natural gas combustion to surface water in the study area. The description of emission calculations for the PFR is described in Chapter 2.0 and in Section 3.1, Air Quality.

3.10.4.5.1 Navajo Generating Station

3.10.4.5.1.1 Emissions and Deposition

The Renewable PFR Alternative would result in less coal burned and lower deposition of metals and other chemicals of concern in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Gap Regions of the Colorado River, and the San Juan River) when compared to the Proposed Action (**Table 3.10-6**).

Table 3.10-6 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Renewable PFR Alternative

Trace Metals	Proposed Action Emissions (tpy)		Renewable PFR 100-MW Power Reduction (tpy / % change)	Renewable PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.174 / -3%	2.075 / -7%
Selenium	2-Unit	1.491	1.424 / 4%	1.325 / -11%
Mercury (total)	3-Unit	0.117	0.114 / -3%	0.108 / -7%
Mercury (total)	2-Unit	0.078	0.075 / 4%	0.069 / -11%
Arsenic	3-Unit	0.133	0.130 / -3%	0.124 / -7%
Arsenic	2-Unit	0.089	0.086 / -4%	0.080 / -11%

As a result of lower deposition of metals, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight

reduction in project risks from mercury and selenium, the combination of Renewable PFR Alternative with baseline conditions would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas PFR Alternative.

3.10.4.5.1.2 Operations and Maintenance

Impacts to terrestrial wildlife species as a result of operation, maintenance, and improvement activities occurring at NGS and associated facilities, and along the BM&LP Railroad as a result of the Renewable PFR would be the same or less as the Proposed Action. All activities would remain within existing defined boundaries and ROWs and known disturbance to associated vegetation communities would be limited to the ash disposal site. Because coal production is less under the Renewable PFR Alternative, O&M activities which occur at NGS, associated facilities, and the BM&LP Railroad may occur less frequently. The reductions in coal production are between 2 percent and 11 percent annually under the Renewable PFR Alternative and because effects from disturbance under the Proposed Action were considered minor, they are considered minor under the Renewable PFR Alternative.

3.10.4.5.2 Proposed Kayenta Mine Complex

3.10.4.5.2.1 Operations and Maintenance

Surface disturbance caused by mining at the proposed KMC under the Renewable PFR Alternative would be proportionally reduced from 3 to 10 percent as compared to the Proposed Action, and by 5 to 18 percent as compared to the Natural Gas PFR Alternative (**Table 3.0-7**). Implementation of the Natural Gas PFR Alternative would not require any changes in the operation and maintenance of the WTS, STS, and the associated communication sites. The impacts of surface coal mining to terrestrial wildlife species under the Renewable PFR Alternative would be similar to the Proposed Action and the Natural Gas PFR Alternative; and be considered as moderate for terrestrial wildlife species. As discussed in Section 3.8.4.3, the Proposed Action would remove approximately 4,741 to 5,230 acres (12.5 and 13.8 percent) of native vegetation under the 3-Unit Operation and 2-Unit Operation. As displayed in **Table 3.0-7**, approximately 4,267 to 5,072 acres of new surface disturbance would occur under the 100-MW and 250-MW reductions under the Renewable PFR Alternative.

Under the Renewable PFR Alternative, decommissioning and final reclamation of the NGS and BM&LP Railroad would be the same as described for the Proposed Action.

3.10.4.5.2.2 Emissions and Deposition

The effects of the Renewable PFR Alternative from emissions on terrestrial wildlife would be similar to those described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on associated aquatic resources utilized by terrestrial wildlife species from KMC emissions in relation to the 8.1 million tpy (3-Unit) and 5.5 million tpy (2-Unit) coal production operations.

3.10.4.5.2.3 Groundwater Pumping

The effects of the Renewable PFR Alternative from groundwater pumping on terrestrial wildlife would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on associated aquatic resources utilized by terrestrial wildlife species from groundwater pumping in relation to the 8.1 million tpy (3-Unit) and 5.5 million tpy (2-Unit) coal production operations.

3.10.4.5.3 Transmission Systems and Communication Sites

3.10.4.5.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Impacts to terrestrial wildlife species do not differ from the Proposed Action and would be considered minor under Renewable PFR Alternative.

3.10.4.5.4 Project Impact Summary – All Project Components

The overall effects of the Renewable PFR Alternative on wildlife species and associated habitats would be similar to the Proposed Action and would vary from negligible to moderate depending on the activities conducted within each study area.

The Renewable PFR Alternative would result in lower emissions and deposition of metals within the study area compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by refined HQ values of less than one. The effects of the Renewable PFR Alternative in combination with baseline conditions would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. In addition, impacts from surface disturbing activities, human disturbance, and groundwater pumping would be the same as the Proposed Action and the Natural Gas PFR Alternative.

3.10.4.5.5 Cumulative Impacts

The cumulative impacts of surface disturbance would be 3 to 10 percent less than those estimated for the Proposed Action. However, similar to the Proposed Action, no cumulative impacts caused by overlapping on-the-ground activities in the NGS and associated facilities area are foreseen. In addition, no foreseeable actions would increase the area of disturbance, or the level of human activity. Therefore, cumulative impacts from mine activity from 2020-2044 would be negligible to terrestrial wildlife species. The combination of NGS and Proposed KMC emissions under the Renewable PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to terrestrial wildlife species.

All other cumulative impacts for the Renewable PFR Alternative would be the same as the Proposed Action and the Natural Gas PFR Alternative.

3.10.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate NEPA process once a facility location is identified. Key assumptions about terrestrial wildlife related to the construction of a new photovoltaic facility are detailed below.

- The construction of a new photovoltaic generation site on tribal land would require the commitment of land and would result in new surface disturbance at a location that would be evaluated in a subsequent NEPA action in which specific impacts to terrestrial wildlife will be discussed.
- Natural gas combined cycle firming power would not result in COPEC emissions deposition that would overlap with the associated with coal combustion emissions and deposition from NGS under the Proposed Action. The emissions caused from construction of the solar facility (fugitive dust and vehicles) could be located in the NGS study area but would be very localized and temporary, and therefore, considered to have no effect on terrestrial wildlife resources and not

carried forward in the analysis. This description of emission calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.

- The duration of construction of a photovoltaic site would take between 1.5 and three years.
- The land area required for a photovoltaic site would be between approximately 1,200 and 3,000 acres.

3.10.4.6.1 Navajo Generating Station

3.10.4.6.1.1 Emissions and Deposition

Selenium, arsenic and mercury for PFR NGS stack emissions would be reduced relative to the Proposed Action (**Table 3.10-7**).

Table 3.10-7 Emissions Reductions of Selenium, Mercury, and Arsenic Under the Tribal PFR Alternative

Trace Metals	Proposed Action (tpy)		Tribal PFR 100-MW Power Reduction (tpy / % change)	Tribal PFR 250-MW Power Reduction (tpy / % change)
Selenium	3-Unit	2.237	2.193 / -2%	2.123 / -5%
Selenium	2-Unit	1.491	1.443 / -3%	1.373 / -8%
Mercury (total)	3-Unit	0.117	0.115 / -2%	0.111 / -5%
Mercury (total)	2-Unit	0.078	0.076 / -3%	0.072 / -8%
Arsenic	3-Unit	0.133	0.121 / 9%	0.127 / -5%
Arsenic	2-Unit	0.089	0.087 / -3%	0.083 / -8%

As a result of lower deposition of metals, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in project risks from arsenic, mercury and selenium, the combination of Tribal PFR Alternative with baseline conditions would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas and Renewable PFR alternatives.

3.10.4.6.1.2 Operations and Maintenance

Impacts to terrestrial wildlife species as a result of operation, maintenance, and improvement activities occurring at NGS and along the BM&LP Railroad as a result of the Tribal PFR would be nearly the same as the Proposed Action and both the Natural Gas and Renewable PFR alternatives. All activities would remain within existing defined boundaries and ROWs and known disturbance to associated vegetation communities would be limited to the ash disposal site. Because coal production is less under the Renewable PFR Alternative, O&M activities which occur at NGS, associated facilities, and the BM&LP Railroad may occur less frequently. The reductions in coal production are between 2 and 7 percent annually under the Tribal PFR Alternative and because effects from disturbance under the Proposed Action were considered minor, they are considered minor under the Tribal PFR Alternative.

Under the Tribal PFR Alternative, decommissioning and final reclamation of the NGS and BM&LP Railroad would be the same as described for the Proposed Action.

3.10.4.6.2 Proposed Kayenta Mine Complex

3.10.4.6.2.1 Operations and Maintenance

Surface disturbance caused by mining at the proposed KMC under the Tribal PFR Alternative would be proportionally reduced from 2 to 7 percent, compared to 5 to 18 percent under the Natural Gas PFR

Alternative and 3 to 10 percent under the Renewable PFR Alternative (**Table 3.0-7**). The impacts of surface coal mining to terrestrial wildlife species under the Tribal PFR Alternative would be similar to the Proposed Action and both the Natural Gas and Renewable PFR alternatives; and be considered as a moderate impact to terrestrial wildlife species. As discussed in Section 3.8.4.4, the Proposed Action would remove approximately 4,741 to 5,230 acres of native vegetation under the 3-Unit Operation and 2-Unit Operation. This is between 12.5 percent and 13.8 percent of native vegetation removed, having a moderate impact on native vegetation. These areas would eventually be reclaimed with a grassland community. As displayed in **Table 3.0-7**, approximately 4,409 to 5,124 acres of new surface disturbance would occur under the 100-MW and 250-MW reductions under the Tribal PFR Alternative.

3.10.4.6.2.2 Emissions and Deposition

The effects of the Tribal PFR Alternative from emissions on terrestrial wildlife would be similar to those described for the Proposed Action and both the Natural Gas and Renewable PFR alternatives. There would be negligible effects on associated aquatic resources utilized by terrestrial wildlife species from KMC emissions in relation to the 8.1 million tpy (3-Unit) and 5.5 million tpy (2-Unit) coal production operations.

3.10.4.6.2.3 Groundwater Pumping

The effects of the Tribal PFR Alternative from groundwater pumping on terrestrial wildlife would be similar to those described for the Proposed Action and both the Natural Gas and Renewable PFR alternatives. There would be negligible effects on associated aquatic resources utilized by terrestrial wildlife species from groundwater pumping in relation to the 8.1 million tpy (3-Unit) and 5.5 million tpy (2-Unit) coal production operations.

3.10.4.6.3 Transmission Systems and Communication Sites

3.10.4.6.3.1 Operations and Maintenance

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Impacts to terrestrial wildlife species do not differ from the Proposed Action and would be considered minor under the Tribal PFR Alternative. Additional disturbance could occur to an unknown number of acres related to connecting a new photovoltaic generation site on tribal land to the existing transmission system and would be evaluated in a subsequent NEPA action.

3.10.4.6.4 Project Impact Summary – All Project Components

In summary, the Tribal PFR Alternative would result in lower emissions and deposition of metals within the study area compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by refined HQ values of less than one. The effects of the Tribal PFR Alternative in combination with baseline conditions would be the same as described for the Proposed Action and both the Natural Gas and Renewable PFR alternatives.

Impacts from surface disturbing activities, human disturbance, and groundwater pumping would be the same as the Proposed Action and both the Natural Gas and Renewable PFR alternatives. In terms of the analysis for the proposed KMC, there would be 2 to 7 percent less surface disturbance than the Proposed Action, which is still a moderate effect on terrestrial wildlife species. Effects from groundwater pumping for the KMC would be negligible.

The operation and maintenance of the transmission systems would result in negligible effects to general vegetation due to vegetation maintenance and other O&M activities. By following best management practices, effects on general vegetation will be minimized.

3.10.4.6.5 Cumulative Impacts

The impacts of the construction of a new photovoltaic generation site on tribal land would require additional commitments of the land, and would result in new surface disturbance and impacts to terrestrial wildlife species. However, similar to the Proposed Action, no cumulative impacts caused by overlapping on-the-ground activities in the NGS and associated facilities area are foreseen. In addition, no foreseeable actions would increase the area of disturbance, or the level of human activity. Therefore, cumulative impacts from mine activity from 2020-2044 would be negligible to terrestrial wildlife species. The combination of NGS and Proposed KMC emissions under the Tribal PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to terrestrial wildlife species.

All other cumulative impacts from the Tribal PFR Alternative would be the same as the Proposed Action and both the Natural Gas and Renewable PFR alternatives.

3.10.4.7 No Action

3.10.4.7.1 Navajo Generating Station

If continued operation of NGS and the BM&LP Railroad is not approved, the power plant would be decommissioned, and components of the plant demolished and placed in on-site or off-site landfills. As described under Section 3.8.4.7, there is low risk that additional vegetation would be removed because disturbed areas would not be enlarged during decommissioning and reclamation. However, due to the earthwork necessary for decommissioning activities like grading and revegetation, some vegetation would likely be disturbed in the existing ROW and lease area footprint. These areas would be revegetated with native vegetation once the decommissioning activities are completed. Similar to the Proposed Action, the effects of the No Action Alternative would be considered minor due to the expected surface disturbance and human disturbance.

Emissions under the No Action Alternative would be represented by the existing conditions plus the cumulative source impacts over the same time period (through 2074), but with the exclusion of current NGS emissions. The elimination of current NGS emissions would subtract a very small emission level from existing conditions. As a result, the risk indicator or HQ for terrestrial wildlife species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in project risks from arsenic, mercury and selenium, the baseline conditions would represent the same risks and effects as discussed for the Proposed Action and PFR alternatives.

3.10.4.7.2 Proposed Kayenta Mine Complex

No mining would occur in the proposed KMC coal resource areas after 2019. The predicted removal of natural vegetation (up to 5,230 acres) by the Proposed Action would not occur. Reclamation would consist of regrading, application of growth media (suitable overburden and soil), and reseeding disturbed areas. There is low risk that additional wildlife habitat would be removed because disturbed areas would not be enlarged during decommissioning and mine reclamation. Additional mitigation measures and best management practices would be applied to mine areas to benefit wildlife species during reclamation of the site. Therefore, there would be short-term minor impacts to terrestrial wildlife species from reclamation activities, similar to those described for the Proposed Action. However, terrestrial wildlife species would receive long-term benefits from the lack of mining and the return of native habitats.

The effect of emissions from the No Action Alternative would be the same as baseline conditions combined with other cumulative sources analyzed in the proposed KMC ERA. Emissions under the No Action Alternative would subtract the very small contribution from the proposed KMC facilities. Because the elimination of emission effects from the proposed KMC facilities would be very small, the resulting metal concentrations in waterbodies would be nearly the same as baseline conditions in combination with other cumulative sources characterized in the proposed KMC ERA (Ramboll Environ 2016d).

The actions required for decommissioning of NGS and associated facilities under the No Action alternative would be the same as those described under the Proposed Action.

The No Action Alternative includes pumping from community wells and windmills, pumping from leasehold wells for reclamation activities and water needs of local residents and the Many Mules project, and residual effects from past mine pumping. Pumping under the No Action Alternative would result in flow reductions of approximately 18 to 47 percent in Polacca, Chinle, and Begashibito washes and Laguna Creek, primarily caused by local community pumping. No future mine dewatering from the proposed KMC facilities would occur under the No Action Alternative resulting in negligible impacts to water resources.

3.10.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.10.4.7.4 No Action Impact Summary – All Project Components

In summary, the No Action Alternative would result in emissions resulting from existing baseline conditions plus the cumulative source impacts over the same time period (through 2074), but with the exclusion of current NGS emissions. The elimination of current NGS emissions would subtract a very small emission level from existing conditions. Therefore, the effects of No Action emissions on terrestrial wildlife communities in any of the ERA study areas would be the same as the Proposed Action because of the current baseline conditions. Because the elimination of emission effects from the proposed KMC facilities would be very small, the resulting metal concentrations would be nearly the same as baseline conditions in combination with other cumulative sources characterized in the proposed KMC ERA.

The No Action Alternative would result in minor impacts to terrestrial wildlife resources as a result of decommissioning and reclamation of the existing project facilities. Shorter-term effects would occur during restoration leading to longer-term benefits to resources as terrestrial wildlife habitats are established.

Pumping considered under the No Action Alternative would result in flow reductions of approximately 18 to 47 percent in Polacca, Chinle, and Begashibito washes and Laguna Creek (mostly caused by local community pumping), which would moderately reduce aquatic habitat and invertebrate and plant abundance when water is present. No future mine dewatering from the proposed KMC facilities would occur under the No Action Alternative. The impacts of No Action on terrestrial wildlife species and

associated habitat that are near or crossed by the transmission line ROWs generally would be the same as discussed for the Proposed Action.

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Section 3.11

Special Status Wildlife Resources

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Acronyms and Abbreviations

°F	degrees Fahrenheit
1969 Lease	Navajo Project Indenture of Lease
AGFD	Arizona Game and Fish Department
APLIC	Avian Powerline Interaction Committee
BART	Best Available Retrofit Technology
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
FCR	Field Contact Representative
FR	Federal Register
HHRA	Human Health Risk Assessment
HQ	hazard quotient
IM	Instruction Memoranda
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MBTA	Migratory Bird Treaty Act
MW	megawatt
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide

NO_X	nitrogen oxide
OSMRE	Office of Surface Mining Reclamation and Enforcement
PAC	protected activity center
PFR	Partial Federal Replacement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
RMPs	Resource Management Plans
ROW	Right-of-way
SGCN	species of greatest conservation need
SO_2	Sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
tpy	tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WTS	Western Transmission System

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3.11 Special Status Wildlife Resources

3.11.1 Regulatory Framework

Laws, regulations, and policies that directly influence wildlife management decisions for the project primarily are implemented by the U.S. Fish and Wildlife Service (USFWS), Navajo Nation, Hopi Tribe, Bureau of Land Management (BLM), U.S. Forest Service, Arizona Game and Fish Department (AGFD), Utah Division of Wildlife Resources, Office of Surface Mining Reclamation and Enforcement (OSMRE), and Nevada Division of Wildlife. A summary of prominent laws, regulations, directives, and agreements relevant to the proposed Project are included in **Table 3.11-1**.

Table 3.11-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
Endangered Species Act (ESA) of 1973 (16 United States Code 1531-1544)	The ESA provides broad protection for species of fish, wildlife, and plants listed as threatened or endangered by the USFWS. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. All federal agencies in consultation with and with the assistance of the USFWS, also must use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species. All federal agencies, in consultation with, and assistance of, the USFWS must ensure any action authorized, funded, or carried out by federal agency is not likely to jeopardize the continued existence of an endangered, threatened, or proposed listed species, or result in destruction or adverse modification of critical habitat of a species. Agencies are required to use the best scientific and commercial data available to fulfill this change.
Surface Mining Control and Reclamation Act of 1977	The Surface Mining Control and Reclamation Act of 1977 establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement. The law establishes minimum requirements for all coal surface mining on Federal and State lands, including exploration activities and the surface effects of underground mining. Mine operators are required to minimize disturbance and adverse impacts to biological resources and achieve enhancement of these resources where practicable.
Bald and Golden Eagle Protection Act (BGEPA) (16 United States Code, § 668 et seq.)	The BGEPA enacted in 1940 and amended several times since enactment, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment (USFWS 2016). Eagle breeding activities and nesting locations are afforded legal protection under the act.
Migratory Bird Treaty Act (MBTA)[1] (16 United States Code 703 et seq.)	The MBTA, originally passed in 1918, implements the U.S. commitment to four bilateral treaties [with Canada, Mexico, Japan, and Russia], or conventions, for the protection of a shared migratory bird resource (16 United States Code 703-712). The MBTA applies only to migratory bird species that are native to the U.S. or its territories. A native migratory bird is defined as one that is present as a result of natural biological or ecological processes. Excluded are species whose presence in the U.S. is solely the result of intentional or unintentional human-assisted introductions. The list of migratory bird species protected by the MBTA appears in

Table 3.11-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
	50 Code of Federal Regulations 10.13. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. "Take" is defined in regulations as: "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt." Nongame species that are excluded from protection under the MBTA include the rock pigeon, Eurasian collared-dove, European starling, and house sparrow. For all other native migratory bird species, the MBTA includes, but is not limited to, the following protections: • A total of 1,007 species of migratory birds and their parts, including eggs, feathers, and nests, are protected. • Proof of intent to violate the MBTA is not required for prosecution. • The MBTA has no consultation process such as Section 7 consultation under the ESA. The MBTA does not permit incidental or unintentional take, such as that provided by Sections 7 and 10 of the ESA.
Executive Order 13186 (66 Federal Register [FR] 3853)	Executive Order 13186 directs federal agencies that take actions that either directly or indirectly effect on migratory birds to develop a Memorandum of Understanding, and to work with the USFWS, and other federal agencies to promote the conservation of migratory bird populations. So far, nine agencies have completed a Memorandum of Understanding with the USFWS under the Executive Order, and several other Memorandums of Understanding are in progress.
Navajo Nation Code Title 17[2]	The Navajo Nation's Title 17 (subchapter 26) classifies wildlife species as big game animals, waterfowl, small game animals, fur-bearing animals, game birds, raptors, invasive species, and endangered species. These codes also establish regulations on unlawful take of these species.
Navajo Nation Golden and Bald Eagle Nest Protection Regulations	These regulations provide protection for golden eagles and bald eagles and their nests on the Navajo Nation by regulating human activities associated with land use, land development, and other activities in close proximity to known eagle nests.
Navajo Nation Raptor Electrocution Prevention Regulations	These regulations implement the Navajo Nation's policy of reducing the likelihood of electrocution of raptors by enforcing raptor-safe power pole design standards for new powerlines and repairs or upgrades to existing power lines within designated Raptor Sensitive Areas. The regulations include BMPs and information on raptor-safe power line designs based on Avian Powerline Interaction Committee (APLIC 2006) standards.
BLM Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6-125)	BLM Manual 6840 contains BLM's special status species management policy and guidance for the conservation of special status species and their habitats. Under this policy, special status species include animal and plant species listed as threatened or endangered, proposed for listing, and candidates for listing under the provisions of the ESA; those listed as sensitive species by a state; and those listed by the BLM State Director as sensitive. The objective of this policy is to ensure actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list nay special status species, under provisions of the ESA.
BLM Instruction Memoranda (IM) 2010-156; UT 2006-096; AZ 2011-005	BLM IM 2010-156 provides direction for complying with the BGEPA, including its implementing regulations (i.e., September 11, 2009, Eagle Rule [Rule] 50 Code of Federal Regulations parts 13 and 22) for golden eagles, and to identify steps that may be necessary within the habitat of golden eagles to ensure environmentally responsible authorization and development of renewable energy resources. This IM primarily addresses golden eagles, because a process to acquire take permits for bald eagles already exists. BLM IM UT 2006-096 provides supplemental planning guidance on raptor best

Table 3.11-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
	management practices. These raptor best Management practices apply to all ongoing and future land use planning efforts and they implement seasonal and spatial buffers, as well as mitigation, to maintain and enhance raptor nesting and foraging habitat, while allowing other resource uses. BLM IM AZ 2011-005is established as list of BLM sensitive plant and animal species on BLM-administered lands in Arizona in compliance with Manual Section 6840 and to clarify requirements regarding Sensitive Species.
BLM Resource Management Plans (RMPs)	The Western Transmission System (WTS) and Southern Transmission System (STS) and associated communication sites are subject to BLM RMPs where their rights-of-way (ROWs) traverse BLM-administered lands. Applicable RMPs include: the Arizona Strip, Hassayampa, Kanab, St. George, Caliente, and Las Vegas Field Office RMPs and the Aqua Fria National Monument RMP.
U.S. Forest Service Manual 2670	Section 2670 of the U.S. Forest Service Manual directs each Regional Forester to designation sensitive species on lands managed by the U.S. Forest Service. A sensitive species is defined as: a "plant or animal species identified by a Regional Forester for which population viability is a concern, as evidenced by a significant current or predicted downward trend in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution."
U.S Forest Service Land and RMPs	The STS is subject to management standards and guidelines contained in U.S. Forest Service Land and RMPs (Forest Plans) where the transmission line ROW traverses and communication sites are located on National Forest System lands. Applicable Forest Plans include those associated with the Kaibab and Prescott National Forests.
National Park Service Management Policies	Section 4.2.3 "Management of Threatened and Endangered Plants and Animals" of the National Park Service's *Management Policies 2006* (National Park Service 2006) requires the National Park Service to survey for, protect, and strive to recover all species native to the national park system that are listed under the ESA. In addition, the National Park Service is required to inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible.
Arizona Administrative Code Title 12, Chapter 4, Articles 3 and 4	Arizona Administrative Code Title 12, Chapter 4, Articles 3 and 4 establish rules for the taking and handling of wildlife and rules for live wildlife.
Arizona Revised Statute Title 17, Chapters 3 and 4	Arizona Revised Statute Title 17, Chapters 3 and 4 establish regulations for the taking and handling of wildlife and conservation projects and federal cooperation.
Utah Rules R657-3, R657-19, and R657-48	Utah Rule R657-3 regulates collection, importation, trasporation , and possession of animals. R657-19 regulates the taking and possesion of nongame mammals. R657-48 establishes the Wildlife Species of Concern and Habitat Designation Advisory Committee; defines its purpose and relationship to local, state, and federal governments, the public, business, and industry functions of the state; defines the Utah Sensitive Species List; and defines the procedure for the (a) designation of wildlife species of concern as part of a process to preclude listing under the ESA; and (b) review, identification and analysis of wildlife habitat designation and management recommendations relating to significant land use development projects.

Table 3.11-1 Relevant Statutes, Regulations, and Policies for Wildlife Species

Statutes, Regulations, and Policies	Summary
Nevada Administrative Code 503.0001-503.104	Nevada Administrative Code 503.0001-503.104 provides definitions for wildlife including "endangered," "protected," "sensitive," and "threatened" species as well as classifications of wildlife, including protected, threated, and sensitive species, and rules on taking of wildlife.

[1] The MBTA does not apply to bird species in families that are not referenced in any of the four treaties underlying the MBTA. These include the grouse, turkey, and quail species.

[2] Applies to the Proposed KMC only. Under the 1969 Lease, the Navajo Nation agreed not to regulate the construction, maintenance or operation of NGS facilities, including the BM&LP Railroad, as well as the WTS and STS on Navajo Nation land.

IM = Instruction Memoranda.

MBTA = Migratory Bird Treaty Act.

3.11.2 Study Areas

3.11.2.1 Proposed Action and Action Alternatives

As described in Chapter 1.0, there are three main components of the Navajo Generating Station (NGS) and proposed Kayenta Mine Complex (KMC) Project: the NGS and associated facilities, the proposed KMC, and the transmission systems and communication sites. To facilitate description of the affected environment and analysis of project effects, a total of nine different study areas divided among the three project components have been identified. Refer to Section 3.0 for a detailed description of these study areas. The project components and their associated study areas are listed below:

Navajo Generating Station:

- NGS Near-field study area
- Northeast Gap Region study area
- Southwest Gap Region study area
- San Juan River study area
- Black Mesa & Lake Powell (BM&LP) Railroad study area

Proposed KMC:

- Proposed KMC study area
- N-Aquifer study area

Transmission Systems:

- WTS study area
- STS study area

3.11.2.2 Cumulative

For special status wildlife resources, the cumulative effects study areas are the same as those described for the Proposed Action and its alternatives. The cumulative effects analysis includes an assessment of total project affects across all study areas plus the effects of other past, present, and reasonably foreseeable actions affecting special status wildlife species within these areas. It should be noted that

the actions assessed as part of the cumulative effects analysis may be located outside of the study areas listed above (e.g., mercury emissions associated with sources outside of the U.S.). However, to the extent that the effects of these actions combine with project-related effects to special status wildlife within the nine NGS-KMC study areas listed above, they are assessed as cumulative effects.

3.11.2.3 Ecological Risk Assessments – Role in Assessing Baseline Risk and Environmental Consequences

In order to evaluate total future risks associated with future emissions from the NGS, the proposed KMC, and other cumulative sources, it is necessary to consider the level of risk from chemicals of potential ecological concern (COPECs) currently present in the environment (i.e., the environmental baseline). Baseline conditions capture naturally occurring chemicals; past and on-going emissions and deposition from the NGS and proposed KMC; and past and on-going deposition from other local, regional, global sources up to the year 2020. As described in Section 3.0.3, four Ecological Risk Assessments (ERAs) were performed to evaluate environmental conditions in the vicinity of the NGS and proposed KMC. The NGS Near-field ERA evaluated the potential risk to special status wildlife species based on concentrations of NGS emission COPECs in soil, sediment, and surface water within a 20-kilometer (km) radius deposition area around the NGS plant. The Gap Regions ERA evaluated potential risks associated with baseline conditions as well as future operations of NGS to special status aquatic and aquatic-oriented wildlife species along the Colorado River outside of the NGS Near-field study area in the Northeast Gap Region above Glen Canyon Dam and in the Southwest Gap Region below Glen Canyon Dam. The San Juan River ERA evaluated potential risk from NGS stack emissions on aquatic-oriented wildlife within the San Juan River watershed based on sediment, surface water, and fish tissue concentrations. The KMC ERA evaluated potential risk to special status wildlife species resulting from baseline conditions, proposed future mine operations, NGS emissions, and other cumulative sources of COPECs within the proposed KMC. The determination of the ERA study areas is discussed in Section 3.0.2 and described in detail in **Appendix 3RA**, Ecological and Human Health Risk Assessments. Ecological risk for special status wildlife species that only have potential to occur along the transmission systems is not evaluated. It is assumed that, outside of the NGS Near-field study area, terrestrial species occurring along the WTS and STS corridors would not be affected by NGS emissions.

Exposure of wildlife receptors (terrestrial and aquatic-oriented invertebrates, mammals, and birds) was considered for a variety of representative and special status wildlife species with potential to occur in the study area of each ERA. The exposure pathway evaluated for terrestrial invertebrates included direct contact with COPECs in surface soil. The potential exposure of avian and mammalian receptors (including special status wildlife species) to COPECs in surface soil and food items was evaluated by modeling the ingestion of prey items (i.e., terrestrial invertebrates and small mammals), terrestrial plants, and surface water and the incidental ingestion of soil. Data used to characterize baseline conditions for the ERA study areas around the NGS was obtained from a combination of literature reviews, available data, and field sampling.

Hazard quotients (HQs) are calculated for each COPEC for each species considered. HQs are a unitless ratio of known or predicted COPEC concentrations and the appropriate ecological screening value below which impacts to a given species from exposure to a given COPEC are unlikely. The HQ is not a predictor of risk but rather is an indicator of whether or not there is a potential for risk. More information on how HQs are calculated and what the HQ result means is provided in Section 3.0.3 and in **Appendix 3RA**, Ecological and Human Health Risk Assessments. The HQ valued calculated for exposure to maximum concentrations of COPECs, denoted herein as HQ_{max}, is considered a screening-level HQ. It provides a very conservative indicator of risk because receptors (such as special status wildlife species) would practically never be exposed to maximum concentrations of COPECs in the wild. The HQ value calculated for refined concentrations of COPECs, denoted herein as $HQ_{refined}$, is considered to be a more realistic indicator of ecological risk than HQ_{max}.

If the maximum value of HQ_{max} at the no adverse effects level across all COPECs is less than or equal to (≤) 1, risk to the species is considered negligible. If HQ_{max} is greater than (>) 1, ecological risk is evaluated further using $HQ_{refined}$ for the particular COPEC. If $HQ_{refined}$ is less than (<) 1, risk is considered negligible. Conversely, if $HQ_{refined}$ is greater than or equal to (≥) 1 there is a potential risk to that species from one or more COPECs (**Appendix 3RA**, Ecological and Human Health Risk Assessments). For simplicity, in reporting HQs for species with potential to occur in more than one of the NGS ERA study areas, only the highest HQ values across all COPECs and study areas are provided when risk in each of the study areas is negligible. If the reader desires additional information, such as HQ values for other applicable COPECs or study areas, s/he may review the ERA summary provided in **Appendix 3RA** or the specific ERA reports of interest (Ramboll Environ 2016a,b,c,d). When there is potential risk to a species in one or more study areas, the study area(s) and COPEC(s) with HQs exceeding the risk threshold are identified.

Risks to special status wildlife species associated with baseline conditions are discussed in the Affected Environment section. Risks associated with the Proposed Action, and the Proposed Action when added to baseline conditions, are disclosed in the Environmental Consequence section. It should be noted that all HQs presented for the Proposed Action are associated with the 3-Unit Operation and are considered a worst-case scenario. HQs for the 2-Unit Operation are slightly lower than those for the 3-Unit Operation but, given that ecological risk to special status wildlife species is primarily a factor of baseline conditions and, in one case, other cumulative sources, implementation of the 2-Unit Operation would provide only incremental benefits to special status wildlife relative to the 3-Unit Operation.

3.11.3 Affected Environment

Special status wildlife species include species listed as threatened or endangered under the ESA, species that are candidates or have been proposed for listing under the ESA, species listed in Groups 2 and 3 of the Navajo Endangered Species List, species of cultural importance to the Hopi Tribe, species considered sensitive by the BLM and U.S. Forest Service, and state-listed sensitive species including species of greatest conservation need (SGCN) as identified in state wildlife action plans. Special status amphibian and fish species are addressed in Section 3.13, Special Status Aquatic Species.

This section provides information on the occurrence of federally listed species within the three main components of the project area and their associated study areas listed above. Pertinent life history and habitat information along with a summary of the species' listing and conservation status is provided for each of the threatened, endangered, and candidate species known or with potential to occur in the project area. Occurrence information and analysis of impacts to other special status wildlife species (i.e., BLM-, U.S. Forest Service-, Hopi-, and/or Navajo-designated sensitive species) are provided in tables by project component.

3.11.3.1 Navajo Generating Station

3.11.3.1.1 Federally Listed, Candidate, and Proposed Wildlife Species

Federally listed, proposed, and candidate wildlife species that are known or have potential to occur in the NGS study area include the California condor, Mexican spotted owl, southwestern willow flycatcher, and western yellow-billed cuckoo. Additional information on these species is presented below.

3.11.3.1.1.1 California Condor

<u>Species Occurrence</u>

In the vicinity of NGS and its associated facilities, condors are part of the "Southwest population" of condors, a designated non-essential experimental population. For the purposes of Section 7 of the Endangered Species Act, condors in this population are treated as a proposed species except within

National Parks and National Wildlife Refuges, where they are treated as a threatened species. Critical habitat is not present within the area occupied by the Southwest population.

As evidenced by images of condor telemetry data provided by the Peregrine Fund (Parish 2014, 2013), California condors occasionally fly by NGS, but the vast majority of condor activity occurs in and around Vermilion Cliffs National Monument (where the release site is located), Grand Canyon and Zion National Parks, the Kaibab Plateau and, to a lesser extent, Marble Canyon (**Figure 3.11-1**). Condors occurring in the easternmost portion of Vermilion Cliffs National Monument and along the Colorado River from Glen Canyon Dam downstream to the confluence of the Paria River are within the radius of the NGS Near-field emissions deposition area.

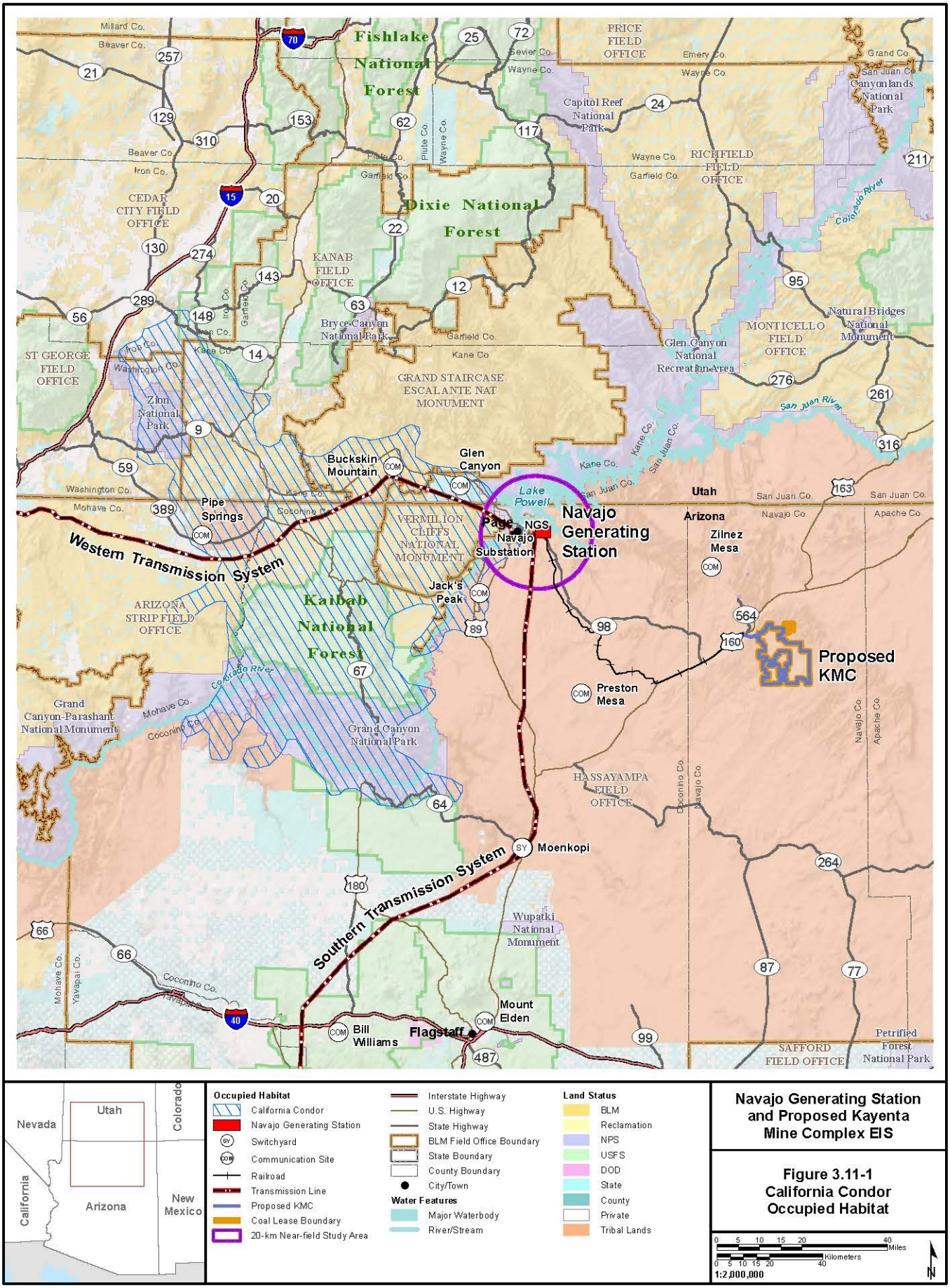
A map showing California condor telemetry relocations of individuals associated with the Southwest experimental non-essential population indicates that eight or nine condor flight paths have traversed the BM&LP Railroad ROW over the last 5 years (Parish 2014, 2013; The Peregrine Fund 2015). The vast majority of telemetry data have been recorded west and north of the railroad. Individuals recorded east of the railroad were on foraging flights as there are no records of condors nesting in this area.

Life History and Habitat Association

California condors are opportunistic scavengers that only feed on carrion. Condors are social feeders with typical foraging behavior consisting of long-distance reconnaissance flights, circle-soaring over a carcass, and hours of waiting at roosts or on the ground near a carcass (USFWS 1996). Condors do not use their sense of smell to locate food but rely on sight and the presence of other scavengers such as eagles and ravens to indicate the presence of food. Prior to Euro-American settlement of North America, condors inhabiting interior California likely fed on mule deer, elk, pronghorn, and smaller mammals. Condors have been observed feeding on 24 different mammal species in the last two centuries, and 95 percent of the diet consisted of cattle, domestic sheep, ground squirrels, mule deer, and horses. Over half of these observations were of condors feeding on cattle carcasses, mostly calves (USFWS 2013a). There also is some evidence that suggests California condors prefer deer over cattle.

California condors have an expansive home range and are capable of travelling from 50 to over 100 miles in a single day. Condors require open habitat for soaring and easily locating feeding opportunities. Condors do not build nests; rather, they move sand, branches, rocks, and other materials around in nest sites to produce an appropriate substrate needed for egg laying (USFWS 2013a). Breeding habitat typically is located in steep remote mountainous or canyon terrain on rock or cliff escarpments at low to moderate elevation.

Condor habitat must support large mammals that provide a source of carrion. Foraging habitats consist of open grasslands, shrublands, and pinyon-juniper woodlands that support populations of deer, elk, and cattle. Condors require large foraging areas because feeding opportunities are limited and often widely distributed across their range. Roosts found in or near both foraging and nesting habitat areas typically consist of large trees or snags with open lateral branches or cliff faces and rock spires with available perches. Because they are such large birds, condors typically select roosting sites near cliffs where updrafts provide adequate lift for them to take flight (AGFD 2012; Snyder and Rea 1998; USFWS 1996).



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-1 California Condor Occupied Habitat

7/20/2016

Courtship and nest site selection by breeding California condors occurs from December into spring. California condors primarily are a cavity-nesting species and typically nest in cavities located on steep rock formations or in burned out hollows of old-growth conifers (Koford 1953 and Snyder et al. 1986 as cited in USFWS 1996). Nest sites also may include cliff ledges, cup-shaped broken tops of old-growth conifers, and occasionally nests of other species (Snyder et al. 1986; USFWS 1996). Female condors typically lay a single egg between late January and early April. The egg is incubated by both parents and hatches after approximately 56 days. Both parents share responsibilities for feeding the chick. Feeding usually occurs daily for the first 2 months and tapers off thereafter. Condor chicks leave the nest at 2 to 3 months of age, but remain in the vicinity of the nest where they are fed by their parents. Chicks begin to fly at 6 to 7 months of age but do not become fully independent from their parents until the following year. Parent birds occasionally continue to feed a fledgling even after it has begun to make longer flights to foraging grounds. California condors may lay a replacement clutch if their first or even second egg is lost (Harrison and Kiff 1980; Snyder and Hamber 1985). California condors typically do not nest until they are at least 6 years old, and it is a long lived species, living up to 50 years (USFWS 1996).

Listing and Conservation Status

The California condor was designated as endangered on March 11, 1967, under the Endangered Species Preservation Act of 1966 (32 FR 4001). Following passage of the ESA of 1973, the species was listed as endangered under the ESA in 1975 (50 Code of Federal Regulations 17.11). Critical habitat for the California condor was designated in 1976 (41 FR 41914) and subsequently corrected and augmented in 1977 (42 FR 47840). No critical habitat is present within the project area.

A special provision of the ESA allows for the designation of experimental/non-essential populations of listed species, and re-introduction efforts for the condor were developed under this rule. The California condors that occur in the vicinity of NGS are part of the experimental/non-essential population that was reintroduced to the Vermilion Cliffs area of northern Arizona/southern Utah in 1996.

From 1992 to 2012, the primary threats to the Arizona population of California condors were lead poisoning (25 mortalities), predation (7 mortalities), starvation (4 mortalities), and shooting (3 mortalities). During this time, there was a single recorded incident of powerline-related mortality in this population. It is unknown whether this mortality was associated with a high voltage transmission line or with a lower voltage distribution line or whether it was due to collision or electrocution. Pre-release powerline aversion training of captive-reared condors began in 1995 and has proven successful in reducing condors' tendency to associate with power poles. As of 2013, no powerline-associated deaths from blunt-force trauma (i.e., collisions) or electrocutions have occurred since 2007 (USFWS 2013a).

The current recovery plan for the species was issued in April 1996 (Third Revision) and the most recent 5-year Review of the species' status was completed in June 2013. California condor population growth has been steady over the last two decades, and in late 2008 the wild condor population exceeded the captive population for the first time since 1983. As of December 31, 2015, the wild condor population totaled 268 individuals with 155 birds in California, 80 birds in Arizona/Utah, and 33 birds in Baja, Mexico (USFWS 2015a). The wild-fledged population is growing as a result of breeding in the wild by captive-released birds. The first chick fledged in the wild was produced in Arizona in the summer of 2003. Since then, the wild population has continued to grow and 2015 marked the first year in the history of the California Condor Recovery Program that the number of wild-fledged birds exceeded the number of deaths in the free-flying population (USFWS 2015a).

Factors Affecting Species

General factors affecting the California condor and its habitat within the project area are identified in the Listing and Conservation Status section, above. Lead poisoning through ingestion of lead ammunition continues to be the greatest factor affecting the Arizona/Utah population of condors. As of 2013, the most recent information on condor deaths indicated that nearly 50 percent of known deaths in the Arizona/Utah population resulted from lead toxicity (USFWS 2013a).

Due to the proximity of the Southwest population to NGS, baseline ecological risk to the California condor from past and on-going NGS emissions was evaluated qualitatively in the NGS Near-field ERA. Because the condor's diet consists primarily of carrion, exposure to COPECs is expected to be via pathways similar to those evaluated for predatory birds such as the red-tailed hawk. Further, condors are expected to be accidental or occasional visitors to the area thus limiting potential exposure. As even maximum concentrations of COPECs resulted in HQs <1 for the hawk (maximum HQ_{max} value is 0.06 for lead), potential baseline risk to the condor is not expected (**Appendix 3RA**, Ecological and Human Health Risk Assessments) (Ramboll Environ 2016a).

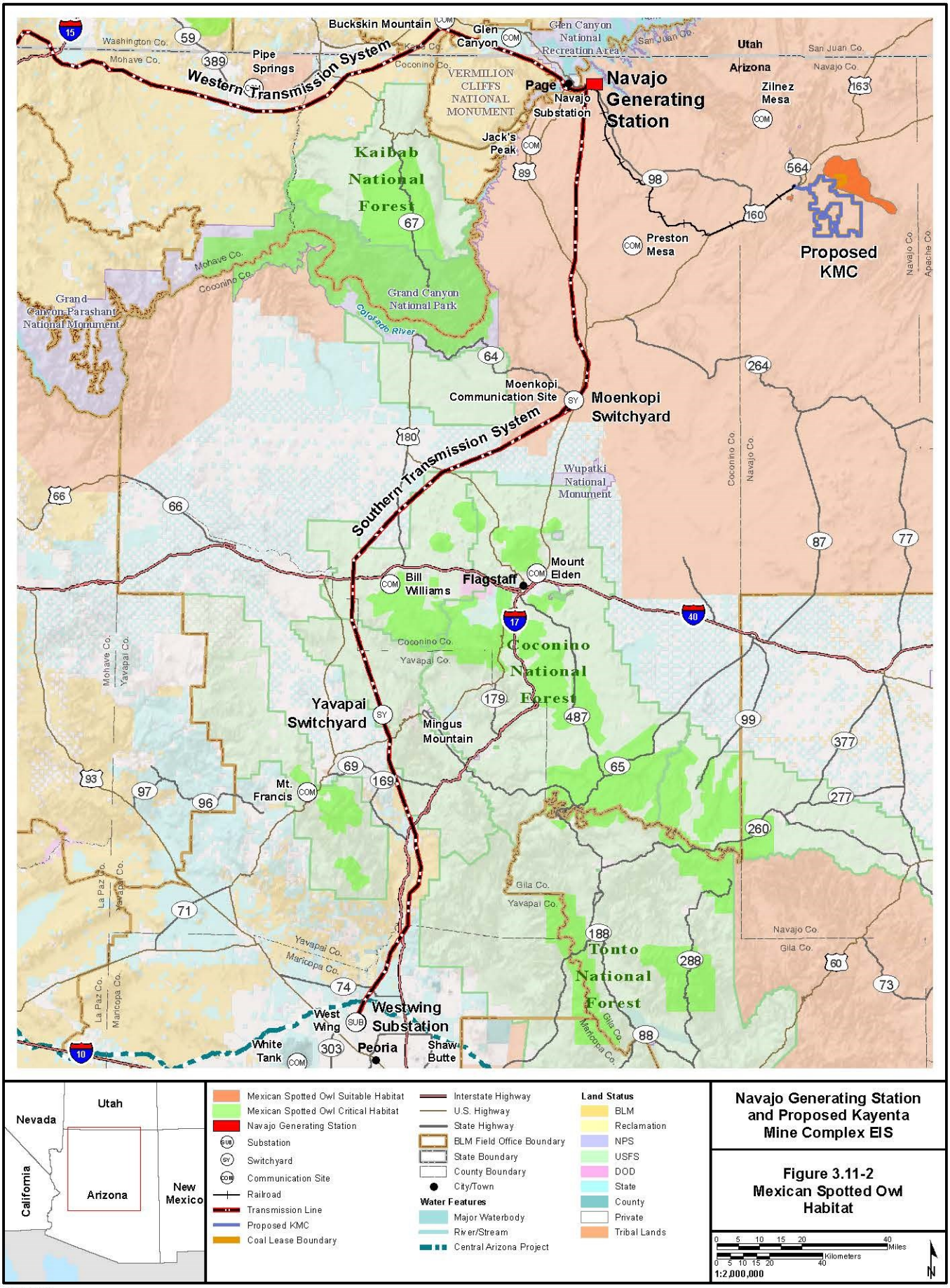
3.11.3.1.1.2 Mexican Spotted Owl

Species Occurrence

The nearest known Mexican spotted owl site to NGS is located in canyon habitat on the north side of Lake Powell, approximately 17 miles northeast of NGS (USFWS 2012). Other known nesting sites occur over 50 miles away in the Grand Canyon. Due to the lack of tree cover, Mexican spotted owls are unlikely to occur in the vicinity of NGS and associated facilities on a regular basis. Although there is some potential for Mexican spotted owls to occur in canyons present within the NGS emissions deposition area (e.g., Navajo Canyon, lower Paria River Canyon), the width of these canyons and general lack of riparian woodlands, mixed conifer forest, pinyon-juniper woodlands, or other woody vegetation in the lower portions of these canyons close to NGS suggests that they do not contain suitable Mexican spotted owl habitat (Willey 2016). Species-specific surveys conducted in lower Paria River Canyon from 2013 to 2015 did not detect any Mexican spotted owls in this area (Willey 2015). Refer to **Figure 3.11-2** for a map of designated critical habitat for Mexican spotted owl habitat in the analysis area.

Life History and Habitat Association

The Mexican spotted owl is one of three recognized subspecies of spotted owl in North America. The Mexican spotted owl is a permanent resident in the interior mountain ranges of western North America, ranging from southern Utah and central Colorado south through the mountains of Arizona, New Mexico, and extreme west Texas. The species typically occupies old growth forest in mixed conifer, pine-oak woodland, deciduous riparian forest, or a combination of these habitats that will support a home range of 1,400 to 4,500 acres (Ehrlich et al. 1988; Gutiérrez et al. 1995). An undisturbed core area, or "protected activity center," of approximately 600 acres centered on the nest site is the currently recommended disturbance buffer (Gutierrez et al. 1995).



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-2
Mexican Spotted Owl Habitat

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Mexican spotted owls have been reported at elevations ranging from 3,700 feet above mean sea level to the subalpine transition zone (Ganey et al. 1998; Gutierrez et al. 1995; Johnsgard 1988). The species typically inhabits steep canyons with mature or old growth forest, but they also may occur in canyons with steep cliffs and relatively little forest habitat. Mexican spotted owl habitat typically has a structured canopy, a perennial water source, and a rodent-dominated prey base of adequate size (Gutierrez et al. 1995). The Mexican spotted owl diet varies with geography with owls inhabiting the Colorado Plateau taking more woodrats versus owls occupying montane forest with forest-meadow interfaces consuming more voles (Ward and Block 1995).

Mexican spotted owls exhibit high nest fidelity and construct nests in rock crevices, tree cavities (usually in live trees) or on constructed platforms on tree limbs. In northern Arizona, owls have been reported in both canyon and montane forest situations (Ganey and Dick 1995 cited in: USFWS 2012). Mexican spotted owls also will utilize abandoned raptor or corvid platform nests (Ehrlich et al. 1988; Terres 1980).

Listing and Conservation Status

The Mexican spotted owl was designated as threatened on March 16, 1993 (58 FR 14248-14271) and a Recovery Plan was released on June 6, 1995 (60 FR 29913-29951). A revised Recovery Plan was issued in September 2012. Critical habitat for the Mexican spotted owl, as currently defined, was established on August 31, 2004 (69 FR 53181-53298). In the general vicinity of NGS and associated facilities, critical habitat has been designated in the lower portion of Marble Canyon, throughout Grand Canyon National Park, and in the Kaibab National Forest north of Grand Canyon. There is no designated critical habitat within the NGS Near-field study area. Mexican spotted owls in the vicinity of NGS and associated facilities occur in the Colorado Plateau Ecological Management Unit.

Forest management practices that have altered forest structure and increased the potential for stand-replacing wildfires is one of the primary factors affecting the quality and extent of Mexican spotted owl habitat (USFWS 2012). Wildfire can be detrimental and/or beneficial depending on several factors including whether or not the fire and/or suppression activities are within owl habitat; whether they affect nesting/roosting, foraging, or dispersal habitat; the intensity or severity of the fire; the areal extent, location, and intensity of fire suppression activities; the frequency and cumulative effects of suppression activities; and the time of year (USFWS 2012).

Grazing by domestic and wild ungulates comprises a potential threat to spotted owls when it reduces prey species habitat (e.g., by reducing herbaceous ground cover), adversely affects nesting/roosting habitat (e.g., by limiting regeneration of important tree species, especially in riparian areas), and limits the capacity for resource managers to restore and maintain conditions supporting natural fire regimes within a variety of habitat types (USFWS 2012). This potential threat occurs throughout the owl's range and often during periods of its reproductive cycle when prey availability is most critical.

Energy development and associated infrastructure development, including the construction and maintenance of power lines and roads, may affect owls through habitat loss and fragmentation. Other anthropogenic activities also can threaten the quality and quantity of Mexican spotted owl habitat. Water development can adversely affect owl habitat through permanent flooding of riparian forests as well as stream dewatering and altered flow regimes resulting in loss or degradation of both owl and owl prey habitats, disruption of migration corridors, and inhibited gene flow. For example, the creation of Lake Powell flooded habitat for a potentially large population of owls (Willey and Spotskey 2000).

Noise and disturbance also can threaten the quality of Mexican spotted owl habitat. Although infrequent, noise-producing activities are thought to have relatively little long-term adverse effect on spotted owls. Owls will change behavior and may flush from their perches in response to noise disturbances (Delaney et al. 1999; Swarthout and Steidl 2003). Owl flushing has been observed to be negatively related to distance and positively related to noise level (Delaney et al. 1999). Pater et al. (2009) quantified this response by determining that noise levels greater than approximately 69 decibels on the A-weighted

scale had a greater than 60 percent probability of causing an owl to flush. This noise level is approximately twice as loud as ordinary conversation. Although there is little research comparing the relative impact of various noise types, persistent noises are likely to be more disruptive than infrequent noises, and the intensity of disturbance is proportional to the noise level (USFWS 2012).

Climate Change, to the extent that it directly or indirectly affects forest ecosystems through altered temperature, precipitation, and disturbance regimes has potential to affect Mexican spotted owl habitat (USFWS 2012). Mawdsley et al. (2009) identified a number of climate change-related factors that could adversely affect the Mexican spotted owl including shifts in distribution of the owl and its major prey species, potential predators, and competitors along elevational or latitudinal gradients; effects on key demographic parameters such as survival and reproductive rates; changes in predator-prey relationships; loss of habitat due to increased severity of wildfire and bark beetle outbreaks; and increased populations or range expansion of direct competitors such as the barred owl.

A Recovery Plan for the Mexican spotted owl was approved in 1995, and a revision was completed and approved in 2012 (USFWS 2012). Population trends in the Colorado Plateau Ecological Management Unit and throughout the species range remain unclear (USFWS 2012). Data on trends in populations and site occupancy rates are few, and methods and sample sizes differ among studies making comparisons difficult. Nonetheless, results from specific study areas have all noted that the study populations have declined in the recent past (Gutiérrez et al. 2003 cited in: USFWS 2012; Seamans et al. 1999 cited in: USFWS 2012; Stacey and Peery 2002 cited in: USFWS 2012).

Factors Affecting Species

Potential and historic Mexican spotted owl habitat within the project area is likely being affected by several of the factors described as threats under the Listing and Conservation Status section, above. By necessity, maintenance of the STS ROW through forested habitats on and adjacent to the Kaibab and Prescott National Forests continues to fragment this habitat immediately adjacent to the ROW. However, given that the vast majority of these habitats are comprised of pinyon-juniper woodland and the fact that no Protected Activity Centers have been identified along the STS, maintenance of this ROW is unlikely to be causing a substantive impact on Mexican spotted owl habitat. Noise and disturbance associated with continued mining and reclamation operations in the northeastern portion of the proposed KMC has likely resulted in reduced habitat quality for Mexican spotted owl in the historic Protected Activity Centers located closest to these activities. To the extent that increased temperatures and reduced precipitation have adversely affected steep-slope conifer communities, riparian habitats, and/or prey abundance within the NGS Near-field study area, the northeastern portion of Black Mesa, and/or along the WTS and STS, climate change is likely playing a role in degrading Mexican spotted owl habitat quality within the project area.

Due to the potential for Mexican spotted owls to occur in the vicinity of NGS and associated facilities, potential ecological risk to this species from past NGS emissions was evaluated quantitatively in the NGS Near-field ERA. Under baseline conditions, maximum concentrations of all COPECs resulted in a maximum HQ_{max} <1 (HQ = 0.6 for lead and zinc) (Ramboll Environ 2016a). Thus, existing baseline conditions, which include historic NGS emissions, pose no risk to the Mexican spotted owl (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

3.11.3.1.1.3 Southwestern Willow Flycatcher

Species Occurrence

Within the NGS emissions deposition area there are documented occurrences of southwestern willow flycatcher along the Colorado River both upstream and downstream of Glen Canyon Dam. They also have potential to occur wherever suitable riparian habitats are present in this area. Refer to **Figure 3.11-3** for a map of potential and designated critical southwestern willow flycatcher habitat in and near the analysis area.

There have been no documented occurrences of the southwestern willow flycatcher in the vicinity of the BM&LP Railroad. There is potential for this species to occur immediately adjacent to the railroad in riparian habitat associated with Begashibito Wash/Cow Springs.

Life History and Habitat Association

The southwestern willow flycatcher is a neotropical migratory bird species that breeds in the U.S. Southwest and winters in the rain forests of Mexico, Central America, and northern South America. Males generally arrive at breeding areas approximately 1 or 2 weeks before the female and nest building usually begins 1 week thereafter. Nests are constructed as open cup nests approximately 8 centimeters high and 8 centimeters wide and typically are placed in the fork of a branch. Egg-laying can begin as early as late May but typically occurs in early to mid-June. Clutch size is usually 3 or 4 eggs for initial nests. Incubation last between 12 and 13 days from the date the last egg is laid, and eggs typically hatch within 24 to 48 hours of each other. Chicks can be present in the nest from mid-June through early August and fledging typically occurs from late June through mid-August. Adults then depart from breeding areas between mid-August to mid-September (Sogge et al. 1997).

The breeding season diet of southwestern willow flycatchers is almost exclusively insectivorous. Willow flycatchers forage on a wide range of prey taxa commonly including wasps and bees, flies, beetles, butterflies/moths and caterpillars, and spittlebugs (USFWS 2002). Diet studies of adult southwestern willow flycatchers have shown the subspecies' diet to be similar with major prey items ranging from small (e.g., flying ants) to large (e.g., dragonflies) flying insects with bees, flies, and true bugs comprising half of the prey items (DeLay et al. 2002; Drost et al. 1998). Diet can vary between years and among different habitat types. Foraging is done primarily by sallying from a perch to perform aerial hawking and gleaning. Foraging frequently takes place at edges and opening with a habitat patch, or at the top of the upper canopy (Sogge et al. 2010).

The southwestern willow flycatcher is considered a riparian obligate species during the breeding season. Four specific types of riparian communities have been described as southwestern willow flycatcher breeding habitat. The first is comprised of dense stands of willows 10 to 23 feet in height with no distinct overstory. This community is often associated with sedges, rushes, or other herbaceous wetland plants. A second habitat type includes dense stands of salt cedar or Russian olive, up to 33 feet in height. These species form a dense, closed canopy with no distinct understory layer. Native broadleaf-dominated communities form a third habitat type, and the fourth habitat type is a mixture of native and exotic riparian species (Sogge et al. 2010). It should be noted that the potential southwestern willow flycatcher habitat identified in **Figure 3.11-3** is based on the following Southwest Regional Gap Analysis Project (SWReGAP) land cover types: Invasive Southwest Riparian Woodland and Shrubland, North American Warm Desert Lower Montane Riparian Woodland and Shrubland, North American Warm Desert Riparian Mesquite Bosque, North American Warm Desert Riparian Woodland and Shrubland, and Rocky Mountain Lower Montane Riparian Woodland and Shrubland (U.S. Geological Survey 2005, 2004). These data are likely to overestimate potential flycatcher habitat in some areas and underestimate it in others.

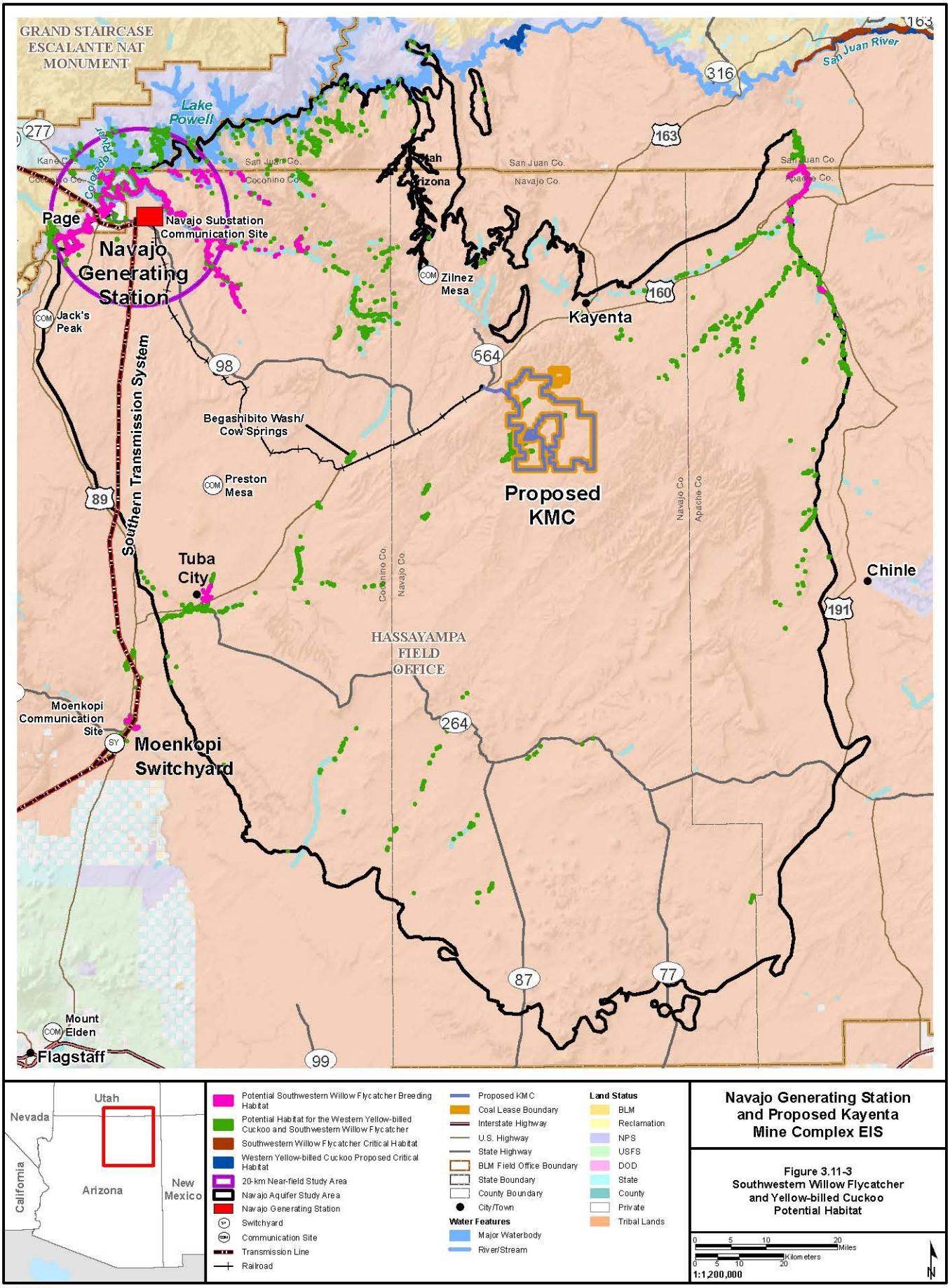

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Figure 3.11-3
Southwestern Willow Flycatcher and Yellow-billed Cuckoo Potential Habitat

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Regardless of the vegetation species composition, all of these habitats share common structural characteristics. Occupied southwestern willow flycatcher habitats always have dense vegetation in the interior that often are interspersed with small clearings, open water, or areas of sparse shrubs. Habitat patches can vary in size and shape with some occupied areas being relatively dense, linear, contiguous stands and others being large, irregularly shaped mosaics of dense vegetation intermingled with open areas. Habitat patch sizes can range from as little as 2 acres to several hundred or a thousand acres. Southwestern willow flycatchers may occur at elevations as high as 7,875 feet above mean sea level. They also inhabit willow or cottonwood riparian areas that extend into desert regions (Terres 1980). Migration and winter habitat could differ from breeding habitat for this subspecies. During migration, riparian habitat along major southwestern drainages commonly is utilized, but a close association with water may not always exist. These drainages could provide migration habitat for the southwestern willow flycatcher (USFWS 2002).

Listing and Conservation Status

The southwestern willow flycatcher was designated as endangered on February 27, 1995 (60 FR 10693-10715). Critical habitat was later designated on July 22, 1997 (62 FR 39129-39147), and the Final Recovery Plan for the subspecies was issued in August of 2002 with a notice of availability published in the FR on March 5, 2003 (68 FR 10485). A court decision in 2001 resulted in a subsequent Final Rule on Critical Habitat on October 19, 2005 (70 FR 60885-61009). The most recent 5-year review of the subspecies was completed by the USFWS in 2014 (USFWS 2014). On January 3, 2013, the USFWS revised critical habitat for the southwestern willow flycatcher (78 FR 344-534). In total, approximately 1,227 stream miles have been designated as critical habitat, with a lateral extent including riparian areas and streams that occur within the 100-year flood plain or flood-prone areas totaling 208,973 acres. A Final Recovery Plan for the southwestern willow flycatcher was issued in August of 2002 (USFWS 2002).

The most critical threats to the southwestern willow flycatcher include extensive loss, fragmentation, and modification of riparian breeding habitat (Sogge et al.1997), with consequent reductions in population levels (USFWS 2002). This species also is affected directly by factors that impact their survival and reproductive success such as brood parasitism by brown-headed cowbirds, which further reduce population levels. Destruction and modification of riparian habitats primarily have been caused by reduction of surface water and groundwater due to diversion and groundwater pumping, changes in flood and fire regimes due to dams and stream channelization, clearing and controlling vegetation, livestock grazing, changes in water and soil chemistry due to disrupted hydrologic cycles, and establishment of invasive plants (USFWS 2002). More recently, there have been widespread impacts to southwestern willow flycatcher habitat resulting from the release and spread of the tamarisk beetle (*Diorhabda* spp.). Beetle-caused tamarisk defoliation surrounding southwestern willow flycatcher nests results in decreased vegetation and nest cover and may, in turn, result in increased predation and brood parasitism risk and altered microclimate, which, when combined with drought-related reductions in surface water and groundwater, can result in reduced chick survival (Bateman and Johnson 2015; McLeod and Pellegrini 2013 cited in: Bloodworth et al. 2016).

As of 2007, there were data for 288 southwestern willow flycatcher breeding sites and 1,299 nesting territories (Durst et al. 2008). This was a marked difference from the 41 sites and 140 breeding territories that were known in 1993, but this increase was largely a function of the increased survey effort over that time period (Paradzick and Woodward 2003, cited in: Durst et al. 2006). In Arizona, 124 southwestern willow flycatcher breeding sites and 459 territories were known as of 2007 (Durst et al. 2008). This is an increase of nearly 127 percent in number of sites and over 200 percent in number of territories over 10 years from 1998 to 2007 (Durst et al. 2008, 2006). Again, this increase is mostly likely a function of increased survey effort rather than increased population. Determination of actual population trends is difficult due to a lack of annual standardized survey efforts, terminology (e.g., definition of “site”), reporting, and the associated variances in survey effort. As of 2005, it was known that willow flycatchers territories had disappeared from 133 of 275 sites tracked since 1993 (Durst et al. 2006). However,

because the majority of the sites in which flycatchers no longer are detected contained only one or two territories, their loss does not greatly affect the overall rangewide territory estimates (Durst et al. 2006).

Factors Affecting Species

Existing and potentially suitable southwestern willow flycatcher habitat within the project area has been and continues to be affected by most, if not all, of the factors identified as threats in the Listing and Conservation Status section, above.

Because the southwestern willow flycatcher is known to occur in the vicinity of NGS and associated facilities and has potential to occur along the Colorado and San Juan rivers, potential ecological risk to this species from past NGS emissions was evaluated quantitatively in the NGS Near-field, Gap Regions, and San Juan River ERAs. Under baseline conditions, maximum concentrations of all COPECs resulted in HQs below 1 for this species. The highest baseline HQ_{max} values calculated for southwestern willow flycatcher were 0.2 for selenium in the Northeast Gap Region and selenium and methylmercury along the San Juan River (**Appendix 3RA,** Ecological and Human Health Risk Assessments). Thus, existing baseline conditions, which include historic NGS emissions, pose negligible risk to the southwestern willow flycatcher.

3.11.3.1.1.4 Western Yellow-billed Cuckoo

Species Occurrence

There are no known occurrences of the western yellow-billed cuckoo in the vicinity of the NGS Plant. Within the NGS emissions deposition area, there is some potential for the species to occur in riparian habitats in side canyons to Lake Powell, such as Navajo Canyon, but it is unlikely that the species composition, structure, and/or areal extent of these habitat patches are sufficient to support breeding pairs. There are known occurrences of the western yellow-billed cuckoo along the San Juan River, but potentially suitable habitat along the San Juan is located nearly 50 miles east-northeast of NGS and associated facilities. The nearest proposed critical habitat is located along the San Juan River over 55 miles from NGS. There also is some potential for the species to occur in the gap regions, but riparian habitat is likely too narrow and limited in extent to support breeding cuckoos in the Southwest Gap Region. The Northeast Gap Region has marginally more potential to support nesting pairs but ends at the confluence of the Colorado and Green rivers in Utah. Proposed critical habitat is located along the Green River upstream of the confluence. Refer to **Figure 3.11-3** for a map of potential and proposed critical western yellow-billed cuckoo habitat in the analysis area.

There are records of occurrence of western yellow-billed cuckoo from Begashibito Wash/Cow Springs, which is located on the Navajo Nation adjacent to the BM&LP Railroad; however, these were not nesting records (Corman and Magill 2000); The woody riparian/wetland habitat in this area appears to be dominated by tamarisk with few native cottonwoods or willows present. As such, this site is probably only used by cuckoos during migration, as it is unlikely to support breeding or nesting western yellow-billed cuckoos.

Life History and Habitat Association

The western yellow-billed cuckoo is a neotropical migrant that spends the winter in South America, east of the Andes and primarily south of the Amazon Basin (78 FR 6121). The winter range and migration routes of the western yellow-billed cuckoo are poorly known, but research indicates that the San Pedro River and the lower Colorado River and its tributaries are migratory corridors (Halterman 2009). In Arizona, most cuckoos do not arrive on their breeding grounds until mid-June (Corman and Wise-Gervais 2005). Nesting typically occurs between late June and late July but may begin as early as May and continue into September (Halterman et al. 2015). Western yellow-billed cuckoos typically have one

brood per year (Ehrlich et al. 1988), but double broods have been regularly observed on the lower Colorado and Bill Williams rivers (McNeil et al. 2013).

Western yellow-billed cuckoos are considered riparian obligates because they nest almost exclusively in low- to moderate-elevation riparian woodlands that are located within arid to semiarid landscapes and contain native broadleaf trees and shrubs (Hughes 1999, 79 FR 59992). The species is most commonly associated with cottonwood and willow-dominated vegetation, but the composition of its habitat varies across its range.

Breeding sites often have a distinct overstory of willow, cottonwood, or other broadleaf trees with discernible sub-canopy layers and an understory of mixed trees and shrubs, including tamarisk (Halterman et al. 2015). Western yellow-billed cuckoos in Arizona most commonly occur in cottonwood/willow/ash/mesquite habitat but suitable habitat also may include elderberry, desert willow, mimosa, juniper, and Russian olive (USFWS 2016). In some areas, especially in southern Arizona, cuckoos have been found breeding in narrow stringers of mature trees in drier reaches or in narrow drainages, although at a lower density than in wider riparian habitats (USFWS 2016). Western yellow-billed cuckoos least commonly occur in habitat comprised of greater than 75 percent tamarisk cover (Johnson et al. 2010). Along the lower Colorado River, cuckoos nest in large (i.e., greater than 50-acre) patches of habitat with a dense canopy (McNeil et al. 2013). It should be noted that the potential western yellow-billed cuckoo habitat identified in **Figure 3.11-3** is based on the following Southwest Regional Gap Analysis Project land cover types: Invasive Southwest Riparian Woodland and Shrubland, North American Warm Desert Lower Montane Riparian Woodland and Shrubland, North American Warm Desert Riparian Mesquite Bosque, North American Warm Desert Riparian Woodland and Shrubland, and Rocky Mountain Lower Montane Riparian Woodland and Shrubland. Although it is possible for migrating cuckoos to use these habitats on a transitory basis, the potential habitat, as depicted, probably is an overestimate of potential cuckoo breeding habitat as many of these areas are unsuitable for cuckoo nesting due to insufficient areal extent and/or dominance by exotic vegetation.

Cuckoos eat a variety of prey items with large arthropods (e.g., cicadas, katydids, grasshoppers, and caterpillars) as their primary prey. Other prey includes small lizards, frogs, spiders, tent caterpillars, and a variety of other insects (Halterman et al. 2015). There is evidence to suggest that population levels and breeding may be closely tied to the abundance of certain food items (Halterman 2009; McNeil et al. 2013; and multiple other authors cited in: Halterman et al. 2015).

Listing and Conservation Status

The Western U.S. distinct population segment of the yellow-billed cuckoo (hereafter referred to as western yellow-billed cuckoo) became a candidate species for listing as threatened or endangered on October 30, 2001 (66 FR 54807-54832). On October 3, 2013, the western yellow-billed cuckoo was proposed for listing under the ESA (78 FR 61621-61666). On November 3, 2014, the species was listed as threatened by the USFWS (79 FR 59992-60038). On August 15, 2014, the USFWS proposed critical habitat for the western yellow-billed cuckoo (79 FR 48548-48652).

Habitat loss is the primary threat to the western yellow-billed cuckoo (Corman and Wise-Gervais 2005; Floyd et al. 2007). Western yellow-billed cuckoos appear to require large tracts of contiguous habitat (Sutter et al. 2005), and population declines across the Western U.S. primarily are due to the loss of cottonwood-dominated riparian habitat. This loss primarily is a result of conversion to agriculture, dams and river flow management, bank protection, overgrazing, competition from exotic plants such as tamarisk, urban development including transportation infrastructure, and increased wildfire (Bennett and Keinath 2003; USFWS 2013c). Western yellow-billed cuckoos are further threatened by their low population size, extreme population fluctuations, and patchy distribution (Bennett and Keinath 2003). Heavy pesticide usage during the last 50 years also has likely contributed to population declines by removing prey, directly poisoning birds, and causing egg shell thinning (Bennet and Keinath 2003).

Due to the rarity of western yellow-billed cuckoo habitat and because populations tend to be small and isolated, the remaining populations in western North America are increasingly susceptible to further declines through lack of immigration, chance weather events, fluctuating availability of prey populations, pesticides, collisions with tall vertical structures during migration, spread of the introduced tamarisk leaf beetle as a biocontrol agent in the Southwest, and climate change (USFWS 2013b).

No recovery plan has yet been developed for the western yellow-billed cuckoo. Most locations in Arizona that have western yellow-billed cuckoo populations have not been surveyed regularly enough to provide population trend information. The only two locations with fairly regular monitoring (the Bill Williams and San Pedro rivers) both show downward trends in cuckoo populations (79 FR 60005). The population along the lower Colorado River on the Arizona-California border appears to be increasing with riparian restoration activities in that area, but more years of survey data are needed to determine whether or not that is a long-term trend (79 FR 6005).

Factors Affecting Species

Factors affecting potential western yellow-billed cuckoo habitat within the project area include several of those described as threats in the Listing and Conservation Status section, above. The primary factors likely include loss or conversion of habitat due to river flow management and invasion of exotic invasive riparian vegetation including tamarisk and Russian olive. Overgrazing has likely also led to loss of suitable riparian habitat in portions of the project area. In addition, to the extent that increased temperatures and decreased or more variable precipitation resulting from climate change have reduced the extent of or degraded riparian woodland habitats in the project area, these factors also have reduced the quality and extent of suitable yellow-billed cuckoo habitat in this area.

Because the western yellow-billed cuckoo has potential to occur in the vicinity of NGS and along the Colorado River upstream and downstream of Glen Canyon Dam and is known to occur along the San Juan River, potential ecological risk to this species from past NGS emissions was evaluated quantitatively in the NGS Near-field, Gap Regions, and San Juan River ERAs. Under baseline conditions, maximum concentrations of all COPECs resulted in maximum and refined HQs below 1 for this species in the NGS Near-field study area, San Juan River, as well as in the Northeast and Southwest Gap Regions. The maximum HQmax value calculated for the western yellow-billed cuckoo was 0.8 for methylmercury in the Southwest Gap Region study area (**Appendix 3RA**, Ecological and Human Health Risk Assessments). Thus, existing baseline conditions pose negligible risk to the western yellow-billed cuckoo in these areas.

3.11.3.1.2 Other Special Status Wildlife Species

Other special status wildlife species include species listed in Groups 2 and 3 of the Navajo Endangered Species List that also are not listed under the ESA, BLM-, and U.S. Forest Service-designated sensitive species, and state-listed SGCN at the Tier 1a level for Arizona. Navajo Endangered Species List Group 4 species are identified for species that are considered special status by other federal or state agencies. Similarly, Arizona SGCN at the Tier 1b level are identified for species considered special status by federal or tribal agencies but Tier 1b species are not included if that is their sole designation. Other special status wildlife species with potential to occur in the vicinity of NGS and its associated facilities, including the BM&LP Railroad, and have potential to be affected by NGS emissions or plant operations are listed in **Table 3.11-2**.

Table 3.11-2 Other Special Status Wildlife Species Occurrence in the NGS Study Areas

Species	Status[1]	Occurrence in Study Areas[2]	Habitat and Diet
Desert Bighorn Sheep (*Ovis canadensis nelsoni*)	NESL G3, BLMS	NGS: P RR: P	Desert bighorn sheep occur in cliff and canyon and desert scrub habitats. Their diet comprises mostly grasses but they also eat forbs and browse (Festa-Bianchet 2008).
Houserock Valley Chisel-toothed Kangaroo Rat (*Dipodomys microps leucotis*)	FS, BLMS, SGCN 1b	NGS: P	This kangaroo rat is found in desert valleys dominated by desert scrub habitat. Nests are found in underground burrows. The species is essentially solitary and its diet consists primarily of leaves of terrestrial plants (particularly salt bush) and seeds but it will sometimes eat insects and fungi. Kangaroo rats are nocturnal and active throughout the year (Linzey and NatureServe 2008).
Spotted Bat (*Euderma maculatum*)	BLMS, FS, SGCN 1b	NGS: K RR: P	Spotted bats occur in a wide variety of habitats including: barren/sparsely vegetated, cliff and canyon, desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands, and conifer woodland habitats. They are typically solitary and feed primarily on moths (Adams 2003).
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	BLMS, NESL G4	NGS: P RR: P	The Townsend's big-eared bat may occur in desert scrub, herbaceous wetland, open water, woody riparian and wetlands, and conifer woodland habitats. They feed on moths, lacewings, and flies (Adams 2003).
American Dipper (*Cinclus mexicanus*)	NESL G3, SGCN 1b	NGS: P GR: P SJR: P	The American dipper is an aquatic-oriented bird primarily associated with fast-moving, clear, unpolluted streams with cascades, riffles, and waterfalls (Wilson and Kingery 2011). This species primarily feeds on aquatic insects but also may take small fish and fish eggs (Wilson and Kingery 2011).
Bald Eagle (*Haliaeetus leucocephalus*)	FS, BLMS, NESL G2, H, SGCN 1a, BGEPA	NGS: K GR: K SJR: K RR: P	Bald eagles typically nest in trees adjacent to large waterbodies with suitable prey. There are no known bald eagle nests within the project area. Winter roosts are in large trees in forests, river bottoms, or near canyon rims within a few miles of ponds, lakes, and rivers with adequate prey. Wintering eagles occur along the San Juan and Colorado Rivers (Mikesic and Roth 2008). Preferred prey is fish but also consumes birds and mammals, often as carrion (especially in winter). Takes a variety of aquatic and terrestrial mammals, including muskrats, hares, reptiles and amphibians, and a variety of birds including many species of waterfowl and gulls (Buehler 2000).

Table 3.11-2 Other Special Status Wildlife Species Occurrence in the NGS Study Areas

Species	Status[1]	Occurrence in Study Areas[2]	Habitat and Diet
Ferruginous Hawk (*Buteo regalis*)	NESL G3, H, SGCN 1b	NGS: P RR: K	Ferruginous hawks nest in badlands, flat or rolling desert grasslands, and desert scrub. On the Navajo Nation, most nests are located on clay or rock pinnacles, small buttes, and short cliffs. Some nests are placed on juniper trees or on the ground. Preferred prey consists of cottontail rabbits, jackrabbits, prairie dogs, ground squirrels, and gophers (Mikesic and Roth 2008).
Golden Eagle (*Aguila chrysaetos*)	NESL G3, H, BLMS, SGCN 1b, BGEPA	NGS: K RR: K	Golden eagles nest on steep cliffs, 100 feet tall or greater. Nesting cliffs are typically adjacent to foraging habitat of desert grasslands or desert scrub that supports primary prey of cottontail rabbits and jackrabbits (Mikesic and Roth 2008).
American Peregrine Falcon (*Falco peregrinus anatum*)	FS, BLMS, NESL G4, H, SGCN 1a	NGS: K RR: P	Peregrine falcons nest on steep cliffs greater than 100 feet tall within approximately 7 miles of quality foraging habitat comprising extensive wetlands and other open landscapes with available prey. Known to nest in Glen Canyon and the canyon reaches of San Juan, Colorado, and Little Colorado Rivers (Mikesic and Roth 2008). Prey comprised mostly of birds (primarily pigeons and doves) and occasionally mammals (primarily bats) (White et al. 2002).
Western Burrowing Owl (*Athene cunicularia hypugaea*)	BLMS, NESL G4, SGCN 1b	NGS: P RR: P	Burrowing owl breeding habitat includes desert grasslands, desert scrub and pinyon-juniper woodlands. The species nests in ground burrows (typically abandoned prairie dog burrows) in dry open grasslands and grasslands with sparsely distributed junipers (Mikesic and Roth 2008). Primary prey comprised of insects (mainly grasshoppers, crickets, moths, and beetles) and small mammals such as mice, voles, and shrews (Poulin et al. 2011).

[1] Status: NESL = Navajo Endangered Species List, G2 = Group 2, G3 = Group 3, G4 = Group 4; H = Hopi Cultural Sensitive Species; FS = Forest Service Sensitive; BLMS = BLM Sensitive; CAS = Conservation Agreement Species; SGCN = State Species of Greatest Conservation Need, 1a = Tier 1a, 1b = Tier 1b; BGEPA = Bald and Golden Eagle Protection Act.

[2] Occurrence Categories: NGS = NGS Near-field study area; GR = Gap Region study area; SJR = San Juan River study area; RR = BM&LP Railroad study area; K = Known occurrence based on Natural Heritage Program data, Navajo data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, the USFWS IPaC system, and/or the AGFD HabiMap utility.

3.11.3.1.2.1 Factors Affecting Other Special Status Wildlife Species

General factors affecting other special status wildlife species within the NGS Near-field study area include habitat loss and degradation associated with residential and recreational development (e.g., the communities of Page, Lechee, and Wahweap, Arizona), and the seasonally high levels of vehicle traffic and human activity associated with these areas. Vehicle traffic associated with tourism and current NGS operations (commuter traffic and chemical deliveries) likely results in some level of direct injury and mortality to small mammals such as kangaroo rats crossing roads and raptors (particularly bald eagles) that feed on roadkill. Bighorn sheep likely avoid developed areas, reducing the amount of functional habitat available for this species in the NGS Near-field study area. Moreover, the presence of the BM&LP Railroad is a barrier to bighorn sheep movement, fragmenting available habitat for this species. It should be noted that the overhead distribution line that runs between NGS and the Lake Pump Station and supplies power to the cooling water intake pumps has been designed and built to be raptor-safe according to standards developed by the Avian Powerline Interaction Committee (2006). Consequently, there is negligible avian electrocution risk associated with this line. Although there is potential for large raptors to be electrocuted by the BM&LP Railroad catenary system, there have been no known electrocutions of raptors or other large birds associated with operation of the railroad to date.

Baseline ecological risk to other special status wildlife species within the NGS Near-field, Gap Regions, and San Juan River study areas was directly assessed only for the bald eagle, which was modeled as a representative piscivorous (fish-eating) species and special status aquatic-oriented species. Under baseline conditions the bald eagle was determined to have HQ_{max} values less than 1 in the Northeast Gap Region and San Juan River study areas, indicating negligible baseline risk to the bald eagle in these areas. However, for the NGS Near-field study area and the Southwest Gap Region, baseline HQ_{max} values for the bald eagle were determined to be 1 and 4, respectively. $HQ_{refined}$ in the NGS Near-field area drops to 0.6, indicating negligible risk to the bald eagle under this more realistic exposure scenario. In the Southwest Gap Region study area, $HQ_{refined} = 3$, indicating potential baseline risk to the bald eagle from methylmercury exposure in this area. It should be noted that the elevated baseline ecological risk calculated for bald eagles in the Southwest Gap Region resulted from the inclusion of data collected by Walters et al. (2015). The model results for methylmercury in bald eagles were heavily influenced by the high levels of mercury observed in fish species that are prey for bald eagles. However, it questionable whether the results of Walters et al. (2015) investigation are representative of actual baseline conditions (Ramboll Environ 2016c, Appendix A-1D).

Baseline ecological risk to other special status species in the NGS ERA study areas may be inferred from ERA results pertaining to representative wildlife species. In the NGS Near-field study area, all HQ values calculated using maximum COPEC concentrations are below 1 for representative wildlife species, indicating that baseline conditions pose negligible risk to other terrestrial and aquatic-oriented special status species in the vicinity of the NGS (Ramboll Environ 2016a). Similarly, in the Northeast and Southwest Gap Regions and San Juan River study areas, HQ_{max} for all COPEC/receptor combinations are below 1 (Ramboll Environ 2016b,c), indicating that baseline conditions pose negligible risk to other special status wildlife species with potential to occur in these. Refer to **Table 3.11-5** for more detail on representative species used in this analysis.

3.11.3.2 Proposed Kayenta Mine Complex

3.11.3.2.1 Federally Listed, Candidate, and Proposed Wildlife Species

3.11.3.2.1.1 Black-footed Ferret

<u>Species Occurrence</u>

No black-footed ferrets have been documented within the overall project area. There are two known active Gunnison prairie dog colonies within the proposed KMC permit area: Colony PD 17-18 and Colony PD-20. As of 2015, PD 17-18, located in sagebrush shrubland habitat, was approximately 36 acres in size with a population estimate of approximately 14 prairie dogs. PD-20, located in reclaimed

grassland habitat, is approximately 25 acres in size with a 2015 population estimate of 57 adult prairie dogs (Ecosystem Management, Inc. 2016). Neither of these colonies is considered large enough to support black-footed ferrets. To the extent that there are Gunnison prairie dog colonies greater than 400 acres in size within the N-Aquifer study area, there is potential for black-footed ferrets to occur there. However, it is very unlikely that any wild populations of the species survive on the Navajo Nation and there have been no observations of ferrets on the Navajo Nation in several decades (Smith and Hazelton 2014).

Life History and Habitat Association

Black-footed ferrets are prairie dog obligates, and prairie dog colonies are the only known habitat that sustains black-footed ferret populations (Biggins et al. 2006). Prairie dog colonies typically are found in short- and mid-grass prairies, and semi-desert areas with mosaics of grass and shrubs (Esch et al. 2005). Ferret-occupied prairie dog colonies typically are on level ground or rolling hills. Suitable soils include clay-loam to unconsolidated gravelly soils, which are more stable for burrow construction by prairie dogs and provide good drainage (Esch et al. 2005). Vegetation typically is a type of wheatgrass-needlegrass, including buffalo grass, blue grama, western wheatgrass, green needlegrass, and patches of forbs and mixed shrubs such as sagebrush and rabbitbrush (Esch et al. 2005).

Ferrets prey on prairie dogs almost exclusively, and depend on prairie dog burrows for thermal cover, predator escape, hunting sites, parturition sites, and rearing of young (Esch et al. 2005). One study found that prairie dog remains constituted 91 percent of analyzed ferret scat (Hillman and Clark 1980). Other prey animals include ground squirrels, cottontail rabbits, deer mice, and possibly birds (NatureServe 2015). It has been estimated that approximately 100 to 150 acres of prairie dog colony are needed to support 1 ferret (Esch et al. 2005). The minimum area required to sustain a ferret is 91 to 235 acres in black-tailed prairie dog habitat (38 prairie dogs/acre) and 413 to 877 acres in white-tailed prairie dog habitat (10 prairie dogs/acre) (Esch et al. 2005), indicating a rather strong and predictable relationship between ferret area requirements and prairie dog density.

Many avian and mammalian predators are attracted to prairie dog colonies where ferrets could be encountered. Studies suggest that coyote, golden eagle, and great horned owls (as well as domestic cats and dogs) opportunistically prey on black-footed ferrets (Hillman and Clark 1980). Ferrets also are susceptible to parasites and disease. Sylvatic plague and canine distemper could pose a serious threat to ferret populations in areas where outbreaks occur among other wild and domestic animals (Hillman and Clark 1980).

Listing and Conservation Status

The black-footed ferret was designated as endangered in 1966. The species was subsequently listed as threatened with extinction under the ESA on March 11, 1967 (32 FR 4001) and as endangered under the ESA on June 2, 1970 (35 FR 8491). No critical habitat has been designated for the species. The USFWS initiated a 5-year species status review for the black-footed ferret on July 7, 2005 (70 FR 39326). The current Black-footed Ferret Recovery Plan was approved in 2013 (USFWS 2013c). This plan replaced the 1978 recovery plan, which was drafted when no extant, wild black-footed ferrets were known to exist.

Black-footed ferrets continue to face a high degree of threat due to potential economic conflicts regarding the ferret's obligatory dependence on prairie dogs, which are widely viewed as pests by agricultural interests. The high degree of threat to black-footed ferrets is largely due to inadequate management and conservation of prairie dogs.

Despite extensive and intensive searches throughout the species historic range, no wild populations of black-footed ferrets have been found following the final capture of the last known wild ferret in Meeteetse, Wyoming, in 1987. It is very unlikely that any undiscovered wild populations of the species remain (USFWS 2013c). As of 2012, there have been 20 black-footed ferret reintroduction projects,

which have met with varying success. The size of the resulting populations and population trends are difficult to determine due to the species' nocturnal habits and the logistical challenges and costs associated with the requisite field surveys.

According to USFWS, the recovery of black-footed ferrets will depend upon: 1) the continued efforts of captive breeding facilities to provide animals of suitable quality and quantity for release into the wild, 2) the conservation of prairie dog habitat adequate to sustain ferrets in several populations distributed throughout their historical range, and 3) the management of sylvatic plague to minimize impacts to ferrets at reintroduction sites (USFWS 2013c).

Factors Affecting Species

If any wild black-footed ferrets are present within the project area, it is likely that the primary factor affecting them is continued losses of or local fluctuations in populations of their main prey species, the Gunnison prairie dog, due to sylvatic plague.

With regard to ecological risk, the ERA prepared for the proposed KMC used a food web model to evaluate risk to terrestrial wildlife exposed to baseline contaminant levels. For aquatic- and terrestrial-oriented birds and mammals, possible exposure routes included incidental ingestion of soil, surface water, and/or sediment (as appropriate), as well as food items containing COPECs. The extent of exposure of COPECs via ingestion depends on a number of factors including concentrations of COPECs in food items, size of the receptor, and COPEC bioavailability. Current site-specific tissue data in food items are not available, so concentrations of COPECs in these tissues were estimated using baseline media concentrations and literature-derived uptake factors in the food web model to fill in gaps. Results of the ERA indicated that baseline conditions do not pose an unacceptable risk to the red fox (HQ_{max} <1), a terrestrial carnivore which could be considered a representative species for black-footed ferret (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

3.11.3.2.1.2 California Condor

For information on the California condor's life history and habitat associations, as well as the listing and conservation status of the species, refer to the corresponding discussion under Section 3.11.3.1, NGS and Associated Facilities.

Species Occurrence

There are no records of occurrence for California condor within the proposed KMC. Maps of telemetry relocations of tagged individuals associated with the Southwest experimental non-essential population provided by The Peregrine Fund indicate that three recorded flight paths have been in the general vicinity of the proposed KMC (Parish 2013; The Peregrine Fund 2015). Prior to 2015, the closest of these came within approximately 25 miles of the western edge of the proposed KMC boundary where a condor flew around the east side of White Mesa. Telemetry data from November 2015 shows one flight path extending from the Kaibab Plateau eastward past Four Corners and another flight path extending from Vermilion Cliffs National Monument southeastward over the Black Mesa and proposed KMC to a point north of Chinle and back (The Peregrine Fund 2015).

The Kayenta Mine Permit Renewal Environmental Assessment (OSMRE 2011) reported that it is unlikely that the California condor would use the proposed KMC area as a foraging site, but livestock and big game in the area could provide a limited source of carrion for this species.

Factors Affecting Species

The proposed KMC ERA indicates that baseline conditions do not pose an unacceptable risk to terrestrial carnivores including the red-tailed hawk and red fox. To the extent that these species can be

considered representative of the California condor, baseline conditions do not pose an unacceptable risk to this species (**Appendix 3RA,** Ecological and Human Health Risk Assessments).

Because the California condor is unlikely to occur in the proposed KMC and is not at risk from mine emissions or operations, this species is not carried forward in the analysis of environmental consequences for the Proposed Action and Partial Federal Replacement (PFR) alternatives at the proposed KMC.

3.11.3.2.1.3 Mexican Spotted Owl

For information on the Mexican spotted owls' life history and habitat associations, listing and conservation statuses, and recovery, please refer to the corresponding discussion under Section 3.11.3.1, NGS and Associated Facilities.

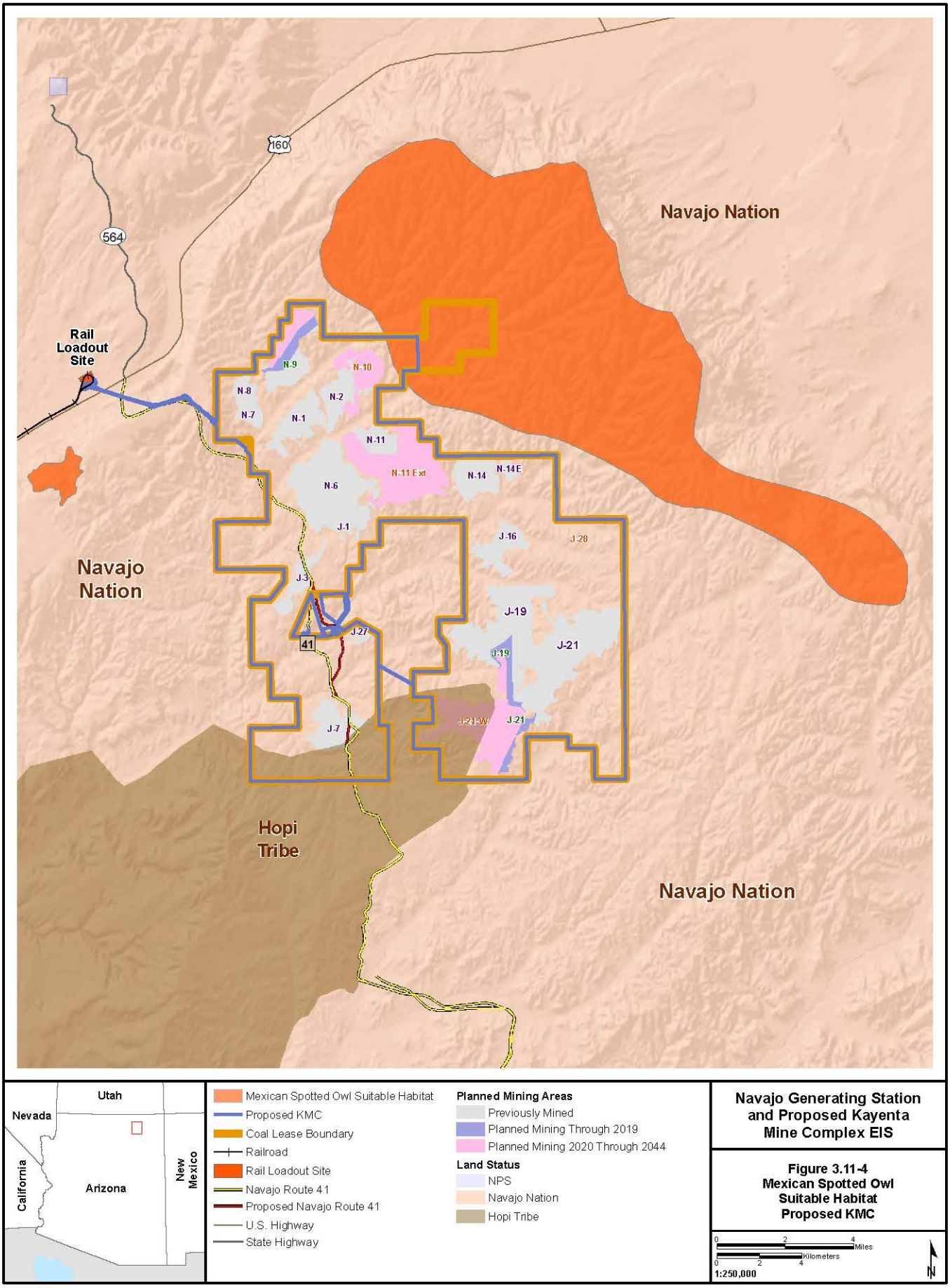
Species Occurrence

Thirteen years ago, the Mexican spotted owl was considered a year-round resident of the northeastern part of Black Mesa (BIOME 2003) where individuals had been observed within 2 miles of the northeastern boundary of the proposed KMC. Areas in which the species was documented and protected activity centers were designated include upper Yellow Water Canyon, the side canyons of Coal Mine Wash, and upper Moenkopi Wash (BIOME 2003). The upper northeastern portion of the proposed KMC permit area overlaps one of these protected activity centers. Mexican spotted owl surveys conducted in 1999 detected six unpaired male owls and one breeding pair, the latter of which was observed in upper Coal Mine Wash. From 2000 and 2010, no spotted owl surveys were conducted because there was no mine-related activity in the vicinity of the protected activity centers. With implementation of mining activities in coal resource area N-9, spotted owl surveys resumed in 2011 and have been conducted annually since then. In 2015, there were two spotted owl detections within approximately 1.9 miles of coal resource area N-9. These detections are thought to have been of the same individual due to their close temporal and spatial proximity. A follow-up visit the next morning yielded no further detections of the bird(s) and a nest could not be located (Ecosystem Management Inc. 2016). Refer to **Figure 3.11-4** for the general location of Mexican spotted owl habitat in the vicinity of the proposed KMC.

Factors Affecting Species

Mining-related noise and disturbance may be affecting Mexican spotted owl habitat quality within the proposed KMC study area. Night-lighting also can be a source of disturbance for Mexican spotted owls. However, impacts from night-lighting at the proposed KMC are currently and would continue to be minimized through implementation of best practices that ensure the safety of mine workers and compliance with Mine Safety and Health Administration requirements while minimizing light pollution. These practices include the use of directional, shielded, yellow lighting. Because no lights typically are mounted on the draglines that are above the spoil pile elevation, all direct illumination is oriented downward toward the digging face of the excavation and therefore contained within the active pit. The majority of indirect lighting (i.e., reflected light) also is contained within the active pit.

Because Mexican spotted owls are known to occur in the vicinity of the proposed KMC, potential risk to this species from exposure to baseline chemical levels was evaluated quantitatively in the KMC ERA. Under baseline conditions, the maximum HQ_{max} = 1for methyl mercury. Using refined exposures, the HQ for methylmercury dropped to less than 0.01 and the highest $HQ_{refined}$ value was calculated to be 0.3 for copper (Ramboll Environ 2016d). Thus, baseline chemical exposure poses negligible risk to Mexican spotted owls present within the mine lease area and adjacent suitable habitat.



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-4
Mexican Spotted Owl Suitable Habitat Proposed KMC

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3.11.3.2.1.4 Southwestern Willow Flycatcher

For information on the southwestern willow flycatcher's life history and habitat associations, listing and conservation statuses, and recovery, please refer to the corresponding discussion under Section 3.11.3.1, NGS and Associated Facilities.

Species Occurrence

Willow flycatchers have been documented on Black Mesa during migration, but it is unknown whether these observations have been of the southwestern subspecies (BIOME 2003). No willow flycatchers have been observed in the proposed KMC during more recent monitoring efforts (e.g., Ecosystem Management, Inc. 2016). Potential habitat is present in the proposed KMC where larger blocks of riparian shrubs and trees occur along perennial streams, springs, and/or seeps in Yellow Water Canyon Wash, Moenkopi Wash, and Dinnebito Wash (BIOME 2003). No critical habitat for the southwestern willow flycatcher occurs in or adjacent to the proposed KMC.

Factors Affecting Species

Although southwestern willow flycatchers currently are not known to occur within the proposed KMC lease area, potentially suitable habitat in the area may be affected by several factors that affect the species range-wide. These factors include brown-headed cowbirds, which are known to occur in the proposed KMC permit area; reduction of surface water and groundwater due to diversions and groundwater pumping; changes in flood and fire regimes due to dams and stream channelization; clearing and controlling vegetation; livestock grazing; changes in water and soil chemistry due to disrupted hydrologic cycles; and establishment of invasive plants.

With regard to baseline ecological risk, the KMC ERA indicated that baseline conditions in the proposed KMC do not pose unacceptable risks to the southwestern willow flycatcher (HQ_{max} = 0.1) (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

3.11.3.2.1.5 Western Yellow-billed Cuckoo

For information on the western yellow-billed cuckoo's life history and habitat associations, listing and conservation statuses, and recovery, refer to the corresponding discussion under Section 3.11.3.1, NGS and Associated Facilities.

Species Occurrence

There are no records of occurrence for western yellow-billed cuckoo within the proposed KMC. The lack of multi-layered, predominately native riparian woodlands in the lease area suggests that it is unlikely cuckoo would nest in the area, though it is possible they could occur there during migration. There are areas of suitable habitat within the larger areas defined by the confined and unconfined portions of the N-Aquifer study area (e.g., such as the riparian woodland at Begashibito Wash/Cow Springs) and, as noted above, there are records of occurrence for non-breeding cuckoos from the Cow Springs area (Corman and Magill 2000). No critical habitat for the western yellow-billed cuckoo occurs within the proposed KMC or surrounding N-Aquifer study area.

Factors Affecting Species

The Proposed KMC ERA indicates that baseline conditions in the proposed KMC do not pose unacceptable risks to the western yellow-billed cuckoo (HQ_{max} = 0.6) (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

3.11.3.2.2 Other Special Status Wildlife Species

Other special status wildlife species with potential to occur in the proposed KMC and surrounding N-Aquifer study area and have potential to be affected by mine operations and/or groundwater pumping, are listed in **Table 3.11-3**.

Table 3.11-3 Other Special Status Wildlife Species Occurrence in the Proposed KMC and N-Aquifer Study Areas

Species	Status[1]	Occurrence [2]	Habitat and Diet
Bald Eagle (*Haliaeetus leucocephalus*)	FS, BLMS, NESL G2, H, SGCN 1a, BGEPA	KMC: K N-Aquifer: K	Bald eagles typically use mature forested riparian habitats associated with perennial waterbodies. However, similar to the western yellow-billed cuckoo, existing riparian habitats found in these areas are unlikely to support nesting eagles and, therefore, this species is considered a winter migrant within the proposed KMC (USFWS 2015b – IPaC, Kayenta Mine ERA). Within the proposed KMC study area, bald eagles also may occur in pinyon-juniper habitat. Bald eagles are mainly piscivorous, but their diet also includes waterfowl and carrion.
Ferruginous Hawk (*Buteo regalis*)	NESL G3, H, SGCN 1b	KMC: K N-Aquifer: K	Ferruginous hawks are considered year-round residents on the Navajo Nation (Mikesic and Roth 2008). Ferruginous hawks are typically found within badlands, grasslands and desert scrub habitats and may nest in pinyon and juniper trees on the edges of these habitats. They are carnivores and typically prey upon cottontail and jackrabbits, prairie dogs, ground squirrels and gophers (Mikesic and Roth 2008). No known nest sites have been documented with the proposed KMC.
Golden Eagle (*Aguila chrysaetos*)	NESL G3, H, BLMS, SGCN 1b, BGEPA	KMC: K N-Aquifer: K	Golden eagles are year-round residents within these areas (USFWS 2015b – IPaC). Nesting habitat includes cliff substrates within desert grasslands or desert scrub habitats (Mikesic and Roth 2008). No nesting has been documented within the proposed KMC.
Northern Goshawk (*Accipiter gentilis*)	FS, BLMS, NESL G4, H, SGCN 1b	KMC: K N-Aquifer: K	Northern goshawks are breeding residents within the proposed KMC and N-Aquifer study areas and their habitat consists of mature conifer or mixed-conifer forests within drainages, canyon bottoms, or north-facing slopes (Mikesic and Roth 2008). Goshawks feed mainly on small birds (band-tailed pigeons, mourning doves, Steller's jays, and northern flickers) and small mammals (squirrels and cottontails) (AGFD 2003). Peabody Western Coal Company (PWCC) conducts annual surveys to determine the presence or absence of goshawks immediately adjacent to the N-9 and J-21 active mine sites. Northern goshawks have not been detected during these survey efforts.

Table 3.11-3 Other Special Status Wildlife Species Occurrence in the Proposed KMC and N-Aquifer Study Areas

Species	Status[1]	Occurrence [2]	Habitat and Diet
Peregrine Falcon (*Falco peregrinus*)	FS, BLMS, NESL G4, H, SGCN 1a	KMC: K N-Aquifer: K	Peregrine falcons are considered breeding residents within the proposed KMC and N-Aquifer study areas. Nesting sites include cliff substrates; however, no known nest sites have been documented within the proposed KMC study area. Peregrine falcons feed primarily on other birds and occasionally on bats.
Western Burrowing Owl (*Athene cunicularia hypugea*)	BLMS, NESL G4, SGCN 1b	KMC: P N-Aquifer: K	Burrowing owls have potential to occur within the proposed KMC and are known to occur in the N-Aquifer study area during the breeding season (USFWS 2015b – IPaC, OSMRE 2011). Burrowing owls inhabit small mammal burrows (most commonly prairie-dog burrows) within grassland and desert scrub habitats (Mikesic and Roth 2008). Primary food items include In large insects and small mammals, as well as fish, reptiles, amphibians, birds and prickly pear cactus seeds (AGFD 2001). There are two known active Gunnison prairie dog colonies within the proposed KMC: Colony PD 17-18 and Colony PD-20. As of 2015, PD 17-18, located in sagebrush shrubland habitat, was approximately 36 acres in size with a population estimate of approximately 14 prairie dogs. PD-20, located in reclaimed grassland habitat, is approximately 25 acres in size with a 2015 population estimate of 57 adult prairie dogs (Ecosystem Management Inc. 2016). Although these colonies may provide suitable burrowing owl nesting habitat, no burrowing owls have been documented within the proposed KMC.

[1] Status: NESL = Navajo Endangered Species List, G2 = Group 2, G3 = Group 3, G4 = Group 4; H = Hopi Cultural Sensitive Species; FS = Forest Service Sensitive; BLMS = BLM Sensitive; CAS = Conservation Agreement Species; SGCN = State Species of Greatest Conservation Need, 1a = Tier 1a, 1b = Tier 1b; BGEPA = Bald and Golden Eagle Protection Act.

[2] Occurrence Categories: KMC = Proposed KMC study area; N-Aquifer = N-Aquifer study area; K = Known occurrence based on Natural Heritage Program data, Navajo data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, the USFWS IPaC system, and/or the AGFD HabiMap utility.

The main factors affecting other special status species within the proposed KMC study area are those related to existing mining and reclamation activities. Mining and associated vehicle use and human activity reduce or degrade potential nesting and/or foraging habitat for all six of the special status raptors listed in **Table 3.11-3**. To the extent that reclaimed areas are occupied by small mammals, these areas provide foraging habitat for bald and golden eagles and the ferruginous hawk. Reclaimed areas with fossorial mammal populations (e.g., Gunnison prairie dog, ground squirrels) and insects provide potential nesting and foraging habitat for burrowing owls.

The KMC ERA indicated that baseline conditions in the proposed KMC pose negligible risks to the bald eagle (HQ_{max} <1) and representatives of the other special status raptor species listed in **Table 3.11-3**, such as the red-tailed hawk (HQ_{max} <1) and Mexican spotted owl ($HQ_{refined}$ <1) (Ramboll Environ 2016d).

3.11.3.3 Transmission Systems and Communication Sites

3.11.3.3.1 Federally Listed, Candidate, and Proposed Wildlife Species

3.11.3.3.1.1 Black-footed Ferret

For information on the black-footed ferret's life history and habitat associations, listing and conservation statuses, and recovery, refer to the corresponding discussion under Section 3.11.2.3, Kayenta Mine.

Species Occurrence

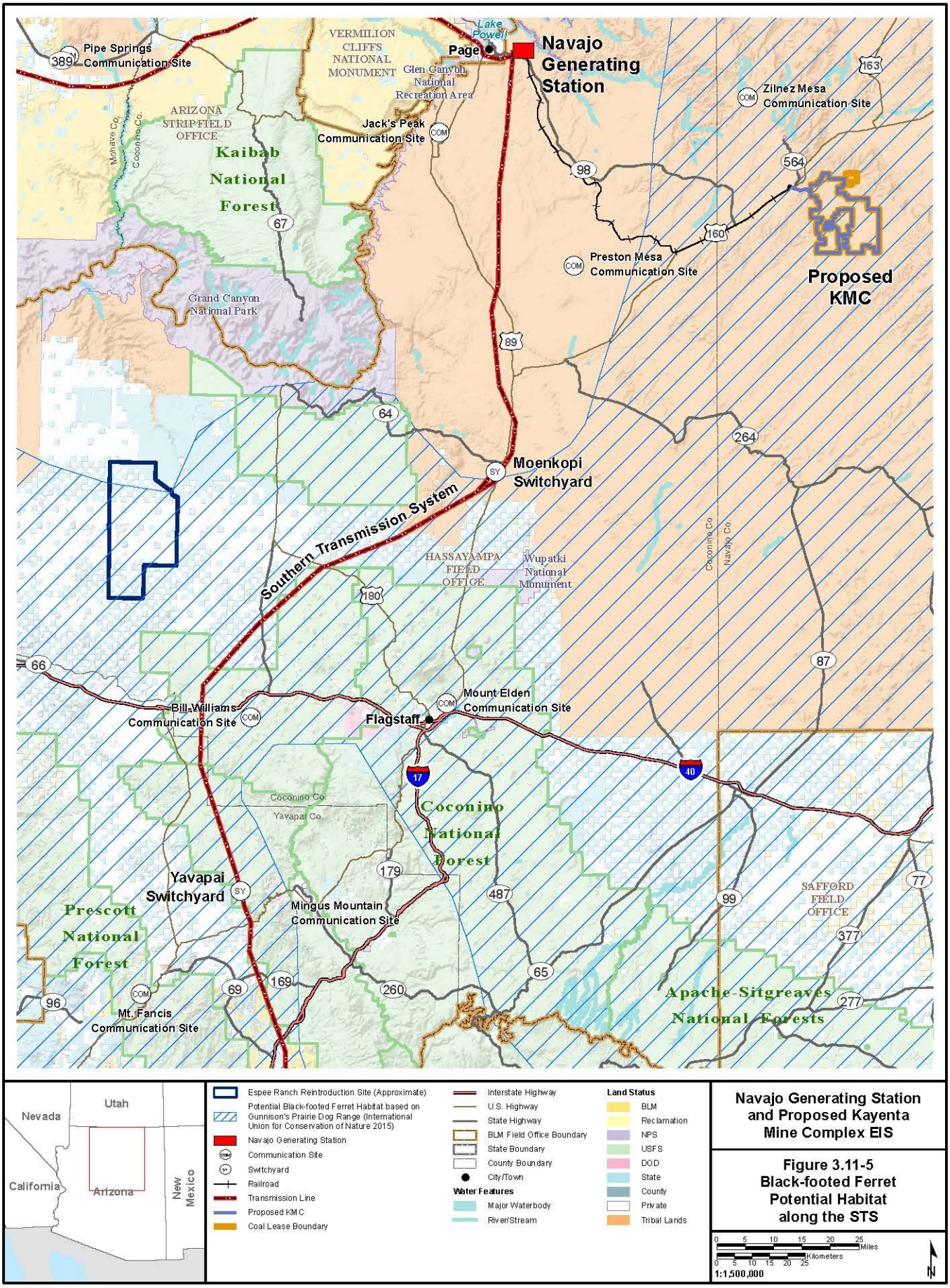
No black-footed ferrets have been documented within the overall project analysis area. Prairie dogs do not occur proximate to the WTS and STS in northeastern Arizona, or to the WTS in southwestern Utah and southeastern Nevada. Consequently, there have been no black-footed ferret introductions in this area, and there is little or no potential for ferrets to occur along the WTS. Black-footed ferrets have been introduced on the Espee Ranch northwest of Flagstaff in Coconino County, Arizona. This population is located approximately 18 miles northwest of the STS where it crosses State Highway 64 north of Williams, Arizona. Seventy-seven ferrets were released in this area in 2007 (USFWS 2013c), and an additional 25 ferrets were released there in 2014 (AGFD 2014). Female ferrets typically remain on the natal colony and males typically do not move more than 4.3 miles (Miller et al. 1996). Young ferrets dispersing in the fall can make more extensive movements, but it is unlikely that ferrets will colonize the STS ROW as the ROW is approximately 500 feet higher in elevation and predominately surrounded by pinyon-juniper woodland rather than the grassland habitats typical of the large Gunnison prairie dog colonies at Espee Ranch. **Figure 3.11-5** provides a map of the Espee Ranch release site and potential habitat (based on the distribution of Gunnison's prairie dog) in the analysis area.

Factors Affecting Species

It is unknown whether black-footed ferrets were present along the STS at the time it was constructed. If so, the main factor affecting the species was likely the distribution and abundance of the Gunnison prairie dog. Construction and operation of the STS is unlikely to have had a substantive adverse effect on prairie dog populations. However, to the extent that prairie dog populations in and along the STS corridor may have been adversely affected by sylvatic plague or depredated by adjacent ranching interests, the resulting reduction in prairie dog populations would also have impacted any black-footed ferrets associated with these colonies.

3.11.3.3.1.2 California Condor

For information on the California condor's life history and habitat associations and factors affecting the species recovery, refer to the corresponding discussion under Section 3.11.3.


Pipe Springs Communication Site
VERMILION CLIFFS NATIONAL MONUMENT
Lake Powell
Page
Navajo Generating Station
Glen Canyon National Recreation Area
Zilnez Mesa Communication Site
ARIZONA STRIP FIELD OFFICE
Jack's Peak Communication Site
Mohave Co.
Coconino Co.
Kaibab National Forest
Preston Mesa Communication Site
Proposed KMC
Grand Canyon National Park
Moenkopi Switchyard
Southern Transmission System
HASSAYAMPA FIELD OFFICE
Wupatki National Monument
Navajo Co.
Bill Williams Communication Site
Mount Elden Communication Site
Flagstaff
Coconino Co.
Yavapai Co.
Coconino National Forest
Yavapai Switchyard
Mingus Mountain Communication Site
Prescott National Forest
SAFFORD FIELD OFFICE
Mt. Fancis Communication Site
Apache-Sitgreaves National Forests
Nevada
Utah
California
Arizona
New Mexico
Espee Ranch Reintroduction Site (Approximate)
Potential Black-footed Ferret Habitat based on Gunnison's Prairie Dog Range (International Union for Conservation of Nature 2015)
Navajo Generating Station
Communication Site
Switchyard
Railroad
Transmission Line
Proposed KMC
Coal Lease Boundary
Interstate Highway
U.S. Highway
State Highway
BLM Field Office Boundary
State Boundary
County Boundary
City/Town
Water Features
Major Waterbody
River/Stream
Land Status
BLM
Reclamation
NPS
USFS
DOD
State
County
Private
Tribal Lands
Navajo Generating Station and Proposed Kayenta Mine Complex EIS
Figure 3.11-5 Black-footed Ferret Potential Habitat along the STS
Miles
Kilometers
1:1,500,000
N

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Species Occurrence

Maps of California condor telemetry data from 2009, 2011, 2012, and 2015 show eight or nine condor flight paths traversing the STS alignment (Parish 2013; The Peregrine Fund 2015). A map of 2013 telemetry data shows no relocations east of U.S. Highway 89 (Parish 2014). In contrast, the 2009, 2011, 2012, and 2015 flight path maps show numerous crossings of the WTS as tagged birds moved between the Vermilion Cliffs introduction site in Arizona and concentration areas in Marble Canyon, Grand Canyon, and the western escarpment of the Kaibab Plateau northward to the Vermilion Cliffs and Zion National Park in Utah (Parish 2013; The Peregrine Fund 2015). Although the 2013 and 2015 telemetry data show a relative lack of condor locations in the immediate vicinity of the WTS, it is clear from the earlier flight path data that condors traverse the transmission line ROW on a regular basis and likely forage throughout the area.

Listing and Conservation Status

In southern Utah, northwestern Arizona and southern Nevada, Interstate 15 (I-15), Interstate-515, and U.S. Highway 93 form the western boundary of the California condor's experimental non-essential population, i.e., the 10(j) boundary. The WTS traverses I-15 in southwestern Utah and remains to the west of I-15 through the northwestern corner of Arizona and through southern Nevada to a point just south of the Crystal Substation, where it crosses back to the east side of I-15. Southeast of Henderson, Nevada, the WTS crosses Interstate-515. Condors are listed as endangered everywhere that they occur and west and south (i.e., outside) of the 10(j) boundary, the species enjoys the full protection of that listing. Within the 10(j) area (i.e., east and north of the boundary described above), ESA section 9 prohibitions apply only to incidents of intentional take. These prohibitions do not apply when take is unavoidable and unintentional, provided that such take is non-negligent and incidental to lawful activity, and the take is reported as soon as possible. Other aspects of this species listing and conservation status are as described in Section 3.11.2.2, above.

Factors Affecting Species

Construction of the WTS and STS pre-dated the introduction of California condors in the Vermilion Cliffs and, thus, would have had no effect on this species. On-going operations and maintenance of the WTS and the northern portion of the STS involve periodic aerial inspections of the transmission line. Such inspections are infrequent, occurring approximately every 5 years along the WTS and annually along the STS (**Appendix 1B**). Whereas the passage of a helicopter between 50 and 300 feet above and adjacent to these transmission lines has the potential to disturb condors flying or foraging in the area at the time, the infrequency and short duration of disturbance associated with these inspections likely render the impacts of these inspections negligible. The primary factor affecting condors along the WTS is lead poisoning associated with consuming animals killed by lead ammunition.

3.11.3.3.1.3 Mexican Spotted Owl

For information on the Mexican spotted owls' life history and habitat associations, listing and conservation statuses, and factors affecting species recovery, refer to the corresponding discussion under Section 3.11.3.

Species Occurrence

The WTS ROW comes within approximately 8 miles of Mexican spotted owl critical habitat in Grand Staircase-Escalante National Monument and within 13 miles of critical habitat located in the canyon country around Mount Canaan and Zion National Park north of Colorado City, Arizona. However, the transmission line itself is located in extremely arid habitat, largely devoid of coniferous forests and perennial water. There are no records of occurrence for Mexican spotted owl along the WTS ROW. Moreover, aerial photo interpretation indicates that there is little, if any, suitable spotted owl habitat

crossed by the transmission line. Accordingly, recent survey efforts in portions of Paria River Canyon and Kanab Creek Canyon traversed by the WTS did not detect any spotted owls in these areas (Willey 2015). Consequently, it is unlikely that the Mexican spotted owl occurs along the WTS.

The STS passes within a few miles of designated critical habitat for the Mexican spotted owl in the Kaibab National Forest (**Figure 3.11-2**); however, there are no known records of occurrence for this species on or immediately adjacent to the transmission line ROW. Although habitat within the ROW likely is unsuitable for nesting owls, given the proximity of critical habitat and other potentially suitable habitat along portions of the line, there is potential for owls to occur in and immediately adjacent to the STS on a transitory basis during foraging flights or dispersal. Two of the STS communication sites, Bill Williams and Mt. Elden, are located within the boundaries of designated critical habitat for Mexican spotted owl; however, these sites and associated access roads do not contain the primary constituent elements that define critical habitat for this species.

Factors Affecting Species

By necessity, construction and maintenance of the STS ROW through forested habitats on and adjacent to the Kaibab and Prescott National Forests has fragmented spotted owl habitat immediately adjacent to the ROW. However, given that the vast majority of these habitats are comprised of pinyon-juniper woodland and the fact that no protected activity centers (PACs) have been identified along the STS, maintenance of this ROW is unlikely to be causing a substantive impact on Mexican spotted owls. To the extent that increased temperatures and reduced precipitation have adversely affected steep-slope conifer communities, riparian habitats, and/or prey abundance along the WTS and STS, climate change is likely playing a role in degrading Mexican spotted owl habitat quality within and adjacent to the transmission line corridors.

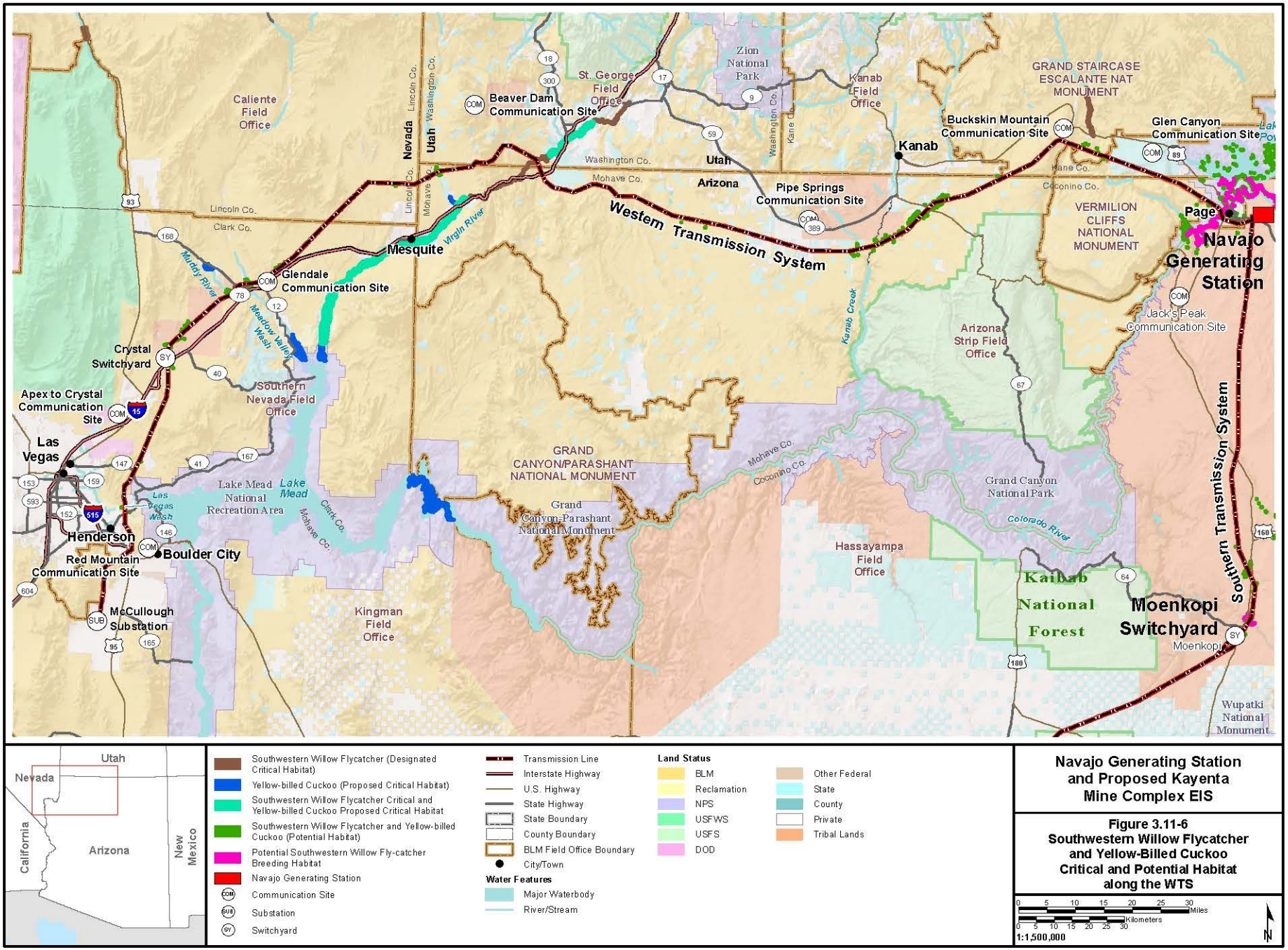
3.11.3.3.1.4 Southwestern Willow Flycatcher

For information on the southwestern willow flycatcher's life history and habitat associations, listing and conservation statuses, and factors affecting species recovery, refer to the corresponding discussion under Section 3.11.3.

Species Occurrence

The WTS traverses potentially suitable southwestern willow flycatcher habitat in a number of locations (**Figure 3.11-6**) starting where the line crosses the Colorado River just west of Page, Arizona. Critical habitat has been designated in Cottonwood Canyon, a tributary to the Paria River, approximately 3 miles north of where the transmission line crosses this drainage. However, potentially suitable habitat does not occur in the portion of the drainage crossed by the transmission line. Similarly, potentially suitable riparian habitat appears to be lacking where the WTS crosses Kanab Creek. Farther to the west, the WTS crosses designated critical habitat where it traverses the Virgin River southwest of St. George, Utah. The species also may occur along the WTS where it crosses Meadow Valley Wash and the Muddy River on the Moapa Indian Reservation and where it crosses Las Vegas Wash near Henderson, Nevada. Documented occurrences of southwestern willow flycatcher are known from Horseshoe Bend on the Colorado River approximately 1.5 miles from the WTS crossing, along Cottonwood Creek approximately 5 miles north of the WTS, along the Virgin River, and along Las Vegas Wash. The southwestern willow flycatcher is a confirmed breeder along the Muddy River in Nevada (Floyd et al. 2007).

The STS does not traverse any designated critical habitat for the southwestern willow flycatcher. However, it does cross potentially suitable riparian habitat located along the Verde River and the Agua Fria River (**Figure 3.11-7**). There is a record of occurrence for the species within 1.5 miles of the STS just south of Lake Pleasant in Maricopa County, Arizona.



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-6
Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Critical and Potential Habitat along the WTS

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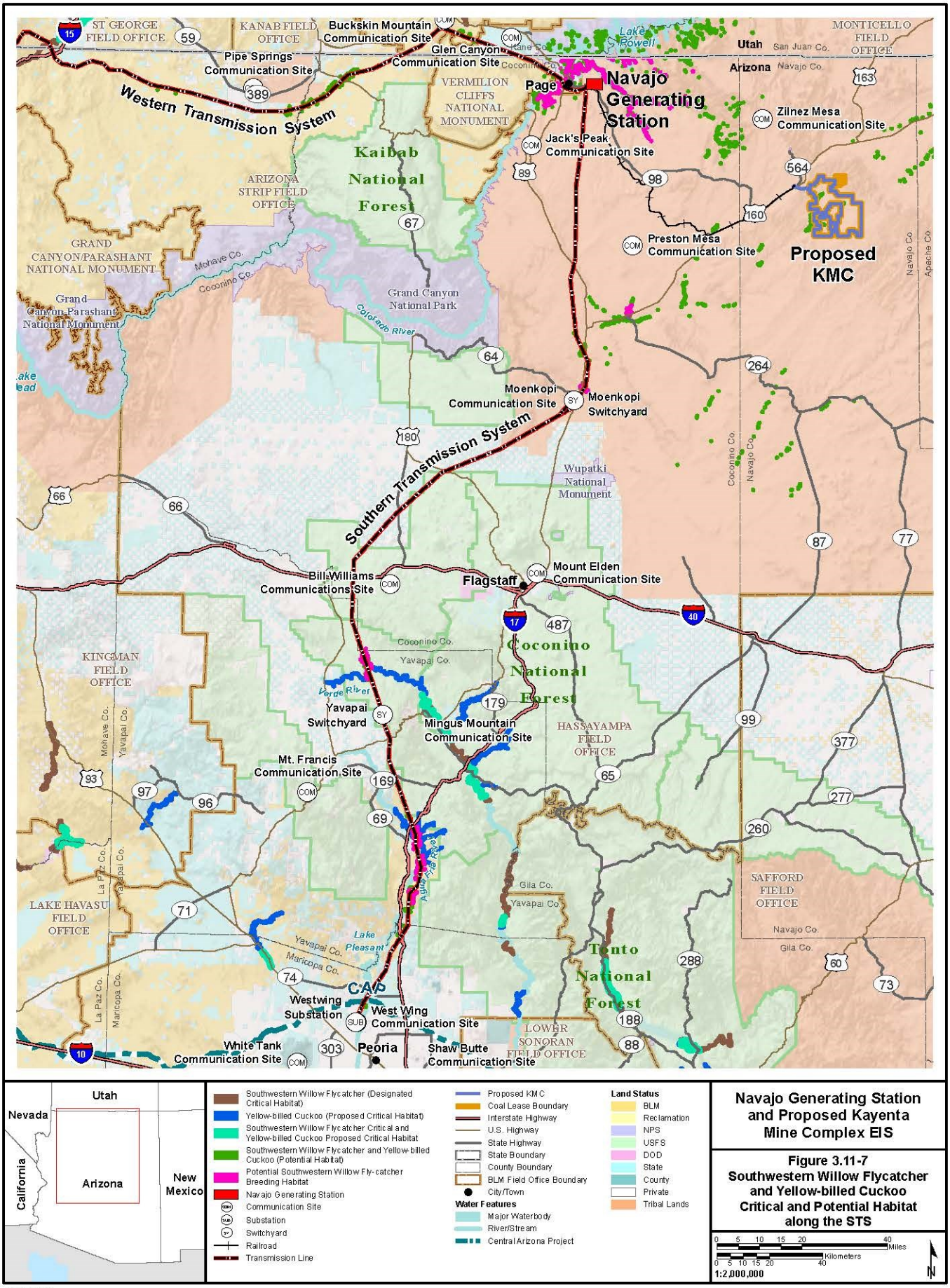

Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-7 Southwestern Willow Flycatcher and Yellow-billed Cuckoo Critical and Potential Habitat along the STS

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Factors Affecting Species

Because the WTS and STS span riparian habitats capable of supporting southwestern willow flycatchers, the original construction and on-going maintenance of these transmission lines has likely had minimal impacts on this species and its habitat. Aerial inspections of these lines have the potential to disturb nesting flycatchers if the inspections are conducted during the species' breeding season, but these disturbances are infrequent (every 5 years for the WTS and annually for the STS) and of short duration. Other factors affecting southwestern willow flycatchers along the transmission systems likely include changes in flood and fire regimes due to stream channelization, livestock grazing, changes in water and soil chemistry due to disrupted hydrologic cycles, and establishment of invasive plants. Another factor likely affecting southwestern willow flycatchers along the WTS and STS is brood parasitism by brown-headed cowbirds, which is known to affect nestling survival and result in reduced population levels. In addition, to the extent that increased temperatures and decreased or more variable precipitation has reduced the extent of or degraded riparian woodland habitats in the action area, it also has reduced the quality and extent of suitable yellow-billed cuckoo habitat in this area.

3.11.3.3.1.5 Western Yellow-billed Cuckoo

For information on the western yellow-billed cuckoo's life history and habitat associations, listing and conservation statuses, and factors affecting species recovery, refer to the corresponding discussion under Section 3.11.3.

Species Occurrence

The western yellow-billed cuckoo has potential to occur in multiple locations along the WTS and STS where these lines cross proposed critical habitat. Along the WTS, the western yellow-billed cuckoo may occur in proposed critical habitat along the Virgin River, and it has been documented along the lower Virgin River in Meadow Valley Wash and in Las Vegas Wash (Great Basin Bird Observatory 2010; Nevada Natural Heritage Program 2014). Along the STS the species may occur in proposed critical habitat along the Verde and Agua Fria rivers.

Factors Affecting Species

Similar to the southwestern willow flycatcher, the primary factors affecting western yellow-billed cuckoos along the WTS and STS likely include loss or conversion of habitat due to river flow management and invasion of exotic invasive riparian vegetation including tamarisk and Russian olive. Overgrazing has likely also led to loss and degradation of suitable riparian habitat along portions of the transmission line corridors. To the extent that increased temperatures and decreased or more variable precipitation has reduced the extent of or degraded riparian woodland habitats along the transmission lines, it also has reduced the quality and extent of suitable yellow-billed cuckoo habitat in these areas.

3.11.3.3.1.6 Mojave Desert Tortoise

Species Occurrence

Potentially suitable habitat for the Mojave desert tortoise is prevalent along the WTS, covering approximately 136 miles of the ROW from the Hurricane Cliffs in Mohave County, Arizona, to the southern terminus of the line in the Eldorado Valley, Clark County, Nevada. Within this area, designated critical habitat is present along approximately 46 miles of the ROW. There have been numerous records of occurrence for desert tortoise adjacent to portions of the line that are collocated with other existing and proposed linear utilities. Potential Mojave desert tortoise habitat has been modeled by the U.S. Geological Survey with habitat values ranging from 0.0 to 1.0 (Nussear et al. 2009). Habitat values of 0.6 and greater are considered suitable habitat for this species. In addition, a field-based habitat assessment specific to the NGS-KMC Project was completed for the portion of the WTS located in U.S. Geological Survey-modeled suitable habitat that has not undergone recent tortoise surveys. This habitat

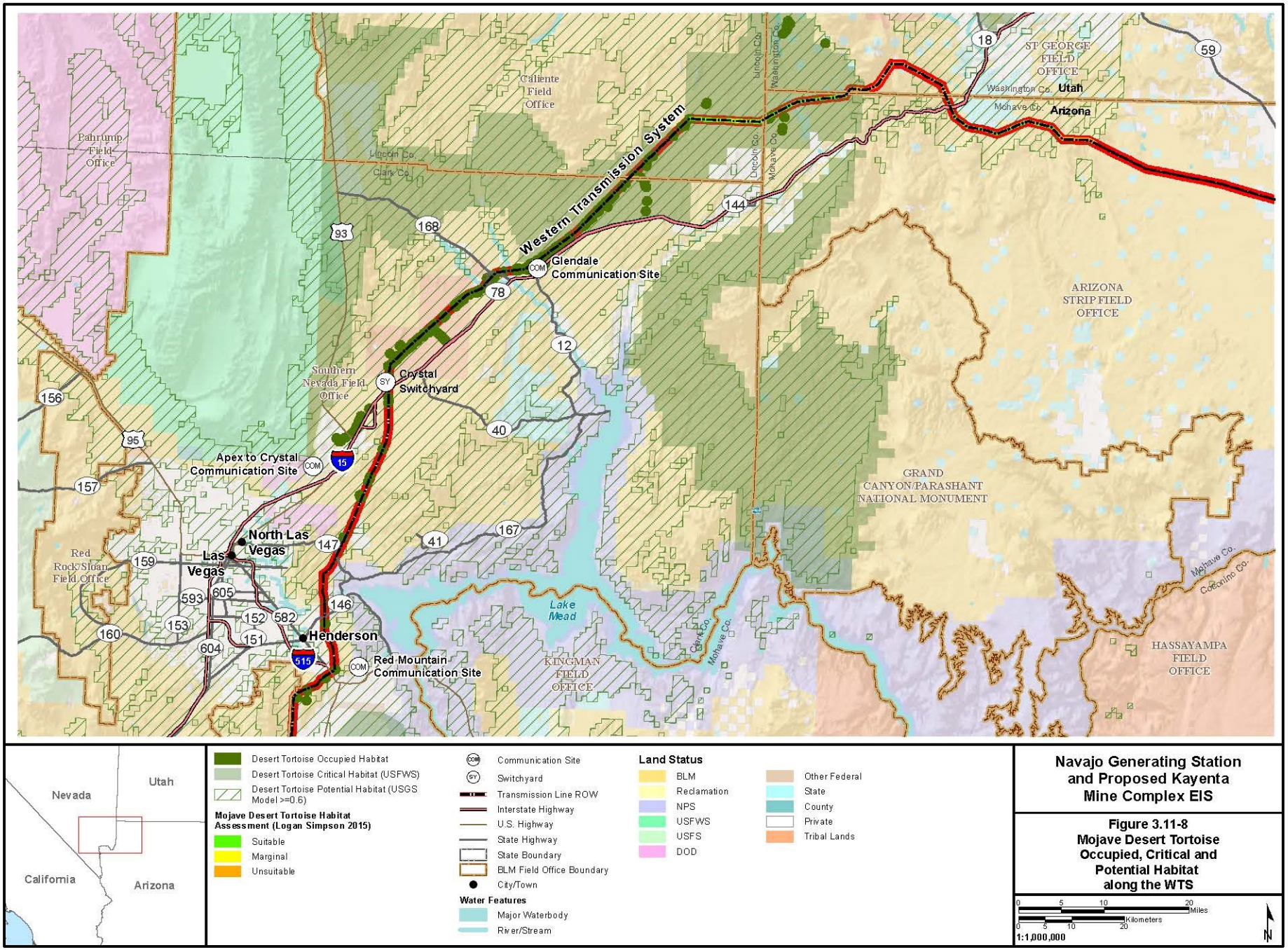
assessment included ground-truthing Southwest Regional Gap Analysis Project and LANDFIRE land cover data, evaluating adjacent land uses, and determining whether habitat was suitable, marginal, or unsuitable. Habitat suitability was based on key habitat parameters derived from a review of pertinent literature including current published information, habitat models, and the primary constituent elements of Mojave desert tortoise critical habitat as determined by the USFWS. The habitat assessment covered approximately 55 miles of the WTS ROW and found that 11 percent of the study plots did not agree with Southwest Regional Gap Analysis Project land cover mapping. It found that approximately 32.5 miles of this portion of the ROW comprise suitable Mojave desert tortoise habitat, 20.7 miles contain unsuitable habitat, and 1.8 miles are of marginal habitat quality (Logan Simpson 2015a). A map of Mojave desert tortoise habitat along the WTS, including the results of the 2015 field-based habitat assessment, is provided on **Figure 3.11-8**. Occupied habitat shown on this map is based on buffered locations of live tortoise observations from protocol-level tortoise surveys conducted for other existing and proposed linear utility projects located in the same corridor adjacent to the WTS. The Mojave desert tortoise does not occur along the STS.

Life History and Habitat Association

The Mojave population of desert tortoise is a long-lived species with a maximum lifespan estimated at greater than 50 years, although tortoises often survive for only 20 to 25 years of adulthood (Germano 1994). The Mojave desert tortoise mating season typically begins in February or March when they emerge from hibernation but can last into fall. Between one and seven eggs are laid in an excavated nest near a shrub or burrow entrance between May and July (Ernst and Lovich 2009). Hatching occurs 90 to 120 days later, depending on environmental conditions, especially temperature. Eggs and young are unattended by the parents. Hatchlings develop into females when the incubation (i.e., soil) temperature is greater than 89.3 degrees Fahrenheit (°F) and males when the temperature is below that (Spotila et al. 1994). Egg hatch rates vary, but hatchling, and juvenile mortalities are assumed to be very high. It has been estimated that only one hatchling for every 15 to 20 nests will survive to reach sexual maturity. The average age of reproductive viability of females primarily is a function of individual size, but it usually is between the ages of 12 and 25 years (USFWS 1994). Females from the Mojave population produce from one to three clutches of eggs staggered throughout the reproductive season (Turner et al. 1986).

The desert tortoise is normally an obligate herbivore, subsisting largely on various annual and perennial forbs, grasses, cacti, and other non-woody plants (Ernst and Lovich 2009). A study of desert tortoise food habits in the Mojave Desert found that they will consume at least 43 plant species, including 37 annuals and 6 perennials. The diet showed a very strong preference for native plants (95 percent), and some of their preferred food plants were uncommon to rare (Jennings 1997). The most important food items seem to be desert annuals, plants that often have a life span of less than 30 days, and plants that generally are available only from April to June. Preferred plants are often uncommon or rare in tortoise environments (Ernst and Lovich 2009; Jennings 1997). Tortoises are capable of eating large quantities of food when it is available; the contents of a tortoise's digestive tracts can constitute 11 to 21 percent of its total body mass (Ernst and Lovich 2009). Desert tortoises also ingest rocks, bones, and soil, possibly to maintain intestinal bacteria, to provide additional minerals, or as gastroliths (small stones) to aid digestion (Ernst and Lovich 2009; Esque and Peters 1994).

Mojave desert tortoises are primarily found in Mojave Desert scrub habitat. Typical habitat consists of creosote bush scrub vegetation characteristic of the Upper Sonoran life zones of the Mojave and Colorado deserts. Typical desert tortoise habitat extends to 5,500 feet above mean sea level where annual precipitation ranges from 2 to 8 inches, the diversity of perennial plants is relatively high, and production of ephemerals is high. Aside from typical creosote scrub habitat, Mojave desert tortoises also are associated with creosote bursage, shadscale scrub, and Joshua tree woodland vegetation communities. Some parts of their range contain abundant Joshua trees. Desert tortoises also inhabit mixed blackbrush scrub found in the northern extent of their range between 3,500 and 5,000 feet above mean sea level (NatureServe 2015).



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-8 Mojave Desert Tortoise Occupied, Critical and Potential Habitat along the WTS

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In the Mojave Desert, tortoises occur most commonly on gently sloping terrain with sandy-gravel soils and a sparse cover of low-growing shrubs, which allows establishment of herbaceous plants. Soils must be friable enough for the digging of burrows but firm enough so that burrows do not collapse (USFWS 2011). Tortoise burrows often are located close to washes and arroyos, especially in Mojave Desert habitats consisting of sandy loam soils covered by a more coarse surface of pebbles, cobbles, or desert pavement (Luckenbach 1982).

Of particular importance to desert tortoises is the presence of suitable burrowing substrate and vegetation that offers protective thermal cover for extreme temperatures during the summer months. Desert tortoises can spend more than 98 percent of their lives underground, especially in drought year (Ernst and Lovich 2009). Mojave desert tortoises usually will construct their own burrows to avoid extreme hot or cold temperatures that could cause life-threatening conditions for this ectothermic species. Shelters such as caliche caves or overhangs might be utilized as well. Mojave desert tortoises often excavate burrows under vegetation (such as a creosote bush, ephedra spp., or bursage), which can extend to a depth of 33 feet. Desert tortoises typically use between 12 and 25 different burrows, dens, or pallets over the course of 1 year (Ernst and Lovich 2009). Home ranges of adults tend to be larger than those of juveniles, and male home ranges of an estimated 62 acres are typically twice the size of female home ranges, although individual and seasonal variation can be considerable (O'Connor et al. 1994).

Listing and Conservation Status

The Mojave population of desert tortoise was designated as threatened in 1989 under the ESA (54 FR 32326). In 1994, a Draft Recovery Plan was issued. Critical habitat was designated in 1994, encompassing 6 million acres within six management units across California, Nevada, Utah, and Arizona (59 FR 5820). In 2011, the USFWS issued a Final Revised Recovery Plan, which reduced the number of recovery units to five and changed some boundaries of the 1994 recovery units (USFWS 2011). Since then, no significant changes in the distribution of the species have been documented, despite a decline in local populations, and no status change has been recommended (USFWS 2010).

The 2011 Final Revised Recovery Plan established five recovery units to provide for movement, dispersal, and gene flow; sufficient quantity and quality of forage species and the proper soil conditions to provide for the growth of such species; suitable substrates for burrowing, nesting, and overwintering burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality (USFWS 2011).

The primary threats to the Mojave desert tortoise are anthropogenic in nature. Human population growth and associated urbanization of Mojave desert tortoise habitat has resulted in a suite of direct and indirect impacts to the tortoise and its habitat. Proliferation of paved and unpaved roads, introduction of non-native invasive plant species and associated changes in the frequency and severity of wildfire, and continued energy development (especially renewable energy development and associated utility corridors) have comprised the primary threats to this species in recent years (USFWS 2010). These threats continue to result in habitat loss and fragmentation, nutritional compromise, and soil erosion. Indirect impacts associated with human presence in desert tortoise habitat include illegal dumping, human subsidies for tortoise predators (e.g., common ravens), and introduction of toxins. Unauthorized use of off-highway vehicles continues to be a major source of habitat degradation for the Mojave desert tortoise (USFWS 2010).

Population density studies have been conducted for many years in several areas throughout desert tortoise range; however, inconsistencies in sampling methods, study scale, environmental conditions, and research goals make long-term population trend determinations difficult. Those data could provide a general overview of the species' range-wide status and demonstrate considerable declines at the local level, particularly in the western Mojave Desert (Corn 1994; USFWS 2011). Berry and Medica (1995), in

their U.S. Geological Survey report, estimated that densities ranged from approximately 13 to 168 adult tortoises per square mile, depending on location. Berry and Medica also found a density of approximately 44 tortoises per square mile in southeastern Nevada, and most populations discussed in that report showed a downward trend (Berry and Medica 1995).

Beginning in 2001 (1999 in the Upper Virgin River recovery unit) annual range-wide monitoring was initiated. Results from the first 5 years of this program estimated a population density low of 2 to 8 tortoises per square mile for the Northeastern Mojave recovery unit and a high of 44 to 78 tortoises per square mile for the Upper Virgin River recovery unit. Because this monitoring program is designed to measure long-term population trends, the first 5 years of the program essentially serve to establish baseline densities and variability between years and between recovery units (USFWS 2006).

Factors Affecting Species

General factors affecting Mojave desert tortoise habitat within the project area include all of those identified as threats in the Listing and Conservation Status section, above, with construction of new utility corridors, proliferation of non-native plant species, and increased frequency and severity of wildfire likely being chief among them. Baseline ecological risk has not been evaluated for this species as it occurs outside of the area affected by emissions from NGS and the proposed KMC.

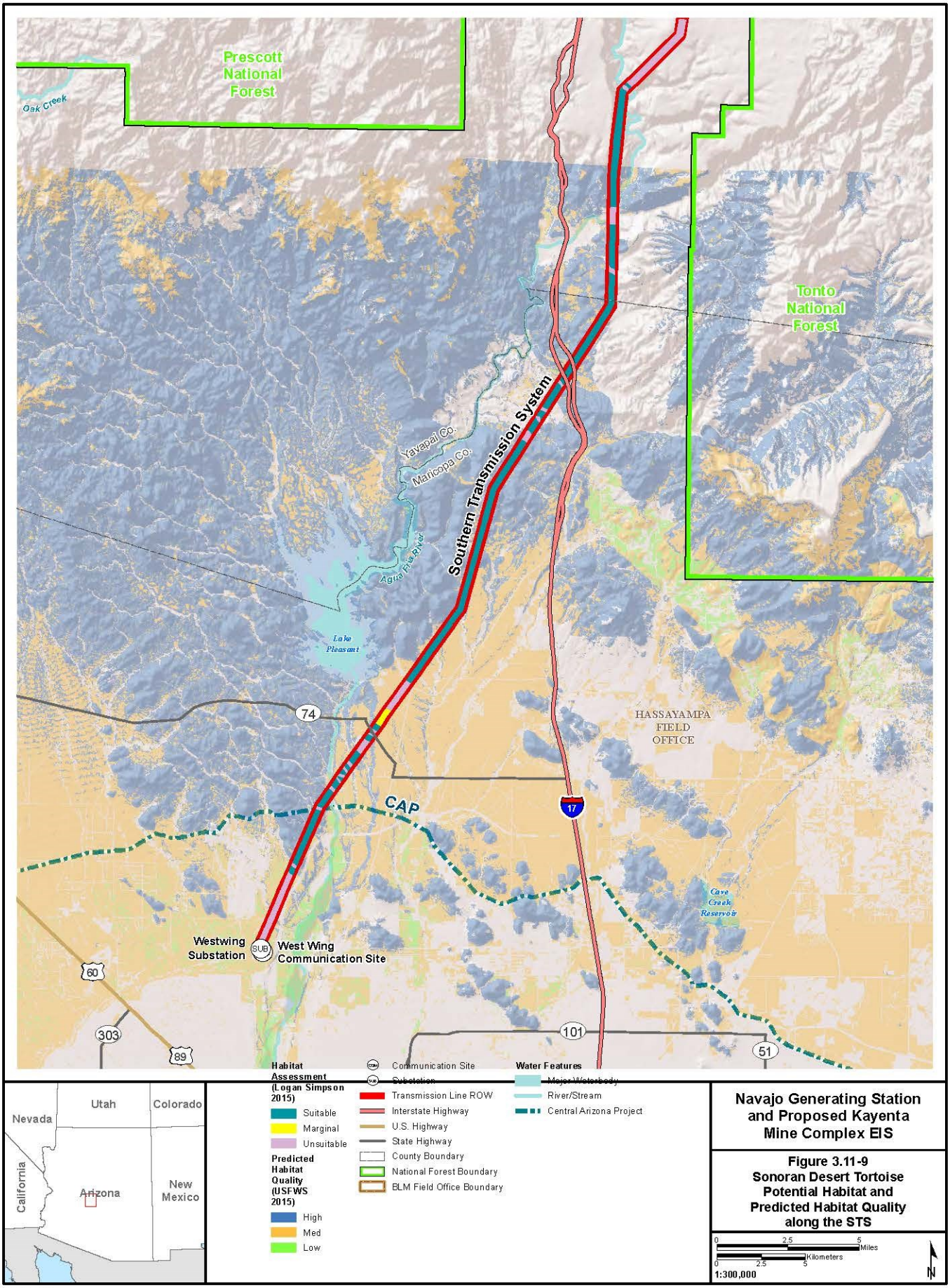
3.11.3.3.1.7 Sonoran Desert Tortoise

Species Occurrence

The Sonoran desert tortoise is known to occur along the southern portion of the STS from a few miles north of Black Canyon City south to the southern terminus of the line at the Westwing Substation. In May 2015, the USFWS completed an update to their Sonoran desert tortoise habitat model, which ranks habitat quality as high, medium, or low based on key habitat factors including elevation, vegetation type, and slope (USFWS 2015c). In addition, a field-based habitat assessment specific to the NGS-KMC Project was completed for the portion of the STS ROW that is located in potential Sonoran desert tortoise habitat. This habitat assessment included ground-truthing Southwest Regional Gap Analysis Project and LANDFIRE land cover data, evaluating adjacent land uses, and determining whether habitat was suitable or unsuitable based on key habitat parameters derived from a review of pertinent literature including current published information, habitat models, and geographic and land cover data. The habitat assessment covered approximately 37 miles along the southernmost portion of the STS. It found that only 5 percent of the study plots did not agree with Southwest Regional Gap Analysis Project land cover mapping and approximately 27 miles of this portion of the ROW comprise suitable Sonoran desert tortoise habitat and 10 miles contain unsuitable habitat (Logan Simpson 2015b). Refer to **Figure 3.11-9** for a map of Sonoran desert tortoise habitat, showing both the USFWS predicted habitat quality as well as the results of the Logan Simpson field-based habitat assessment, along the STS.

Life History and Habitat Association

The Sonoran desert tortoise is a long-lived species that is slow to reach sexual maturity and has a low reproductive rate. Females reach sexual maturity at approximately 15 years of age and reproductive activity is greatly influenced by levels of winter and spring precipitation. The species' breeding season generally is from July through October, and one clutch of 1 to 12 eggs (5 eggs average) is produced annually. Eggs hatch in September and October, and some hatchlings may overwinter in nests. Predation on nests and hatchlings is high in some populations (Arizona Interagency Desert Tortoise Team 2015).



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Sonoran desert tortoises primarily feed on forbs, grasses, woody plants, and succulents and are known to eat nearly 200 types of different plants. They are attracted to areas with calcium carbonate-rich soils and have been regularly observed congregating in these areas eating these soils, presumably to meet dietary mineral needs (Arizona Interagency Desert Tortoise Team 2015).

The Sonoran desert tortoise is diurnal but may emerge from shelters at night in response to rainfall. Peak activity is from late June through September, but they may be active on the surface during any month of the year. During the winter dormancy period, surface activity is dictated by thermoregulatory needs, movements between shelters, and/or the need to rehydrate during or after rainfall (Arizona Interagency Desert Tortoise Team 2015).

Home range size has been observed to vary with the size of the tortoise, habitat type, season, precipitation levels, and in response to the availability of forage plants. Observed average annual home range sizes for male tortoises have varied from approximately 23 acres to 64 acres and for female tortoises from approximately 6 acres to 58 acres (Arizona Interagency Desert Tortoise Team 2015). With the exception of dispersal movements, Sonoran desert tortoise exhibit high site fidelity to their home ranges and often focus their activities on a group of relatively closely located shelters within their home range.

Listing and Conservation Status

The USFWS established the Sonoran desert tortoise as a candidate for listing under the ESA in December 2010. On October 6, 2015, the USFWS announced the results of their 12-month finding on a petition to list the Sonoran desert tortoise as endangered or threatened under the ESA. After review of the best available scientific and commercial data, they found that listing the Sonoran desert tortoise is not warranted at this time.

In June of 2015, a candidate conservation agreement for the Sonoran desert tortoise in Arizona was executed by the Arizona Interagency Desert Tortoise Team, a consortium of federal and state agencies. The goals of the candidate conservation agreement are to provide an enforceable management strategy for desert tortoises in Arizona that will conserve existing populations of the species and be considered in the decision of whether or not to list the species in the future. Specific objectives of the candidate conservation agreement include the identification and implementation of proactive conservation measures across the range of the Sonoran desert tortoise in Arizona.

Primary anthropogenic threats to the Sonoran desert tortoise include a variety of impacts to the quality and extent of its habitat including invasion and purposeful cultivation of nonnative plant species that greatly increase the threat of wildfire in an ecosystem that evolved in the absence of wildfire, increased human population growth and associated urban development, and livestock grazing. In addition, the slow rate of recovery of desert scrub habitat following disturbance hinders the ability of remediation projects to prevent Sonoran desert tortoise population declines in the short- and medium-term (75 FR 78121).

Although illegal, collection of wild Sonoran desert tortoises for pets may be a continuing threat to this species, particularly in areas of new development that are in close proximity to tortoise habitat. A related threat is the intentional and unintentional release of captive-bred and hybrid pet desert tortoises into the wild. Such releases pose a risk of genetic contamination of wild populations, which can weaken the genetic fitness of wild tortoise populations and render them vulnerable to extirpation (75 FR 78122).

Predation by feral and off-leash dogs pose a threat to the Sonoran desert tortoise and, in most cases, is strongly correlated with distance to urban areas. Predation by feral dogs has been documented in approximately half of the long-term monitoring plots in Arizona and may be a major cause of population decline in one plot (75 FR 78122).

Human depredation, or intentional killing, of Sonoran desert tortoises as a result of vandalism (most commonly by recreational target shooters) is another threat to this species. This threat is most prevalent in areas of great vehicular access and in proximity to urban areas. The effect of human depredation on Sonoran desert tortoises is not well known, but it is likely most prevalent on the more conspicuous adult size class and may act synergistically with other threats (75 FR 78122).

There is insufficient monitoring data to analyze overall population trends for the Sonoran desert tortoise, and a variety of factors make it difficult to obtain accurate population data including the tortoise's slow movement and camouflaged appearance, the complexity of its habitat (large boulders, relatively dense vegetation, and high topographic relief), and behavioral factors (75 FR 78101). In addition, the relatively short sampling period for such a long-lived species renders overall population trend analysis problematic. It is known that there have been periodic, localized, and occasionally substantial declines in at least 5 of the 17 monitored populations, but these are thought to have been random events and not indicative of population trends as a whole (75 FR 78101).

Factors Affecting Species

Factors affecting Sonoran desert tortoise habitat within the project area are the same as those described as threats in the Listing and Conservation Status section, above. Baseline ecological risk has not been evaluated for this species as it occurs outside of the area affected by emissions from NGS and the proposed KMC.

3.11.3.3.1.8 Narrow-headed Gartersnake

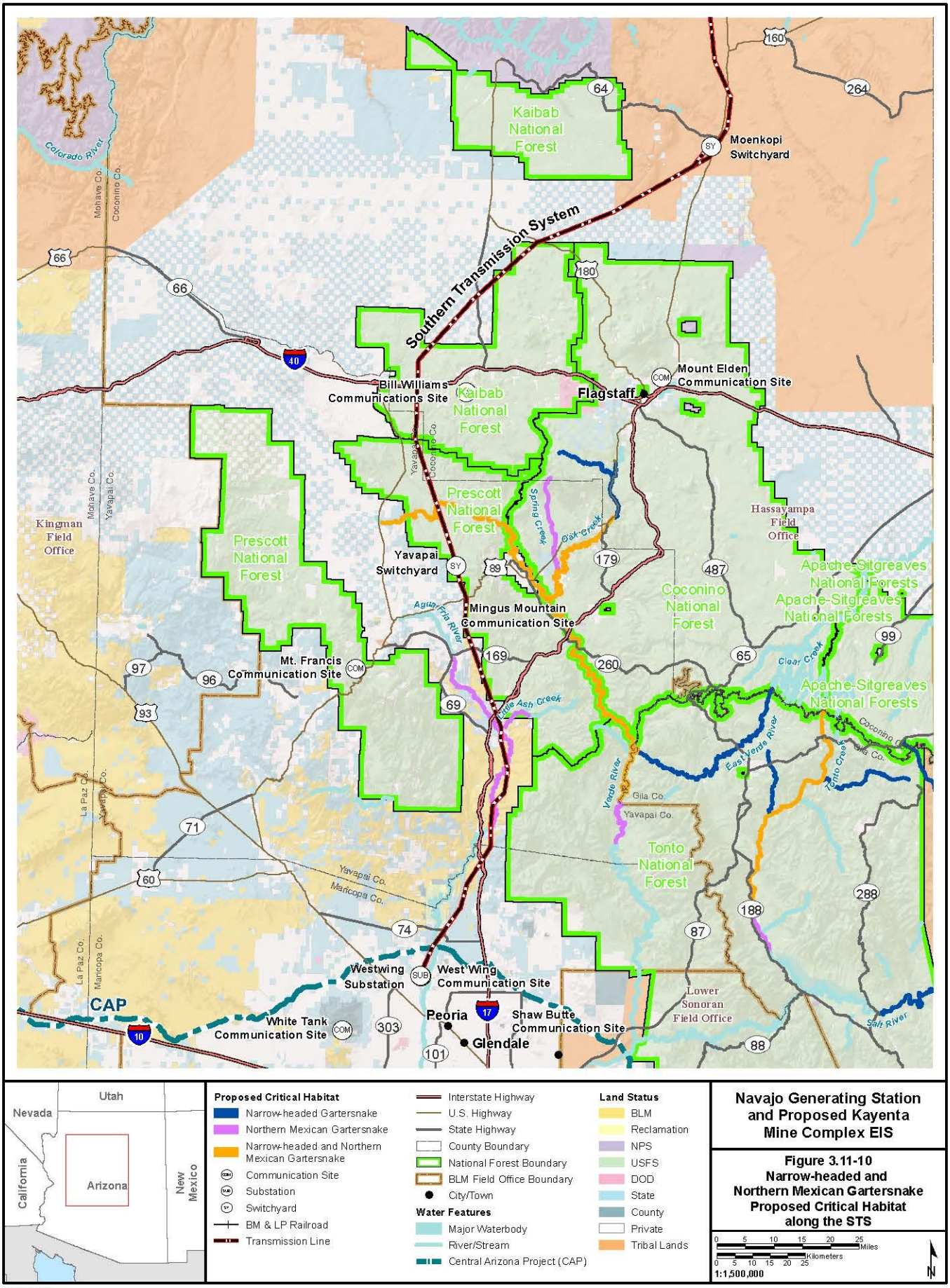
Species Occurrence

The Upper Verde River in the vicinity of the STS crossing has been proposed as critical habitat for the narrow-headed gartersnake (78 FR 41550-41608). Records of occurrence for the Upper Verde are as recent as 2012 (79 FR 38687). Although the population is considered likely not viable, it is assumed that the species currently is extant within the STS ROW where it crosses the Verde River. Refer to **Figure 3.11-10** for a map of narrow-headed gartersnake habitat along the STS.

Life History and Habitat Association

Narrow-headed gartersnakes may live as long as 10 years in the wild (Rosen and Schwalbe 1988, cited in: 79 FR 38685). Sexual maturity occurs at 2.5 years of age in males and at 2 years of age in females (Degenhardt et al. 1996, cited in: 79 FR 38685). There is little information on suitable temperatures for surface activity of the narrow-headed gartersnake; however, along Oak Creek in Arizona the snake has been observed to be surface active at air temperatures ranging from 52°F to 89°F and water temperatures ranging from 54°F to 72°F (Nowak 2006 cited in 79 FR 38685). On an annual basis, the narrow-headed gartersnake is surface-active generally between March and November (Nowak 2006 cited in: 79 FR 38684). There is no information on home range size for this species.

The narrow-headed gartersnake occurs at elevations ranging from approximately 2,300 to 8,000 feet above mean sea level. It is considered to be one of the most aquatic of the gartersnakes (Drummond and Garcia 1983; Rossman et al. 1996, cited in: 79 FR 38684). Accordingly, it is strongly associated with clear, rocky streams where it predominantly uses pool and riffle habitat that includes cobbles and boulders (multiple authors cited in: 79 FR 38684). Although highly aquatic, narrow-headed gartersnakes are known to use upland habitats within approximately 330 feet of aquatic habitat during the early fall and spring months, be strongly associated with boulders in the floodplain during summer months, and use upland habitat up to approximately 660 feet out of the floodplain during hibernation (Nowak 2006 cited in 79 FR 38684). Adjacent upland habitats used typically include Petran Montane Conifer Forest,



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.11-10 Narrow-headed and Northern Mexican Gartersnake Proposed Critical Habitat along the STS

7/20/2016

Great Basin Conifer Woodland, Interior Chapparal, and the Arizona Upland subdivision of Sonoran Desertscrub communities (Brennan and Holycross 2006 cited in: 79 FR 38684; Rosen and Schwalbe 1988). Stream bank vegetation is an important component of suitable habitat for this species, with common associated plant species including Arizona alder, velvet ash, willows, canyon grape, blackberry, Arizona sycamore, Arizona black walnut, Fremont cottonwood, Gambel oak, and ponderosa pine (Rosen and Schwalbe 1988 cited in: 79 FR 38684).

The narrow-headed gartersnake is a predator and specializes on fish as their primary prey item (multiple authors cited in: 79 FR 38685). Native fish species including Sonora sucker, desert sucker, speckled dace, roundtail chub, Gila chub, and headwater chub are the most common prey for this gartersnake (79 FR 38685). Fingerling size classes of nonnative predatory fish also are used as prey by the narrow-headed gartersnake. Although the narrow-headed gartersnake has been reported to prey upon frogs, tadpoles, and salamanders, these are not considered important items in the diet of this species (79 FR 38685).

Native predators of the narrow-headed gartersnake include raptors, other snakes such as the regal ringneck snake, wading birds, mergansers, belted kingfishers, raccoons, and other generalist mammalian predators. Historically, Colorado pikeminnow may have preyed upon narrow-headed gartersnakes where the two species co-occurred. Native chubs also may prey on neonatal gartersnakes (79 FR 38685).

Listing and Conservation Status

The narrow-headed gartersnake was listed as a threatened species under the ESA effective August 7, 2014 (79 FR 38678). Critical habitat for this species has been proposed (78 FR 41549) but not finalized. Proposed critical habitat units occur along the STS where it crosses the Verde and Agua Fria rivers (78 FR 41550-41608).

There is no recovery plan yet in place for the narrow-headed gartersnake. Population status information indicates that the species has experienced considerable declines in population density and distribution along streams and rivers where it was formerly documented and regularly detected. As of 2004-2005, narrow-headed gartersnakes were detected in only 5 of 16 historical localities in Arizona and New Mexico (Holycross et al. 2006 as cited in: 79 FR 38678). As of 2011, the only remaining site in Arizona where the species could reliably be found was Oak Creek Canyon (79 FR 38686).

Similar to the northern Mexican gartersnake, the primary threat to the survival and recovery of the narrow-headed gartersnake is the presence of harmful nonnative species that directly prey upon them and compete with them for prey. Secondary threats are largely the same as those listed below for the northern Mexican gartersnake.

Factors Affecting Species

Factors affecting the narrow-headed gartersnake and its habitat within the project area are likely the same as those listed as threats in the Listing and Conservation Status section, above. The primary factor is the presence of harmful nonnative species. The influence of other factors likely varies by location, with relatively few factors affecting narrow-headed gartersnake proposed critical habitat at the Verde River crossing and a greater number of factors affecting potential habitat at the Agua Fria River crossings, which are in closer proximity to development and therefore at greater risk of direct and indirect impacts from recreation within riparian corridors; livestock grazing; adverse human interactions; road construction, use, and maintenance; wildfires; and environmental contaminants. Baseline ecological risk has not been evaluated for this species as it occurs outside of the area affected by emissions from NGS and the proposed KMC.

3.11.3.3.1.9 Northern Mexican Gartersnake

Species Occurrence

The only known occurrences of the northern Mexican gartersnake in the project area includes one record from the upper Verde River near where it is crossed by the STS and four records from the Agua Fria River, three of which are in the immediate vicinity of the transmission line crossings. These portions of the Verde and Agua Fria rivers have been proposed as critical habitat for the species (FR 78 41550-41608). The population occurring along the upper and middle Verde River is one of only five known populations in Arizona where the species is considered viable, and there are recent (2012) observations of the species (79 FR 38681). The most recent observation of northern Mexican gartersnakes along the Agua Fria River is from 1986, and the Agua Fria population is considered likely not viable (79 FR 38682). Refer to **Figure 3.11-10** for a map of northern Mexican gartersnake habitat along the STS.

Life History and Habitat Association

There is no information on the longevity of the northern Mexican gartersnake, but it is presumed that they may live as long as 10 years in the wild (79 FR 38678). Sexual maturity occurs at 2 years of age in males and at 2 to 3 years of age in females (79 FR 38679). The snake tends to be surface active at ambient temperatures ranging from 71°F to 91°F but spends most of its time inactive. In the northern-most portion of its range, the northern Mexican gartersnake appears to be most active from June to September, with peak activity occurring in July and August (79 FR 38679). Home range size has been documented as ranging from 1.7 acres to 10.4 acres, with a mean of 6.2 acres (Young and Boyarski 2012 cited in: 79 FR 38679).

The northern Mexican gartersnake occurs at elevations ranging from approximately 130 to 8,500 feet above mean sea level. It is a riparian obligate species, meaning that it is generally found in riparian habitats when it is not engaged in dispersal, gestation, or hibernation activities (79 FR 38678). Habitats generally suitable for this species include small, isolated wetlands such as cienegas and stock tanks; large-river riparian woodlands and forests with pools and backwaters; and streamside gallery forests (i.e., well-developed broadleaf deciduous riparian forests with limited or no herbaceous ground cover or dense grass) (multiple authors cited in: 79 FR 38679). Although considered a highly aquatic species, this snake uses terrestrial habitat for hibernation (Young and Boyarski 2012), gestation, seeking mates, and dispersal.

The northern Mexican gartersnake is a predator and forages along the banks of waterbodies where it feeds on smaller animals, including native amphibians (e.g., adult and larval leopard frogs) and fishes (e.g., desert pupfish and roundtail chub) (79 FR 38679). Additional prey items may include young Woodhouse's toads, treefrogs, earthworms, deer mice, some lizards, larval tiger salamanders, and leaches (various authors cited in: 79 FR 38678). In areas where native prey species are rare or absent, the northern Mexican gartersnake diet may comprise nonnative species including larval and juvenile bullfrogs (*Lithobates catesbeinanus*), mosquitofish (*Gambusia affinis*), or subadult green sunfish, bluegill, or largemouth bass (Emmons and Nowak 2013 cited in: 79 FR 38680).

Native predators of the northern Mexican gartersnake include raptors, other snakes, wading birds, mergansers (*Mergus merganser*), belted kingfishers (*Megaceryle alcyon*), raccoons (*Procyon lotor*), skunks (*Mephitis* spp.), and coyotes (*Canis latrans*) (Brennan et al. 2009 cited in: 79 FR 38680; Rosen and Schwalbe 1988). Historically, large predatory native fish such as the Colorado pikeminnow may have preyed upon the northern Mexican gartersnake where the two species co-occurred (79 FR 38680).

Listing and Conservation Status

The northern Mexican gartersnake was listed as a threatened species under the ESA effective August 7, 2014 (79 FR 38677). Critical habitat for this species has been proposed (78 FR 41549) but not finalized. Proposed critical habitat units occur along the STS where it crosses the Verde and Agua Fria rivers (FR 78 41550-41608).

There is no recovery plan in place for the northern Mexican gartersnake, and existing data are insufficient to determine an overall population trend for the species. Population trends at certain monitoring sites have been established and reflect considerable declines in the species with only 5 of the 29 currently known populations in the U.S. likely being viable into the foreseeable future (79 FR 38677, 38742).

The aquatic ecosystems upon which the northern Mexican gartersnake depends have been greatly degraded by the introduction and proliferation of harmful nonnative species. These species consist mainly of predatory fishes, bullfrogs, and crayfish and have been intentionally released or have dispersed into nearly every subbasin throughout the range of the northern Mexican gartersnake. The result has been widespread declines in the native fish and amphibians that comprise the primary food source for this snake and are therefore integral to its survival. These indirect impacts to the gartersnake's food source are accompanied by direct impacts to the gartersnake itself as young snakes fall prey to nonnative fishes and bullfrogs. Harmful non-native species are the most critical and pervasive threat to the survival and recovery of the northern Mexican gartersnake (79 FR 38742).

Other factors negatively affecting the northern Mexican gartersnake include amphibian decline; water management and use activities (e.g., dams, diversions, flood-control projects, and groundwater pumping); climate change; drought; development and recreation within riparian corridors; livestock grazing; adverse human interactions; road construction, use, and maintenance; high-intensity wildfires; environmental contaminants; disease and parasites; erosion control techniques; and possible competitive pressures from sympatric species (79 FR 38692-38742).

Factors Affecting Species

Factors affecting the northern Mexican gartersnake and its habitat within the project area are likely the same as those identified as threats in Listing and Conservation Status section, above. The primary factor is the presence of harmful nonnative species. The influence of other factors likely varies by location, with relatively few factors affecting proposed critical habitat for the northern Mexican gartersnake at the Verde River crossing and a greater number of factors affecting proposed critical habitat at the Agua Fria River crossings, which are in closer proximity to development and therefore at greater risk of direct and indirect impacts from recreation within riparian corridors; livestock grazing; adverse human interactions; road construction, use, and maintenance; wildfires; and environmental contaminants. Baseline ecological risk has not been evaluated for this species as it occurs outside of the area affected by emissions from NGS and the proposed KMC.

3.11.3.3.2 Other Special Status Wildlife Species

Other special status wildlife species with potential to occur along the WTS and STS and have potential to be affected by transmission line operations and maintenance activities are listed in **Table 3.11-4**.

Table 3.11-4 Other Special Status Wildlife Species Occurrence along the Transmission System ROWs

Species	Status[1]	Associated Vegetation Communities/Habitat Types[2]	WTS[3]	STS[3]
Mammals				
Desert Bighorn Sheep (*Ovis canadensis nelsoni*)	NESL G3, BLMS	Cliff and canyon, desert scrub	P	P
Pronghorn (*Antilocapra americana*)	NESL G3	Desert scrub, desert grasslands	P	K
Kit Fox (*Vulpes macrotis*)	BLMS, NESL G4	Desert scrub, desert grasslands	P	--
Northern Pocket Gopher (*Thomomys talpoides*)	FS	Desert scrub, desert grasslands, herbaceous wetland , riparian, barren/sparsely vegetated		P
Allen's Big-Eared Bat (*Idionycteris phyllotis*)	BLMS	Desert scrub, riparian, woody riparian and wetlands,	P	--
Big Free-Tailed Bat (*Nyctinomops macrotis*)	BLMS	Barren/sparsely vegetated, cliff and canyon, desert scrub, herbaceous wetland, riparian, woody riparian and wetlands, conifer woodlands.	P	--
California Leaf-Nosed Bat (*Macrotus californicus*)	BLMS	Desert scrub, riparian, woody riparian and wetlands, conifer woodlands	P	--
California Myotis (*Myotis californicus*)	BLMS	Desert scrub, herbaceous wetland, open water, riparian, , woody riparian and wetlands	P	--
Cave Myotis (*Myotis velifer*)	BLMS	Desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands	P	--
Fringed Myotis (*Myotis thysanodes*)	BLMS	Desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands	P	--
Greater Western Mastiff Bat (*Eumops perotis californicus*)	BLMS	Barren/sparsely vegetated, cliff and canyon, desert scrub, riparian	P	--
Little Brown Myotis (*Myotis lucifugus*)	BLMS	Barren/sparsely vegetated, cliff and canyon, desert scrub, riparian	P	--
Spotted Bat (*Euderma maculatum*)	BLMS, FS	Barren/sparsely vegetated, cliff and canyon, desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands, conifer woodlands	K	--
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	BLM, NESL G4	Desert scrub, herbaceous wetland, open water, woody riparian and wetlands, conifer woodlands	K	P

Table 3.11-4 Other Special Status Wildlife Species Occurrence along the Transmission System ROWs

Species	Status[1]	Associated Vegetation Communities/Habitat Types[2]	WTS[3]	STS[3]
Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)	BLMS, FS	Desert scrub, herbaceous wetland, open water, woody riparian and wetlands, conifer woodlands	K	--
Western Red Bat (*Lasiurus blossevillii*)	BLMS	Desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands, conifer woodlands	P	--
Yuma Myotis (*Myotis yumanensis*)	BLMS	Barren/sparsely vegetated, cliff and canyon, desert scrub, herbaceous wetland, open water, riparian, woody riparian and wetlands	P	--
Birds				
Bald Eagle (*Haliaeetus leucocephalus*)	FS, BLMS, NESL G2, H, SGCN 1a, BGEPA	Open water, woody riparian and wetlands	K	K
Bendire's Thrasher (*Toxostoma bendirei*)	BLMS	Desert scrub	P	--
Black Swift (*Cypseloides niger*)	BLMS	Desert scrub, herbaceous wetland, open water, cliff and canyon	P	--
Bobolink (*Dolichonyx oryzivorous*)	BLMS	Desert grasslands, herbaceous wetlands	P	--
Ferruginous Hawk (*Buteo regalis*)	NESL G3, H, BLMS, SGCN 1b	Desert scrub, desert grasslands, barren/sparsely vegetated	K	K
Golden Eagle (*Aguila chrysaetos*)	NESL G3, H, BLMS, SGCN 1b, BGEPA	Desert scrub, desert grasslands, cliff and canyon, barren/sparsely vegetated, conifer woodlands	K	K
Grasshopper Sparrow (*Ammodramus savannarum*)	BLMS	Desert grasslands	P	--
LeConte's Thrasher (*Toxostoma lecontei*)	BLMS	Desert scrub, woody riparian and wetlands	P	--
Lewis's Woodpecker (*Melanerpes lewis*)	BLMS	Woody riparian and wetlands, conifer woodlands	P	--
Loggerhead Shrike (*Lanius ludovicianus*)	BLMS	Desert scrub, desert grasslands	P	--
Long-billed Curlew (*Numenius americana*)	BLMS	Desert scrub, desert grasslands, herbaceous wetlands	P	--
Northern Goshawk (*Accipiter gentilis*)	FS, BLMS, NESL G4, H, SGCN 1b	Conifer woodlands	K	K

Table 3.11-4 Other Special Status Wildlife Species Occurrence along the Transmission System ROWs

Species	Status[1]	Associated Vegetation Communities/Habitat Types[2]	WTS[3]	STS[3]
American Peregrine Falcon (*Falco peregrinus anatum*)	FS, BLMS, NESL G4, H, SGCN 1a	Cliff and canyon, desert scrub, herbaceous wetland, woody riparian and wetlands	K	K
Short-eared Owl (*Asio flammeus*)	BLMS	Desert grasslands, desert scrub, herbaceous wetlands	P	--
Snowy Plover (*Charadrius alexandrines*)	BLMS	Barren/sparsely vegetated, herbaceous wetland	P	--
Swainson's Hawk (*Buteo swainsoni*)	BLMS	Barren/sparsely vegetated, desert shrubland, desert grasslands, conifer woodlands	P	--
Western Burrowing Owl (*Athene cunicularia hypugea*)	BLMS, NESL G4, SGCN 1b	Barren/sparsely vegetated, desert shrubland, desert grasslands	K	K
Reptiles				
Common Chuckwalla (*Sauromalus ater*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Desert Iguana (*Dipsosaurus dorsalis*)	BLMS	Barren/sparsely vegetated, desert scrub,	P	--
Desert Night Lizard (*Xantusia vigilis*)	BLMS	Barren/sparsely vegetated, cliff and canyon, desert scrub	P	--
Banded Gila Monster (*Heloderma suspectum cinctum*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Mojave Desert Sidewinder (*Crotalus cerastes cerastes*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Mojave Rattlesnake (*Crotalus scutulatus*)	BLMS	Desert scrub	P	--
Mojave Shovel-Nosed Snake (*Chionactis occipitalis occipitalis*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Nevada Shovel-Nosed Snake (*Chionactis occipitalis talpina*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Speckled rattlesnake (*Crotalus mitchellii*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Western Banded Gecko (*Coleonyx variegatus*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Western Threadsnake (*Leptotyphlops humilis*)	BLMS	Barren/sparsely vegetated, desert scrub, herbaceous wetland, riparian, woody riparian and wetlands	P	--

Table 3.11-4 Other Special Status Wildlife Species Occurrence along the Transmission System ROWs

Species	Status[1]	Associated Vegetation Communities/Habitat Types[2]	WTS[3]	STS[3]
Zebra-tailed lizard (*Callisaurus draconoides*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Invertebrates				
MacNeill Sooty Wing Skipper (*Hesperopsis gracielae*)	BLMS	Herbaceous wetland, riparian, woody riparian and wetlands	P	--
Mojave Gypsum Bee (*Andrena balsamorhizae*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Mojave Poppy Bee (*Perdita meconis*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--
Northern Mojave Blue (*Euphilotes mojave virginensis*)	BLMS	Barren/sparsely vegetated, desert scrub	P	--

[1] Status: NESL = Navajo Endangered Species List, G2 = Group 2, G3 = Group 3, G4 = Group 4; H = Hopi Cultural Sensitive Species; FS = Forest Service Sensitive; BLMS = BLM Sensitive; CAS = Conservation Agreement Species; SGCN = State Species of Greatest Conservation Need, 1a = Tier 1a, 1b = Tier 1b; BGEPA = Bald and Golden Eagle Protection Act.

[2] Habitat types are based on the vegetation communities described in Section 3.8.

[3] Occurrence Categories: K = Known occurrence based on Natural Heritage Program data, Navajo data, and agency input; P = Potential occurrence based on distribution and habitat information, agency input, the USFWS IPaC system, and/or the AGFD HabiMap utility; -- = species not known to occur or not considered sensitive in that area.

The primary factors affecting other special status species along the two transmission line corridors are likely limited to existing operations and maintenance activities (particularly vegetation management actions) and the public use of transmission line access roads. Vehicle use associated with operation and maintenance of the WTS and other immediately adjacent above- and below-ground linear utilities in Lincoln and Clark counties, Nevada, along the STS, and public recreational vehicle use of access roads along these corridors can result in direct injury to and mortality of fossorial and other slow-moving special status wildlife species. Road use and maintenance activities can generate fugitive dust and introduce non-native invasive plants and noxious weeds to the transmission system ROWs and associated access routes. Fugitive dust can impact productivity of native plants and reduce their value as forage for special status wildlife species. Establishment and spread of invasive plants and noxious weeds can degrade habitat and lead to increased frequency or severity of wildfires resulting in loss and degradation of habitat for special status wildlife species. Mechanical and chemical vegetation management activities such as clearing/trimming and herbicide use also can result in habitat degradation and direct injury to special status wildlife and invertebrates depending on timing of activities and site-specific conditions. Transmission towers provide perching opportunities for raptors and ravens, which are thought by some researchers (e.g., Boarman 2002) to increase predation rates in the vicinity of transmission lines. Increased predation rates along transmission lines could affect local populations of special status small mammal and reptile species. To the extent that climate change is affecting temperatures and the frequency, timing, and/or amount of precipitation along the transmission line corridors, it is likely affecting the natural wildfire regime as well as the productivity and phenology of native plants. These factors have potential to, in turn, impact the quality and areal extent of native wildlife habitats and the special status wildlife species that depend on them.

Baseline ecological risk has not been evaluated for other special status wildlife species associated with the WTS and STS study areas. Outside of the NGS Near-field study area, species occurring along the transmission systems are not affected by NGS emissions.

3.11.4 Environmental Consequences

3.11.4.1 Issues

The following issues related to special status wildlife species were identified through public and agency scoping. Although there is overlap, issues vary somewhat by project component:

3.11.4.1.1 Navajo Generating Station

Issue 1 – Emissions and Deposition - effects of NGS emissions on special status wildlife species.

Issue 2 – Operations and Maintenance - effects of operations and maintenance of NGS and associated facilities, including the BM&LP Railroad, on special status wildlife species.

3.11.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Emissions and Deposition - effects of combined emissions from the proposed KMC and NGS on special status wildlife species within the proposed KMC study area.

Issue 2 – Operations and Reclamation - effects of mining operations and reclamation on special status wildlife species.

Issue 3 – Groundwater Pumping - effects of mine-related groundwater pumping from the N-Aquifer on associated stream and spring baseflows that support aquatic, wetland, and/or riparian habitats that may be used by special status wildlife species.

3.11.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operation and Maintenance - effects of transmission line operations and maintenance on special status wildlife species.

3.11.4.2 Assumptions and Impact Methodology

The following is a list of assumptions made and methodology uses to assess impacts of the project as they relate to special status wildlife species. The impacts identified under the separate project components below are based on correspondence with federal and state agencies, tribal representatives, and on the public scoping comments (see Section 1.11).

- Special status wildlife species and associated habitat within each of the project components was determined by:
  - Consultation and review of existing published data sources from federal and state agencies, as well as PWCC, Navajo Nation, and Hopi Tribe.
  - Identification of the types of terrestrial wildlife habitats (e.g., grasslands, forested lands, riparian areas) located within the study area using data from the vegetation analysis.
- Species was considered as having the potential to occur within the project area if:
  - Occurrence in the vicinity of one or more of the project study areas has been documented for the species; and
  - The species' current range overlaps the project area and potentially suitable habitat is present.

- There would be no construction disturbance for the NGS, BM&LP Railroad, transmission lines, and communication sites components of the project. The analysis of impacts to special status wildlife species from these components of the project is limited to the effects of operation and maintenance activities.
- Human activity, noise, and surface disturbance associated with decommissioning and reclaiming project facilities including the NGS plant, BM&LP Railroad, and proposed KMC in 2045 may result in short-term impacts on special status wildlife species and their habitats known or with potential to occur in proximity to these facilities. Following completion of these activities, it is assumed that there would be beneficial effects to special status wildlife.

3.11.4.2.1 Navajo Generating Station

- The results of the NGS Near-field ERA, Gap Regions ERA, and San Juan River ERA are used to determine the impacts of NGS emissions on special status wildlife species. Screening-level HQs based on exposure to maximum COPEC concentrations (HQ_{max}) for the 3-Unit Operation at the no adverse effects level are used to indicate potential risk to special status wildlife species. For HQ_{max} values greater than 1, the more realistic HQ value for exposure to refined COPEC concentrations is provided as an indicator of risk ($HQ_{refined}$). Refer to Section 3.0.3 for an overview of the ERAs and how they are used to evaluate the effects of NGS emissions on special status wildlife species.
- Special status wildlife habitat located within the NGS Near-field ERA, Gap Region ERA, San Juan River ERA, and proposed KMC study areas were analyzed for emission effects on wildlife habitat and representative species.
- For special status species not directly modeled in the four ERAs, analysis of modeled species with similar diets is representative of special status wildlife that occur in the analysis area.
- As detailed in the four ERAs, the risk characterization for future scenarios is conducted in the same way as the risk characterization for baseline conditions.
- As identified in the ERAs, potential exposure routes for wildlife receptors include incidental ingestion of sediment, surface water, or soil, as well as ingestion of food items containing COPECs. The actual amount of exposure by wildlife species as the result of ingestion depends on a number of factors including concentrations of COPECs in food items, size of the receptor, and bioavailability of the COPEC once consumed by the receptor.
- Known or potential occurrence of special status wildlife species were evaluated for the BM&LP Railroad in a qualitative analysis.

3.11.4.2.2 Proposed Kayenta Mine Complex

- The results of the ERA prepared for the proposed KMC study area are used to determine impacts to special status wildlife species with potential to occur in this area. Screening-level HQs based on exposure to maximum COPEC concentrations (HQ_{max}) for the 3-Unit Operation at the no adverse effects level are used to indicate potential risk to special status wildlife species. Refer to Section 3.0.2 for an overview of the ERAs and how they are used to evaluate the effects of NGS emissions on special status wildlife species.
- The known occurrence of special status wildlife species within the proposed KMC study area is based on previous National Environmental Policy Act documents, wildlife surveys, and annual monitoring reports prepared by OSMRE, PWCC, and/or PWCC contractors. Potential occurrence is based on individual species range and habitat affiliation and presence of potential habitat in the study area as documented through the vegetation analysis (Section 3.8).
- The analysis of surface water and groundwater impacts to special status wildlife species associated with riparian habitats is based on groundwater modeling presented in the water resources section (Section 3.7).

3.11.4.2.3 Transmission Systems and Communication Sites

- Known or potential occurrence of special status wildlife species were evaluated for the transmission lines and associated communication sites in a qualitative analysis.
- Operation and maintenance of communication sites would be infrequent and confined to the existing disturbance footprints of these facilities. Consequently, these activities are expected to have negligible impacts to special status wildlife species and their habitats.

3.11.4.3 Proposed Action

3.11.4.3.1 Navajo Generating Station

3.11.4.3.1.1 Federally Listed Species

California Condor

The primary activity area of the Southwest experimental non-essential population of California condor is centered 50 to 60 miles west of NGS (**Figure 3.11-1**). However, individuals occasionally fly within the vicinity of the NGS and have potential to nest in Marble Canyon, the upper portion of which is located in the NGS Near-field ERA study area. Tracked individuals also have been recorded flying east of NGS and the BM&LP Railroad. These individuals likely were on foraging flights as there don't appear to be any areas of concentrated flight activity that would suggest nesting east of Marble Canyon. Therefore, the impact issues most relevant to California condor are continued NGS operations and associated emissions.

Emissions and Deposition

The NGS Near-field ERA provided a qualitative evaluation of project risks to the California condor. As described in Section 3.11.2, Affected Environment, the condor diet primarily consists of carrion. Consequently, exposure to COPECs is expected to be via pathways similar to those evaluated for other carnivorous birds such as the red-tailed hawk. The ERA found that even maximum concentrations of COPECs resulted in HQs <1 for the red-tailed hawk. Therefore, risk to the California condor from NGS stack emissions and secondary source emissions under the Proposed Action is expected to be negligible (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

Operations and Maintenance

Impacts to California condor associated with operation and maintenance of NGS and associated facilities, including the BM&LP Railroad, are not expected as occurrence of California condors in the vicinity of these facilities is infrequent and transitory. Moreover, these facilities are fenced, thereby preventing cattle and big game from occurring in the facilities and providing a source of carrion that would attract condors and render them susceptible to impacts from operation and maintenance activities. Consequently, operation and maintenance of NGS and associated facilities, including the BM&LP Railroad, under the Proposed Action would have no effect on the California condor.

Mexican Spotted Owl

As described in Section 3.11.2, Affected Environment, Mexican spotted owls have potential to occur in the NGS Near-field ERA study area (the 20-km deposition area).

Emissions and Deposition

Results of the NGS Near-field ERA indicate that operation of NGS under the Proposed Action would have no effect on the Mexican spotted owl. Under the 3-Unit Operation, the maximum HQ_{max} <1. The combination of the Proposed Action and baseline conditions also results in HQ_{max} <1. No direct or

indirect impacts to Mexican spotted owl resulting from other activities associated with the operation and maintenance of NGS and associated facilities, including the BM&LP Railroad, are expected as there is no potentially suitable Mexican spotted owl nesting or roosting habitat located within 3 miles of these facilities.

Operations and Maintenance

Mexican spotted owls do not occur on the NGS plant site or along the BM&LP railroad and therefore would not be affected by other NGS operations and maintenance activities.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is known to occur in riparian woodland and shrubland habitats within the NGS Near-field ERA study area and San Juan River corridor, has potential to occur in the Northeast Gap Region and, at least on a transitory basis during migration, in the Southwest Gap Region. For this reason, the southwestern willow flycatcher was evaluated in the NGS Near-field, Gap Region, and San Juan River ERAs to determine if NGS emissions under the Proposed Action would be likely to have an adverse effect on this species.

Emissions and Deposition

Results of all three NGS ERAs indicate that emissions from proposed future operations of NGS would have no effect on the southwestern willow flycatcher (HQ_{max} <1). Moreover, potential impacts to the southwestern willow flycatcher remain negligible even when combined with baseline conditions (HQ_{max} <1) (**Appendix 3RA**, Ecological and Human Health Risk Assessments; Ramboll Environ 2016a,b,c). Because the Proposed Action's only effect on southwestern willow flycatcher critical habitat along the San Juan River would be through deposition of NGS emissions, and results of the NGS San Juan River ERA indicate that the 3-Unit Operation would not result in unacceptable risk to the southwestern willow flycatcher (HQ_{max} <1), the Proposed Action would have a negligible impact on critical habitat for this species.

Operations and Maintenance

The southwestern willow flycatcher has potential to occur in riparian habitat in the Begashibito Wash/Cow Springs area adjacent to the BM&LP Railroad. Operation of the coal train under both the 3-Unit Operation and 2-Unit Operation would be a regular source of disturbance to riparian habitat in at least the lower (more southern) portions of this area. To the extent that breeding and/or migrating southwestern willow flycatchers currently use the Begashibito Wash/Cow Springs area, they are acclimated to this disturbance and train operations under either the 3-Unit Operation or 2-Unit Operation of the Proposed Action would not be expected to impact this species.

Western Yellow-billed Cuckoo

The western yellow-billed cuckoo is not known to occur within the NGS Near-field study area. It is known to occur in the San Juan River corridor, and critical habitat for the species has been proposed for portions of the river corridor containing large areas of well-developed riparian woodland vegetation. The species also has potential to occur on a transitory basis in the Southwest and the Northeast Gap Regions during migration, but the lack of riparian habitat in these areas likely render them unsuitable for breeding and nesting by this species. Due to the species potential to occur in these areas, the western yellow-billed cuckoo was evaluated in the NGS Near-field, Gap Regions, and San Juan River ERAs to determine if NGS emissions under the Proposed Action would be likely to have an adverse effect on this species.

Emissions and Deposition

Results of all three NGS ERAs indicate that maximum emissions from proposed future operations of NGS under the 3-Unit Operation would have negligible effects on the western yellow-billed cuckoo (HQ_{max} <1). Moreover, these effects would remain negligible when combined with baseline conditions (HQ_{max} <1) (**Appendix 3RA,** Ecological and Human Health Risk Assessments; Ramboll Environ 2016a,b,c). Because the Proposed Action's only affect to proposed critical habitat for the western yellow-billed cuckoo along the San Juan River would be through deposition of NGS emissions, and results of the NGS San Juan River ERA indicate that the 3-Unit Operation would not result in unacceptable risk to the western yellow-billed cuckoo (HQ_{max} <1), the Proposed Action would have a negligible impact on proposed critical habitat for this species.

Operations and Maintenance

The western yellow-billed cuckoo has been detected in riparian habitat associated with the Begashibito Wash/Cow Springs area adjacent to the BM&LP Railroad during migration. As described in Section 3.11.2, Affected Environment, this area does not appear to provide the size or stature of woody riparian vegetation necessary to support breeding and nesting cuckoos. To the extent that migrating cuckoos use this area now, operation of the coal train under both of the 3-Unit Operation and 2-Unit Operation, would not be expected to affect the cuckoo's use of the area under the Proposed Action.

3.11.4.3.1.2 Other Special Status Wildlife Species

Impacts to other special status wildlife species known or with potential to occur in the NGS Near-field, Gap Region, and San Juan River study areas are summarized in **Table 3.11-5**.

Table 3.11-5 Impacts to Other Special Status Wildlife Species Known or with Potential to Occur in the NGS ERA Study Areas under the Proposed Action

Species	Potential Impacts
Desert Bighorn Sheep	*Issue 1 – NGS Emissions/Deposition*: Desert bighorn sheep have potential to occur in the NGS Near-field study area and along the BM&LP Railroad. This species diet comprises mostly grasses and other terrestrial plants. Thus, for the purpose of determining ecological risk from NGS, the meadow vole can be considered a representative species based on similarity of diet. The NGS Near-field ERA indicates that future operation of the plant under the 3-Unit Operation would pose negligible risk to the meadow vole (HQ_{max} <1). Ecological risk to bighorn sheep would continue to be minimal when the effects of the Proposed Action are combined with baseline conditions (HQ_{max} <1). Thus, continued emissions from the plant are expected to have a negligible impact on this species. *Issue 2 – NGS Operations/Maintenance*: Due to the lack of vegetation, the high levels of human and industrial activities, and perimeter fencing around NGS, the ash disposal site, and other adjacent facilities, bighorn sheep are unlikely to occur in the immediate vicinity of NGS. Thus, future operations would have no effect on this species. Commuter vehicle and delivery truck traffic to NGS under the Proposed Action would continue to fragment and degrade bighorn sheep habitat and provide a potential source of injury/mortality in the vicinity of affected roadways. Under the 2-Unit Operation, the risk of NGS vehicle-related impact to bighorn sheep would be reduced by up to one-third relative to the 3-Unit Operation. Although desert bighorn sheep have potential to occur along a portion of the BM&LP Railroad, the railroad ROW is entirely fenced, minimizing the potential for bighorn sheep to be struck and injured or killed by the coal train. Railroad-related fragmentation of bighorn sheep habitat would continue under the Proposed Action

Table 3.11-5 Impacts to Other Special Status Wildlife Species Known or with Potential to Occur in the NGS ERA Study Areas under the Proposed Action

Species	Potential Impacts
Houserock Valley Chisel-toothed Kangaroo Rat	*Issue 1 – NGS Emissions/Deposition*: This kangaroo rat has potential to occur in the NGS Near-field study area. The species' diet consists primarily of leaves of terrestrial plants (particularly salt bush) and seeds. Because insects comprise a small portion of the species' diet, the mourning dove can be considered a representative species for assessing ecological risk from NGS emissions based on similarity of diet. The NGS Near-field ERA indicates that future operation of the plant under the 3-Unit Operation would not pose unacceptable risk to the mourning dove (HQ_{max} <1). Ecological risk to this kangaroo rat would continue to be minimal when the effects of the Proposed Action are combined with baseline conditions (HQ_{max} <1). Thus, continued emissions from the plant would have a negligible impact on this species. *Issue 2 – NGS Operations/Maintenance*: NGS-related vehicle traffic under the Proposed Action would continue to provide a potential source of injury/mortality to the Houserock Valley chisel-toothed kangaroo rat. Under the 2-Unit Operation, the level of impact associated with vehicle traffic is expected to be reduced by up to one-third relative to the 3-Unit Operation.
Bats: Spotted Bat Townsend's Big-eared Bat	*Issue 1 – NGS Emissions/Deposition*: The spotted bat and Townsend's big-eared bat have potential to occur in the vicinity of NGS and associated facilities, including the BM&LP Railroad. Using the little brown bat as representative species, future operations of NGS under the 3-Unit Operation would pose negligible risk to the little brown bat (HQ_{max} <1) and, by extension, spotted and Townsend's big-eared bats. Ecological risk to these bats would continue to be minimal when the effects of the Proposed Action are combined with baseline conditions (HQ_{max} <1). *Issue 2 – NGS Operations/Maintenance*: Future operation of the BM&LP Railroad under the 3-Unit Operation is unlikely to affect bats because these species are highly mobile and capable of avoiding collisions with the train and associated infrastructure. Based on the above, future operations of NGS and associated facilities under the Proposed Action would have negligible effects on special status bat species with potential to occur in these areas.
American Dipper	*Issue 1 – NGS Emissions/Deposition*: The American dipper is an aquatic-oriented bird that is primarily associated with fast-moving, clear, unpolluted streams with cascades, riffles, and waterfalls (Wilson and Kingery 2011). The species is therefore unlikely to occur along the main-stem Colorado or San Juan Rivers on a regular basis but may be present along streams that are tributary to these rivers. For the purposes of this Environmental Impact Statement, it is assumed that the American Dipper may occur in the NGS Near-field, Northeast Gap Region, Southwest Gap Region, and San Juan River study areas. The American Dipper primarily feeds on aquatic insects but also may take small fish and fish eggs (Wilson and Kingery 2011). For assessing ecological risk, the southwestern willow flycatcher is assumed to be representative of the American dipper. For future NGS emissions under the Proposed Action 3-Unit Operation, the maximum HQ_{max} value across all applicable study areas is less than 1. Combined with baseline conditions, the maximum HQ value across all applicable study areas remains less than 1. Thus, emissions associated with both the 3-Unit Operation and 2-Unit Operation of the Proposed Action are considered to have negligible effects on the American Dipper. *Issue 2 – NGS Operations/Maintenance*: The American dipper does not occur in the vicinity of the NGS plant or BM&LP Railroad. Thus, operation and maintenance activities proposed for these facilities would have no effect on this species.

Table 3.11-5 Impacts to Other Special Status Wildlife Species Known or with Potential to Occur in the NGS ERA Study Areas under the Proposed Action

Species	Potential Impacts
Bald Eagle	*Issue 1 – NGS Emissions/Deposition*: The bald eagle may occur in all four of the study areas used to evaluate ecological risk from NGS emissions as well as along the BM&LP Railroad. With regard to emissions impacts, the ERAs indicate that future operations of NGS under the 3-Unit Operation would result in HQ_{max} values less than 1 for all four study areas. When combined with ERA results for baseline conditions, HQ_{max} values are less than 1 for the Northeast Gap and San Juan River study areas, indicating negligible risk to bald eagles in these areas. For the NGS Near-field study area, HQ_{max} = 1 and $HQ_{refined}$ <1, indicating negligible risk to bald eagles within 20 km of the NGS facility. In contrast, in the Southwest Gap Region the HQ_{max} value for methyl mercury under the Proposed Action combined with baseline conditions is 4, with $HQ_{refined}$ = 3. Thus, future NGS emissions when combined with baseline conditions may pose risk to the bald eagle. As discussed in Section 3.11.3.1, baseline mercury levels in the Southwest Gap Region may be overestimated due to the use of questionable baseline mercury data (Ramboll Environ 2016c, Appendix A-1D). Furthermore, the Gap Region ERA assumed that bald eagles occur in the area year round when in fact they primarily spend only winter in the area (Spence 2016). Consequently, exposure duration is likely overestimated and, as a result, the potential for risk overestimated as well. Although the contribution of the Proposed Action is minimal in and of itself, when it is combined with the potentially degraded baseline conditions in the Southwest Gap Region, it may pose risk to the bald eagle. Given the uncertainty regarding the validity of baseline data and the potential overestimation of risk due to high exposure duration, impacts to the bald eagle are expected to be only minor under the Proposed Action. *Issue 2 – NGS Operations/Maintenance*: NGS-related vehicle traffic under the Proposed Action would continue to provide a potential source of injury/mortality to bald eagles feeding on roadkill in the area. Under the 2-Unit Operation, the level of impact associated with vehicle traffic is expected to be reduced by up to one-third relative to the 3-Unit Operation. Electrocution risk to bald eagles from power infrastructure at the NGS Plant site and the catenary system along the BM&LP Railroad is expected to decline as these facilities are replaced by raptor-safe designs meeting APLIC guidelines (APLIC 2012).
Other Raptors: Ferruginous Hawk Golden Eagle American Peregrine Falcon Western Burrowing Owl	*Issue 1 – NGS Emissions/Deposition*: Other special status raptors have potential to occur within the NGS Near-field study area and along the BM&LP Railroad. For the purpose of evaluating ecological risk to these species associated with baseline conditions and future operations of the NGS under the Proposed Action, the red-tailed hawk can be used as a representative species for the ferruginous hawk, golden eagle, and peregrine falcon; and the Mexican spotted owl can be used as a representative species for the burrowing owl. For the red-tailed hawk under the Proposed Action 3-Unit Operation, HQ_{max} <1. Even when combined with baseline conditions, HQ_{max} <1. Consequently, emissions associated with future operations of NGS under the Proposed Action would pose negligible risk to the ferruginous hawk, golden eagle, and American peregrine falcon. Similarly, the Proposed Action is expected to pose negligible risk to the Mexican spotted owl on its own (HQ_{max} <1) and when combined with baseline ecological risk (HQ_{max} <1). Thus, emissions associated with future operations of NGS under the Proposed Action 3-Unit Operation and 2-Unit Operation are expected to have negligible effects on the Western burrowing owl. *Issue 2 – NGS Operations/Maintenance*: Electrocution risk to other special status raptors from power infrastructure at the NGS Plant site and the catenary system along the BM&LP Railroad is expected to decline as these facilities are replaced by raptor-safe designs meeting APLIC guidelines (APLIC 2012).

3.11.4.3.1.3 Decommissioning and Abandonment

Under the Proposed Action, the majority of the operating and support facilities at the plant site would be dismantled and demolished to ground level by December 22, 2045, unless the Navajo Nation elects to continue NGS operations beyond 2044. Most of the 3,724 acres comprising the plant site and coal ash landfill would be capped, contoured, and revegetated. **Appendix 1B** provides an overview of the decommissioning process. Following decommissioning of the plant site, several buildings and other facilities would remain for use by the Navajo Nation and fences around the site and along the railroad would be left in place. Decommissioning of the BM&LP Railroad would involve removal of rails, ties, and overhead power lines. Railbed embankments would be abandoned in place and revegetated.

It is estimated that herb-dominated habitats such as grasslands would take a minimum of 2 to 5 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species. Woody habitats like sagebrush shrublands would require at least 10 to 25 years for shrubs to recolonize the area.

Although there would be short-term impacts to wildlife associated with increased levels of noise and activity associated with these efforts, decommissioning of the NGS plant site and BM&LP Railroad is expected to re-open and restore wildlife habitat over the long term. Special status wildlife species expected to benefit from decommissioning of NGS and associated facilities include the Houserock Valley chisel-toothed kangaroo rat, ferruginous hawk, and burrowing owl. Because fences would be left in place, larger special status species such as the desert bighorn sheep would not benefit from restoration of the plant site, and the railroad ROW would remain a barrier to the movement of this species.

3.11.4.3.2 Proposed Kayenta Mine Complex

3.11.4.3.2.1 Federally Listed Species

Black-footed Ferret

Although Gunnison's prairie dogs have been observed within the proposed KMC, no black-footed ferrets or their sign have been observed in these areas, and the prairie dog colonies are too small to support black-footed ferrets. Even if these colonies were to grow to a size capable of supporting ferrets, there is no known source population capable of colonizing the site. Thus, operations of the proposed KMC from 2020 to 2044 would have no effect on the black-footed ferret.

Mexican Spotted Owl

Emissions and Deposition

The ERA completed for the proposed KMC study area resulted in a baseline HQ_{max} value of 1 for methylmercury. Whereas this HQ value would seem to indicate that baseline conditions pose some level of risk to the Mexican spotted owl, the more realistic refined (95 percent upper concentration limit) HQ value indicates that baseline emissions pose negligible risk of methylmercury contamination to this species ($HQ_{refined}$ <1). All other HQ values calculated for the Mexican spotted owl under baseline conditions were below 1, indicating that COPECs pose negligible risk to this species (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

Operations and Reclamation

As described in the affected environment section, noise and disturbance can impact the quality of Mexican spotted owl habitat. Development of the N-10 Coal Resource Area under the 3-Unit Operation of the Proposed Action would result in increases in noise and other mining-related disturbance (e.g., night lighting and increased levels of human activity) that could degrade habitat quality in the Scoria Site Protected Activity Center and perhaps other adjacent Protected Activity Centers within the general

habitat area depicted in **Figure 3.11-4**. In May 2015, there were two Mexican spotted owl detections within approximately 1.9 miles of coal resource area N-9 (Ecosystem Management Inc. 2016). Due to the close proximity of the two detections, they were likely of the same individual. A follow-up visit the next morning yielded no further detections of the bird(s) and a nest could not be located. The 2015 owl detections were the first since surveys re-commenced in 2011 and it was speculated that higher amounts of precipitation in recent years could be resulting in increased prey populations and, thus, increased habitat quality for Mexican spotted owls (Ecosystem Management Inc. 2016). The results of future surveys will determine whether or not owls have begun breeding in the area and may provide an indication of whether owl use of habitat around the historic PACs is more affected by prey density than it is by mine activity. Implementation of Conservation Measure AS-1 below, would avoid or minimize potential impacts to nesting Mexican spotted owls in the vicinity of active mining. Under the 2-Unit Operation, coal resource area N10 would remain undeveloped and potential impacts to owl habitat in adjacent PACs would be negligible.

AS-1: Mexican Spotted Owl

- Prior to implementing mining activities within 2 miles of suitable coniferous forest/canyon habitat, conduct protocol surveys for Mexican spotted owl.
- If Mexican spotted owls are determined to be nesting within the survey area, suspend surface disturbing activities within 0.25 mile of the PAC boundaries between March 1 and August 31.

Effectiveness: Implementation of this measure would determine whether Mexican spotted owls are nesting within the area with potential to be affected by noise from mining operations.

Groundwater Pumping

Mexican spotted owls and their primary prey are not obligate riparian or aquatic-oriented species. Thus, groundwater pumping would have no effect on this species.

Southwestern Willow Flycatcher

The southwestern willow flycatcher has potential to occur in tamarisk-dominated riparian areas along perennial waters within the proposed KMC and the N-Aquifer study area.

Emissions and Deposition

The ERA prepared for the proposed KMC indicates that emissions resulting from the combined operation of NGS and KMC from 2020 to 2044 within the KMC study area would not cause unacceptable ecological risks to southwestern willow flycatcher populations from exposure to trace metals under the 8.1 million tons per year (tpy) mining scenario (HQ_{max} <1). Moreover, this level of mining combined with baseline conditions results in an HQ_{max} <1, indicating that the emissions associated with the level of mining expected under the Proposed Action 3-Unit Operation would have negligible effects on southwestern willow flycatchers within the proposed KMC study area (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

Operations and Reclamation

As summarized in **Table 3.8-11**, continued mine operations would have no impact to tamarisk-dominated riparian woodland and shrubland habitat. Moreover, PWCC currently has no plans for tamarisk removal within the proposed KMC (Dunfee 2016). Thus, future impacts to potential southwestern willow flycatcher habitat under the proposed action and its alternatives are not anticipated. However, if requested by the Bureau of Indian Affairs and Tribes, PWCC would likely partner with these entities to do tamarisk control work in the future (Dunfee 2016). This work would be conducted under separate authorization as necessary and appropriate at the time it is proposed.

Groundwater Pumping

Continued groundwater pumping to support mine operations under the Proposed Action are predicted to result in small decreases in baseflow (seaonsal low flow) in four of seven modeled creeks and washes within the N-Aquifer study area (Section 3.7, Water Resources). These mine-related baseflow reductions would range from 0.0004 cubic feet per second to 0.0027 cubic feet per second, a relative reduction of approximately 0.02 – 0.87 percent. Based on groundwater modeling, no change in spring flows would be expected in 95 of 98 non-monitored springs. One spring in each of Spring Groups D (Pasture Canyon/Tuba City/Moenkopi Wash area), F1 (Dennehotso area), and I (Tselani Valley area west of Chinle) would be expected to experience small decreases in flow as a result of mine pumping and associated drawdown of the N-Aquifer (Section 3.7). These decreased spring flows would range from 0.00003 gallons per minute to 0.0005 gallons per minute. Based on aerial photo interpretation, there does not appear to be any suitable habitat for southwestern willow flycatcher in Spring Group I. There does appear to be some potential southwestern willow flycatcher habitat associated with Pasture Canyon and Moenkopi Wash in Spring Group D and along Laguna Creek in Spring Group F1; although it appears to be limited and of marginal quality. As discussed in Section 3.8 these small reductions in flow are not expected to affect the tamarisk-dominated riparian vegetation in the area, particularly after 2020. Consequently, mine-related groundwater pumping is expected to have no effect on southwestern willow flycatchers with potential to use these habitats during migration.

Surface mining activities such as pit excavations and backfills are predicted to have localized effects on spring and seeps associated with the shallower Wepo Formation and hydraulically connected channel alluvium (Section 3.7). The anticipated flow reductions would be incremental and occur within an over-riding trend of declining springflows due to region-wide drought. Thus, associated impacts to riparian habitat supported by these springs are likely to be limited to areas adjacent to active mining sites. Although these effects could reduce the quality and extent of potential flycatcher habitat within the proposed KMC, given that the species currently is not known to occur in this area, impacts to riparian habitat adjacent to active mine sites would have no effect on the species itself.

Western Yellow-billed Cuckoo

Because the riparian habitats in and around the proposed KMC and the N-Aquifer study area are narrow, discontinuous, and dominated by tamarisk, they are unlikely to support the western yellow-billed cuckoo. Nevertheless, there is the possibility that the species could occur in these areas on a transitory basis during migration. For that reason, potential risk of continued mine operations have been evaluated in the proposed KMC ERA.

Emissions and Deposition

Results of the ERA indicate that emissions resulting from the proposed operation of the mine under the 8.1 million tpy mining scenario, combined with emissions from NGS from 2020 to 2044, would not impact the western yellow-billed cuckoo (HQ_{max} <1). Moreover, this level of mining combined with baseline conditions results in an HQ_{max} <1, indicating that the emissions associated with the level of mining expected under the Proposed Action 3-Unit Operation would have negligible effects on western yellow-billed cuckoos within the proposed KMC study area (**Appendix 3RA**, Ecological and Human Health Risk Assessments).

Operations and Reclamation

As described above for the southwestern willow flycatcher, mine operations would have no impact to riparian woodland and shrubland habitat under the Proposed Action and its alternatives. Consequently, there would be no impact to potential western yellow-billed cuckoo habitat within the proposed KMC permit area,

Groundwater Pumping

As for the southwestern willow flycatcher, continued groundwater pumping to support mine operations under the Proposed Action are predicted to result in small decreases in flow in four of seven modeled creeks and washes within the N-Aquifer study area (Section 3.7). Predicted minor impacts to individual spring flows in the Pasture Canyon/Moenkopi Wash area, the Dennehotso area, and in the Tselani Valley area west of Chinle (Section 3.7) would not be expected to affect the western yellow-billed cuckoo because these areas do not contain riparian habitat of sufficient stature and extent to support this species. Similarly, although mine-related water use would have localized effects on shallow Wepo Formation spring flows, riparian habitats associated with these springs typically are narrow, dominated by tamarisk, and unlikely to support western yellow-billed cuckoos. Therefore, continued groundwater pumping associated with mine operations under both the 3-Unit Operation and 2-Unit Operation of the Proposed Action would not be expected to affect the western yellow-billed cuckoo.

3.11.4.3.2.2 Other Special Status Wildlife Species

Other special status wildlife species that are known or have potential to occur within the proposed KMC and the N-Aquifer study areas are listed in **Table 3.11-3**. Impacts to these species due to the proposed KMC would be similar to those described in Section 3.10.3.3, Kayenta Mine. Impacts that would occur to general vegetation communities within the proposed KMC where these bird species may breed and/or forage is found in **Table 3.10-4**. A brief summary of relevant life history information and the potential for occurrence, as well as any species specific impacts for other special status wildlife species within the study area are listed in **Table 3.11-6** below.

Locations of proposed pits for mining under the Proposed Action would be the same between the 3-Unit Operation and 2-Unit Operation except that under the 2-Unit Operation, the rate of mining would proceed more slowly and mining would not occur in the N-10 coal resource area. As shown in **Table 3.8-10**, the 3-Unit Operation would directly impact approximately 488 more acres of native vegetation/wildlife habitat than would the 2-Unit Operation.

Table 3.11-6 Impacts for Other Special Status Wildlife Species within the Proposed KMC and N-Aquifer Study Areas

Species	Potential Impacts
Bald Eagle	*Issue 1 – Proposed KMC Emissions/Deposition:* The Proposed KMC ERA indicates that emissions resulting from the operation of NGS and proposed KMC from 2020 through 2044 would not cause unacceptable ecological risks to bald eagle from exposure to trace metals (HQmax <1 for both project-related effects under the 8.1 million tpy operation and for project effects plus baseline) (**Appendix 3RA**, Ecological and Human Health Risk Assessments). *Issue 2 – Proposed KMC Operations/Reclamation:* Surface disturbance associated with mining operations would result in no impacts to open water habitat with potential to be used for foraging by bald eagles (**Table 3.8-5**). Under the 3-Unit Operation, impacts to pinyon-juniper woodlands, sagebrush shrublands, and mixed salt desert scrub habitats would comprise 4,738 acres, 456 acres, and 35 acres, respectively. Under the 2-Unit Operation, these impacts would be incrementally lower with 4,306 acres of pinyon-juniper woodland, 427 acres of sagebrush shrubland, and 8 acres of mixed salt desert scrub affected. Given the infrequency of bald eagle use of the proposed KMC lease area and the small magnitude of these habitat impacts relative to the amount of available habitat in the surrounding region, operation and reclamation activities within the proposed KMC are expected to have a negligible effect on this species.

Table 3.11-6 Impacts for Other Special Status Wildlife Species within the Proposed KMC and N-Aquifer Study Areas

Species	Potential Impacts
	Issue 3 – Proposed KMC Groundwater Pumping: Because groundwater pumping to support mine operations would not affect any fish-bearing streams, it would have negligible impact on bald eagle habitat within the proposed KMC and N-Aquifer study areas.
Ferruginous Hawk	*Issue 1 – Proposed KMC Emissions/Deposition:* The Proposed KMC ERA indicates that emissions resulting from the operation of NGS and proposed KMC from 2020 to 2044 would pose negligible ecological risks to the red-tailed hawk, a representative species for the ferruginous hawk (HQmax <1 for Proposed Action under the 8.1 million tpy operation; HQmax <1 when Proposed Action is combined with baseline ecological risk) (**Appendix 3RA**, Ecological and Human Health Risk Assessments). Thus, impacts to ferruginous hawk from project emissions within the proposed KMC study area would be negligible under the Proposed Action 3-Unit Operation and 2-Unit Operation. *Issue 2 – Proposed KMC Operations/Reclamation:* Mining operations would result in combined surface disturbance impacts to approximately 435 - 491 acres of native sagebrush shrubland and salt desert scrub habitats preferred by ferruginous hawks under the 3-Unit Operation and 2-Unit Operation, respectively (**Table 3.8-10**). Potential nesting habitat would be incrementally reduced where pinyon-juniper woodlands are removed along the edges of grassland and shrubland habitats. The small magnitude of these impacts relative to habitat available in the surrounding area and the long-term increase in suitable foraging habitat associated with reclaimed grassland vegetation indicate that impacts to potentially suitable ferruginous hawk habitat would be negligible. *Issue 3 – Proposed KMC Groundwater Pumping:* The ferruginous hawk is not associated with wetlands or riparian habitats. Thus, groundwater pumping to support mine operations under the Proposed Action would have no effect on this species.
Golden Eagle	*Issue 1 – Proposed KMC Emissions/Deposition:* Similar to the ferruginous hawk, emissions resulting from the operation of NGS and proposed KMC from 2020 to 2044 would pose negligible ecological risks to the golden eagle from exposure to trace metals (**Appendix 3RA**, Ecological and Human Health Risk Assessments). *Issue 2 – Proposed KMC Operations/Reclamation:* Mining operations would not result in surface disturbance to nesting habitat nor impact to nesting golden eagles as the species is not currently known to nest within the proposed KMC study area. Impacts to foraging habitat would be the same as those described above for the ferruginous hawk. *Issue 3 – Proposed KMC Groundwater Pumping:* The golden eagle is not closely associated with wetlands or riparian habitats. Thus, groundwater pumping to support mine operations would have no effect on this species.

Table 3.11-6 Impacts for Other Special Status Wildlife Species within the Proposed KMC and N-Aquifer Study Areas

Species	Potential Impacts
Northern Goshawk	*Issue 1 – Proposed KMC Emissions/Deposition:* To the extent that the red-tailed hawk can be considered representative of the northern goshawk, project emissions under the Proposed Action would have negligible effects on this species (refer to analysis for the ferruginous hawk, above). *Issue 2 – Proposed KMC Operations/Reclamation:* Because northern goshawks are not known to nest in the vicinity of the proposed KMC, potential habitat impacts associated with mining operations under the Proposed Action are expected to have no effect on this species. *Issue 3 – Proposed KMC Groundwater Pumping:* The northern goshawk is not associated with wetlands or riparian habitats. Thus, groundwater pumping to support mine operations would have no effect on this species.
Peregrine Falcon	*Issue 1 – Proposed KMC Emissions/Deposition:* Emission-related impacts to the peregrine falcon would be similar to those described for the ferruginous hawk above, i.e., project-related emissions under the Proposed Action would be expected to have negligible effects on the peregrine falcon. *Issue 2 – Proposed KMC Operations/Reclamation:* Because the peregrine falcon is not known to nest in the vicinity of the proposed KMC, potential habitat impacts associated with mining operations under the Proposed Action are expected to have no effect on this species. *Issue 3 – Proposed KMC Groundwater Pumping:* To the extent that the quality and extent of wetland and riparian habitat and associated birds and bats are affected by groundwater pumping, the peregrine falcon could be indirectly affected by the Proposed Action. However, given that impacts to riparian vegetation are expected to be negligible under the Proposed Action, impacts to the peregrine falcon would be negligible as well.
Western Burrowing Owl	*Issue 1 – Proposed KMC Emissions/Deposition:* For the purposes of ERA, the Mexican spotted owl can be considered a representative species for the western burrowing owl. As described above, project-related emissions under the Proposed Action pose negligible risk to the Mexican spotted owl and, by extension, the western burrowing owl (**Appendix 3RA**, Ecological and Human Health Risk Assessments). *Issue 2 – Proposed KMC Operations/Reclamation:* Under the Proposed Action 3-Unit Operation, mining activities would result in 456 acres (3.5 percent) of surface disturbance to sagebrush shrubland habitat and 35 acres (3.6 percent) of surface disturbance to desert scrub habitat with potential to support burrowing owls. Under the 2-Unit Operation, there would be approximately 427 acres (3.2 percent) and 8 acres (<1 percent) of disturbance in each of these habitats, respectively. However, because burrowing owls are not currently known to nest within the proposed KMC study area, it is likely that proposed mine operations would have no effect on this species. *Issue 3 – Proposed KMC Groundwater Pumping:* The western burrowing owl is not associated with wetlands or riparian habitats. Thus, groundwater pumping to support mine operations would have no effect on this species.

3.11.4.3.2.3 Decommissioning and Abandonment

Under the Proposed Action, no mining would occur in the proposed KMC after December 21, 2044. Facilities such as buildings, parking lots, roads, wells, and utilities that are requested to be kept by the tribes would be turned over to them. Other materials having economic value (such as structures and equipment) would be salvaged or recycled. All other materials would be disposed of using approved procedures and in accordance with applicable regulations. All sites would be re-contoured to conform to the natural landform, covered with topsoil, and revegetated, using the same post-mining techniques as those proposed for areas disturbed by mining.

The effects of mine decommissioning on special status wildlife species are expected to be beneficial over the long term. Reclamation and re-vegetation of disturbed lands would restore wildlife habitat for special status species. The first species to benefit would be those associated with herbaceous habitats, such as the western burrowing owl and ferruginous hawk. Over time, as shrubs and eventually forest cover returns to the site, other special status species such as northern goshawk and Mexican spotted owl could benefit as well.

3.11.4.3.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Under the Proposed Action, general impacts to special status wildlife species resulting from operation and maintenance of the WTS, STS, and associated communication sites would be similar to those described for terrestrial wildlife in Section 3.10.4.3. The following section provides a more detailed assessment of potential transmission system operation and maintenance impacts to federally listed wildlife species and other special status wildlife species that are known or have potential to occur along the WTS and STS.

3.11.4.3.3.1 Federally Listed Species

<u>Black-footed Ferret</u>

In the desert Southwest, black-footed ferrets only have potential to occur where there are large colonies of Gunnison's prairie dog. The only portions of the study area where prairie dogs are known or have potential to occur are along a portion of the STS, within the proposed KMC, and portions of the surrounding N-Aquifer study area. The impact issues evaluated for this species relate to operations and maintenance activities along the STS and operations of the proposed KMC.

There are large colonies of Gunnison's prairie dog in the vicinity of Valle, Arizona. As described above, an experimental non-essential population of black-footed ferrets has been established on Espee Ranch, approximately 15 miles west of Valle (**Figure 3.11-5**). Although there is a remote possibility that ferrets from this population could colonize the STS corridor, given that the closest portion of the corridor is approximately 18 miles away from Espee Ranch, it is highly unlikely that ferrets would establish a self-sustaining population in the STS corridor during the timeframe of this project. Therefore, continued operation and maintenance of the STS are expected to have no effect on the black-footed ferret.

<u>California Condor</u>

California condors regularly fly over the WTS in traversing between nesting and foraging sites between Zion National Park, the Vermilion Cliffs, Kaibab Plateau, and Grand and Marble Canyons. To date, there has been only one known mortality of a condor from the Southwest population associated with a powerline. Between 2007 and 2013, there were no powerline-associated mortalities for this population. The size of the WTS towers and conductors make this facility highly visible. Similarly, the spacing

between conductors far exceeds a condor's wingspan. Therefore, the likelihood of a condor colliding with or being electrocuted by interactions with the transmission line is very low and continued operation of the WTS would have negligible effects on the California condor. Aerial inspections of the WTS have potential to disturb condors foraging in the vicinity of the transmission line during inspections. However, aerial inspections of the WTS occur only once every 5 years and the disturbance is brief and unlikely to affect nesting condors. Thus, impacts to the California condor resulting from WTS maintenance activities are also likely to be negligible.

Mexican Spotted Owl

The Mexican spotted owl has potential to occur along both the WTS and STS. Potential nesting habitat along the WTS likely is limited to the Colorado and Paria River canyons. Due to height at which the transmission line crosses above these two rivers, combined with the relative lack of vegetation and/or the low stature of the vegetation within and adjacent to the ROW at these crossings, there is no need to clear or trim riparian vegetation in these locations. Consequently, transmission line operations and maintenance activities are expected to have no impact on spotted owls nesting in or flying through the Colorado and Paria River canyons.

The STS passes through potentially suitable Mexican spotted owl habitat where it traverses steep-slope coniferous cover in the Kaibab and Prescott National Forests. Where it crosses the Kaibab National Forest, the transmission lines come within approximately 2 miles of designated critical habitat for Mexican spotted owl. Vegetation within this portion of the ROW is cleared. Past ROW clearing and ongoing vegetation management have fragmented spotted owl habitat in the area and rendered the ROW largely unsuitable for nesting. However, large expanses of relatively undisturbed forest habitat remain in the area, including within and along the sides of canyons traversed by the STS. To the extent that owls occur in the area, they could forage along the transmission line ROW. Owls using the area during foraging activities may be affected by noise disturbance associated with O&M activities. Helicopter patrols may flush or disrupt MSO breeding or foraging activities. However, noise disturbances due to O&M activities, including helicopter patrols, would be temporary and localized, and would occur during daylight hours when owls are less likely to be foraging. Although the transmission lines would likely pose some collision risk to Mexican spotted owls, it is unknown to what extent powerline collisions have affected owls in this area in the past or would likely affect them in the future under the Proposed Action or otherwise. Because of the large size of the towers and conductors, these facilities are highly visible and probably easily avoided by foraging owls. Given the large spacing between conductors, the transmission lines pose very little electrocution risk to spotted owls. Operations and maintenance activities along the STS would have negligible impact on Mexican spotted owls and no effect on designated critical habitat for this species. Although the Bill Williams and Mt. Elden communication sites are located within the boundaries of designated critical habitat for the Mexican spotted owl, these facilities and their access roads do not contain the primary constituent elements of critical habitat for this species. Operation and maintenance activities associated with these communication sites would be confined to the existing disturbance footprints and therefore have no effect on the surrounding Mexican spotted owl critical habitat.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is known to occur along both the WTS and STS, and critical habitat for this species is crossed by the WTS where it traverses the Virgin River in Washington County, Utah. Along the STS, this species is known to occur in riparian habitat associated with the Verde and Agua Fria rivers, both of which are crossed by the transmission lines. At each of these crossings, the rivers are spanned by the lines (i.e., there are no tower structures or other project facilities located in or immediately adjacent to riparian habitat associated with these waterbodies). Due to the height at which these rivers are crossed (approximately 300 feet above the Virgin River, 400 feet above the Verde River, and 100 to 200 feet above the Agua Fria River) there would be no need to clear or trim riparian vegetation at these crossings. There is potential for southwestern willow flycatchers to be disturbed by

helicopters during aerial inspections of the transmission line. Such disturbances would be temporary and impacts would be avoided or minimized through implementation of Conservation Measure AS-2 described below. Therefore, transmission line operation and maintenance activities are expected to have negligible effects on the southwestern willow flycatcher.

The potential for impacts to the southwestern willow flycatcher during transmission line operations and maintenance activities would be further reduced through implementation of the following avoidance and minimization measures:

AS-2: Southwestern Willow Flycatcher

- Avoid ground work disturbance in the floodplain containing occupied breeding habitat between May 1 and August 30.
- For aerial patrols and inspections, transmission line operators and contractors thereof would not land the helicopter for refueling within 0.25 mile of southwestern willow flycatcher occupied habitat during the breeding season.

Effectiveness: Implementation of Conservation Measure AS-2 would avoid impacts to nesting southwestern willow flycatchers associated with ground-disturbing operation and maintenance activities and it would minimize disturbance to nesting flycatchers associated with aerial inspections of the transmission line.

<u>Western Yellow-billed Cuckoo</u>

The western yellow-billed cuckoo is known or has potential to occur along both the WTS and STS, and proposed critical habitat for this species is crossed by the STS where it crosses the Verde and Agua Fria rivers in Yavapai County, Arizona. At each of these crossings, the rivers are spanned by the lines (i.e., there are no tower structures or other project facilities located in or immediately adjacent to riparian habitat associated with these waterbodies). Due to the height at which these rivers are crossed (approximately 400 feet above the Verde River and 100 to 200 feet above the Agua Fria River), there would be no need to clear or trim riparian vegetation at the crossings. Therefore, continued operation and maintenance of the STS would not be likely to affect western yellow-billed cuckoo habitat or the species itself.

Riparian habitats associated with the Virgin River in Washington County, Utah, and with Meadow Valley Wash, Muddy River, and Las Vegas Wash in Lincoln and Clark counties, Nevada, are likely not suitable for western yellow-billed cuckoo breeding but may provide habitat for the species during migration. This is particularly true of the Virgin River as there is proposed critical habitat for the species both upstream and downstream of the WTS crossing. The Virgin River is spanned by the transmission line at a height above river bottom of over 300 feet. Therefore, there would be no need to clear or prune the tamarisk-dominated riparian vegetation in order to maintain adequate line clearances in this area. Similarly, surrounding upland vegetation is comprised of low-stature desert scrub and would require no management. Towers on either side of the river are well outside of and above the riparian zone and, based on aerial photo interpretation, there is no evidence of erosion around these structures that would lead to sedimentation of the riparian and riverine habitats below. Whereas the crossings of Meadow Valley Wash, the Muddy River, and Las Vegas Wash are closer to the river bottoms than the Virgin River crossing, aerial photos indicate that riparian vegetation management would either not be necessary in these areas or has not been conducted for some time. Given the highly disturbed nature of these three crossings and the narrowness of their riparian corridors, it is unlikely they are used by western yellow-billed cuckoo to any substantive degree. There is potential for western yellow-billed cuckoos to be disturbed by helicopters during aerial inspections of the transmission line. Such disturbances would be temporary and impacts would be avoided or minimized through implementation of Conservation Measure AS-3 described below. The lack of vegetation management, combined with the low likelihood

that the species would occur in these locations indicate that continued operation and maintenance of the WTS under the Proposed Action would likely have negligible effects on the western yellow-billed cuckoo.

The potential for impacts to the western yellow-billed cuckoo during transmission systems operations and maintenance activities would be further reduced through implementation of the following avoidance and minimization measures:

AS-3: Western Yellow-billed Cuckoo

- Avoid ground work disturbance in the floodplain containing occupied breeding habitat between June 1 and August 30.
- For aerial patrols and inspections, transmission line operators and contractors thereof would not land the helicopter for refueling within 0.25 mile of yellow-billed cuckoo occupied habitat during the breeding season.

Effectiveness: Implementation of Conservation Measure AS-3 would avoid impacts to nesting western yellow-billed cuckoos associated with ground-disturbing operation and maintenance activities and it would minimize disturbance to nesting cuckoos associated with aerial inspections of the transmission line.

Mojave Desert Tortoise

The Mojave desert tortoise only occurs along the western portion of the WTS, outside of the NGS Near-field study area. Therefore, the only potential for this species to be affected by project activities would be through maintenance activities conducted within occupied and suitable habitat (**Figure 3.11-8**). Potential impacts to the Mojave desert tortoise include crushing of individuals and occupied burrows by maintenance vehicles and equipment. This species also may be impacted by short-term, localized increases in human presence and noise during maintenance events, inadvertent subsidization of tortoise predators due to trash and food scraps left on the ROW by maintenance workers, invasion and spread of noxious or invasive plant species that outcompete native plants used as forage by desert tortoises and result in increases in the frequency or severity of wildfire. Other potential impacts include inadvertent trapping of tortoises as a result of excavation and grading activities and improper handling of tortoises when they are being relocated out of harm's way.

Ground-disturbing maintenance activities within the WTS ROW generally would be limited to existing disturbed areas such as equipment pads at the bases of structures and existing access roads. Much of the WTS ROW has been previously disturbed due to past construction and maintenance activities. Consequently, operations and maintenance activities associated with the Proposed Action are expected to have minor effects on suitable habitat for Mojave desert tortoises.

Effects to designated critical habitat would be similar to those in suitable habitat. Use of access roads would not affect critical habitat, as roads and existing infrastructure, as well as localized areas of disturbance surrounding transmission towers, are excluded from critical habitat due to the lack of primary constituent elements.

A suite of Mojave desert tortoise conservation measures has been developed to avoid and minimize potential impacts to this species and its habitat associated with proposed operations and maintenance activities along the WTS. These measures and the potential impacts they address are listed under Conservation Measure RS-1, below:

RS-1 Mojave Desert Tortoise: To avoid and minimize impacts to the Mojave desert tortoise and its habitat, the WTS Operator would coordinate with Reclamation, BLM, and USFWS and, as appropriate, other federal and state land and wildlife management agencies and local government jurisdictions to implement conservation measures during operations and maintenance (including transmission

infrastructure repair) activities in suitable desert tortoise habitat along the WTS. Depending on the timing (i.e., desert tortoise active vs. inactive season) and the nature and level of disturbance associated with specific operation & maintenance activities, these measures would include the following:

1. The WTS Operator would designate a company Field Contact Representative (FCR) to ensure compliance with the biological stipulations as stated in the federal ROW permits, the terms and conditions of the Biological Opinion issued for this Project, and other applicable requirements. The duties of the FCR would include the following:
    a. Complete a desert tortoise education program prior to training employees and contractors.
    b. Develop an employee and contractor environmental awareness program that would be approved by the USFWS and would cover such topics as desert tortoise distribution within the project area, general behavior and ecology, sensitivity to human activities, legal protection, penalties for violation (ESA), conservation and protection measures, reporting requirements, fire prevention, etc.
    c. Train all internal and contractor staff prior to conducting operation and maintenance activities in suitable habitat for Mojave desert tortoise.
    d. Coordinate with the USFWS regarding the approval and appropriate number of authorized biologists to be assigned on operation and maintenance activities.
    e. Maintain a training log (date and attendees) and submit this log as part of the annual reporting to Reclamation, the USFWS, BLM, and applicable state wildlife management agencies, as appropriate.
2. To limit the potential for predation of desert tortoise by ravens, the WTS Operator would implement the following measures:
    a. During any operation and maintenance activities, baseline nesting bird information would be recorded. This information would include stick nest locations, tower numbers, and notation of nesting species if possible. The operator or on-site biological monitors will conduct follow-up monitoring to determine if juvenile tortoise carcasses or bones are located under stick nests and report this information to the USFWS within 3 calendar days. This includes reporting known active raven nests (containing eggs or nestlings) so USFWS can coordinate removal. Inactive raven nests (no eggs or nestlings) may be removed at any time.
    b. To limit the potential for predation of desert tortoise by ravens, coyotes, feral dogs, and other opportunistic predators, the Operator would require all operations and maintenance waste to be contained and removed from the project area in a manner that does not attract ravens to the project area. All trash and food items would be placed in raven-proof containers and removed daily.
3. The following measures would apply to all operation and maintenance activities in Mojave desert tortoise habitat:
    a. Prior to daily operation and maintenance field activities, the Operator's on-site supervisor would review the tortoise conservation measures with crews, log the meeting and attendees, and provide the log to the FCR at the end of the job.
    b. Project activities outside of fenced facilities would be scheduled between November 1 and February 28, as feasible.
    c. Excavations greater than 1 foot-deep would be fenced, covered, or filled at the end of each working day, or have escape ramps (1: 1 slope) provided to prevent the entrapment of wildlife. Trenches and holes would be inspected for entrapped wildlife before being filled. Any entrapped animals would be allowed to escape voluntarily before operation and

maintenance activities resume or, if necessary, they may be removed by qualified personnel with an appropriate handling permit.

d. Any pipe, culvert, or similar structure with a diameter greater than 3 inches left aboveground on the work site for one or more nights would be inspected for tortoises before the material is moved, buried, or capped. As an alternative, all structures may be capped before being stored on the site.

e. Vehicle traffic would be restricted to designated access routes and the immediate vicinity of operation and maintenance sites. Vehicle speeds would not exceed 25 mph on access and maintenance roads and 20 mph on unimproved access routes. Vehicles and equipment would be parked on pavement, existing roads, and previously disturbed areas, to the maximum extent feasible. Off-road travel in suitable habitat will be prohibited.

f. No pets (except service animals) will be permitted at work sites.

g. Prior to starting operations each day in work areas which are not totally enclosed by tortoise-proof fencing and cattle guards, the Operator's on-site Supervisor and any contract personnel would be responsible for conducting a desert tortoise inspection in coordination with the authorized desert tortoise biologist or monitor, if present (see #4 and #5, below), using techniques approved by the USFWS. The inspection would determine if any desert tortoises are present in the following locations:

i. around and under all equipment;

ii. in and around all routes of ingress and egress; and

iii. in and around all other areas where the operation might expand to during that day.

If a tortoise is discovered during this inspection or later in the day, the Operator would immediately cease all operations in the immediate vicinity of the tortoise and notify the FCR or on-site biologist, if present.

h. Desert tortoise mortalities or injuries that occur as a result of Project- or maintenance-related actions would be reported immediately to the FCR and USFWS, who would instruct operation and maintenance personnel on the appropriate action. The phone number for the FCR or USFWS point of contact would be provided to maintenance supervisors and to the appropriate agencies.

4. For operation and maintenance activities which do not result in substantial ground-disturbance, as determined by the FCR, the following measures will apply in addition to #3, above:

a. For all non-patrol project activities occurring during the tortoise activity season (March 1 to October 31), a qualified biologist would conduct preconstruction surveys for Mojave desert tortoise in suitable habitat. The biologist would survey all work areas, including staging/laydown areas and access routes. Tortoise burrows and other sensitive features identified during the pre-construction survey would be flagged and monitored, as determined by the FCR. If tortoises are found in the work area, activities would be modified to avoid injury or harm.

b. For all non-patrol project activities, a qualified biological monitor shall be present for all project activities occurring in designated critical habitat for Mojave desert tortoise. The biological monitor shall conduct pre-construction surveys for Mojave desert tortoise in suitable habitat. The biologist would survey all work areas, including staging/laydown areas and access routes. Tortoise burrows and other sensitive features identified during the preconstruction survey would be flagged and monitored by the biologist for avoidance.

5. For operation and maintenance activities which result in substantial ground-disturbance as determined by the FCR, the following measures would apply, in addition to #3, above:

a. An authorized desert tortoise biologist would be on-site during all ground-disturbing project activities in suitable habitat during the active desert tortoise season (March to October). At other times, a qualified biological monitor may be present in place of an authorized biologist. The biologist(s) would conduct pre-construction surveys for Mojave desert tortoise in suitable habitat. The biologist(s) would survey all work areas, including staging/laydown areas and access routes. Tortoise burrows and other sensitive features identified during the pre-construction survey shall be flagged and monitored by the biologist for avoidance.

b. Tortoises discovered to be in imminent danger during project activities may only be moved out of harm's way by an authorized desert tortoise biologist and following the terms of any concurrence or biological opinion issued by the USFWS for the work. Desert tortoises would be handled only by qualified individuals following recognized protocol (USFWS 2009, or current revisions).

c. Overnight parking and storage of equipment and materials, including stockpiling, would occur in previously-disturbed areas or areas to be disturbed that have been cleared by a qualified desert tortoise biologist. If not possible, areas for overnight parking and storage of equipment would be designated by the FCR based on recommendations of a qualified desert tortoise biologist.

d. An authorized biologist would be present for road grading activities in designated critical habitat for Mojave desert tortoise during the tortoise active season (March 1 to October 31); a qualified biologist may be present at other times of the year. The biological monitor would conduct pre-construction surveys for Mojave desert tortoise in suitable habitat. The biologist would survey all work areas, including staging/laydown areas and access routes. Tortoise burrows and other sensitive features identified during the pre-construction survey would be flagged and monitored by the biologist for avoidance.

e. Water or other substances used as dust suppressants in designated critical habitat for Mojave desert tortoise would not be allowed to pool.

6. The use of herbicides within USFWS-designated critical habitat, areas of critical environmental concern, and suitable desert tortoise habitat would be prohibited without prior approval from the USFWS and applicable land management agencies.

7. The FCR would submit annual and reports for operation and maintenance activities that result in ground disturbance or require the presence of an authorized biologist or monitor. The annual report would be submitted to Reclamation and the USFWS. Annual reports would document operation and maintenance activities that required monitors; numbers and locations of desert tortoises encountered; all instances of tortoise take resulting from harassment, harm, injury, or mortality; their disposition; effectiveness of protective measures; practicality of protective measures; recommendations for future measures that allow for better protection or more workable implementation; and the number of acres where vegetation is cleared and/or soil is disturbed. Annual reports would cover the calendar year and are due February 15 of the following year (e.g., the annual report for calendar year 2020 is due February 15, 2021).

8. Any deaths and injuries of desert tortoises would be investigated as thoroughly as possible to determine the cause. For any Mojave desert tortoise fatalities in Nevada, the wildlife staff of the USFWS Las Vegas Field Office (702-515-5230) and applicable land-managing agencies must be verbally informed of desert tortoise injuries or death immediately and within 5 business days in writing (electronic mail is sufficient). For any Mojave desert tortoise fatalities in Arizona, Law Enforcement Office (505-248-7889) and Arizona Ecological Services Office (602-242-0210) must be notified within 3 working days. The FCR or other authorized desert tortoise biologist would complete a Desert Tortoise Handling and Take Report.

9. Emergency Repairs: for emergency repairs beyond those typical operation and maintenance activities described as part of the Proposed Action, the WTS Operator would notify the local

USFWS office and appropriate federal or state land management agency within 48 hours to determine appropriate follow-up actions

Effectiveness: Implementation of the above measures would ensure that Category A and B routine maintenance activities within the permitted ROW would have only minor effects on the Mojave desert tortoise. Similarly, Category C Transmission System Activities would have minor effects on desert tortoise if the above measures are followed. However, Category C activities include actions outside of the permitted ROW and are not part of the Proposed Action. Category C actions would be permitted separately on an as-needed basis.

Sonoran Desert Tortoise

The Sonoran desert tortoise only occurs along the southern portion of the STS, outside of the NGS emissions deposition area. Therefore, the only potential for this species to be affected by Project activities would be through maintenance activities conducted within suitable habitat (**Figure 3.11-9**). Potential impacts to the Sonoran desert tortoise include crushing of individuals and occupied burrows by maintenance vehicles and equipment. This species also may be impacted by short-term, localized increases in human presence and noise during maintenance events, inadvertent subsidization of tortoise predators due to trash and food scraps left on the ROW by maintenance workers, invasion and spread of noxious or invasive plant species that outcompete native plants used as forage by desert tortoises and result in increases in the frequency or severity of wildfire. Other potential impacts include inadvertent trapping of tortoises as a result of excavation and grading activities and improper handling of tortoises when they are being relocated out of harm's way.

Ground-disturbing maintenance activities within the STS ROW generally would be limited to existing disturbed areas such as equipment pads at the bases of structures and existing access roads. Much of the STS ROW has been previously disturbed due to past construction, maintenance, and vegetation management activities. Consequently, operations and maintenance activities associated with the Proposed Action are expected to have only minor effects on suitable habitat for Sonoran desert tortoises.

A number of Sonoran desert tortoise conservation measures, collectively referred to as measure RS-2, would be implemented as part of the Proposed Action. Implementation of these measures, along with the vegetation management BMPs identified in the NGS Operation and Maintenance Plan (**Appendix 1B**), would ensure that Project-related impacts to this species and its habitat are avoided or minimized to the extent practicable. Measure RS-2 is described below.

RS-2 Sonoran Desert Tortoise: To avoid or minimize impacts to the Sonoran desert tortoise and its habitat, the Southern Transmission System Operator ("STS Operator") would coordinate with Reclamation and the AGFD, and, as appropriate, other applicable federal and state land and wildlife management agencies to implement conservation measures during transmission line operation and maintenance (including repair) activities in suitable Sonoran desert tortoise habitat along the STS. Depending on the nature and level of disturbance associated with specific operations and maintenance activities, the STS Operator would implement the following actions:

1. Designate a company FCR to assure compliance with the project Record of Decision (i.e., including these conservation measures), biological stipulations stated in the federal ROW permits, and other applicable agreements
2. Develop a training and awareness program for all operation and maintenance personnel and contractors. Training would be conducted by the FCR or a qualified contractor annually for employees conducting operations and maintenance and for contractors prior to initiating work.
3. Develop an annual refresher training program to be implemented each July, prior to the peak activity season for Sonoran desert tortoises.

4. Provide detailed instruction to all crews with regard to proper and legal tortoise handling and relocation protocols. Provide disposable gloves to minimize risk of spreading Upper Respiratory Tract Disease and other transmissible diseases from tortoise to tortoise.
5. Document all known Sonoran desert tortoise injuries and mortalities from Southern Operator's O&M activities, and record in a central database. As part of the annual training program, conduct a root cause analysis of these mortalities with recommendations from field staff to minimize.
6. Cover any holes augured for vertical structure replacement if left unattended, and inspect for trapped animals prior to filling the holes.
7. Use trained field supervisors and linemen to implement proper monitoring techniques including search for and inspection of potential burrows within work areas prior to implementing authorized repair activities, including prior to clearing of vegetation. Develop standard clearance protocol and documentation standards. FCR or qualified contractor staff would conduct field audits of clearance activities to ensure compliance and adequacy of inspections. Field audits would be conducted on 10 percent of all work conducted in high and medium value habitat as identified by the USFWS (2015b).
8. During the annual refresher training, provide all attendees a rearview mirror placard for placement in all O&M vehicles. The placard will remind workers to check under vehicles and around work areas for tortoises prior to moving vehicles.
9. Develop a database within the Southern Operator Geographic Information System, including records of Sonoran desert tortoises killed, injured, handled to move from harm's way, or detected, and tortoise shelters identified within the STS ROW during O&M activities. This database would be used by the FCR to identify hot spots and areas of special concern that may need more focused conservation awareness.
10. To reduce impacts to suitable habitat, the FCR would coordinate with the O&M project managers to minimize the work area needed repair of infrastructure or repair of unpaved access roads occurring within suitable habitat for the Sonoran desert tortoise. To the maximum extent practical and safe, repair crews would use existing disturbed areas for O&M activities. Because of the disturbance associated with initial construction of the line and ongoing routine vegetation maintenance activities, in most cases during infrastructure maintenance activities very limited vegetation clearing would be required.

Effectiveness: Implementation of the above measures would ensure that Category A and B routine maintenance activities within the permitted ROW would have only minor effects on the Sonoran desert tortoise. Similarly, Category C Transmission System Activities would have minor effects on desert tortoise if the above measures are followed; however, Category C activities would include actions outside of the permitted ROW and are not part of the Proposed Action. Category C actions would be permitted separately on an as-needed basis.

Narrow-headed Gartersnake

Within the analysis area, the narrow-headed gartersnake only has potential to occur along the STS where it crosses the Verde River. Because the transmission line spans the river canyon approximately 400 feet above the river itself, no vegetation management or other maintenance activities would be required in or adjacent to the river. As described in the Section 3.11.2, Affected Environment, narrow-headed gartersnakes are highly aquatic and stay within 660 feet of the floodplain throughout their life cycle (Nowak 2006). Therefore, any snakes extant along this portion of the river would likely stay within the river canyon, which is over 1,320 feet wide from rim to rim where it is crossed by the STS. Consequently, continued operation and maintenance of the STS would be expected to have negligible effects on this species and its habitat.

Northern Mexican Gartersnake

Within the analysis area, the northern Mexican gartersnake only has potential to occur along the STS where it crosses the Verde and Agua Fria rivers. Because the transmission line spans the Verde River canyon approximately 400 feet above the river bottom, no vegetation management or other maintenance activities would be required in or adjacent to the river. The STS crosses the Agua Fria River in three places and parallels the river for approximately 1 mile north of the middle crossing. The southernmost crossing is below Lake Pleasant where the river has been dewatered and no suitable gartersnake habitat is present.

At the northern and middle Agua Fria crossings, the STS spans the river canyon. The lines are approximately 100 feet above the active floodplain at the northern crossing and 200 feet above the active floodplain at the southern crossing. The portion of the line that parallels the river is located within 600 feet of the river bottom, but the towers are located on bluffs ranging from 50 to over 300 vertical feet above the active floodplain. The height of these two crossings precludes the need to manage riparian vegetation along the river bottom. Similarly, the topography along the portion of the line that parallels the river, combined with the relatively low stature of upland vegetation in this area, would prevent the need to clear or trim vegetation or perform any surface-disturbing maintenance activities that could affect northern Mexican gartersnakes during dispersal, gestation, and/or hibernation, or result in erosion and sedimentation of the riparian and riverine habitats below. Consequently, continued operation and maintenance of the STS would be expected to have negligible effects on the northern Mexican gartersnake or its habitat.

3.11.4.3.3.2 Other Special Status Species

Impacts to other special status wildlife species that are known or have potential to occur along the WTS and STS have been evaluated on a qualitative basis. These species and potential project-related impacts to them are described in **Table 3.11-7**, below. The acreages of these habitats along the WTS and STS are identified in **Tables 3.8-7** and **3.8-8**. There would be no difference between the 3-Unit Operation and 2-Unit Operation in terms of operation and maintenance along the transmission lines.

Table 3.11-7 Impacts for Other Special Status Wildlife Species known or with Potential to Occur Along the WTS and STS

Species	Potential Impacts
Mammals	
Desert Bighorn Sheep	Desert bighorn sheep have potential to occur along the WTS and the northern portion of the STS. While transmission line operations and maintenance activities have potential to displace bighorn sheep due to noise and human activity, such disturbances would be localized and temporary and would likely have no effect on this species.
Pronghorn	Pronghorn have potential to occur along the WTS and are known to occur along the STS. Transmission line operations and maintenance activities have potential to displace pronghorn due to noise and human activity. However, such disturbances would be localized and temporary and would likely have no effect on this species.
Kit Fox	Kit fox have potential to occur along the WTS. This is a nocturnal species that uses dens year-round for daytime resting, escaping predators, avoiding temperature extremes, conserving moisture, and bearing and rearing young. Transmission line operations and maintenance activities are only likely to affect kit fox if equipment drives over and collapses an occupied den. The likelihood of impacts to kit fox dens is small, particularly with implementation of the Applicant-committed worker environmental awareness program. Thus, transmission line operation and maintenance is likely to have a negligible effect on kit fox.

Table 3.11-7 Impacts for Other Special Status Wildlife Species known or with Potential to Occur Along the WTS and STS

Species	Potential Impacts
Northern Pocket Gopher	The northern pocket gopher has potential to occur along the STS where it crosses the Kaibab National Forest north-northeast of Williams, Arizona. The species is primarily fossorial (lives underground) and is most active at dawn and dusk. Like the kit fox, transmission line operations and maintenance activities could affect pocket gophers if equipment drives over and collapses an occupied burrow. Another source of impact could be the use of herbicides for vegetation management along the STS. To the extent that herbicide use reduces the abundance or palatability of roots and tubers and the occasional above-ground plant eaten by pocket gophers, it would render habitat unsuitable in affected areas. The likelihood of impacts due to herbicide use and collapsing burrows is small and the impacts would be localized and temporary. Thus, transmission line operation and maintenance would have a negligible effect on the northern pocket gopher.
Bats • Allen's big-eared bat • Big Free-tailed Bat • California Leaf-Nosed Bat • California Myotis • Cave Myotis • Fringed Myotis • Greater Western Mastiff Bat • Little Brown Myotis • Spotted Bat • Townsend's Big-eared Bat • Pale Townsend's Big-eared Bat • Western Red Bat • Yuma Myotis	As summarized in **Table 3.11-4**, several species of bats with potential to occur along the WTS are considered BLM sensitive species. Many of these species also may occur along the STS, but are not considered sensitive in the BLM Districts traversed by the STS. All of the bat species listed here are associated with desert scrub vegetation and as well as riparian, wetland, and/or open water habitats where insect prey tend to be concentrated and free water is available. Some species, such as Allen's big-eared bat, are known to roost in tree snags that could be impacted through vegetation maintenance but snag removal is only likely to be required on the STS where this species is not considered sensitive. Bats' primary prey vary somewhat by species but generally consist of moths, butterflies, dragonflies, beetles, grasshoppers, flying ants, lacewings, and mosquitoes. Transmission line operations and maintenance activities are expected to have negligible impacts to bat habitat and prey. Transmission towers provide perching habitat for raptors, such as peregrine falcons, which prey upon bats. Consequently, bat predation rates may be higher in the immediate vicinity of the WTS, particularly where it crosses wetland and riparian habitats in which bat use is concentrated, and transmission towers provide the tallest perching substrates around. However, given that the WTS has been in place for over 40 years and, for much of its length in Nevada, is co-located with other transmission lines, bat populations have likely adapted to its presence thereby minimizing potential effects of increased predation rates in the vicinity of the line. Bats are not known to collide with stationary objects such as transmission towers and conductors. Consequently, the Proposed Action is expected have negligible impacts on BLM and U.S. Forest Service-listed sensitive bats species with potential to occur along the WTS and STS.
Birds	
Raptors • American Peregrine Falcon • Bald Eagle • Ferruginous Hawk • Golden Eagle • Northern Goshawk • Short-eared Owl • Swainson's Hawk • Western Burrowing Owl	As described above, transmission lines likely to benefit raptors in open habitats along the WTS by providing substrates (towers) for nesting and perching while hunting. Forest openings maintained along the STS likely benefit raptor species, such as the Swainson's hawk, that prefer to hunt in more open grass- and shrub-dominated habitats. Conversely, they fragment habitat for forest raptors such as the northern goshawk. Transmission lines may pose some collision risk for raptors but, given the large diameter of conductors used in high-voltage lines, they are highly visible and unlikely to pose a substantial collision risk. To the extent that transmission line operations and maintenance activities are conducted during the raptor breeding season and raptors are nesting on or adjacent to the ROW, semi-annual aerial and ground inspections and/or repair activities may disturb these birds and affect nest success. Such impacts would be avoided through implementation of the transmission line operators' BMPs and mitigation measures listed above. Consequently, transmission line

Table 3.11-7 Impacts for Other Special Status Wildlife Species known or with Potential to Occur Along the WTS and STS

Species	Potential Impacts
	operations and maintenance activities are expected to have negligible effects on the other special status raptors with potential to occur along the WTS and STS.
Songbirds • Bendire's Thrasher • Black Swift • Bobolink • Grasshopper Sparrow • Le Conte's Thrasher • Lewis's Woodpecker • Loggerhead Shrike	The primary effects of the WTS and STS on the BLM-designated sensitive songbirds listed at left is likely related to the extent to which these transmission systems are used by raptors, ravens, and brood parasites such as the brown-headed cowbird for perching, nesting, and impacting songbirds through predation or brood parasitism. Such impacts are likely to be more pronounced in and adjacent to transmission line crossings of open water, wetland, and riparian habitats where songbirds tend to be more concentrated. However, given the length of time that these transmission lines have been in place, it is likely that songbirds have adjusted their behavior and nesting locations to minimize risk of predation in proximity to the transmission line. Transmission line operations and maintenance activities may affect special status songbirds if they are conducted during the breeding season and active nests are disturbed or destroyed as a result of these activities. Transmission line operators have committed to monitor for nesting birds and avoid disturbing areas with active nests until after the nesting season. Thus, operation and maintenance of the WTS and STS are expected to have negligible impacts on BLM-listed sensitive songbirds.
Shorebirds • Long-billed Curlew • Snowy Plover	BLM-listed sensitive shorebirds including the long-billed curlew and snowy plover have potential to occur in herbaceous wetlands, playas, and adjacent desert grasslands and desert scrub along the WTS. Because of the low-growing nature of the vegetation in these habitats, they would not be impacted by vegetation management activities. Periodic line inspections and ground-disturbing maintenance activities conducted during the avian breeding season would have potential to impact nesting shorebirds but these impacts would be avoided or minimized through operator-committed BMPs and mitigation measures that would avoid disturbance of active nests until after the breeding season. Both species have potential to be impacted by increased predation rates associated with raptors perching on the WTS towers and conductors.
Reptiles	
Lizards • Common Chuckwalla • Desert Iguana • Desert Night Lizard • Banded Gila Monster • Western Banded Gecko • Zebra-tailed lizard Snakes • Mojave Desert Sidewinder • Mojave Rattlesnake • Mojave Shovel-nosed Snake • Nevada Shovel-nosed Snake • Speckled rattlesnake • Western Threadsnake	BLM-listed sensitive lizards and snakes occurring along the WTS ROWs have potential to be affected by increased predation from raptors and corvids perching on transmission line infrastructure. Given the length of time that these transmission lines have been in place, reptile species prone to this predation pressure have likely shifted their habitat use away from the ROWs, thereby avoiding or minimizing their risk of predation from birds using the transmission towers and conductors as hunting perches. Operation and maintenance activities such as ground inspections and repair work have potential to impact lizards and snakes directly through the increased noise and human presence associated with these activities, crushing of individuals or their burrows by maintenance personnel and their vehicles, and/or through crushing of burrows used by small mammals that are prey to these species. Excavations associated with tower replacements or other work in the ROW could trap reptiles, cutting them off from food and cover and increasing their risk of predation. Introduction and spread of noxious weeds and other invasive plant species could degrade habitat quality and increase the frequency or severity of wildfire, leading to additional habitat degradation and loss. Fugitive dust generated by maintenance activities also could degrade habitat quality by negatively affecting the productivity and palatability of vegetation consumed by herbivorous reptiles such as desert iguana. Operation and maintenance impacts would be avoided or minimized through the implementation of operator-committed BMPs and mitigation measures including ensuring that equipment with high potential to

Table 3.11-7 Impacts for Other Special Status Wildlife Species known or with Potential to Occur Along the WTS and STS

Species	Potential Impacts
	carry weed propagules is free of soil, weeds, vegetative matter, or other debris that could harbor weed seeds prior to entering the ROW; reducing travel speeds and numbers of trips, which would minimize crushing of individuals and their burrows and minimize generation of fugitive dust; and through monitoring and covering excavation sites and maintaining wildlife escape ramps in excavated areas. Use of these measures would render impacts to BLM-sensitive reptiles along the WTS negligible.
Invertebrates	
Bees • Mojave Gypsum Bee • Mojave Poppy Bee Butterflies • MacNeill's Sooty Wing Skipper • Northern Mojave Blue or Mojave Dotted-Blue	The Mojave gypsum bee has potential to occur along the WTS in desert scrub habitat containing silverleaf sunray (*Enceliopsis argophylla*) of which the species is an obligate. The Mojave poppy bee may occur along the WTS in desert scrub habitat of the Virgin River Basin. The bee is an obligate of dwarf bear poppy, an endangered plant species (refer to Section 3.9 for more information on this bee's host plant). MacNeill's sooty wing skipper may occur along the WTS in desert washes with high water tables containing quailbush (*Atriplex lentiformis*) upon which the species deposits its eggs and which provides its larvae's only source of food. Adults require nectar-producing plants, such as heliotrope, nearby. The Mojave dotted-blue butterfly may occur along the WTS in desert scrub habitat containing plants in the genus *Eriogonum*, upon which the adults deposit their eggs and larvae feed. Transmission line operations and maintenance activities with potential to affect these invertebrates are vegetation management actions; fugitive dust generated by and introduction of noxious weeds and other invasive plants associated with use of ROW access roads by maintenance vehicles and equipment. Spread of noxious weeds and other invasive plants could, in turn, outcompete host plants and/or alter the frequency or severity wildfire in a way that results in localized loss and extirpation of host plants. Quailbush may grow to 10 feet tall. Consequently, quailbush occurring within the WTS ROW may need to be cut back on occasion in order to maintain required clearances between conductors and vegetation. However, given that quailbush with potential to support MacNeill's sooty wing skipper only occurs along washes with high water tables (such as Meadow Valley Wash in Clark County, Nevada), the transmission line is likely to span these habitats from high points on either side of the wash, thus increasing clearances and minimizing the need for trimming riparian vegetation like quailbush. Host plants associated with the other three BLM-sensitive invertebrates listed at left are low-growing and unlikely to be affected by vegetation management in the ROW. Moreover, the Mojave poppy bee's host plant is protected under the ESA and potential operation and maintenance activities affecting the plant and its pollinator would be avoided. Fugitive dust-related impacts to these species' host plants would be avoided or minimized through implementation of operator-committed BMPs including reduced speed limits along ROW access roads. Based on the above it is likely that operation and maintenance activities along the WTS would have negligible impacts on BLM-sensitive invertebrate species.

The following Applicant-committed BMPs and mitigation measures would further minimize impacts to special status wildlife associated with operation and maintenance of the WTS, STS, and/or NGS and associated facilities including the BM&LP Railroad (where applicable):

- For routine vegetation maintenance (mechanical and hand clearing) and ground-disturbing maintenance activities, workers will watch for nesting birds. If an active nest is found, the vegetation containing the active nest will be avoided until after the nesting season. If the active nest is in vegetation that is causing a safety or system reliably risk, the utility will coordinate with the USFWS and the federal land manager to determine the appropriate removal procedures and assure compliance with the MBTA.
- If raptor nests are found on system infrastructure and nest removal or repair work is necessary, the utility (i.e., Salt River Project Agricultural Improvement and Power District, Arizona Public Service Company, NV Energy) would coordinate with the USFWS and the federal land manager to assure compliance with the MBTA and Bald and Golden Eagle Protection Act, as appropriate.
- Herbicide treatments BMPs (STS only):
  - All applicable labels, federal and state laws, and regulations with regard to the use and application of herbicides will be strictly adhered to.
  - All herbicide applications will be spot treatments utilizing backpack, handheld, and quad/all-terrain vehicle mounted sprayers with plant specific treatment.
  - There will be no new roads or ground disturbing activities.
  - If a portion of the transmission line is inaccessible by road or sensitive habitats occur within the ROW, the crew will drive to the nearest location and walk to the site with the necessary equipment.
  - Between April 15 and August 15, the spray vehicle will watch for ground nesting birds. If any are seen, the operation will be stopped and the area completed utilizing handheld or backpack sprayers.
  - At any location where the vegetation density is sufficient to provide adequate cover for nest sites, for example dense stands riparian areas, the area to be treated will be surveyed by the contractor for nests prior to spraying. If nests are found during the survey or encountered during the course of the application, spraying will cease and be postponed until after August 15 or until the nest is inactive.
  - All vehicles will be operated in a safe and prudent manner during daylight hours, maintaining speeds of 15 to 20 miles per hours within the ROW.
- As transmission and lower voltage power lines are replaced and maintained, installed equipment will meet the most current Avian Power Line Interaction Committee design standards to prevent bird electrocutions.
- Speed limits would minimize vehicular collisions with wildlife and decrease fugitive dust emissions.
- Excavation sites would be monitored or covered to avoid trapping wildlife, and routes of escape for wildlife would be maintained. The construction site would be inspected daily for appropriate covering and flagging of excavation sites. Each morning the construction site would be inspected for wildlife trapped in excavation pits.
- While working in riparian areas, workers will reduce the number of trips in and out, use hand crews if possible, minimize time spent working within the riparian area, and/or stage vehicles and materials outside riparian areas, if possible.
- Biologically sensitive areas as identified by USFWS and federal land managers in the Environmental Impact Statement, Biological Assessment, and Biological Opinion will be marked or mapped prior to construction or maintenance actions, by the utility and the appropriate measures will be implemented to avoid and/or minimize impacts to known populations of threatened, endangered, or sensitive species (see species-specific measures below).

- Vegetation management on WTS and STS systems:
  - Vegetation management would not widen the ROW corridor.
  - Existing established roads would be used to access powerline ROWs.
  - Where vehicle access is not available, crews would hike in from the nearest access point.
  - Existing established roads within the powerline ROW would be used, where possible.
  - Mowers would not be operated on slopes greater than 30 percent.
- Ensure that utility mower, track or other off-road equipment, which has high potential to carry noxious weeds (not including service vehicles, pick-up trucks, passenger cars, bucket trucks, or utility vehicles/all-terrain vehicles) are free of soil, weeds, vegetative matter, or other debris that could harbor seeds prior to initiating vegetation management and treatments.
- During repairs and maintenance of project infrastructure, standard BMPs to prevent degradation of surface waters (i.e., spill prevention and capture plans, storm water runoff controls, silt fencing and straw bales, and sediment and erosion controls) would be implemented.
- Staging areas for loading and unloading of equipment will be located in previously disturbed areas, but outside of floodplains and other wet areas.
- Driving support vehicles or quad/utility terrain vehicle in riparian area will be avoided unless there is/are established road(s).

3.11.4.3.3.3 Decommissioning and Abandonment

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.11.4.3.4 Project Impact Summary – All Project Components

The overall effects of the Proposed Action's emissions on special status wildlife species would range from negligible to minor when considered in aggregate over the various study areas. With the exception of the bald eagle, NGS and proposed KMC emissions combined with baseline conditions would pose negligible risk to special status wildlife species within the NGS Near-field, Northeast Gap Region, Southwest Gap Region, San Juan River, and proposed KMC study areas as indicated by maximum HQs less than 1 for maximum exposure and no adverse effects levels for all species and COPEC combinations. Bald eagles in the Southwest Gap Region study area, due to seemingly elevated levels of methylmercury in their diet, are at risk of mercury toxicity under baseline conditions.

Impacts to special status wildlife species resulting from operation and maintenance of NGS and associated facilities, the proposed KMC, and the two transmission systems also would range from negligible to minor, depending on species (see species-specific summary below). Implementation of general and species-specific mitigation measures would ensure that impacts to special status wildlife resulting from mine operations and transmission line operation and maintenance activities are avoided and minimized to the extent practicable.

Mine-related groundwater pumping under the 3-Unit Operation is predicted to result in small reductions (0.0004 – 0.0027 cubic feet per second) in baseflow in four different washes and at three springs in three different spring groups (0.00003 – 0.0005 gallons per minute flow reduction) associated with the N-Aquifer. These predicted reductions in spring flows are expected to have negligible effects on riparian habitats with potential to support special status wildlife species.

The following is a summary of total project impacts to federally listed wildlife species expected under the Proposed Action:

- Black-footed Ferret – No effect: this species is not known to occur in the project area.
- California Condor – Negligible impact: NGS and associated facilities and the Kayenta Mine site currently do not provide nesting or foraging habitat for condors and NGS emissions pose negligible risk to this species. Condors are unlikely to collide with transmission infrastructure along the WTS and energized components are too widely spaced to cause a risk of electrocution. While aerial inspections of the WTS could disturb condors present along the ROW during inspections, such disturbances would be temporary and unlikely to impact the survival or reproductive potential of affected individuals.
- Mexican Spotted Owl – Minor impact: there is some potential for this species to occur in Navajo Canyon but potential habitat is located over 2 miles from the ash disposal site and, thus, plant operations would be unlikely to effect this species. NGS emissions pose negligible risk to the Mexican spotted owl as determined through the NGS Near-field ERA. Under the Proposed Action, mining in Coal Resource Areas N-10 or N-11Ext. could cause impacts to the quality and extent of Mexican spotted owl habitat in the vicinity of historic Protected Activity Centers located within 2 miles of these areas. These impacts would be minimized through implementation of Conservation Measure AS-1, which would suspend surface disturbing activities in the vicinity of the PAC boundary while Mexican spotted owls are actively nesting.
- Southwestern Willow Flycatcher – Negligible impact: there is no habitat likely to support breeding southwestern willow flycatchers within areas that would be directly or indirectly affected by operation of NGS and associated facilities and the proposed KMC. Potential migratory stopover habitat at Begashibito Wash/Cow Springs may be affected by operation of the BM&LP Railroad but, to the extent that the species is using this habitat now, it is acclimated to disturbance caused by the train and future operations of the railroad are unlikely to impact this use. Emissions associated with NGS and the proposed KMC were determined to pose negligible risk to the southwestern willow flycatcher as determined through ERA modeling. Operation and maintenance of the WTS and STS could disturb southwestern willow flycatchers nesting in the area during maintenance activities but such disturbances would be temporary and unlikely to affect habitat quality given that the transmission lines are located hundreds of feet above the riparian zone, precluding the need to clear or trim vegetation that may support nesting by this species. Implementation of Conservation Measure AS-2 would ensure that potential impacts to southwestern willow flycatcher are avoided or minimized during transmission line aerial inspections.
- Western Yellow-billed Cuckoo – Negligible impact: project-related impacts to the western yellow-billed cuckoo would be essentially identical to those summarized above for the southwestern willow flycatcher.
- Mojave Desert Tortoise – Minor impact: the Mojave desert tortoise occurs along the WTS and could be affected by maintenance activities along this ROW. Implementation of the impact avoidance and minimization measures listed under Conservation Measure RS-1 would preclude the majority of potential impacts to this species.
- Sonoran Desert Tortoise – Minor impact: the Sonoran desert tortoise occurs along the STS and could be affected by maintenance activities along this ROW. Implementation of the impact avoidance and minimization measures listed under Conservation Measure RS-2 would preclude the majority of potential impacts to this species.
- Narrow-headed Gartersnake – Negligible impact: Within the project area, potentially suitable habitat for the narrow-headed gartersnake is likely limited to the Verde and Agua Fria Rivers. These rivers are spanned by the STS at a height that precludes the need to clear or trim riparian vegetation or otherwise affect the quality of riverine, wetland, and riparian habitat capable of supporting this species. Inadvertent impacts to narrow-headed gartersnake habitat could occur from fuel or pesticide spills during vegetation management or other routine maintenance

activities along the STS, but implementation of BMPs and applicant-committed environmental protection measures would render such impacts unlikely.

- Northern Mexican Gartersnake – Negligible impact: project-related impacts to the northern Mexican gartersnake would be essentially identical to those summarized above for the narrow-headed gartersnake.

3.11.4.3.5 Cumulative Impacts

Cumulative impacts occur when the incremental effects of an action are added with the effects of other past, present, and reasonably foreseeable actions. The following text breaks down potential cumulative effects by project component and analysis issue.

3.11.4.3.5.1 Navajo Generating Station

No reasonably foreseeable future actions are anticipated at the NGS plant site that would result in cumulative impacts to special status wildlife habitat. All surface disturbances would be confined to the existing plant site and the existing railroad ROW as a continuation of operations that began in the late 1960s and 1970s. No foreseeable future tribal or federal actions would overlap these areas and result in cumulative impacts on special status wildlife species. Moreover, given that general operations of NGS and associated facilities under the Proposed Action are expected to result in negligible impacts to special status wildlife, there would be no cumulative impacts to these species associated with this alternative.

Cumulative effects associated with emissions and deposition of heavy metals and other COPECs on special status wildlife species may result when baseline conditions plus future NGS stack emissions pose a potential risk to a given species. Where this is the case, other cumulative emission sources are then evaluated to assess cumulative effects to that species. As described in previous sections, emissions from future operation of NGS under the Proposed Action would result in negligible impacts to all special status wildlife species except the bald eagle. Consequently, cumulative impacts associated with NGS emissions are evaluated only for this species.

In the Northeast Gap Region study area, the analysis of total cumulative sources (baseline + Proposed Action + other cumulative sources) resulted in an HQ_{max} = 2 for the bald eagle and methylmercury. Given that HQ_{max} for the Proposed Action was determined to be 0.003, and HQ_{max} for baseline conditions was 0.9, it is clear that other cumulative sources of methylmercury are responsible for pushing the bald eagle's total cumulative HQ_{max} value to 2 in the Northeast Gap Region. It should be noted that the total cumulative HQ value calculated for exposure to refined COPEC concentrations, a more realistic predictor of risk, was $HQ_{refined}$ = 1, indicating that bald eagles are on the cusp of being affected by methylmercury from baseline and other cumulative sources in the Northeast Gap Region. Similarly, the bald eagle appears also to be at risk of methylmercury toxicity from baseline conditions and other cumulative sources in the Southwest Gap Region. The analysis of total cumulative sources in this study area resulted in HQ_{max} = 7 and $HQ_{refined}$ = 5. The Proposed Action contributed $HQ_{refined}$ = 0.003 to this total while baseline conditions contributed $HQ_{refined}$ = 3 and other cumulative sources contributed $HQ_{refined}$ = 2. Whereas the bald eagle may be at risk of mercury toxicity in the Southwest Gap Region, it should be noted that the contribution of the Proposed Action to that risk is only 0.06 percent.

As discussed in Section 3.11.3, climate change is likely affecting special status wildlife species within the NGS Near-field, San Juan River, Northeast Gap Region, and Southwest Gap Region study areas. Climate change-related shifts in plant productivity and species composition, more extreme weather events, reduced streamflows and higher water temperatures, along with increased frequency and severity of wildfire have potential to result in direct and indirect effects to the special status wildlife species known or with potential to occur in the NGS study areas. As discussed above, NGS emissions combined with degraded baseline conditions have the potential to result in minor effects to bald eagles within the Southwest Gap Region. Cumulative impacts to bald eagles would occur when these effects combine with the effects of climate change. To the extent that climate change causes reductions in

streamflow, increased water temperatures, and shifts in riparian vegetation it has potential to affect the species composition, distribution, and abundance of fish (the bald eagle's primary prey) as well as the recruitment and long-term viability of cottonwood trees, which bald eagles commonly used for perching, roosting, and nesting. Because streamflow and water temperatures in the Southwest Gap Region are and will likely continue to be more strongly influenced by Glen Canyon Dam operations than by climate change over the life of the Proposed Action, climate change-related impacts to bald eagle are likely to be negligible in this area. Streamflow and water temperatures in the Northeast Gap Region are more susceptible to ambient environmental conditions. Consequently, over the life of the Proposed Action, climate change could result in minor impacts to the bald eagle in this area.

3.11.4.3.5.2 Proposed Kayenta Mine Complex

No reasonably foreseeable future actions are anticipated that would result in cumulative impacts to special status species habitat within the proposed KMC study area. All surface disturbance would be confined within the proposed KMC lease boundary as a continuation of operations that began in the late 1960s and 1970s. No foreseeable actions would enlarge the footprint of these facilities.

As described in Section 3.7, Water Resources, groundwater pumping for mine water supplies under the Proposed Action would cause small reductions (<1%) in baseflows but these reductions are not expected to be at a level that would impact existing riparian vegetation associated with affected washes and springs. Cumulative impacts to baseflows would be more pronounced. Groundwater pumping for community water supplies is expected to result in flow reductions in seven different creeks and washes. The most pronounced reductions in baseline (2020) flow rates caused by cumulative pumping are predicted to occur in Chinle Creek (48 percent reduction), Laguna Creek (43 percent reduction), Polacca Wash (32 percent reduction), and Begashibito Wash (18 percent reduction). These flow reductions could increase moisture stress on riparian and wetland habitats, resulting in reduced extent, or less vigorous riparian communities that support riparian-dependent wildlife species, including special status wildlife species such as the southwestern willow flycatcher and western yellow-billed cuckoo, that may use these riparian areas during breeding and/or migration. Thus, the incremental reductions in baseflows under the Proposed Action, when combined with flow reductions associated with other demands on the N-Aquifer, may result in moderate to major impacts to potential habitat for these special status bird species. However, because the riparian habitats along affected washes are not currently known to support breeding southwestern willow flycatchers and western yellow-billed cuckoos, these habitat impacts are not expected to affect survival and recovery of these species. Furthermore, potential cumulative impacts to riparian vegetation would be expected to manifest slowly over many years, likely allowing any migrating southwestern willow flycatchers and western yellow-billed cuckoos that use these habitats time to shift their migratory stopover locations to other riparian habitats in the region that would not be affected by cumulative groundwater pumping.

Climate change-related effects on vegetation have potential to effect the distribution, abundance, and quality of habitat available for special status wildlife species in the proposed KMC and surrounding N-Aquifer study areas. The effects of increased temperatures and reduced or more variable precipitation could combine with project and other cumulative effects on baseflows to further impact riparian habitats potentially used by southwestern willow flycatcher and western yellow-billed cuckoo. The effects of climate change, in the form of drought, may already be responsible for degradation of Mexican spotted owl habitat in the vicinity of the proposed KMC. Ecosystem Management, Inc. (2016) hypothesized that several years of drought were responsible for loss of Douglas fir in the historic PAC north of coal resource area N-9. Death of these trees has likely degraded spotted owl habitat through effects on microclimate and loss of habitat structure. Drought may also have resulted in reduced prey densities, further degrading Mexican spotted owl habitat in the area (Ecosystem Management, Inc. 2016). To the extent that climate change is responsible for degradation of Mexican spotted owl habitat in the vicinity of the proposed KMC, these trends can be expected to continue over the life of the Proposed Action and beyond, potentially resulting in the eventual loss of suitable spotted owl habitat on Black Mesa.

3.11.4.3.5.3 Transmission Systems and Communication Sites

The reasonably foreseeable future actions that could result in cumulative impacts to special status wildlife species when combined with impacts associated with transmission line operations and maintenance activities under the Proposed Action all occur along the WTS. These actions include construction of the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines, and the Lake Powell water pipeline and transmission line. The TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines may be constructed in the existing West-Wide Utility Corridor adjacent to the WTS from Toquop Wash (approximately 12 miles northwest of Mesquite, Nevada) to the southern terminus of the WTS in the Eldorado Valley approximately 15 miles southwest of Boulder City, Nevada (**Figure 3.0-4**). Segments of the Lake Powell water pipeline and transmission line are proposed to be constructed adjacent to the WTS through portions of Coconino and Kane counties, Arizona, and Kane County, Utah (**Figure 3.0-3**).

Potential impacts to special status wildlife from these foreseeable future actions include the following:

- Expansion of surface disturbance within the existing utility corridor that would require vegetation removal, followed by soil reapplication and revegetation. Assuming a construction ROW of 150 feet in width for transmission projects, new surface disturbance could range from 18 acres per mile for a single project to 54 acres per mile for three parallel projects.
- There would be overlapping use of existing access roads by construction and maintenance equipment for adjacent utility projects sharing the same broadly defined utility corridor.
- Authorized and unauthorized use of access roads by off-road recreational vehicles may result in surface disturbance outside the road ROW. Because of the rural setting of these transmission lines and lack of fencing or other controls, there would be potential for off-road vehicle disturbance to special status wildlife, particularly the Mojave desert tortoise, throughout the length of these transmission lines.

Any other specific proposals to construct new projects and maintain existing facilities would be coordinated through the responsible BLM or other federal and tribal land management agency offices in Nevada, Arizona, and Utah. Requirement for new roads, maintenance of existing roads, and repair of damaged roads would be developed on a project-specific basis. The net result of co-locating these facilities in a single utility corridor would be reduced requirements for new access roads, which would reduce erosion and sedimentation from the road system, reduce requirements for revegetation, and reduce habitat fragmentation for special status wildlife species relative to constructing the facilities in separate corridors.

Climate change-related impacts to vegetation and wildlife habitat could combine with Project-related and other cumulative effects to exacerbate impacts to Mojave desert tortoise over the life of the Proposed Action. Degradation of tortoise habitat quality resulting from expanded coverage of noxious weeds and other invasive plants, increased frequency and severity of wildfire, and associated losses of native plants used as forage by desert tortoises may result from climate change. These effects, combined with other cumulative impacts to tortoise habitat, could affect tortoise survival and recovery along the WTS over the next 25 years.

3.11.4.4 Natural Gas Partial Federal Replacement Alternative

This discussion is divided into two parts. The first part describes the alternative site and operational characteristics, and primary impacts to special status wildlife that have occurred, or would occur. The second part addresses the impacts to special status wildlife from reducing the power generated at NGS with consequent reductions in coal production at the Kayenta Mine.

Under the Natural Gas PFR Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently

unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to currently exist, prior disturbance impacts to special status wildlife are not evaluated. Key assumptions about special status wildlife related to such an existing site are detailed below.

- A combined-cycle natural gas power plant is typically located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Wildlife habitat has already been removed from the entire site, and will not be restored until after facility decommissioning.
- Natural gas combustion for power generation would not result in COPEC emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS; therefore, there would be no deposition from natural gas combustion to wildlife habitats within any of the NGS-KMC ERA study areas. The description of emission calculations for the PFR are described in Chapter 2.0 and in Section 3.1, Air Quality.
- An existing gas plant would have been permitted by the U.S. Environmental Protection Agency to operate and would thus meet all air quality standards protective of environment including special status wildlife species.
- Because the impacts of NGS emissions under the Proposed Action 3-Unit Operation pose negligible risk to special status wildlife species and the anticipated emissions from a natural gas combined cycle plant would be a fraction of NGS emissions (see Section 3.1 Air Quality), the impacts to wildlife from emissions associated with the Natural Gas PFR Alternative would be negligible as well.

3.11.4.4.1 Navajo Generating Station

3.11.4.4.1.1 Emissions and Deposition

Under the Natural Gas PFR Alternative, NGS stack emissions of heavy metals and other COPECs would be reduced relative to the Proposed Action. For example, under the 100-MW Natural Gas PFR Alternative, there would be a 7 to 8 percent reduction in selenium, mercury, and arsenic emissions relative to the Proposed Action 2-Unit Operation and a 5 percent reduction in emissions of these metals relative to the Proposed Action 3-Unit Operation. Similarly, under the 250-MW Natural Gas PFR Alternative, there would be an 18 to 19 percent reduction in emissions of these trace metals relative to the Proposed Action 2-Unit Operation and a 12 to 13 percent reduction in emissions of selenium, mercury, and arsenic compared to the Proposed Action 3-Unit Operation. Similar reductions are assumed for other COPECs relevant to special status wildlife species.

As described in Section 3.11.4.3, NGS emissions are expected to pose negligible risk to special status wildlife species under the Proposed Action 3-Unit Operation and 2-Unit Operation. Under the 100-MW and 250-MW Natural Gas PFR Alternative, emissions and associated risks would be lower than those associated with the Proposed Action. Consequently, implementation of this alternative is expected to have no effect on special status wildlife species. Whereas plant emissions under the Natural Gas PFR Alternative would have no direct impact on special status species, when future plant emissions are combined with baseline conditions, there could be potential risk of mercury contamination to bald eagle populations within the Southwest Gap Region due to potentially elevated mercury levels associated with baseline conditions (Section 3.11.4.3).

3.11.4.4.1.2 Operations and Maintenance

Relative to the Proposed Action, there would be an incremental reduction in the amount of chemicals required by and trucked to the plant, a reduction in the amount of coal mined and transported to the plant via the BM&LP Railroad, and an associated reduction in coal combustion residuals trucked from the plant to the adjacent ash disposal site under the Natural Gas PFR Alternative. As operations and

maintenance of NGS and associated facilities are expected to have negligible impacts on special status species under the Proposed Action, they would have less impact to special status wildlife species under the Natural Gas PFR Alternative.

3.11.4.4.2 Proposed Kayenta Mine Complex

3.11.4.4.2.1 Emissions and Deposition

Due to the reduction in mining and NGS power production under the 100-MW and 250-MW Natural Gas PFR alternatives there would be associated reductions in mine and plant emissions within the proposed KMC study area. As described in Section 3.11.4.3, results of the KMC ERA indicated that emissions from the mine, combined with those from NGS and baseline conditions, would pose negligible risk to special status wildlife species known or with potential to occur in the proposed KMC study area. Consequently, combined mine and plant emissions under the Natural Gas PFR Alternative are expected to have no effect on federally listed and other special status wildlife species within and adjacent to the mine permit boundary.

3.11.4.4.2.2 Operations and Reclamation

Under the Proposed Action, mining of new or expanded coal resource areas would have minor impacts to potentially suitable habitat for special status wildlife species that may occur in the proposed KMC study area. Under the 100-MW Natural Gas PFR Alternative, these impacts would be reduced by 5 and 7 percent relative to the Proposed Action 3-Unit Operation and 2-Unit Operation, respectively. Under the 250-MW Natural Gas PFR Alternative, habitat impacts would be reduced by 12 and 18 percent relative to the Proposed Action 3-Unit Operation and 2-Unit Operation, respectively. Like the Proposed Action, mine operations under the Natural Gas PFR alternatives would have a minor impact on potentially suitable habitat for special status wildlife species with potential to occur in the area. However, these impacts would be less than those expected under the Proposed Action 3-Unit Operation and 2-Unit Operation.

3.11.4.4.2.3 Groundwater Pumping

Water pumped from the N-Aquifer to support mine operations is assumed to be the same under the Natural Gas PFR Alternative as it would be under the Proposed Action. Because groundwater pumping under the Proposed Action would be expected to have negligible impacts on special status wildlife species, groundwater pumping under implementation of the 100-MW or 250-MW Natural Gas PFR Alternative also would have negligible impacts on special status wildlife.

3.11.4.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Operation and maintenance of the WTS, STS, and communications sites would not change due to implementation of the Natural Gas PFR Alternative. Thus, impacts to special status wildlife species associated with operation and maintenance of the transmission systems and communication sites would be the same as the Proposed Action.

3.11.4.4.4 Project Impact Summary – All Project Components

Implementation of the either the 100-MW or the 250-MW Natural Gas PFR Alternative is expected to have negligible impacts on special status wildlife resources as a result of NGS plant and proposed KMC mine emissions. The combined new land disturbance at NGS and KMC under the Natural Gas PFR Alternative would range from a high of 5,207 acres to a low of 4,087 acres. This habitat disturbance compares to a Proposed Action range of disturbance between a high of 5,469 acres to a low of 4,940 acres, or an overall 4 to 21 percent reduction in new land disturbance for this PFR alternative.

Impacts to special status wildlife species habitat would be considered minor under this alternative because most of the native habitats affected are already degraded as a result of their proximity to active mining areas and previous testing activities and because special status species are not currently known to occur in the affected areas.

3.11.4.4.5 Cumulative Impacts

Although the degree of impact to special status wildlife species from implementation of the Natural Gas PFR Alternative are expected to be incrementally lower than those associated with the Proposed Action, cumulative impacts associated with this alternative are expected to be essentially identical to the cumulative effects described above for the Proposed Action.

3.11.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. As the site is assumed to be an existing facility, prior disturbance impacts to special status wildlife are not evaluated.

3.11.4.5.1 Navajo Generating Station

3.11.4.5.1.1 Emissions and Deposition

Under the Renewable PFR Alternative, NGS stack emissions of heavy metals and other COPECs would be reduced relative to the Proposed Action. For example, under the 100-MW Renewable PFR Alternative, there would be a 4 percent reduction in selenium, mercury, and arsenic emissions relative to the Proposed Action 2-Unit Operation and a 3 percent reduction in emissions of these metals relative to the Proposed Action 3-Unit Operation. Similarly, under the 250-MW Renewable PFR Alternative, there would be an 11 percent reduction in emissions of these trace metals relative to the Proposed Action 2-Unit Operation and a 7 percent reduction in emissions of selenium, mercury, and arsenic compared to the Proposed Action 3-Unit Operation. Similar reductions are assumed for other COPECs relevant to special status wildlife species. As described in Section 3.11.4.3, NGS emissions are expected to pose negligible risk to special status wildlife species under the Proposed Action 3-Unit Operation and 2-Unit Operation. Under the 100-MW and 250-MW Renewable PFR alternatives, emissions and associated risks would be lower than those associated with the Proposed Action. Consequently, implementation of this alternative is expected to have no effect on special status wildlife species. Whereas plant emissions under the Renewable PFR Alternative would have no direct impact on special status species, when future plant emissions are combined with baseline conditions, there could be potential risk of mercury contamination to bald eagle populations within the Southwest Gap Region due to potentially elevated mercury levels associated with baseline conditions (Section 3.11.4.3).

3.11.4.5.1.2 Operations and Maintenance

Relative to the Proposed Action, there would be an incremental reduction in the amount of chemicals required by and trucked to the plant, a reduction in the amount of coal mined and transported to the plant via the BM&LP Railroad, and an associated reduction in coal combustion residuals trucked from the plant to the adjacent ash disposal site under the Renewable PFR Alternative. As operations and maintenance of NGS and associated facilities are expected to have negligible impacts on special status species under the Proposed Action, they also would have negligible impacts on special status wildlife species under the Renewable PFR Alternative.

3.11.4.5.2 Proposed Kayenta Mine Complex

3.11.4.5.2.1 Emissions and Deposition

Due to the reduction in mining and NGS power production under the 100-MW and 250-MW Renewable PFR alternatives there would be associated reductions in mine and plant emissions within the proposed KMC study area. As described in Section 3.11.4.3, results of the KMC ERA indicated that emissions from the mine, combined with those from NGS and baseline conditions, would pose negligible risk to special status wildlife species known or with potential to occur in the proposed KMC study area. Consequently, combined mine and plant emissions under the Renewable PFR Alternative are expected to have no effect on federally listed and other special status wildlife species within and adjacent to the mine permit boundary.

3.11.4.5.2.2 Operations and Reclamation

Under the Proposed Action, mining of new or expanded coal resource areas would have minor impacts to potentially suitable habitat for special status wildlife species that may occur in the proposed KMC study area. Like the Proposed Action, mine operations under the Natural Gas PFR alternatives would have a minor impact on potentially suitable habitat for special status wildlife species with potential to occur in the area. However, these impacts would be less than those expected under the Proposed Action 3-Unit Operation and 2-Unit Operation.

3.11.4.5.2.3 Groundwater Pumping

Water pumped from the N-Aquifer to support mine operations is assumed to be the same under the Renewable PFR Alternative as it would be under the Proposed Action. Because groundwater pumping under the Proposed Action would be expected to have negligible impacts on special status wildlife species, implementation of the 100-MW or 250-MW Renewable PFR alternatives also would have negligible impacts on special status wildlife.

3.11.4.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Operation and maintenance of the WTS, STS, and communications sites would not change due to implementation of the Renewable PFR Alternative. Thus, impacts to special status wildlife species associated with operation and maintenance of the transmission systems and communication sites would be the same as the Proposed Action.

3.11.4.5.4 Project Impact Summary – All Project Components

Implementation of the either the 100-MW or the 250-MW Renewable PFR Alternative is expected to have negligible impacts on special status wildlife resources as a result of NGS plant and proposed KMC mine emissions. The combined new land disturbance at NGS at KMC under the Renewable PFR Alternative would be 3 to 4 percent less than the Proposed Action for the 100-MW alternative and 7 to 10 percent less for the 250-MW alternative. Impacts to special status wildlife species habitat would be considered minor under this alternative because most of the native habitats affected are already degraded as a result of their proximity to active mining areas and previous testing activities, and because special status species are not currently known to occur in the affected areas.

3.11.4.5.5 Cumulative Impacts

Although the degree of impact to special status wildlife species from implementation of the Renewable PFR Alternative are expected to be incrementally lower than those associated with the Proposed Action,

cumulative impacts associated with this alternative are expected to be essentially identical to the cumulative effects described above for the Proposed Action.

3.11.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate National Environmental Policy Act process once a facility location is identified.

3.11.4.6.1 Navajo Generating Station

3.11.4.6.1.1 Emissions and Deposition

Under the Tribal PFR Alternative, NGS stack emissions of heavy metals and other COPECs would be reduced relative to the Proposed Action. For example, under the 100-MW Tribal PFR Alternative, there would be a 3 percent reduction in selenium, mercury, and arsenic emissions relative to the Proposed Action 2-Unit Operation and a 2 percent reduction in emissions of these metals relative to the Proposed Action 3-Unit Operation. Similarly, under the 250-MW Tribal PFR Alternative, there would be an 8 percent reduction in emissions of these trace metals relative to the Proposed Action 2-Unit Operation and a 5 percent reduction in emissions of selenium, mercury, and arsenic compared to the Proposed Action 3-Unit Operation. Similar reductions are assumed for other COPECs relevant to special status wildlife species.

NGS emissions are expected to pose negligible risk to special status wildlife species under the Proposed Action 3-Unit Operation and 2-Unit Operation. Under the 100-MW and 250-MW Tribal PFR alternatives, emissions and associated risks would be lower than those associated with the Proposed Action. Consequently, implementation of this alternative is expected to have no effect on special status wildlife species. Whereas plant emissions under the Tribal PFR Alternative would have no direct impact on special status species, when future plant emissions are combined with baseline conditions, there could be potential risk of mercury contamination to bald eagle populations within the Southwest Gap Region due to potentially elevated mercury levels associated with baseline conditions (Section 3.11.4.3).

3.11.4.6.1.2 Operations and Maintenance

Relative to the Proposed Action, there would be an incremental reduction in the amount of chemicals required by and trucked to the plant, a reduction in the amount of coal mined and transported to the plant via the BM&LP Railroad, and an associated reduction in coal combustion residuals trucked from the plant to the adjacent ash disposal site under the Tribal PFR Alternative. As operations and maintenance of NGS and associated facilities are expected to have negligible impacts on special status species under the Proposed Action, they also would have negligible impacts on special status wildlife species under the Tribal PFR Alternative.

3.11.4.6.2 Proposed Kayenta Mine Complex

3.11.4.6.2.1 Emissions and Deposition

Due to the reduction in mining and NGS power production under the 100-MW and 250-MW Tribal PFR alternatives there would be associated reductions in mine and plant emissions within the proposed KMC study area. As described in Section 3.11.4.3, results of the KMC ERA indicated that emissions from the mine, combined with those from NGS and baseline conditions, would pose negligible risk to special status wildlife species known or with potential to occur in the proposed KMC study area. Consequently, combined mine and plant emissions under the Tribal PFR Alternative are expected to have no effect on federally listed and other special status wildlife species within and adjacent to the mine permit boundary.

3.11.4.6.2.2 Operations and Reclamation

Under the Proposed Action, mining of new or expanded coal resource areas and relocation of Indian Route 41 through the proposed KMC would have minor impacts to potentially suitable habitat for special status wildlife species that may occur in the proposed KMC study area. Like the Proposed Action, mine operations under the Tribal PFR alternatives would have a minor impact on potentially suitable habitat for special status wildlife species with potential to occur in the area. However, these impacts would be less than those expected under the Proposed Action 3-Unit Operation and 2-Unit Operation.

3.11.4.6.2.3 Groundwater Pumping

Water pumped from the N-Aquifer to support mine operations is assumed to be the same under the Tribal PFR Alternative as it would be under the Proposed Action. Because groundwater pumping under the Proposed Action would be expected to have negligible impacts on special status wildlife species, implementation of the 100-MW or 250-MW Tribal PFR alternatives also would have negligible impacts on special status wildlife.

3.11.4.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Operation and maintenance of the WTS, STS, and communications sites would not change due to implementation of the Tribal PFR Alternative. Thus, impacts to special status wildlife species associated with operation and maintenance of the transmission systems and communication sites would be the same as the Proposed Action.

3.11.4.6.4 Project Impact Summary – All Project Components

Implementation of the either the 100-MW or the 250-MW Tribal PFR Alternative is expected to have negligible impacts on special status wildlife resources as a result of NGS plant and proposed KMC mine emissions. The combined new land disturbance at NGS at KMC under the Renewable PFR Alternative would be 2 to 3 percent less than the Proposed Action for the 100-MW alternative and 5 to 7 percent less for the 250-MW alternative. Impacts to special status wildlife species habitat would be considered minor under this alternative because most of the native habitats affected are already degraded as a result of their proximity to active mining areas and previous testing activities, and because special status species are not currently known to occur in the affected areas.

3.11.4.6.5 Cumulative Impacts

Although the degree of impact to special status wildlife species from implementation of the Tribal PFR Alternative are expected to be incrementally lower than those associated with the Proposed Action, cumulative impacts associated with this alternative are expected to be essentially identical to the cumulative effects described above for the Proposed Action.

3.11.4.7 No Action

3.11.4.7.1 Navajo Generating Station

If continued operation of NGS and the BM&LP Railroad is not approved, the power plant would be decommissioned, and the operating and support facilities at the plant site would be dismantled and demolished to ground level over the course of one year. As described in Chapter 2.0, the water supply facilities and certain buildings and equipment would remain in accordance with the terms of the 1969 Lease and Lease Amendment No. 1 (or a leasing agreement with the Navajo Nation having similar terms as the 1969 Lease and Lease Amendment No. 1). Except for hazardous materials and parts and material salvaged, recycled, or sold for scrap, it is anticipated that demolished structure material would

be placed within a landfill area on the plant site, and covered with soil. Hazardous materials would be transported and disposed in compliance with Resource Conservation and Recovery Act and other applicable requirements. Following decommissioning of the plant site, several buildings and other facilities would remain for use by the Navajo Nation and fences around the site and along the railroad would be left in place. Decommissioning of the BM&LP Railroad would involve removal of overhead power lines, rails, and ties. Railbed embankments would be abandoned in place and revegetated.

Currently, there are no special status wildlife species known or likely to occur in or immediately adjacent to the NGS plant site. Thus, decommissioning of the plant itself would have no effect on special status wildlife. As described in the Affected Environment section, above, there is potential for migrating southwestern willow flycatchers and western yellow-billed cuckoos to occur in the Begashibito Wash/Cow Springs area adjacent to the BM&LP Railroad. Should removal of the railroad take place when birds are in the area, the noise and human activity associated with this work could disturb these individuals, displacing them to portions of this habitat away from the railroad or to other migratory stopover habitats present along this wash, such as those around Tonalea, approximately 6 miles downstream. Such displacement would be unlikely to affect survival and reproduction of individuals. Over the long-term, decommissioning of NGS and associated facilities would open up approximately 3,500 acres of habitat for special status wildlife species such as the Houserock Valley chisel-toothed kangaroo rat, ferruginous hawk, and burrowing owl that have potential to occur in the desert scrub and grassland habitats in the area. Because fences would remain in place, larger special status species such as the desert bighorn sheep would not benefit from restoration of the plant site, and the railroad ROW would remain a barrier to the movement of this species.

3.11.4.7.2 Proposed Kayenta Mine Complex

If the continued operation at the proposed KMC is not approved, the mine would be closed and all active mining areas that exist in 2019 would be regraded and suitable overburden or spoil would be overlain with topsoil and seeded. Decommissioning of mine facilities would occur unless the facility has been approved by OSMRE as a permanent facility. Mine facilities with economic value would be demolished and the materials removed for salvage. Non-salvageable facilities would be buried. Concrete foundations and sub-bases would be removed or buried in place if approved by OSMRE. If the foundations are buried in place, the cover over these structures would be a minimum of 4 feet. Grading, topsoil replacement and seeding would occur for the facilities areas as described above. In some cases where facilities have been constructed with significant amounts of cut and fill, if approved by OSMRE, the cut and fill would be retained and blended with the surrounding areas. At the cessation of mining it is expected to take 3 to 5 years to fully abandon facilities and reclaim the surface.

Relative to the Proposed Action, the No Action Alternative would result in approximately 5,000 to 5,500 fewer acres of disturbance to wildlife habitat. Following reclamation of mine sites and facilities and cessation of human activity in the area, habitat for special status wildlife is expected to slowly increase in quality as native vegetation becomes established, spreads, and matures throughout the permit area. Potentially suitable Mexican spotted owl habitat is located less than two miles from active mining area N-9 and previously mined area N-11. It is unknown whether mining activities, environmental factors, and/or species-specific demographic and biogeographic factors have affected spotted owl nesting in the vicinity of the proposed KMC. However, to the extent that noise and light and/or human activity from past and current mining activities have prevented Mexican spotted owls from re-occupying historic Protected Activity Centers on Black Mesa, this species may move back into the area provided that population factors and other environmental factors (e.g., prey densities) are favorable. Other special status species such as the ferruginous hawk, golden eagle, and burrowing owl also are likely to move into the area as small mammal populations increase and ground squirrels and prairie dogs become established on reclaimed lands. While re-occupation of the site by special status wildlife also would be expected following decommissioning of the Proposed Action, under the No Action Alternative, this process would begin 25 years earlier, perhaps increasing the chances of recolonization by species whose ranges may shift out of the area over the next 25 years due to climate change.

3.11.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

The impacts of these activities on special status wildlife species and their habitats generally would be the same as those discussed for the Proposed Action.

3.11.4.7.4 No Action Impact Summary – All Project Components

Under the No Action Alternative, there would be up to approximately 6,300 acres of potential special status wildlife habitat that would not be affected by continued operation of the NGS plant and Kayenta Mine. Whereas under the Proposed Action there are expected to be negligible to minor impacts to special status wildlife species associated with operations of the plant and mine, under the No Action Alternative there would be minor temporary impacts associated with facility decommissioning and reclamation activities followed by increasingly beneficial effects as native habitats rebound and existing levels of habitat fragmentation and degradation associated with proximity to disturbance decline.

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Section 3.12

Aquatic Biological Resources

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practice
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
GCNRA	Glen Canyon National Recreation Area
HHRA	Human Health Risk Assessment
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
N-Aquifer	Navajo Aquifer
NAC	Nevada Administrative Code
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
NPS	National Park Service
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less

PFR	Partial Federal Replacement
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
U.S.	United States
USEPA	U.S. Environmental Protection Agency
WTS	Western Transmission System

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3.12 Aquatic Biological Resources

3.12.1 Regulatory Framework

Laws, regulations, and policies that directly influence management decisions for the project primarily are implemented by the U.S. Fish and Wildlife Service (USFWS), Navajo Nation, Hopi Tribe, Bureau of Land Management (BLM), National Park Service (NPS), U.S. Forest Service, and state agencies (Arizona Game and Fish Department, New Mexico Department of Game and Fish, Nevada Division of Wildlife, and Utah Division of Wildlife Resources). Prominent laws, regulations, directives, and agreements relevant to aquatic biological resources are included in **Table 3.12-1**.

Table 3.12-1 Relevant Statutes, Regulations, and Policies for Aquatic Species

Statutes, Regulations, and Policies	Summary
BLM Manual 6500	• The BLM Manual 6500 declares that it is the BLM policy to manage habitat with emphasis on ecosystems to ensure self-sustaining populations and a natural abundance and diversity of wildlife, fish, and plant resources on public lands. The Manual further states that to carry out the above policy, the BLM will do inventory, planning, research, monitoring, and maintenance; will communicate, cooperate, and automate; and will hire professional staff.
BLM Resource Management Plans	• The Arizona Strip Field Office, Safford District, Bradshaw-Harquahala, Kanab Field Office, Las Vegas and Pahrump Field Office, Ely District, Phoenix, and the St. George Resource Management Plans specify regulations and goals for management of BLM-administered lands and set restrictions to protect fish and wildlife and the habitats on which they depend.
NPS Comprehensive Fisheries Management Plan	• The Comprehensive Fisheries Management Plan was developed in coordination with the Arizona Game and Fish Department and USFWS and includes: fisheries management goals and objectives for specific waters within both NPS units and a comprehensive "toolbox" of fisheries management techniques, such as: – Stocking of sterile (non-spawning) rainbow trout in Lees Ferry in the event the fishery declines; – Translocations (i.e., moving fish from one location to another) of native fish species, including endangered humpback chub; – Removing high risk non-native fish from selected areas that are important for native fish, including through targeted volunteer angler-facilitated river trips in Marble Canyon, and comprehensive mechanical trout control in and near Bright Angel Creek; beneficial use of all non-native fish removed; and – An experimental adaptive strategy for evaluating razorback sucker habitat suitability in the western portions of Grand Canyon.
U.S. Forest Service Land and Resource Management Plans	• The Coconino and Tonto National Forest Land and Resource Management Plans identify goals for forest health and constraints on resource use to meet these goals. LRMPs also identify project restrictions to protect fish and wildlife and Management Indicator Species for each forest.
Navajo Nation Biological Resource Land Use Clearance Policies and Procedures, Code RCS-44-08[1]	• The purpose of the Navajo Nation Biological Resource Land Use Clearance Policies and Procedures is to assist the Navajo Nation government and chapters ensure compliance with federal and Navajo laws which protect, wildlife resources, including plants, and their habitat resulting in an expedited land use clearance process. The Resource Land Use Clearance Policies and Procedures assists in directing development to areas where impacts to wildlife and/or their habitat will be less significant. Development includes but is not limited to human activities that result in permanent structures, temporary, long-term, or repetitive disturbance to wildlife or habitat as defined by Navajo Nation Code 17 Navajo Nation Code § 500 et. Seq.

Table 3.12-1 Relevant Statutes, Regulations, and Policies for Aquatic Species

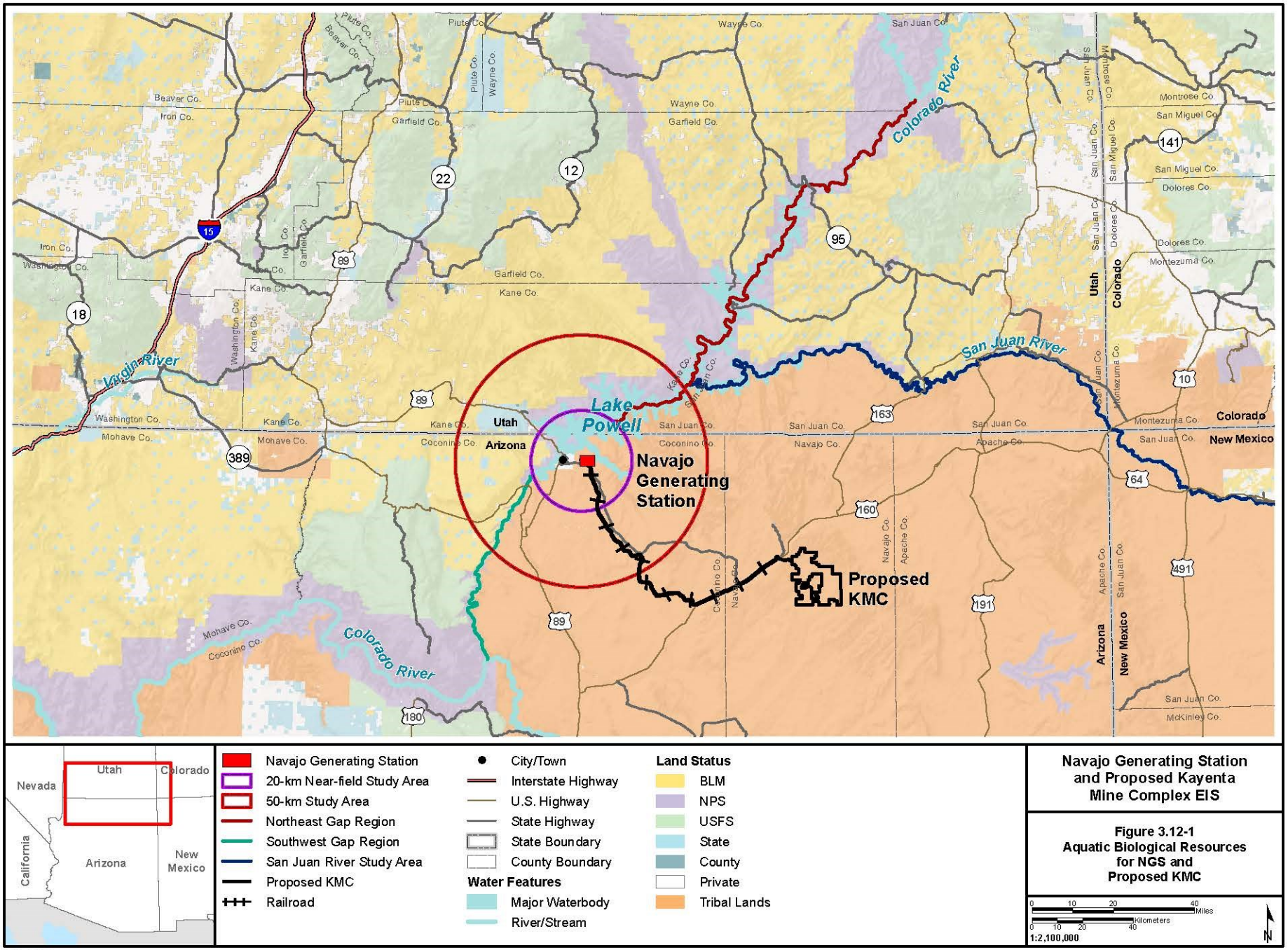
Statutes, Regulations, and Policies	Summary
Arizona Game and Fish Title 17, Game and Fish, Wildlife Habitat Protection, Aquatic Invasive Species	• The State of Arizona's Title 17 – Game and Fish Revised Statutes establish policies and programs for the management, preservation, and harvest of wildlife including aquatic species. Policies directed at managing and conserving aquatic species including invasive species programs and lists, funding/fiscal provisions, rules regarding taking and handling wildlife, and other prohibitions.
New Mexico Title 19 – Natural Resources and Wildlife, Chapter 31, Hunting and Fishing	• Rule 19 New Mexico Administrative Code 31.4, Hunting and Fishing, Part 4 Fisheries describes rules, regulations, and protection for sport fish. The issuing agency is New Mexico Department of Game and Fish.
Nevada Administrative Code (NAC) 503.060, NAC 503.072, and NAC 503.075.	• NAC 503.060 establishes classifications for sport fish species. NAC 503.072 classifies injurious aquatic species. NAC 503.075 classifies amphibians as game, protected, threatened, sensitive, endangered, and unprotected.
Utah Code 23-14-1, 23-48, and Rules R57-13, and R657-53	• Section 23-14-1 of the Utah State Code directs the Utah Division of Wildlife Resources to protect, propagate, manage, conserve, and distribute protected wildlife throughout the state. This statute also authorizes Utah Division of Wildlife Resources to identify and delineate crucial seasonal wildlife habitats. • R657-13 establishes rules for taking of fish and crayfish. • R657-53 establishes rules for amphibian and reptile collection, importation, transportation, and possession.

[1] Applies to the proposed KMC only. Under the 1969 Lease, the Navajo Nation agreed not to regulate the construction, maintenance or operation of NGS facilities, including the BM&LP Railroad, as well as the WTS and STS on Navajo Nation land.

3.12.2 Study Areas

3.12.2.1 Proposed Action and Action Alternatives

The study area for aquatic biological resources was determined by relating fish species and general aquatic community occurrences to the three project components: Navajo Generating Station (NGS), proposed Kayenta Mine Complex (KMC), and the Western and Southern transmission line systems (WTS and STS). The NGS portion of the study area was further divided geographically into three deposition impact areas with each focused on fish species and aquatic community occurrence and aquatic habitat parameters that were defined within the context of the ecological risk assessment (ERA) (**Figure 3.12-1**). The areas were delineated based on an iterative process during the development of the risk assessments in coordination with cooperating agencies. Coordination for the emission/deposition study areas was completed as part of the process for defining sampling locations, data review, and methodologies for the ERAs (Ramboll Environ 2016a,b,c,d).


Navajo Generating Station
Proposed KMC
Lake Powell
Colorado River
San Juan River
Virgin River
Utah
Arizona
Colorado
New Mexico
Navajo Generating Station
20-km Near-field Study Area
50-km Study Area
Northeast Gap Region
Southwest Gap Region
San Juan River Study Area
Proposed KMC
Railroad
City/Town
Interstate Highway
U.S. Highway
State Highway
State Boundary
County Boundary
Water Features
Major Waterbody
River/Stream
Land Status
BLM
NPS
USFS
State
County
Private
Tribal Lands
Navajo Generating Station and Proposed Kayenta Mine Complex EIS
Figure 3.12-1
Aquatic Biological Resources for NGS and Proposed KMC
1:2,100,000
7/20/2016

As discussed in Section 3.0.2, Ecological and Human Health Risk Assessments, three ERAs were conducted to analyze the effects of NGS emissions and the resulting deposition of chemicals on ecological receptors in Lake Powell and a portion of the Colorado River below Glen Canyon Dam (NGS Near-field ERA), the Colorado River (Northeast and Southwest Gap Regions) beyond the near-field area, and the San Juan River (San Juan River ERA). The NGS Near-field study area consists of a 20-kilometer (km) radius from the NGS Facility that overlaps with a portion of Lake Powell. The Northeast Gap Region extends from 20-km extent of the near-field area in Lake Powell upstream to the confluence with the Green River. The Southwest Gap Region extends from Lees Ferry downstream to the confluence with the Little Colorado River. The San Juan River study area extends from the San Juan River arm in Lake Powell upstream in the San Juan River to the Farmington area.

The portion of the overall study area involving the proposed KMC included the mine boundary for emission effects and surface disturbance (**Figure 3.12-1**). The study area for groundwater effects on aquatic species was the N-Aquifer. A detailed discussion of the groundwater study area is provided in Water Resources, Section 3.7.3. A separate proposed KMC ERA was conducted to evaluate existing baseline conditions and potential future environmental conditions in the vicinity of the proposed KMC (Ramboll Environ 2016d).

The portion of the study area involving the transmission systems consists of the perennial streams crossed by the WTS and STS rights-of-way (ROWs) (**Figure 3.12-2**). The basis for focusing on perennial streams for aquatic biological resources is that this type of waterbody provides habitat throughout the year. The study area for the transmission systems included the ROW and an additional 500-foot width on either side of the ROW to cover access roads.

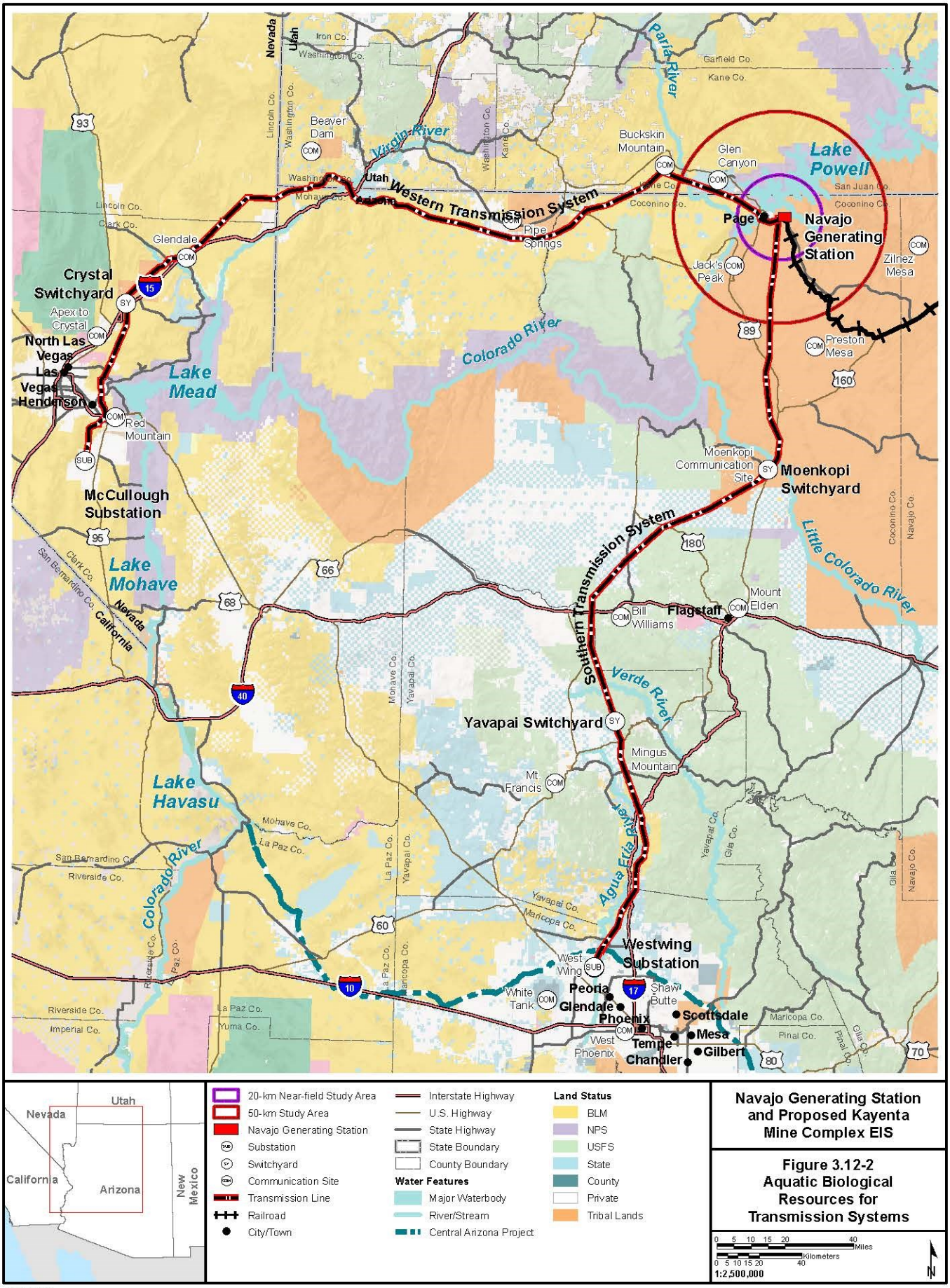
3.12.2.2 Cumulative

The cumulative effects study area is expanded to include cumulative sources in the Upper Colorado River Basin and the upstream portion of the San Juan River to the Navajo Dam. The portion of the Colorado River below Glen Canyon Dam is extended downstream to the inflow to Lake Mead.

3.12.2.3 Ecological Risk Assessment – Role in Assessing Baseline Risk and Environmental Consequences

The potential for risk to aquatic biological resources was evaluated under current conditions (referred to as baseline or baseline conditions), and potential future conditions that considers the deposition of chemicals from NGS emissions and emissions due to mining activity necessary to support NGS operations, plus cumulative effects. The ERAs were intended to (1) investigate whether the combination of site-specific exposure scenarios and chemicals of potential ecological concern (COPECs) may pose current or potential future risks to ecological receptors, and (2) provide information necessary to support the Environmental Impact Statement (EIS) process. Ecological risk assessment involves four key components: problem formulation, analysis (exposure/toxicity assessment), risk characterization and uncertainty analysis. Section 3.0.2 provides an overview of the ERA process and key risk assessment concepts, and **Appendix 3RA** provides further detail of the process and a summary of the ERAs conducted for the project. The reader is directed to each of the ERAs (Ramboll Environ 2016a,b,c,d) for specific detail and rationale for the data evaluated and analyses conducted.

For evaluation of aquatic resources, the outcome of the problem formulation (conceptual site model) identified three key receptors for evaluation. These receptors are described in the context of assessment endpoints (explicit expression of the environmental value to be protected), and measures of effect (ecological characteristic[s] that quantify the assessment endpoint) as defined by U.S. Environmental Protection Agency (USEPA) guidance (USEPA 1997). The following assessment endpoints and measures of effect were defined for aquatic receptors in each of defined study areas for the project (NGS Near-field, Gap Regions, San Juan River and proposed KMC analysis areas):



20-km Near-field Study Area
50-km Study Area
Navajo Generating Station
Substation
Switchyard
Communication Site
Transmission Line
Railroad
City/Town
Interstate Highway
U.S. Highway
State Highway
State Boundary
County Boundary
Water Features
Major Waterbody
River/Stream
Central Arizona Project
Land Status
BLM
NPS
USFS
State
County
Private
Tribal Lands

Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.12-2 Aquatic Biological Resources for Transmission Systems

0 5 10 15 20 40 Miles
0 5 10 15 20 40 Kilometers
1:2,500,000
N

7/20/2016

- Benthic (Sediment) Invertebrate Community
  - Assessment Endpoint: protection and maintenance of benthic invertebrate community.
  - Measure of Effect – comparison of sediment concentrations to ecological sediment quality screening values available in the literature.
- Aquatic Community (Water Column Invertebrate Community, Aquatic Plant Community, and Fish/Amphibians)
  - Assessment Endpoint: protection and maintenance of the aquatic community within the defined analysis area.
  - Measure of Effect – comparison of surface water concentrations to water quality screening values (federal, state, or tribal ambient water quality criteria).
- Fish (Fish Populations, including sport and non-sport fish)
  - Assessment Endpoint: protection and maintenance of fish within the defined analysis area.
  - Measure of Effect - comparison of surface water concentrations to water quality screening values (federal, state, or tribal ambient water quality criteria).
  - Measure of Effect – comparison of measured (based on available literature) and/or modeled fish tissue concentrations to tissue-based thresholds identified in available literature.

The Exposure Assessment of the ERAs (Ramboll Environ 2016a,b,c,d) present the assumptions and parameters used to develop estimates of exposure, which specifically includes determination of environmental concentrations to which a given receptor may be exposed (exposure point concentrations). For ecological communities (groups of actually or potentially interacting species living in the same area), such as each of the receptors identified for evaluation of aquatic biological resources, contaminant exposure is based on the integration of all exposure routes (e.g., exposure via gills, food intake, and direct contact); i.e., food web modeling was not done for these aquatic communities as detailed exposure/food web models are generally not available for community level receptors.

The Analysis or Effects Assessment (USEPA 1998, 1997) phase of the ERAs compiles available toxicity information and correlates receptor exposure to the potential for an undesirable effect to organism health, where a medium-specific (sediment, water or tissue) screening benchmark or critical body residue is identified and subsequently used to characterize the potential for risk. The quantitative metric used to characterize risk, conducted within the context of the Risk Characterization phase, is the Hazard Quotient (HQ). Information regarding how HQs are calculated, and interpretation of the HQ was summarized in Chapter 3.0.2 and is detailed in **Appendix 3RA** and the individual ERA reports (Ramboll Environ 2016a,b,c,d). The risk characterization for the aquatic community and sediment community resulted in a HQ based on comparison of surface water and sediment exposure concentrations to recognized regulatory and literature-based screening concentrations protective of aquatic life and benthic organisms, respectively. The HQ used for the evaluation of fish was based on comparison of literature-based fish tissue toxicity threshold concentrations, known as critical body residues, against data compiled from the literature for each of the study areas. A HQ was reported in the ERAs for individual fish species for which literature-based fish tissue concentrations were available. In addition, the HQ based on the average fish tissue concentration for all species in the compiled dataset also was reported for each study area. Consideration of HQs based on average tissue concentration for multiple fish species is generally representative of the fish community as a whole.

As described in Section 3.0.2, HQs were calculated for each NGS operation scenario to account for current and potential future conditions: baseline, 3-Unit Operation, 2-Unit Operation, 2-Unit Operation with Partial Federal Replacement (PFR) and other cumulative sources. Given the number of scenarios evaluated, all COPECs and receptors were carried forward throughout the ERA process such that a total cumulative sources risk estimate that incorporates baseline, a given NGS production operation

(deposition-related contributions) and other cumulative sources (e.g., baseline + 3-Unit Operation + OCS) could be determined (Ramboll Environ 2016a,b,c,d). For each of these scenarios, HQs were developed for the maximum, refined, and average exposure scenarios for all receptors. The refined HQs are most relevant because these values are based on an estimated upper end average exposure using toxicity data that are considered protective of populations and communities. The refined HQ results are based on comparison of the exposure point concentration represented by the 95 percent upper confidence limit on the arithmetic average wherever it could be calculated, as described in Section 3.0.2. Use of this value generally represents a more realistic estimate of exposure versus use of a maximum concentration and resulting maximum HQ, as ecological receptors are unlikely to be exposed to the highest level of all COPECs at all times (an unrealistic and highly conservative assumption). For these reasons, the environmental consequences sections use the refined HQs as an indicator of risk to aquatic species. Section 3.0.2 provides an overview of interpretation of HQs.

3.12.3 Affected Environment

Aquatic habitats associated with NGS and associated facilities including the Black Mesa & Lake Powell (BM&LP) Railroad, are located in the Great Basin Desert scrub and Plains and Great Basin Grasslands biotic communities (Brown et al. 2007). The waterbodies in this ecoregion consist mainly of ephemeral and intermittent streams, with variations in the number of springs from few to abundant depending on the sub-ecoregion. Although the region is dominated by streams with temporary or seasonal flow, Lake Powell, the Colorado River, and the San Juan River provide perennial habitat within the NGS deposition analysis areas.

Aquatic habitat within the BM&LP Railroad and proposed KMC study areas mainly consists of ephemeral and intermittent streams. Species diversity is reduced in these waterbodies compared to perennial habitat. Water is present on a relatively consistent basis in portions of some streams where groundwater input is available. Perennial habitat within the transmission ROWs varies between small streams and large rivers such as the Colorado River. No perennial habitat is located near the communication sites.

3.12.3.1 Navajo Generating Station

3.12.3.1.1 Habitat

Perennial aquatic habitat in the NGS deposition area is provided by Lake Powell. This large reservoir is formed by waters of the Colorado and San Juan rivers that are impounded by Glen Canyon Dam. The Glen Canyon National Recreation Area (GCNRA) encompasses most of the reservoir perimeter, with the Navajo Reservation on the south shore from the dam eastward along the San Juan River arm. Public access is unrestricted in the GCNRA, but there is no public access on reservation land. The reservoir is approximately 25 miles wide at its widest point, with a linear length of approximately 186 miles (U.S. Bureau of Reclamation [Reclamation] 2007; Utah Department of Environmental Quality- Division of Water Quality 2013). It is estimated to have more than 1,900 miles of shoreline, and the annual average elevation fluctuation is approximately 18 feet (Utah Department of Environmental Quality- Division of Water Quality 2013). Lake Powell fluctuates both annually and seasonally, based on inflow and dam releases. The lake pool elevation can rise more than 10 feet over a short period of time. The mean and maximum depths are 132 and 560 feet, respectively. Habitat types provided by Lake Powell include mainstem river inflow areas and littoral pelagial lentic habitats. Riparian vegetation around Lake Powell is extremely restricted because of the desert terrain around the perimeter and fluctuating water levels (Reclamation 2007).

Aquatic habitat related to the NGS water intake consists of a relatively deep portion of Lake Powell (depths exceeding 400 feet) at a site that is located approximately 1 mile east of Antelope Point (NPS 2007). The nearshore area also is deep as it drops vertical to the lake bottom. The lake bottom is dominated by sandstone with no underwater macrophyte vegetation.

Riverine aquatic habitat in the Northeast and Southwest Gap Regions is provided by the Colorado River. Habitat types in the Northeast Gap Region (Lake Powell upstream to the Colorado River confluence with the Green River) include parts of Lake Powell, slow-moving inflow areas in the Colorado arm, and relatively narrow riverine reaches with flow. A major canyon known as Cataract Canyon is located in the upper portion of the Northeast Gap Region. Cataract Canyon begins 4 miles downstream of the confluence with the Green River and extends approximately 37 miles (Badame 2008). The upper 10 miles of the canyon is within Canyonlands National Park and the lower 27 miles is within the GCNRA. Habitat in the upper section of the canyon mainly consists of large eddy/pool complexes interspersed between large rapids. Some of the larger pools are 75 feet deep. The lower 32 miles of Cataract Canyon are inundated by Lake Powell at full-pool elevation (Badame 2008). The types of aquatic habitat in the Southwest Gap Region (Glen Canyon Dam downstream to the confluence with the Little Colorado River) are influenced by geological conditions and a river with highly regulated flows and water temperatures that are perennially colder than Lake Powell inflows. Reclamation divides the Colorado River below Glen Canyon Dam into three segments. Beginning at Glen Canyon Dam, the first portion of the river is the 15-mile stretch that runs downstream through Glen Canyon to just upstream of the Paria River at Lees Ferry (RM 0). Glen Canyon has a substantially different geomorphic structure compared to the reaches farther downstream, and it has a limited sediment supply. The next section of river is the approximately 62-mile stretch that runs through Marble Canyon. This stretch starts at the mouth of the Paria River at Lees Ferry (RM 0) and extends to just upstream of the Little Colorado River confluence (RM 61.5). The sediment load of this reach is dominated by Paria River inputs. The third section runs through the Grand Canyon and comprises the remainder of the river downstream of the Little Colorado River. The sediment load of this third portion is the cumulative supply provided by contributions from the Paria River reach, the Little Colorado River, and various other small tributaries (Reclamation and NPS 2015).

Habitat types in the San Juan River below Navajo Dam vary in terms of channel characteristics. From Navajo Dam in New Mexico downstream to Farmington, the river is restricted to a single, moderately incised channel with a mixture of riffles, deep runs, and large pools (New Mexico Department of Game and Fish 2006). As the river progresses from Farmington to Shiprock, the gradient diminishes but flow primarily remains in a single channel. Downstream of Shiprock, the river frequently is divided among two to four channels with a more complex habitat diversity including backwaters, embayments, and shoals in combination with riffle, run, and pool habitats. The San Juan River flows approximately 120 miles in Utah before it enters Lake Powell. The portion of the river from the Arizona state line to Chinle Creek is characterized as a relatively broad and braided channel. From Chinle Creek to the San Juan arm of Lake Powell, the river channel meanders and cuts through steep canyons.

No perennial streams, springs, or ponds are located within the BM&LP Railroad 250-foot ROW, or other NGS facility ROW (i.e., water and pipeline ROW to pump station, and NGS and ash disposal access roads); therefore, no fish or other aquatic species are expected to be present and no further analysis was conducted. Ponds located within the NGS plant site are for industrial use and do not contain habitat for fish species.

3.12.3.1.2 Non-native Fish Species

3.12.3.1.2.1 Lake Powell

Common non-native fish species in Lake Powell include walleye, bluegill, green sunfish, carp, gizzard shad, and channel catfish (Arizona Game and Fish Department 2013; Reclamation 2007) (**Table 3.12-2**). Native fish species are discussed in Section 3.13, Special Status Aquatic Species. Non-native fish species associated with the Lake Powell tributaries and inflow areas include fathead minnow, mosquitofish, red shiner, and plains killifish. The pelagic (open water) area of Lake Powell is dominated by striped bass and threadfin shad (Vatland et al. 2008). The occurrence of these fish species in the pelagic zone is characterized as concentrated abundance separated by expanses of habitat with few fish (Mueller and Horn 2004).

Table 3.12-2 Non-native Fish Species in Lake Powell, Colorado River Gap Regions, and San Juan River

Common Name	Scientific Name	Sport Fish (S)	Lake Powell	Colorado River Northeast Gap Region	Colorado River Southwest Gap Region	San Juan River
Black bullhead	*Ameirus melas*	S	X	X	X	X
Black crappie	*Pomoxis nigromaculatus*	S	X	X	X	
Bluegill	*Lepomis macrochirus*	S	X	X	X	X
Brown trout	*Salmo trutta*	S			X	X
Carp	*Cyprinus carpio*		X	X	X	X
Channel catfish	*Ictalurus punctatus*	S	X	X	X	X
Fathead minnow	*Pimephales promelas*		X	X	X	X
Gizzard shad	*Dorosoma cepedianum*		X	X		
Green sunfish	*Lepomis cyanellus*	S	X	X	X	X
Largemouth bass	*Micropterus salmoides*	S	X	X	X	X
Mosquitofish	*Gambusia affinis*		X	X	X	X
Northern pike	*Esox lucius*	S		X		
Plains killifish	*Fundulus zebrinus*		X	X	X	X
Rainbow trout	*Oncorhynchus mykiss*	S	X	X	X	X
Red shiner	*Notropis lutrenis*		X	X	X	X
Sand shiner	*Notropis stramineus*			X		
Smallmouth bass	*Micropterus dolomieui*	S	X	X	X	X
Striped bass	*Morone saxatilis*	S	X	X	X	
Threadfin shad	*Dorosoma petenense*		X			
Walleye	*Sander vitreus*	S	X	X		
White sucker	*Catostomus commersoni*			X		X
Yellow bullhead	*Ameiurus natalis*	S	X	X	X	X

Source: Arizona Game and Fish Department 2013; Breen et al. 2011; Hart 2008; Reclamation 2007; Schleicher 2015; Skorupski et al. 2013; Utah Department of Environmental Quality- Division of Water Quality 2013.

The sport fishery in Lake Powell primarily is focused on striped bass (Reclamation 2007). Other sport fish species are represented by catfishes, sunfishes, largemouth bass, smallmouth bass, and walleye (Arizona Game and Fish Department 2013) (**Table 3.12-2**). Sport fish, forage fish, and other non-native fish occurrences in Lake Powell are from stocking, unintentional introductions, and movements of fishes into the lake from tributaries. Largemouth bass and crappie populations historically were the dominant sport fish species; however, they have declined in relative abundance in recent years due to a lack of habitat structure for young fish and competition with other fish species such as striped bass and gizzard shad (Reclamation 2007). Aging of the reservoir and water level fluctuations have eliminated most of the vegetative in nearshore areas. The change in vegetative cover led to the stocking of smallmouth bass

and striped bass. Threadfin shad were introduced to provide a forage base for striped bass. The striped bass and threadfin shad populations in Lake Powell can show dramatic variations both seasonally and annually (Mueller and Horn 2004). Threadfin shad abundance usually peaks at 5- to 7-year intervals, while striped bass growth and abundance corresponds closely to peaks in threadfin shad foraging (Vatland et al. 2008). Fish species that occur within the intake area of Lake Powell consist of introduced sport species such as striped bass, largemouth bass, black crappie, walleye bluegill, channel catfish, and threadfin shad (NPS 2007). Numbers likely would be low for these species due to the deep water nature of the area. Threadfin shad and striped bass tend to utilize open water habitat. The bass and crappie species prefer areas with shallow nearshore areas.

The Arizona Game and Fish Department and Utah Division of Wildlife Resources issued a mercury fish consumption advisory for striped bass in October 2012 (Arizona Game and Fish Department 2012). The advisory recommends that pregnant women and children limit the consumption of striped bass caught in the southern portion of Lake Powell from the Dangling Rope Marina in Utah to the Glen Canyon Dam in Arizona. The advisory does not limit the consumption of other fish species taken from Lake Powell or the use of the lake for swimming, boating or other recreational activities.

3.12.3.1.2.2 Colorado River – Northeast Gap Region

Sport fish species in the Northeast Gap Region mainly consist of warmwater species such as northern pike, walleye, smallmouth bass, sunfishes, bullheads, and channel catfish. Rainbow trout is present in relatively low numbers. The most abundant non-native fish species in this section of the Colorado River include red shiner, sand shiner, and fathead minnow (Breen et al. 2011).

3.12.3.1.2.3 Colorado River – Southwest Gap Region

The NPS implemented a Comprehensive Fisheries Management Plan, in cooperation with Arizona Game and Fish Department, USFWS, Reclamation, and the U.S. Geological Survey-Grand Canyon Monitoring and Research Center, for GCNRA below Glen Canyon Dam and Grand Canyon National Park (NPS 2013). The purpose of the Comprehensive Fisheries Management Plan is to maintain: 1) a thriving native community within Grand Canyon National Park; and 2) a highly valued recreational trout fishery in the Glen Canyon reach. In 2015 the Arizona Game and Fish Department developed a Fisheries Management Plan for Lees Ferry designed to maintain and enhance a blue-ribbon rainbow trout fishery at Lees Ferry that does not adversely affect the native aquatic community in Grand Canyon National Park (Rogers 2015). Rainbow trout and brown trout are present below the dam, but rainbow trout have a robust reproducing population and dominant the fish species composition. A small reproducing brown trout population exists in Lees Ferry and has shown recent increases in abundance in the past two years (Winters et al. 2016). Flow regulation from Glen Canyon Dam is designed in part to minimize impacts to the rainbow trout fishery. Other management activities include a trout removal program at the mouth of the Little Colorado River confluence for the purpose of reducing trout predation on the federally endangered humpback chub. Other sport fish species that occur in the lower portion of the Glen Canyon Dam to the Little Colorado River segment include green sunfish, bluegill, largemouth bass, bullheads, and channel catfish (NPS 2013). The occurrence of these sport fish species is rare, since water temperatures are too cold in this stretch of the river and are likely fish that are passed through Glen Canyon Dam or reside in pockets of warm water (e.g., springs, sloughs).

3.12.3.1.2.4 Lower San Juan River

Based on recent monitoring studies in the San Juan River, sport fish species present in the San Juan River include black bullhead, yellow bullhead, channel catfish, smallmouth bass, largemouth bass, green sunfish, brown trout, and rainbow trout (Gilbert 2014; Schleicher 2015; Schleicher and Ryden 2013). All of these introduced species are uncommon (1 to 5 percent of the total catch) or rare (less than 1 percent of the catch) except for channel catfish, which is considered to be common (5 percent or greater of the total catch). Channel catfish numbers in the middle and lower portions of the San Juan River have been fairly stable in recent years; however, adult numbers were considerably reduced downstream of the

hogback diversion dam in 2013. Channel catfish is one of the non-native fish species that is targeted in the non-native fish removal program. In the San Juan River, non-native fish species tend to increase in abundance in the lower reaches of the river.

3.12.3.1.2.5 Fish Spawning

General spawning periods and habitat for the more common sport fish species within the study area are provided in **Table 3.12-3**. The spawning periods are approximate, could occur in only a portion of a particular month, and could vary based on different temperature regimes within the northern and southern portions of the analysis area.

Table 3.12-3 Sport Fish Spawning Periods and Habitat

Species or Group	Months												Spawning Habitat
	J	F	M	A	M	J	J	A	S	O	N	D	
Brown trout									■	■			Stream spawners that use tributary streams with gravel substrates in riffle-run areas.
Rainbow trout			■	■	■								Stream spawners that use gravel substrates at head of riffle or downstream portion of pool.
Walleye				■	■								Spawn in lakes and streams in shallow water over rock substrates.
Black bullhead						■	■						Usually spawn in weedy or muddy shallow areas by building nests.
Channel catfish					■	■	■						Prefers areas with structure such as rock ledges, undercut banks, logs, or other structure where it builds nests.
Largemouth bass					■	■	■						Shallow areas over clean gravel and sand bottoms.
Smallmouth bass				■	■	■	■						Builds nests in shallow areas over boulder, cobble, or gravel substrates.
Crappies					■	■	■	■					Spawning is often in open water, typically over mud, sand or gravel bottoms. Prefer sites near vertical cover such as trees or rocks.
Sunfishes					■	■	■	■					Nest builders in diverse substrates and shallow depths.
Striped bass				■	■	■							Egg masses deposited over sand bars, submerged vegetation, or other instream debris.

Source: Arizona Game and Fish Department 2015a.

3.12.3.1.3 Invertebrates

Quagga (*Dreissena bugensis*) and zebra mussels *(Dreissena polymorpha)* are small freshwater mussels that have invaded North America, specifically the Great Lakes. In January 2007 they were found in the Colorado River system (i.e., Lake Mead and Lake Havasu) (NPS 2007) and the mussels are currently present in portions of Lake Powell (NPS 2016). The mussels and their larvae are transported in the ballast water or on the engines and hulls of boats. In addition to being prolific invaders and upsetting the

ecological balance of lakes and other aquatic systems, quagga mussels are notorious for clogging water intake systems, thus creating maintenance issues. Quagga and zebra mussels bioaccumulate metals, which represents a source of metals in aquatic the aquatic food chain that can be transferred to birds and fish as part of their diet (Kwan et al. 2003; Muetting and Gerstenberger 2010). Quagga mussels have been identified as a biomonitoring indicator of metal contamination in lakes (Muetting and Gerstenberger 2010).

3.12.3.1.4 Amphibians

The canyon tree frog (*Hyla arenicolor*) is common along the shores of Lake Powell and relatively steep side canyons (Brennan 2008; Reclamation 2007). Other amphibian species that are known to occur around Lake Powell or the Colorado River include the Woodhouse's toad (*Anaxyrus woodhousii*), red-spotted toad (*Anaxyrus punctatus*), Great Basin spadefoot (*Spea intermontana*), tiger salamander (*Ambystoma tigrinum*), and northern leopard frog (*Lithobates pipiens*). Woodhouse's toad and red-spotted toad generally are associated with riparian areas along the Colorado River in the spring and fall and use the shoreline area in the summer. The Great Basin spadefoot typically is associated with water tanks or wet ditches. Northern leopard frog has disappeared from 70 percent of the known sites above and below Glen Canyon Dam (Reclamation 2007). Although potential habitat exists for this species, but no current populations are known to be present around Lake Powell or near the Colorado River.

3.12.3.1.5 Baseline Characterization for Chemicals of Potential Ecological Concern in Surface Water, Sediment, and Fish Tissue

The COPECs for evaluation for the project were defined in each of the ERAs (Ramboll Environ 2016a,b,c,d) and were identified based on two previous studies conducted by Electric Power Research Institute (EPRI) (EPRI 2009, 2011) and agreement by cooperating agencies regarding project scope in development of the ERAs. These chemicals are associated with coal and coal-fired power plants and included 24 metals (inorganic chemicals), two broad chemical classes of organic compounds (polycyclic aromatic hydrocarbons, or PAHs, and dioxins/furans), and two other organic compounds, benzene and acrolein. Of the COPECs evaluated, only mercury and selenium were identified with refined risk estimates greater than or equal to 1 (refined HQ≥1) for evaluation of fish, surface water, and sediment; refined concentrations were acceptable and below applicable ecological screening level values for all other COPECs. Baseline (current) conditions are described below.

This section summarizes the potential risk to aquatic species from mercury and selenium baseline (current or existing) conditions within the NGS study areas based on the ERAs conducted for the NGS Near-field (Lake Powell), Colorado River (Gap Regions), and the San Juan River (Ramboll Environ 2016a,b,c). The term "baseline condition" is used in this section and the impact discussions for the action alternatives to be consistent with the terminology used in the ERAs, as defined in Section 3.0.2., or briefly, environmental conditions before any future Project activities have taken place. Details regarding the potential effects of mercury and selenium on aquatic species are summarized in the Ecological Risk Assessment Summary, **Appendix 3RA**, and detailed in the ERA documents (Ramboll Environ 2016a,b,c).

Fish tissue concentrations were modeled from surface water data (using chemical-specific uptake factors) or, where available, from measured tissue concentrations available in the literature. Measured fish tissue data for mercury and selenium for sport and non-sport fish species occurring within the ERA study areas are summarized in **Table 3.12-4**. The values presented represent the average whole body fish tissue concentrations that were reported in the summary statistics for the ERA reports (Ramboll Environ 2016a,b,c).

Table 3.12-4 Range in Average Fish Tissue Concentrations

Chemical	Fish Tissue Concentration (mg/kg wet weight)			
	NGS Near-field (Colorado River/ Lake Powell)	Northeast Gap (Colorado River/ Lake Powell)	Southwest Gap (Colorado River)	San Juan River
Mercury (River)	0.02	0.029 – 0.15	0.041 – 1.32	0.0078 – 0.17
Mercury (Lake)[1]	0.12 – 0.2	0.072 – 0.15	--	--
Selenium[1]	--	--	0.42 – 3.85	0.44 – 2.14

[1] -- Indicates that measured tissue data were not available or not applicable.

These measured tissue data were derived from a number of sources including Utah Division of Water Quality (for years 2005 - 2010), National Park Service, USEPA, and United States Geological Survey and Walters et al. (2015), USFWS (2014), Kepner (1988) and Simpson and Lusk (1999). Source of data for all media is summarized in **Appendix 3RA** and detailed in the ERA reports (Ramboll Environ 2016a,b,c).

The effects assessment for water column aquatic species (aquatic community and fish) was based on the comparison of dissolved surface water concentrations to surface water ecological benchmarks. A second effects assessment for fish was conducted by comparing modeled or measured (from the literature) fish tissue concentrations to literature-based critical body residues. Fish tissue-based critical body residues were used to determine the potential for adverse effect based on the assessment endpoint and measure of effect defined in Section 3.12.3. Fish tissue-based critical body residues and the literature-derived tissue concentrations consider total exposure to fish, which is an integrated exposure that reflects uptake and assimilation of the bioavailable fraction of COPECs across multiple pathways, including respiration (via gills), sediment contact/ingestion, and diet. The critical body residues used to evaluate risk are listed below.

- Mercury – For evaluation of early life stage fish, the threshold or no observed effect level of 0.2 mg/kg wet weight per Beckvar et al. (2005) was used. For adult fish, the lowest observed effect level of 0.77 mg/kg wet weight per Dillon et al. (2010) was used.
- Selenium – For evaluation of early life stage fish and adult fish, the threshold no observed effect level of 2 mg/kg wet weight was used (USEPA 2015).

For larval amphibians (tadpoles), potential risk was evaluated using surface water benchmarks protective of aquatic communities, as above, and literature-derived screening concentrations protective of larval amphibians (Sparling et al. 2010). To address adult amphibians, rainbow trout was used as a surrogate species to allow evaluation of potential amphibian exposure (via the diet) to aquatic invertebrates, which also are consumed by predatory fish. A portion of amphibian diet also may come from terrestrial sources.

Refined risk estimates for mercury and selenium exposure for aquatic species are discussed below and summarized in **Tables 3.12-5** and **3.12-6** for the NGS Near-field ERA and Gap Region ERA analysis areas. The HQ values presented in these tables are based on are refined exposure point concentrations (i.e., 95 percent Upper Confidence Limit).

Table 3.12-5 Risk of Mercury Baseline Conditions to Aquatic Species in the NGS Near-field and Gap Regions

Aquatic Receptors	Evaluated Medium	NGS Near-field (Lake Powell)		Northeast Gap (Colorado River above Powell)		Southwest Gap (Colorado River below Powell)	
		Hazard Quotient[1]	Interpretation	Hazard Quotient[1]	Interpretation	Hazard Quotient[1]	Interpretation
Aquatic community[2]	Surface Water	<1	Negligible risk	<1	Negligible risk	<1	Negligible risk
Benthic community[3]	Sediment	<1	Negligible risk	<1	Negligible risk	<1	Negligible risk
Fish[4]	Fish Tissue	<1	Negligible risk	<1	Negligible risk	>1	Potential risk to adult fathead minnow, rainbow trout, and speckled dace

[1] Hazard quotients based on refined exposure point concentrations evaluated in the NGS Near-field ERA and Gap Region ERA (Ramboll Environ 2016a,c).

[2] The aquatic community, which consists of populations of aquatic plants, invertebrates, amphibians and fish, was evaluated by comparing surface water mercury concentrations to applicable water quality criteria protective of aquatic life.

[3] Benthic invertebrates were evaluated by comparing sediment mercury concentrations to the applicable toxicity threshold protective of sediment-dwelling organisms.

[4] Early life stage (ELS) fish were evaluated by comparing modeled mercury tissue concentrations to the mercury no effect tissue threshold of 0.2 mg/kg wet weight protective of fish health. All other fish (adults/representative fish species) were evaluated by comparing tissue concentrations to the lowest effect threshold (0.77 mg/kg wet weight).

Table 3.12-6 Risk of Selenium Baseline Conditions to Aquatic Species in the NGS Near-field and Gap Regions

Aquatic Receptors	Evaluated Medium	NGS Near-field (Lake Powell)		Northeast Gap (Colorado River above Powell)		Southwest Gap (Colorado River below Powell)	
		Hazard Quotient[1]	Interpretation	Hazard Quotient[1]	Interpretation	Hazard Quotient[1]	Interpretation
Aquatic community[2]	Surface Water	=1	Negligible risk	<1	Negligible risk	>1	Potential risk to aquatic community
Benthic community[3]	Sediment	<1	Negligible risk	<1	Negligible risk	<1	Negligible risk
Fish[4]	Fish Tissue	<1	Negligible risk	<1	Negligible risk	>1	Potential risk to adult rainbow trout and speckled dace.

[1] Hazard quotients based on refined exposure point concentrations evaluated in the NGS Near-field ERA and Gap Region ERA (Ramboll Environ 2016a,c).

[2] The aquatic community, which consists of populations of aquatic plants, invertebrates, amphibians and fish, was evaluated by comparing surface water selenium concentrations to applicable water quality criteria protective of aquatic life.

[3] Benthic invertebrates were evaluated by comparing sediment selenium concentrations to the applicable toxicity threshold protective of sediment-dwelling organisms.

[4] Fish were evaluated by comparing selenium tissue concentrations to the selenium no effect tissue threshold of 2 mg/kg wet weight protective of fish health.

Risk to the aquatic and benthic communities under baseline conditions was assessed by comparing current surface water metal concentrations in the water column and in bed sediment, respectively, against appropriate ecological screening values. For evaluation of aquatic communities, unlike most other chemicals, selenium is typically evaluated using total (unfiltered) surface water concentrations (versus dissolved concentrations) because selenium uptake, behavior and toxicity in aquatic systems is highly dependent on site-specific factors, including food web structure and hydrology of the system (USEPA 2015). For this reason, water quality criteria values for selenium promulgated by the USEPA and Navajo Nation were derived on a total (unfiltered) basis and are intended to be compared to total selenium concentrations in surface water. For other chemicals (except aluminum, also evaluated on a total basis), it is the dissolved fraction that is mostly readily taken up and assimilated by aquatic organisms and so dissolved (filtered) results are most applicable. Use of total concentrations for chemicals other than selenium (or aluminum) is conservative and would result in an overestimation of reported risk estimates.

As indicated in **Table 3.12-6**, total selenium concentration in surface water exceeded 1 (refined HQ = 6) in the Southwest Gap, indicating a potential for risk to the aquatic community. It is notable that the refined risk estimate is based on the maximum detected concentration as a 95 percent upper confidence limit could not be calculated for surface water in the Southwest Gap for selenium due to a small dataset; the average concentration also exceeded the criteria. However, no other COPECs exceeded applicable screening levels in any of the other study areas. In the Near-field, the total selenium concentration was equal to the surface water criterion (0.002 mg/L, per Navajo Nation and USEPA). Potential for risk from selenium is not expected however because water criteria are concentrations at or below which effects are not expected – therefore potential risk is considered negligible.

For sediment, the refined HQs were less than 1 for all COPECs in all study areas (**Tables 3.12-5**, **3.12-6**, and **3.12-7**), which indicates that metal concentrations in sediment represent negligible risk to benthic communities as reported in the ERAs (Ramboll Environ 2016a,b,c). The risk characterization and outcome for the fish evaluation is discussed below for each NGS ERA analysis area.

3.12.3.1.5.1 NGS Near-field

The risk characterization for fish under baseline conditions involved evaluation of chemicals in surface water and in fish tissues relative to critical body residues. The critical body residue refined HQs were below 1 for both early life-stage (modeled from surface water only) and adult fish (modeled and measured), which indicates that metal concentrations represent negligible risk to fish. Target fish species used in the measured tissue-based evaluation (data were available for mercury only), consisted of rainbow trout, smallmouth bass, and striped bass. Using literature-based measured mercury concentrations (evaluated as methylmercury) the refined HQs were as follows: rainbow trout (HQ = 0.02), smallmouth bass (HQ = 0.2) and striped bass (HQ = 0.3).

3.12.3.1.5.2 Gap Regions

The Gap Regions consist of two areas in the Colorado River located upstream and downstream of Lake Powell. The Northeast Gap Region extends from the Colorado arm of Lake Powell upstream to the Colorado River confluence with the Green River. The Southwest Gap Region extends from the Glen Canyon Dam downstream in the Colorado River to its confluence with the Little Colorado River.

For the Northeast Gap Region, the risk characterization for baseline conditions indicated that the critical body residue HQs using refined concentrations were below 1 for both early life-stage and adult fish using the 0.2 and 0.77 mg/kg wet weight impact thresholds, respectively. Critical body residue HQs also were calculated based on mercury fish tissue concentrations reported in the literature for the Northeast Gap Region. This analysis showed that refined mercury critical body residue HQs (based on the 0.77 mg/kg wet weight impact threshold) were one to two orders of magnitude below a HQ of 1. The fish species used in the analysis included channel catfish, largemouth bass, and rainbow trout and results were differentiated between fish tissue data obtained from Lake Powell (refined HQ range

from 0.1 to 0.2) or the Colorado River (HQ range from 0.04 to 0.4). The overall average refined HQ for all non-native fish species was 0.2

The Southwest Gap Region analysis for baseline conditions indicated risk estimates exceeding 1 suggesting a potential for risk for fish based on exposure to mercury for three fish species (HQ of 2 for fathead minnow, rainbow trout, and speckled dace) and selenium for two fish species (HQ of 2 for rainbow trout and speckled dace). Several other species had refined selenium HQs equal to 1 (carp, fathead minnow, and flannelmouth sucker), whereas a refined mercury HQ equal to 1 was noted for flannelmouth sucker. It is important to note that the HQs equal to or exceeding 1 for the above fish species are based on data from a study by Walters et al. (2015). Recent tissue data resulting from NPS sampling have shown much lower tissue concentrations for rainbow trout consistent with previous studies (Ramboll Environ 2016c), which suggests a lower level risk to non-native fish species. The overall average refined selenium HQ for all non-native fish species was 1 and less than 1 for mercury, indicating that potential risk to the fish community as a whole from these COPECs is negligible.

As indicated, concentrations of COPECs exceeded 1 for risk from selenium exposure to aquatic communities (that includes larval amphibians) and for mercury and selenium exposure to the rainbow trout that serves as a surrogate for the evaluation of adult amphibians. While there may be a potential for risk to adult amphibians with consideration of the rainbow trout results, risk to larval amphibians is not excepted because the surface water concentration was below the chronic (long-term) amphibian-specific screening level for selenium (6.8 µg/L, Sparling et al. 2010). Therefore, negligible risk is expected for larval amphibians under baseline conditions.

3.12.3.1.5.3 San Juan River

The risk of arsenic, mercury and selenium baseline conditions in the San Juan River is summarized in **Table 3.12-7**. The risk characterization for the San Juan River under baseline conditions indicated that the refined critical body residue HQs were below 1 for early life-stage fish (modeled from surface water only). For adult fish (modeled) for mercury, a refined HQ of 1 was noted. However, measured tissue analysis indicated that all concentrations were less than1, indicating that risk is negligible. The selenium evaluation indicated negligible risk to most non-special status fish species. However, refined HQs equal to 1 for selenium were noted for three fish species: speckled dace, red shiner, and mosquitofish. The ERA reported refined HQs less than 1 (indicating negligible risk) for sport fish species including channel catfish, largemouth bass, rainbow trout, and walleye.

Table 3.12-7 Risk from Arsenic, Mercury, and Selenium Baseline Conditions to Aquatic Species in the San Juan River Analysis Area

Aquatic Receptors	Evaluated Medium	Refined Hazard Quotients	Interpretation
Arsenic			
Aquatic community[1]	Surface Water	<1	Negligible risk
Benthic community[2]	Sediment	<1	Negligible risk
Fish [3]	Fish Tissue	<1	Negligible risk
Mercury			
Aquatic community[1]	Surface Water	<1	Negligible risk
Benthic community[2]	Sediment	<1	Negligible risk
Fish [3]	Fish Tissue	=1 (modeled) <1 (sport and non-sport fish)	Negligible risk. Potential for risk based on modeled tissue data (HQ=1); however, risk is considered negligible as HQ<1 for the

Table 3.12-7 Risk from Arsenic, Mercury, and Selenium Baseline Conditions to Aquatic Species in the San Juan River Analysis Area

Aquatic Receptors	Evaluated Medium	Refined Hazard Quotients	Interpretation
			fish community as a whole (all species) and individual species based on measured tissue data.
Selenium			
Aquatic community[1]	Surface Water	<1	Negligible risk
Benthic community[2]	Sediment	<1	Negligible risk
Fish [3]	Fish Tissue	=1 (3 species) <1 (sport and most non-sport fish)	Negligible risk. Potential risk for speckled dace, red shiner, mosquitofish, and striped bass based on HQ=1); however, risk considered negligible as the HQ<1 for the fish community as a whole (all species) based on modeled and measured tissue data.

[1] The aquatic community, which consists of populations of aquatic plants, invertebrates, amphibians and fish, was evaluated by comparing surface water metals concentrations to applicable water quality criteria protective of aquatic life

[2] Benthic invertebrates were evaluated by comparing sediment metals concentrations to the applicable toxicity threshold protective of sediment-dwelling organisms.

[3] Fish were evaluated by comparing metals tissue concentrations to applicable tissue thresholds protective of fish health.

3.12.3.2 Proposed Kayenta Mine Complex

3.12.3.2.1 Habitat

Aquatic habitat within the proposed KMC mainly consists of intermittent and ephemeral streams, springs, and temporary and permanent sediment impoundment ponds. Portions of the Moenkopi and Dinnebito washes, are located within the mine boundary. As of January 2015, it is anticipated that 39 existing sediment retention ponds and 11 internal draining impoundments would remain permanently after mining and reclamation are complete. In the Navajo Aquifer (N-Aquifer) groundwater study area (see Water Resources, Section 3.7.3), additional intermittent streams and springs are present in the N-Aquifer) groundwater study area (**Figure 3.7-3**), including Moenkopi Wash, Dinnebito Wash, Oraibi Wash, Wepo Wash, Polacca Wash, Chinle Wash, Jeddito Wash, Begashibito Wash, Shonto Wash, Laguna Creek, and Cow Springs. Several of the streams such as Moenkopi Wash, Dinnebito Wash, Shonto Wash, Laguna Creek, and Cow Springs, contain water on a more consistent basis as a result of spring input.

3.12.3.2.2 Aquatic Species

The occurrence of fish species within the proposed KMC is limited to a few sediment ponds where fish may be present from unauthorized introductions. For example, sediment pond N14-G contains largemouth bass; however, no public fishing is allowed in the pond. Channel catfish were stocked in Cow Springs in 2015 by the Navajo Nation Division of Fish and Wildlife. Fish species could be present in portions of additional streams or washes that contain water on a more persistent basis. If present, species could include mosquitofish, western killifish, or other species that are adaptable to waterbodies with minimal flow and higher water temperatures.

3.12.3.2.3 Baseline Characterization for Chemicals of Potential Ecological Concern in Surface Water and Sediment

The COPECs that are evaluated for the project are defined in the proposed KMC ERA (Ramboll Environ 2016d). Baseline conditions of aquatic resources within the proposed KMC ERA study area were evaluated based on surface water and sediment data obtained during field sampling in 2014 (Ramboll Environ 2016e,f) and surface water monitoring data provided by Peabody as reported in (Ramboll Environ 2016d). For convenience, data sources for all evaluated media are summarized by medium of interest in Section 3.0.2. Aquatic habitat within the study area consists of ponds (constructed sediment control structures), springs, and ephemeral streams. The geology of the region (dominated by the Wepo Formation) results in enrichment of surface water by some metals such as aluminum, boron, cadmium, manganese, selenium, and vanadium, which may become entrained in silts and clays carried in runoff during precipitation events (rain, snowmelt) and deposited in receiving waters (Ramboll Environ 2016d). Runoff provides recharge to groundwater (percolation from the surface downward into groundwater) and/or is collected in sediment control structures that manage runoff from active mine areas. Natural enrichment of metals from geological formations and soils may lead to groundwater concentrations within the formation that are in excess of aquatic life criteria and/or domestic drinking water standards in areas where there is connection to surface water (Ramboll Environ 2016d).

The proposed KMC ERA specifically evaluated aquatic biological resources represented by the aquatic community and benthic community only. Fish were not specifically addressed as a separate assessment endpoint at the proposed KMC (as was done at NGS and associated study areas) because such populations are limited or absent due to intermittent nature of streams/washes, low flow and/or limited extent of springs, and small extent and/or intermittent nature of most ponds. Although some ponds are known to contain introduced fish, these populations are limited in abundance and diversity and are present in only a few of the larger permanent ponds (Ramboll Environ 2016d). Fish are evaluated as a component of the aquatic community. For the aquatic community evaluation, refined HQs exceeded 1 for several metals in sediment control structures (aluminum, manganese, and selenium), springs (cadmium, manganese, and selenium) and/or streams (aluminum and manganese). Hazard quotients greater than 1 indicate that a potential risk to aquatic species is possible and indicates that additional evaluation considering other lines of evidence may be warranted to draw conclusions. For the benthic community, all sediment concentrations were below applicable screening levels with refined HQs less than 1 indicating a negligible risk. Although the HQs exceed 1 for some metals for aquatic community receptors, negligible effects to aquatic or benthic species from baseline metal concentrations are anticipated because the aquatic/benthic species that are present in these waterbodies have adapted to the local (natural) hydrogeologic conditions within the proposed KMC ERA analysis area, which is a conclusion in the proposed KMC ERA (Ramboll Environ 2016d).

3.12.3.3 Transmission Lines and Communication Sites

3.12.3.3.1 Habitat

Streams provide perennial habitat within the transmission line ROW as listed below.

- WTS – Colorado River, Paria River, Antelope Creek, Gypsum Wash, Muddy River, Virgin River, Las Vegas Wash, and Meadow Valley Wash; and
- STS – Agua Fria River, Big Bug Creek, and Verde River.

3.12.3.3.2 Aquatic Species

Sport fish species are known to occur in several of the larger streams crossed by the transmission lines such as the Colorado, Muddy, Virgin, and Verde rivers. Sport fish species in the Colorado River are listed in **Table 3.12-2** for the Southwest Gap Region. Sport species in the Verde River include largemouth bass, smallmouth bass, sunfishes, crappies, and channel catfish (Arizona Game and Fish Department 2015b). Streams crossed by the ROWs also contain aquatic invertebrates. However, no

specific sport fish occurrence, abundance, or habitat quality data were collected for the streams crossed by the transmission line ROWs because this type of information is not necessary for the impact analysis of operation and maintenance activities. There would be no construction disturbance for the transmission lines.

No perennial habitat occurs at the communication sites; therefore, fish are not expected to be present and no further analysis was conducted.

3.12.4 Environmental Consequences

3.12.4.1 Issues

3.12.4.1.1 Navajo Generating Station

Issue 1 – Emissions and Deposition - aquatic habitat located within the NGS Near-field ERA, Gap Regions, and the San Juan River ERA areas was analyzed for emission and deposition effects on water quality, aquatic species, and fish tissue.

Issue 2 – Water Use - NGS future use of cooling water drawn from Lake Powell could cause decreases in storage water volume in the lake and result in changes to pool levels and potentially affect aquatic species. Future water withdrawal through the intake could result in entrainment and impingement effects on fish species

Issue 3 – Effects of Implementation of Fish Conservation Measures - effects of implementing fish conservation measures on aquatic species in the San Juan River and Colorado River below Glen Canyon Dam.

3.12.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Operations and Reclamation - effects of mine disturbance on aquatic species and habitat

Issue 2 – Realignment of Navajo Route 41 - effect of realigning Navajo Route 41 on aquatic species and habitat.

Issue 3 – Emissions and Deposition - potential impacts of emission and deposition caused by NGS and proposed KMC combined future operations were analyzed for effects on water quality, aquatic plants, invertebrates, and fish. The study area was discussed above in baseline characterization and in the proposed KMC ERA (Ramboll Environ 2016d).

Issue 4 – Groundwater Pumping - effects of groundwater pumping on surface water and aquatic species.

3.12.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operation and Maintenance - effects of operation and maintenance of transmission systems on perennial streams and aquatic species crossed by the WTS and STS.

3.12.4.2 Assumptions and Impact Methodology

The following information provides a description of the assumptions, project-committed protection measures, and methodologies that were used for aquatic biological resources.

3.12.4.2.1 Assumptions

- Aquatic species or groups analyzed in the ERAs include plants, invertebrates (both water column and bottom-dwelling species), fish, and amphibians throughout the overall study area. The emphasis in this EIS on fish is for sport species due to their recreational importance. Other fish species are included in the ERA analyses due to their role in the aquatic food chain or other ecological roles such as competition for habitat or food.

- The overall study area was divided into three project components: NGS, proposed KMC, and the transmission systems and communication sites. Within each project component, the potential impact of the project actions were analyzed, as discussed below in the various subsections.
- Assumptions used in the emission and deposition analyses are described in the ERAs (Ramboll Environ 2016a,b,c,d).
- Surrogate species identified in the ERAs are representative of species that occur in the analysis area. Surrogates included representatives for fish, macroinvertebrates, and amphibians.
- Potential surface disturbance from operation and maintenance activities could occur within the WTS and STS ROWs. However, there would be no direct disturbance within perennial stream channels crossed by the WTS and STS.

3.12.4.2.2 Methods

3.12.4.2.2.1 Emissions and Deposition

- Three ERAs were conducted to analyze the effects of NGS emissions and the resulting deposition of chemicals on ecological receptors in Lake Powell (NGS Near-field ERA), the Colorado River above and below Lake Powell (Gap Regions ERA), and the San Juan River (San Juan River ERA) (Ramboll Environ 2016a,b,c). A separate fate and transport study was conducted by the EPRI (2016) to assess the impact of mercury, selenium, and arsenic emissions from regional power plants (i.e., NGS, Four Corners Power Plant, and San Juan Generating Station) on federally endangered fish in the San Juan River and to provide quantitative data to estimate the contributions and impacts of other local, regional, and long-range contributions. Results from the EPRI study were used to develop the San Juan River and Gap Regions ERAs. Details describing the methodologies for the ERAs are provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment.
- The methodologies for selecting the study areas for each of the ERAs (Ramboll Environ 2016a,b,c) are provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment.
- The timeframe for impact analysis on aquatic (and terrestrial) communities was from 2020 – 2074. The additional 30 years of analysis following NGS shut down in 2044 was included to assure that the deposition from NGS and proposed KMC had sufficient time to move through the terrestrial landscapes into watersheds and through aquatic systems (see EPRI 2016).
- Ecological risk was calculated for baseline conditions, proposed project impacts, and cumulative impacts. The values are assessed independently (as explained above in baseline evaluations) and combined together to assess overall total risk to aquatic receptors.
- Ecological risk was determined for the aquatic receptors in terms of a quantitative and/or qualitative estimate of ecological risks, based on the potential exposure of a representative receptor to a COPEC present in abiotic media (e.g., soil, surface water, sediment) and in biotic media consumed by the receptor (e.g., plants, invertebrates) relative to defined toxicity data. Ecological risk was determined by calculating HQs for community-based receptors representing the aquatic community and dose-based receptors for higher trophic levels. Detailed information on how HQs were calculated and what the number means is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment. The refined HQ value, which was calculated by comparing the 95 percent upper confidence limit concentration (where available) for each COPEC, is considered to be the most realistic prediction of ecological risk rather than maximum concentrations. This is because receptors are unlikely to be exposed to the highest levels of all COPECs at all times. If the refined HQ is less than 1, there would be negligible ecological risk to aquatic species or community. If the refined HQ is 1 or greater, ecological risk was evaluated using other lines of information to draw conclusions regarding the potential for risk.

- The effects assessment for aquatic species consists of two types of effects metrics: surface water ecological screening values and critical body residues expressed as concentrations of mercury and selenium estimated in whole body invertebrate and fish tissue. Fish tissue-based critical body residues are used as the effects metrics for the measurement endpoint of fish tissue chemistry (i.e., concentrations of mercury and selenium reported in published literature). Fish tissue-based critical body residues reflect the bioavailable fraction of mercury and selenium and include exposures across multiple pathways such as respiration transfer, sediment ingestions, and diet.
- Impacts on aquatic species or species groups also were evaluated in terms of the comparisons to relative population numbers to determine the context of the impact. This consideration of impact context was then used to determine the relative magnitude of the impact. Impacts to resources may fit five categories: none, negligible, minor, moderate, and major. These categories are defined in Section 3.0 of this EIS.

3.12.4.2.2.2 NGS Water Use

- Water level changes in Lake Powell that exceed 1 foot in pool elevation could alter the amount of aquatic habitat in bays or other shallow areas.
- Results from NPS (2007) are used in this EIS to assess entrainment and impingement effects.

3.12.4.2.2.3 Effects of Implementation of Fish Conservation Measures

- Actions involving the control of non-native fish and translocation of razorback sucker in the Colorado River below Lake Powell and transfer of listed fish and habitat enhancement in the San Juan River were analyzed in a qualitative manner by relating the conservation measures actions to general aquatic communities.

3.12.4.2.2.4 Proposed KMC Operations and Reclamation

- Known or potential occurrence of fish was evaluated for mining areas in a qualitative analysis.
- Waterbodies located within the footprint of mine disturbance were identified as aquatic habitats that could be affected by mining activities.

3.12.4.2.2.5 Realignment of Navajo Route 41

- Perennial waterbodies within the footprint of road realignment disturbance area were identified as aquatic habitats that could be affected by road construction and realignment.

3.12.4.2.2.6 Proposed KMC Deposition and Emissions

- Previous baseline studies and the proposed KMC ERA field studies were used to identify aquatic habitat, water, soil, and sediment quality conditions in those habitats, and species within the mining area.

3.12.4.2.2.7 Proposed KMC Groundwater Pumping

- Mine well pumping was modelled to determine potential effects on groundwater and connected surface waters, ultimately affecting fish habitat and species.

3.12.4.2.2.8 Transmission Systems Operations/Maintenance

- It was assumed that perennial streams crossed by the transmission lines would support aquatic species. Perennial streams that intersect the WTS and STS transmission system ROWs were evaluated for operation and maintenance activities in a qualitative analysis. Potential effects to perennial streams crossed by the WTS and STS ROWs could occur if vehicles or equipment disturb soils within 500 feet of the ROW boundaries.

- No perennial stream habitat is located at the communication sites and so no further analysis was conducted for this project component.

3.12.4.2.3 Project Best Management Practices and Protection Measures

Best Management Practices (BMPs) and protection measures that are part of the NGS-KMC Project would be implemented to avoid or reduce impacts to aquatic habitat and species as detailed below.

3.12.4.2.3.1 Navajo Generating Station

- Maintenance of a Spill Prevention, Control, and Countermeasure Plan that contains measures used to prevent oil discharges from occurring and actions for responding to a spill in an effective and timely manner to mitigate the impacts of any discharge to a navigable water. Actions in the Spill Prevention, Control, and Countermeasure Plan include preventative maintenance of equipment and containment and discharge prevention systems; annual employee training; and monthly inspections.
- During repairs and maintenance of project infrastructure, standard BMPs would be used to prevent degradation of surface waters (i.e., spill prevention and capture plans, storm water runoff controls, silt fencing and straw bales, and sediment and erosion controls) would be implemented.
- An ash landfill berm would be used to capture and prevent stormwater runoff.
- Construction, operations, and maintenance activities would be scheduled as feasible to minimize work during periods when the soil is too wet to support construction equipment, which could cause deep ruts, road degradation, and surface disturbance.
- Zero liquid discharge facility would be used.
- Implementation of the Groundwater Protection Plan and compliance with CCR regulations would be used to assure protection of the N-Aquifer.

3.12.4.2.3.2 Proposed Kayenta Mine Complex

- Sediment control and revegetation would be done as part of the Environmental Protection Standards and Reclamation Plan in the KMC Mine Permit.
- Maintenance of a Spill Prevention, Control, and Countermeasure Plan that contains measures used to prevent oil discharges from occurring and actions for responding to a spill in an effective and timely manner to mitigate the impacts of any discharge to navigable waters.
- Stormwater runoff BMP's and National Pollutant Discharge Elimination System water control structures to reduce/eliminate pollution from entering receiving streams.
- Soil erosion and sediment control BMPs.

3.12.4.2.3.3 Transmission Systems and Communication Sites

- Biologically sensitive areas identified by the USFWS and other federal land managers would be mapped prior to maintenance activities. Appropriate measures would be implemented to avoid and/or minimize impacts to known populations of federally listed or other special status species.
- Conservation measures would be implemented on Forest System lands to minimize impacts to federally listed species and their critical habitat. Aquatic species would include loach minnow, Gila topminnow, and Gila chub. The relevant National Forest crossed by the STS is Coconino.
- Standard BMPs involving spill prevention and capture, stormwater runoff control, and erosion control would be implemented during repairs to prevent degradation of surface waters.

- Staging areas for loading and unloading equipment would be located in previously disturbed areas and outside of floodplains and wet areas.
- All applicable labels, federal and state laws, and regulations with regard to the use and application of herbicides would be strictly adhered to avoid effects to the environment.
- All herbicide applications would be spot treatments utilizing backpack, handheld, and quad/all-terrain vehicle mounted sprayers with plant specific treatment.
- There would be no new roads or ground disturbing activities.
- If a portion of the transmission line is inaccessible by road or sensitive habitats occur within the ROW, the crew would drive to the nearest location and walk to the site with the necessary equipment.
- Vegetation management would not widen the ROW corridor.
- Existing established roads would be used to access powerline ROWs.
- Where vehicle access is not available crews would hike in from the nearest access point.
- During repairs and maintenance of project infrastructure, standard BMPs to prevent degradation of surface waters (i.e., spill prevention and capture plans, storm water runoff controls, silt fencing and straw bales, and sediment and erosion controls) would be implemented.
- Staging areas for loading and unloading of equipment would be located in previously disturbed areas, but outside of floodplains and other wet areas.

3.12.4.3 Proposed Action

3.12.4.3.1 Navajo Generating Station

3.12.4.3.1.1 Emissions and Deposition

Potential effects of power plant emissions and deposition on aquatic species in Lake Powell, the Colorado River, and the San Juan River.

A summary of the ERAs conducted for the project, including the contribution of NGS emissions/deposition of metals (and other chemical constituents) on aquatic biological resources, is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment. Detailed methods, supporting information, and results are provided in the ERA reports (Ramboll Environ 2016a,b,c).

<u>NGS Near-field Study Area</u>

The study area for the Near-field ERA was a 20-kilometer (km) radius from NGS, which captured a portion of Lake Powell and that portion of the Colorado River below Glen Canyon Dam that lies within the 20-km study area (**Figure 3.12-1**). The information in **Table 3.12-8** describes the estimated ecological risk of metals emitted and deposited within the near-field from NGS in combination with baseline conditions in Lake Powell on aquatic species in Lake Powell. The overall timeframe of 2020 to 2074 was analyzed to account for the “lag period” between closure of NGS in 2044 and movement of COPECs through the environment (watersheds and food web).

Table 3.12-8 NGS Near-field ERA Potential Impacts of Mercury and Selenium Emissions and Deposition from Baseline Conditions and NGS on Aquatic Species, 2020 – 2074

Aquatic Receptors	Evaluated Medium	3-Unit Operation		2-Unit Operation	
		Refined Hazard Quotients	Interpretation	Refined Hazard Quotients	Interpretation
Aquatic community[1]	Surface water	<1	NGS emissions in combination with baseline conditions would represent a negligible risk to water-column aquatic community, benthic invertebrates or fish in Lake Powell.	<1	Negligible risks to aquatic and benthic communities, fish, and amphibians, but this operation would contribute lower emissions and deposition than the 3-Unit Operation.
Benthic community[2]	Sediment	<1		<1	
Fish[3]	Fish Tissue	<1		<1	
		<1			

[1] The aquatic community, which consists of populations of aquatic plants, invertebrates, amphibians and fish, was evaluated by comparing surface water metals concentrations to applicable water quality criteria protective of aquatic life.

[2] Benthic invertebrates were evaluated by comparing sediment metals concentrations to the applicable toxicity thresholds protective of sediment-dwelling organisms.

[3] Fish were evaluated by comparing metals tissue concentrations to applicable tissue thresholds protective of fish health.

Source: Ramboll Environ 2016a.

Refined HQs were less than 1 for dissolved and total metal concentrations in surface water (protective of aquatic communities), as well as for tissue-based metal concentrations for both early life-stage fish and adult fish. For example, refined tissue-based HQs for non-native fish species (rainbow trout, striped bass and smallmouth bass) were well below 1 ranging from 0.0002 for the 2-Unit Operation to 0.0003 for the 3-Unit Operation. The combination of Proposed Action emissions/deposition with baseline conditions resulted in refined HQs for mercury ranging from about 0.02 to 0.3 for non-native fish species, with an HQ of 0.2 considering all non-native species (average of species data). Therefore, the proposed future operations of NGS (3-Unit Operation or 2-Unit Operation) and the estimated emissions and deposition of metals (including mercury and selenium) to Lake Powell and surrounding watershed, would represent a negligible effect to aquatic communities, sediment communities, and fish species in Lake Powell and that portion of the Colorado River below Glen Canyon Dam that lies within the 20-km analysis area.

Northeast Gap Region

The study area for the Northeast Gap Region extended from the Colorado River inflow area to Lake Powell to the confluence with the Green River. A summary of the Gap Regions ERA is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment and detailed methods and results are provided in the ERA report (Ramboll Environ 2016c). **Table 3.12-8** summarizes the outcome of the ERA for aquatic species in the Colorado River upstream of Lake Powell in the Northeast Gap. The results consider the contribution from NGS emissions/deposition from the 3-Unit Operation and 2-Unit Operation in combination with baseline results for the COPECs identified as a potential concern to aquatic biological resources: mercury and selenium.

The contribution of the NGS 3-Unit Operation or 2-Unit Operation alone would represent a negligible risk to aquatic species in the Northeast Gap Region. Refined HQs were less than 1 for all evaluations and COPECs identified previously for the Northeast Gap region, which included assessment of the aquatic community, sediment community, and fish (early life-stage and adult fish). Potential for risk from baseline in combination with NGS 3-Unit Operation or 2-Unit Operation results in HQs below 1 indicating negligible effects to aquatic biological resources.

Southwest Gap Region

The study area for the Southwest Gap Region extended from extent of the 20-km radius Near-field study area (below Glen Canyon Dam) downstream to the confluence with the Little Colorado River. **Table 3.12-9** summarizes the ERA results for aquatic species in the Colorado River downstream of Lake Powell. The results consider the contribution from NGS emissions/deposition from the 3-Unit Operation and 2-Unit Operation in combination with baseline results for the COPECs identified as a potential concern to aquatic biological resources: mercury and selenium.

The contribution of Proposed Action operations alone would represent a negligible risk to aquatic species in the Colorado River downstream of Lake Powell from metal concentrations. Refined HQs based on NGS operations were less than 1 for all evaluations and COPECs identified previously for the Southwest Gap Region, which included assessment of the aquatic community, sediment community, and fish (early life-stage and adult fish). Baseline results indicate potential for risk from selenium (HQ=6) for aquatic community receptors based on comparison of the total (unfiltered) selenium concentration to water quality criteria protective of aquatic life. However, the 3-Unit Operation (maximum production scenario) contributes a very small percentage (less than 1 percent) to the total HQ for selenium indicating that baseline conditions account for the majority of reported risk. For the sediment evaluation, HQs for both NGS emission scenarios were well below 1 for all COPECs. The impact is considered to be minor because the number of individuals that could be injured would represent a small portion of the overall population numbers for these species.

Table 3.12-9 Gap Regions ERA Potential Impacts of Metal Emissions and Deposition from Baseline Conditions and NGS on Aquatic Species, Years 2020 – 2074

Aquatic Receptor	Evaluated Medium	3-Unit Operation		2-Unit Operation	
		Refined Hazard Quotients	Interpretation	Refined Hazard Quotients	Interpretation
Southwest Region (Colorado River downstream of Lake Powell)					
Aquatic Community	Surface water	<1	Direct contact with water and sediment from NGS emissions in combination with baseline conditions do not pose a risk to aquatic or benthic communities.	<1	Negligible risks to aquatic and benthic communities, but this operation would contribute lower emission levels and deposition.
Benthic Community	Sediment	<1		<1	
Fish	Fish Tissue	Mercury and selenium refined critical body residue HQs >1 for some non-special status species.	Potential risk to several non-special status fish species due to baseline measured (literature-derived) fish tissue concentrations that exceed critical body residues. However, negligible risk to the fish community as a whole. Future NGS emissions and deposition would contribute a very small addition to baseline fish tissue concentrations (less than 1%).	Mercury and selenium refined critical body residue HQs >1 for several non-special status species (HQs range from 1 to 2).	Potential risks to several non-special status fish species, contributed almost entirely from baseline. However, negligible risk to the fish community as a whole. Future project operations would contribute a small fraction to the existing conditions.
Northeast Region (Colorado River upstream of Lake Powell)					
Aquatic Community	Surface water	<1	NGS emissions in combination with baseline conditions would not represent a potential impact to aquatic or benthic communities or fish in the Colorado River upstream of Lake Powell.	<1	Negligible risks to aquatic and benthic communities and fish, Future project operations would contribute a small fraction to the existing conditions.
Benthic Community	Sediment	<1		<1	
Fish	Surface water, food	<1		<1	

Source: Ramboll Environ 2016c.

For the evaluation of fish, based on literature-derived tissue concentration comparison to critical body residues, NGS 3-Unit Operation and 2-Unit Operation alone showed negligible risk to non-native fish because HQs were well below 1 for all COPECs. When combining baseline conditions with NGS emissions scenarios, there would be potential risks to fathead minnow, rainbow trout, and speckled dace from mercury exposure (HQ of 2 for all); and carp, fathead minnow, flannelmouth sucker, rainbow trout, and speckled dace from selenium (HQs ranging from 1 to 2). The 3-Unit Operation contributes a very small percentage (less than 1 percent) to the total HQ for mercury and selenium, indicating that baseline conditions account for the majority of reported risk. The impact level is considered to be minor because the potential injury effects to these species would be a very small percent of their overall population numbers in the Southwest Gap Region.

San Juan River

The study area for the San Juan River extended from the State Route 371 Bridge in Farmington, New Mexico, downstream to the San Juan arm of Lake Powell. A summary of the San Juan River ERA is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment and detailed methods and results are provided in the ERA report (Ramboll Environ 2016b). **Table 3.12.10** summarizes the ERA results for aquatic species in the San Juan River. The results consider the contribution from NGS emissions/deposition from the 3-Unit Operation and 2-Unit Operation in combination with baseline results for the COPECs identified as a potential concern to aquatic biological resources: mercury and selenium.

The contribution of Proposed Action operations alone would represent a negligible risk to aquatic species in the San Juan River from metal concentrations. Refined HQs were less than 1 for all evaluations and COPECs identified previously for the San Juan River (baseline), which included assessment of the aquatic community, sediment community, and fish (early life-stage and adult fish). Potential for risk from baseline in combination with NGS 3-Unit Operation or 2-Unit Operation resulted in negligible risk to the aquatic community and sediment community. In addition, there would be a negligible risk to sport fish and most of the other non-native fish from selenium, based on refined critical body residue-based HQs being 1 or less than 1. A refined HQ of 1 was noted for three non-native fish species (speckled dace, red shiner, and mosquitofish) when combining NGS emissions with baseline fish tissue concentrations. However a HQ of 1 to individual species does not indicate potential risk to the community as whole and therefore potential risk to the fish community is considered negligible. The 3-Unit Operation contributes a very small percentage (less than 1 percent) to the total HQ for selenium indicating that baseline conditions account for the majority of reported risk. The impact level would be considered minor because a very small percent of their overall population numbers in the San Juan River would be affected.

3.12.4.3.1.2 Water Use

If the project is authorized, NGS would be allocated to withdraw up to 40,000 acre-feet per year. Historical use has been 34,100 acre-feet per year. Under a 3-Unit Operation, water use is expected to be 26,000 to 29,000 acre-feet/year within the same range as historical operations. With the installation of SCRs for nitrogen oxide emission control, additional water would be required, but the total withdrawal volume would not exceed 34,100 acre-feet per year. Under a 2-Unit Operation or curtailed generation due to Best Available Retrofit Technology, water withdrawal would be approximately one-third of the 3–Unit Operation (i.e., 8,580 to 9,570 acre-feet less withdrawal). The estimated change in pool level from the 3-Unit Operation and 2-Unit Operation would be extremely small (less than 0.1 foot). The small increase from the 2-Unit Operation or decrease from the 3-Unit Operation in pool elevation would not change the aquatic habitat to the extent that it would affect fish or invertebrate composition or abundance (**Table 3.12-11**). It is important to note that the Lake Powell pool elevation fluctuates annually and seasonally based on inflow and water releases. The pool elevation can rise more than 10 feet in a relatively short period of time.

Table 3.12-10 San Juan River ERA Potential Impacts of Metal Emissions and Deposition from Baseline Conditions and NGS on Aquatic Species, 2020 – 2074

Aquatic Receptor	Evaluated Medium	3-Unit Operation		2-Unit Operation	
		Refined Hazard Quotients)	Interpretation	Refined Hazard Quotients	Interpretation
Aquatic Community	Surface water	<1	NGS emissions in combination with baseline conditions would represent negligible risks to aquatic or benthic communities in the San Juan River.	<1	2-Unit Operation would result in HQ values approximately 20 to 40 percent less than the 3-Unit Operation (depending on the metal) HQ. NGS emissions in combination with baseline conditions and other cumulative emissions would represent negligible effects to aquatic or benthic communities in the San Juan River.
Benthic Community	Sediment	<1	Negligible risk; refined (and maximum) HQ<1.	<1	Negligible risk; refined (and maximum) HQ<1.
Fish	Fish Tissue	Selenium refined critical body residue HQs =1 for some non-special status species	Negligible risk for non-special status fish critical body residue from mercury and selenium.	<1	Negligible risk; HQ for fish would be less than the 3-Unit Operation.
Amphibians	Surface water	None	Negligible risk to amphibians from mercury, arsenic, and selenium.	None	Negligible risk to amphibians from mercury, arsenic, and selenium.

Source: Ramboll Environ 2016b.

Table 3.12-11 NGS Water Use Impacts on Aquatic Biological Resources

Water Use Impacts – 3-Unit Operation	Water Use Impacts – 2-Unit Operation
Pool elevation would decrease less than 0.1 foot, if 34,100 acre-feet are withdrawn from Lake Powell.	Pool elevation would increase less than 0.1 feet, if 8,540 to 9,570 acre-feet less water are withdrawn from Lake Powell.
No change in fish or invertebrate composition or abundance would occur due to the slight reduction in habitat.	No change in fish or invertebrate composition or abundance would occur due to the slight increase in habitat.

The continuation of water withdrawals through the intake system would occur for both the 3-Unit Operation and 2-Unit Operation. There would be a minor effect of the water intake system on the entrainment or impingement of fish, as discussed in NPS (2007). The basis for this conclusion is that the intake system is in a deep portion of the lake where fish numbers are relatively low.

3.12.4.3.1.3 Effects of Implementation of Fish Conservation Measures

Implementation of conservation measures for federally listed fish species in the Southwest Gap Region (Colorado River below Lake Powell) and the San Juan River would result in both negative and beneficial impacts to non-special status fish species. Detailed descriptions of these measures are provided in Section 2.3.1.3. Measures are analyzed for non-special status species as listed below.

- Southwest Gap Region - FS-1 (Non-native Fish Management in the Colorado River Grand Canyon Area) and FS-2 (Razorback Sucker Translocations).
- San Juan River - FS-4 (Support Transport of Colorado Pikeminnow and Razorback Sucker Above the Waterfall Barrier in the San Juan River) and FS-5 (Funding Support for a Habitat Improvement Project in the San Juan River).

<u>FS-1</u>

Implementation of FS-1 would result in the emergency treatment of warmwater non-native fish species in response to invasions of non-native fish in areas that are negatively affecting the federally listed humpback chub and razorback sucker. The removal of non-native fish at selected sites would result in a reduction in non-native fish numbers. The target species or groups would be channel catfish, black bullhead, striped bass, trout, and sunfishes. FS-1 would result in a negative effect on the targeted non-native fish species; however, there would be a beneficial effect on native fish species by removing predation and competition factors. The beneficial effect on native fish species at treatment sites would likely result in increased numbers.

<u>FS-2</u>

The translocation of razorback sucker into areas not presently occupied by this species would have minor effects on other aquatic species. If razorback sucker inhabits a new area, the species would compete with other fish species that feed on invertebrates and plant material. The additional competition for these food sources is not expected to negatively affect other fish species, because these food sources are considered to be abundant throughout the Southwest Gap Region.

<u>FS-4</u>

The transport of Colorado pikeminnow and razorback sucker above the waterfall in the San Juan River would allow these species to utilize habitat throughout the San Juan River. Both species would compete for food sources with other fish species. As previously mentioned, razorback sucker consume

invertebrate and plant material, which are considered to be abundant throughout the San Juan River. Colorado pikeminnow is a predator at the juvenile and adult stage, with the predominant food consisting soft-rayed fishes, including bluehead sucker, flannelmouth sucker, red shiner, sand shiner, and fathead minnow. There could be a reduction in numbers for these fish species in areas where Colorado pikeminnow are more concentrated. However, when considering that pikeminnow are very mobile, the overall effect on other fish species would be considered minor.

FS-5

Habitat enhancements in the San Juan River would create additional habitat for federally listed species as well as other non-native and native fish species. This measure would be beneficial to aquatic species in general, because it would enhance existing habitat in the river.

3.12.4.3.2 Proposed Kayenta Mine Complex

3.12.4.3.2.1 Operations and Reclamation

Mining would occur in mining units N-9, N-10, N-11 Extension, J-19, J-21, and J-21W under the 3-Unit Operation. New sediment ponds are proposed for N-10, N-11 Extension, and J-21W as part of mining. These three mining units would contain a total of 28 sediment ponds. Under the 2-Unit Operation, mining unit N-10 would be eliminated, which would reduce the number of sediment ponds to 21. Three ephemeral stream segments also are located within two of the mining units: Red Peak Valley Wash in J-19 and Sagebrush Wash and Yucca Flat Wash in J-21W. The ephemeral streams would provide habitat for invertebrate species when water is present. Aquatic species in these ponds would likely consist of water column invertebrates and algae as well as bottom-dwelling invertebrates. No fish are known to occur in these ponds. During mining, the ponds would receive runoff that could contain higher levels of suspended particulates for a short-term basis. It is expected aquatic species in the ponds would be able to tolerate temporary fluctuating levels of suspended sediment. After mining is completed, the ponds would be removed. Mining in J21W would disturb the upper portions of three ephemeral stream segments, which would remove marginal aquatic habitat that is not available on a consistent basis. Low quality habitat would be affected by sediment input during mining and eventually removed as part of reclamation. The effect of mine disturbance would be considered minor because of the types of marginal habitat that would be affected as well as the lack of sport fish or other important aquatic species. The effects of proposed KMC under the 8.1 million tons per year (tpy) and 5.5 million tpy plans generally would be the same for aquatic species because the number of sediment ponds and stream segments are very similar (**Table 3.12-12**).

Table 3.12-12 Impacts to Aquatic Species from Mining Disturbance

Parameter	NGS 3-Unit Operation		NGS 2-Unit Operation	
	Number	Impact Conclusion	Number	Impact Conclusion
Number of Proposed Sediment Ponds	28	Minor effects because sediment input to ponds during mining that are considered low quality aquatic habitat, and marginal amount of aquatic habitat would be permanently removed due to mining.	21	Minor effects because sediment input to ponds during mining that are considered low quality aquatic habitat, and marginal amount of aquatic habitat would be permanently removed due to mining.
Number of Stream Segments within Mining Units	3		3	

3.12.4.3.2.2 Realignment of Navajo Route 41

Surface disturbance within or near the pond located adjacent to the Navajo Route 41 realignment could increase sedimentation and turbidity. The pond contains warmwater fish species. The effects from input

to this pond would range from effects on species behavior and physiological functions to activities such as spawning (Waters 1995), depending on the species. In general, many of the warmwater fish species are tolerant of moderate levels of suspended sediment concentrations on a temporary basis. The duration of sediment effects would be short-term in relation to the short timeframe of road construction. The effect from road construction would be the same for both the 3-Unit Operation and 2-Unit Operation.

Implementation of the applicant-committed environmental protection measures for erosion control as well as state and federal regulatory requirements would serve to reduce impacts to aquatic species in the sediment pond. The impact would be considered minor due to the small amount of sediment input and the marginal quality of aquatic habitat in the ponds.

3.12.4.3.2.3 Emissions and Deposition

The study area for the proposed KMC includes the current Kayenta Mine lease property boundary and proposed expansions. In addition, several locations adjacent but outside of the lease boundary associated with special status species occurrence also are included in the overall study area. A summary of the proposed KMC ERA is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessment and detailed methods and results are provided in the ERA report (Ramboll Environ 2016d). As indicated in Section 3.12.2, the proposed KMC ERA specifically evaluated aquatic biological resources represented by the aquatic community and benthic community only. The aquatic ecological receptors within the study area for the proposed KMC ERA are provided in **Table 3.12-13** along with HQ results and impact conclusions based on two future scenarios. The results consider the contribution from surface disturbance from mining activities associated with coal resource yields of 8.1 million tons per year and 5.5 million tpy, which represent the quantity of coal needed to support NGS 3-Unit Operation and 2-Unit Operation, respectively.

The contribution of the 8.1 million tpy and 5.5 million tpy operations alone would represent a negligible risk to aquatic species at the proposed KMC. For the benthic community potential risk is not expected as all sediment concentrations were below applicable screening levels, as indicated by refined HQs less than 1. Although baseline HQs exceeded 1 for some metals for aquatic community receptors, no effect to aquatic community receptors from baseline metal concentrations are anticipated because observed concentrations are comparable to reference locations (ponds) and the aquatic species that are present in these waterbodies are adapted to the local (natural) hydrogeologic conditions and flow regimes within the proposed KMC ERA study area, which is supported by the conclusion of the proposed KMC ERA (Ramboll Environ 2016d). Potential risk to aquatic biological resources is considered negligible.

3.12.4.3.2.4 Groundwater Pumping

Groundwater modeling was conducted to evaluate the effects of mine well pumping on groundwater and connected surface water sources. Details on the groundwater modeling analysis and results are provided in Section 3.7, Water Resources. The modeling analysis investigated potential changes in groundwater contributions to seven streams including Begashibito, Chinle, Dennebito, Jeddito, Moenkopi, and Polacca washes and Laguna Creek. When comparing the simulated stream baseflows for 1956 to those of 2019, modeling results estimated that the maximum decrease in 2019 simulated baseflow would be less than 0.04 cubic feet per second from all previous project groundwater pumping. Over the projected 2020 through 2057 pumping period, the total 3-Unit Operation pumping would be approximately 1,200 acre-feet/year through 2044 and approximately 100 to 500 acre-feet/year through 2057, which is reduced from previous rates, comprising 20 percent of the historic Peabody Western Coal Company pumping volume. It is important to note that the pumping analysis extends until 2110 so that the maximum drawdown effect is determined. There is a continued effect beyond the end of pumping.

Table 3.12-13 Proposed KMC ERA Potential Impacts on Aquatic Species for All COPECs

Representative Ecological Receptor	Evaluation Medium	8.1 Million tpy KMC Mine Plan		5.5 Million tpy KMC Mine Plan	
		Refined Hazard Quotients	Interpretation	Refined Hazard Quotients)	Interpretation
Aquatic Community	Surface water	>1	Negligible risk to aquatic and benthic communities and fish from COPECs. All reported HQs noted for aquatic community attributable to background conditions.	<1	Negligible risk to aquatic and benthic communities from COPECs. This option would contribute lower level of emissions and deposition.
Benthic Community	Sediment	<1		<1	
Fish	Fish Tissue	<1		<1	

Refer to Section 3.7, Water Resources, for additional detail on the groundwater pumping analysis. Based on the future total withdrawal due to proposed project pumping, no measurable change in 2019 stream baseflows are predicted by the model from pumping for either Proposed Action operation (3-Unit Operation and 2-Unit Operation). Therefore, the proposed KMC pumping for operations from 2020 to 2054 would not result in direct or indirect effects to aquatic habitat or species in streams with connections to groundwater.

Groundwater modeling also was conducted for eight geographical groups of springs to determine if project pumping could affect spring outflows. Details for this analysis are provided in Section 3.7, Water Resources. The model results predicted that spring flow reduction from project groundwater pumping could occur in three of the spring groups (in locales near Tuba City/Moenkopi Wash, Chinle, and Dennehotso). The model analysis estimated small flow reductions from less than 0.001 to about 0.06 gallons per minute. For most spring groups, simulated changes in hydraulic head (water level at the ground surface) generally ranged from zero to about 0.01 or 0.02 feet. Immediately west of Chinle, the head change ranged up to about 0.1 foot. These small changes in conditions at some springs would represent a small loss of aquatic habitat from proposed project pumping. The effect of a potential small reduction of flow input or water levels in a few springs would not be expected to affect invertebrate species that likely inhabit springs.

3.12.4.3.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.12.4.3.3.1 Operations and Maintenance

Activities for the WTS and STS transmission lines would involve inspection and minor maintenance (Category A) and routine maintenance (Category B) within the ROWs. Maintenance activities also would occur if there is equipment failure. Surface disturbance could be substantial only for the Category B activities as a result of equipment use and vehicles. Vegetation clearing would be completed by hand or mechanical methods for the Category A activities; mechanical and herbicide treatment would be used for Category B activities on some row segments. Surface disturbance activities near streams that are crossed by the transmission ROWs could result in sediment or spill risks, which could affect habitat for aquatic species. Sport fish species occur in the larger streams such as the Colorado, Paria, Verde, Muddy, and Virgin rivers.

If O&M activities occur near streams crossed by the transmission line ROWs, aquatic habitat could be affected for a short-term duration as a result of potential sediment input. The extent of the area affected would depend on the type of soil composition and characteristics of the stream or standing waterbody (e.g., flow conditions, channel or waterbody morphology, presence of aquatic vegetation, and gradient). Typically, the extent of downstream movement of sediment is less during low flow conditions and more extensive during high flow conditions. However, the suspended sediment levels would be more diluted under high flow conditions due to the higher water volume.

Increases in sediment entering a stream can adversely affect physiological processes for aquatic species or alter habitat conditions. Suspended sediment can affect physiological functions such as oxygen uptake for aquatic species. Depending on the sediment level and sensitivity of the species, effects can range from reduced health to mortality (Waters 1995). Sediment levels can bury invertebrate and early life stages of fish. Sedimentation can affect fish habitat by covering spawning and rearing areas, thereby reducing the survival of fish embryos and juvenile fish. Excessive sedimentation also can fill in pool habitats and blanket structural cover for fish. Pool habitats provide important depth cover and overwintering habitat.

Vehicle and equipment use adjacent to streams and waterbodies also could pose a risk to aquatic biota from fuel spills or lubricant leaks. If fuel were to reach a waterbody, aquatic species could be exposed to toxic conditions. Impacts could include direct mortalities or reduced health of aquatic organisms. The magnitude of a potential spill would depend on the flow conditions, channel or waterbody morphology and gradient, and the response time and effectiveness of containment and cleanup operations.

Vegetation treatment involving herbicides would not affect aquatic species because chemicals that are nontoxic to fish and amphibian species would be approved for use. All herbicide treatments would be applied as specified by the chemical label, state laws, federal land policies, manuals, and guidelines. In general, BMPs that would minimize effects to aquatic species and their habitats would include selecting herbicides with the least effect on waterbodies, using buffer areas, applying herbicides during calm weather conditions, using spot application versus broadcast application, and focusing on protection of waterbodies containing fish or other aquatic species.

Applicant-committed protection measures would be implemented to avoid or reduce impacts to aquatic habitat and species within the transmission line ROWs. A summary of these measures is provided below. Additional detail is provided in Section 3.13.4.1.

- Biologically sensitive areas identified by the USFWS and other federal land managers would be mapped prior to maintenance activities.
- Standard BMPs involving spill prevention and capture, stormwater runoff control, and erosion control would be implemented during repairs to prevent degradation of surface waters.
- Staging areas for loading and unloading equipment would be located in previously disturbed areas and outside of floodplains and wet areas.

When considering applicant-committed protection measures at all perennial stream crossings by the transmission line ROWs, impacts to aquatic species and habitat would be reduced to a low level for a short-term duration. There would be no direct alteration or loss of habitat for aquatic species. As such, impacts are anticipated to be negligible.

3.12.4.3.4 Project Impact Summary – All Project Components

NGS emissions and deposition by itself would represent a negligible risk to aquatic and benthic communities, fish, and amphibians in the overall study area (NGS Near-field study area, Northeast Gap Region, Southwest Gap Region, and San Juan River), as indicated by refined HQs that are orders of magnitude less than 1. When combining NGS emissions with baseline conditions, there would be a negligible risk to aquatic and benthic communities, amphibians, and most fish species in the study area, based on the HQ values less than 1. There would be potential risk to several non-special status fish species from selenium in the Southwest Gap Region and the San Juan River, based on HQs greater than 1. The impact level would be considered minor for these species because the few species potentially negatively affected and the relative small effect on overall population numbers. There would be negligible risks and effects to aquatic species in the NGS Near-field and Northeast Gap Region for NGS emissions in combination with baseline conditions.

The analysis for the proposed KMC also supported a conclusion of minor risk to aquatic species, primarily as a result of groundwater pumping. Proposed KMC emissions under the 8.1 million tpy and 5.5 million tpy plans would not directly, negatively affect aquatic species. The combination of the two mining plans with baseline conditions indicated that there is a minor effect to aquatic communities due to total concentrations of aluminum and selenium, and dissolved concentrations of cadmium and manganese in surface water that exceed toxicity thresholds protective of aquatic life. Refined HQs exceeded 1 in surface water for aluminum, cadmium, manganese and selenium.

However, aquatic species that occur in the proposed KMC area are generally tolerant of these water and sediment conditions. Project pumping in the proposed KMC would result in small flow reductions, which represents minor effect on aquatic species. It also is important to note that aquatic habitat in the proposed KMC is marginal quality due to the lack of perennial streams and use of sediment ponds as part of sediment control rather than the purpose of developing aquatic resources.

The other project component, transmission systems and communication sites, also supports the conclusion of minor effects on aquatic species. By implementing BMPs, operation and maintenance activities would result in negligible effects on stream water quality or habitat.

3.12.4.3.5 Cumulative Impacts

The following discussion is divided into emission and deposition effects followed by other cumulative effects on aquatic species for the portions of the overall study area related to each of the analysis areas.

3.12.4.3.5.1 Navajo Generating Station Emissions and Deposition

The cumulative impact involving emissions and deposition for aquatic biological resources is the contributions of baseline conditions, NGS stack emissions of trace metals, and other cumulative emission sources that are combined to provide an estimate of tissue concentrations in non-special status species within the various impact study areas. The ERA models were used to provide estimated concentrations of the various COPECs. As indicated in **Table 3.12-14**, emissions from NGS future operation under the Proposed Action would result in deposition of trace metals that contributes a small fraction of the total cumulative tissue concentrations in non-special status fish species. The cumulative effects on aquatic species would vary depending on the ERA analysis areas. Total cumulative emissions in the NGS Near-field and Northeast Gap ERAs indicated negligible risk to aquatic species from mercury and selenium under baseline conditions. Total cumulative emissions of mercury and selenium in the Southwest Gap ERA represent a potential risk to fish species from mercury and selenium. Baseline conditions are the main contributor to metal effects. Total cumulative emissions in the San Juan ERA indicated no potential risks to fish species from mercury or selenium.

Table 3.12-14 Measured Fish Tissue Concentrations (Refined) for Adult Non-Special Status Species and Relative Contribution of NGS Operations to Total Cumulative Sources, 2020 – 2074

COPEC[1]	Baseline[2] (µg/kg wet weight)	NGS Operations (µg/kg wet weight)		Other Cumulative Sources (µg/kg wet weight)	Total Cumulative (µg/kg wet weight)		NGS Operations Percent of Total	
		2 Unit	3-Unit		2 Unit	3-Unit	2 Unit	3-Unit
San Juan River								
Arsenic[3]	210	0.086	0.086	11.4	221.5	221.5	0.04%	0.04%
Mercury[3]	73	0.235	0.235	103.2	176.1	176.1	0.13%	0.13%
Selenium	1,110	0.159	0.235	36.6	1,146.8	1,146.8	0.01%	0.02%
Northeast Gap								
Arsenic	*210*	0.00333	0.00460	0.00110	210.0	210.0	<0.01%	<0.01%
Mercury	129	0.210	0.312	315.7	444.9	445.0	0.05%	0.07%
Selenium	*328*	0.046	0.068	0.0103	328.1	328.1	0.01%	0.02%

Table 3.12-14 Measured Fish Tissue Concentrations (Refined) for Adult Non-Special Status Species and Relative Contribution of NGS Operations to Total Cumulative Sources, 2020 – 2074

COPEC[1]	Baseline[2] (µg/kg wet weight)	NGS Operations (µg/kg wet weight)		Other Cumulative Sources (µg/kg wet weight)	Total Cumulative (µg/kg wet weight)		NGS Operations Percent of Total	
		2 Unit	3-Unit		2 Unit	3-Unit	2 Unit	3-Unit
Southwest Gap								
Arsenic	*238*	0.00333	0.00455	0.00004	238.0	238.0	<0.001%	<0.002%
Mercury	8	0.375	0.562	1236	1244.8	1,245.0	0.03%	0.05%
Selenium	2,350	0.351	0.520	0.004	2,350.4	2,350.5	0.01%	0.02%
NGS Near-field								
Arsenic	*174*	0.0137	0.0185	0.0000058	174.0	174.0	<0.01%	0.01%
Mercury	133	0.175	0.216	42.5	175.7	175.7	0.10%	0.12%
Selenium	*400*	0.149	0.261	0.000052	400.1	400.3	0.04%	0.07%

[1] The critical body residue thresholds applied for adult fish are: arsenic (5,500 µg/kg); mercury (770 µg/kg wet weight); and selenium (2,000 µg/kg wet weight). Concentrations presented are based on the average of the refined tissue concentrations for all fish species for which data were available.

[2] Baseline values presented in italicized text indicate measured tissue data were not available; concentrations were based on modeled results using site-specific uptake factor and surface water concentration.

[3] For the 2-Unit Operation, arsenic and mercury concentrations were less than the 3-Unit Operation but extremely small and below the computational limit of the EPRI (2016) model, and so could not be calculated. Therefore, tissue concentrations for the 3-Unit Operation were conservatively used for the 2-Unit Operation.

NGS Near-field Study Area

The cumulative analysis showed that the combination of NGS 3-Unit Operation and 2-Unit Operation and other cumulative emissions with baseline conditions resulted in refined HQs less than 1 for all COPECs. The cumulative effects analysis showed that refined HQs were one to ten orders of magnitude less than 1, which indicates there would be negligible risk to aquatic species.

Potential risk to amphibians was evaluated qualitatively using water quality criteria protective of aquatic communities and toxicity literature for amphibians (Sparling et al. 2010). The primary food source for amphibians is insects, so exposure to COPECs would be via pathways similar to those evaluated for fish such as trout; a portion of diet also may come from terrestrial sources. When considering the refined concentrations of COPECs, HQs for fish (and aquatic communities) were below 1. There would be negligible risk expected for amphibians under baseline conditions or with the addition of NGS or other cumulative emissions.

In summary, HQs for all of the aquatic receptors and individual species were less than 1 for all metals when using refined values for NGS 3-Unit Operation and 2-Unit Operation in combination with baseline conditions, and other cumulative emissions. The conclusion of the NGS Near-field ERA analysis is that the NGS emissions likely would not represent a potential risk to water-column invertebrates, plants, amphibians, benthic invertebrates, and fish in Lake Powell. No additional lines of evidence were required because all HQs were less than 1.

The slight reduction in Lake Powell elevation from NGS water use would combine with other cumulative actions involving the operation of Lake Powell and water withdrawals from Lake Powell for the Lake Powell Pipeline. Because the NGS water use would represent less than 1 percent of the total cumulative change in Lake Powell volume and Colorado River flows, the project contribution to cumulative effects would be minor. Additional discussion of cumulative effects from the long-term operation of Glen Canyon Dam is provided in the Southwest Gap Region section.

Based on the SECURE Water Act Report (Reclamation 2011) and Reclamation and NPS (2015), climate changes in the Colorado River Basin include the following:

- Colorado River Basin temperature is projected to increase by an average of 5 to 6ºF during the 21st Century;
- Precipitation is expected to increase by 2.1 percent in the upper basin and decline by 1.6 percent in the lower basin;
- Mean annual runoff is projected to decrease by 3.5 to 8.5 percent by 2050; and
- Warmer conditions might cause changes in fisheries habitat, shifts in species geographic ranges, increased water demands for instream ecosystems and thermoelectric power production, increased power demands for municipal uses (including cooling) and increased likelihood of invasive species infestations. Endangered species issues might be exacerbated although warmer water may increase spawning success for native species.

Increases in the water temperature of Colorado River mainstem and its tributaries in Grand Canyon due to climate change could expand the distribution of warmwater-adapted non-native fishes (Eaton and Scheller 1996; Rahel and Olden 2008), which can prey on and compete with native fishes such as endangered humpback chub or disadvantaged coldwater non-native species.

Northeast Gap Region

The cumulative emissions analysis showed that the combination of NGS 3-Unit Operation and 2-Unit Operation with baseline conditions and other cumulative emissions in the Northeast Gap Region resulted in refined HQs less than 1 for all COPECs. The cumulative effects analysis showed that refined HQs were 1 to 6 orders of magnitude less than 1, which indicates there would be negligible risks to aquatic species.

In summary, the Northeast Gap Region analysis indicated that the NGS emissions in combination with baseline conditions and other cumulative emissions would not represent potential risks to water-column invertebrates, plants, amphibians, benthic invertebrates, and fish in the Colorado River upstream of Lake Powell. Hazard quotients for all of the aquatic receptors and individual species receptors were less than 1 for all COPECs when using refined values for baseline conditions in combination with NGS 3-Unit Operation and 2-Unit Operation, and other cumulative emissions. No additional lines of evidence were required because all HQs were less than 1.

Climate change and water diversions in the Upper Colorado Basin would contribute additional effects to aquatic species in the Northeast Gap Region. Currently, the magnitude of global climate change is such that its effect on freshwater fisheries and other aquatic species could easily be masked by or attributed to other anthropogenic causes such as overexploitation, deforestation, and land use (Ficke et al. 2007).

Southwest Gap Region

The cumulative emissions analysis for the Southwest Gap Region showed that the combination of NGS 3-Unit Operation and 2-Unit Operation with other cumulative emissions and baseline conditions in the Southwest Gap Region would represent potential risks to some fish species from selenium and

mercury. The effect would be related to fish critical body residues for mercury and selenium, as indicated by HQs slightly above 1 (highest refined HQ=3) for individual fish species based on measured tissue data, although risk from both metals is considered negligible for risk results based on modeled metals results (mercury adult and early life stage HQs less than 1, and selenium HQ equal to 1) and measured mercury and selenium in fish tissue that consider the fish community as a whole (fish average, HQ equal to 1). The effect to individual species primarily would be caused by baseline conditions with a smaller contribution from other cumulative actions. These HQs indicate that mercury and selenium represent potential risks to some fish species in the Southwest Gap Region.

In summary, the Southwest Gap Region analysis indicated that direct contact with water and sediment under a combination of baseline conditions with NGS and other cumulative emissions would represent negligible risks to water-column invertebrates and plants, benthic invertebrates, amphibians, and most fish species in the Colorado River downstream of Lake Powell. However, mercury and selenium represent potential risks to several non-special status fish species, as indicated by critical body residue HQs exceeding 1 using refined concentrations. This risk is due to baseline conditions and to a lesser extent, other cumulative emissions; NGS emissions would contribute a very small amount to the baseline conditions for mercury and selenium.

Five additional sources have been identified, which have the potential to contribute to cumulative impacts in the Southwest Gap Region. These include climate change, Lake Power operations, non-native fish threats, mining, and other human activities.

Climate Change – The effect of climate change on water temperatures and flows in the Colorado River below Lake Powell is the same as discussed for the Northeast Gap Region.

Lake Powell Operations – The long-term operation of Glen Canyon Dam would result in effects on aquatic communities in the Colorado River (Reclamation and NPS 2015). The Preferred Alternative analyzed in the *Long-term Experimental and Management Plan Draft EIS* would result in slightly higher productivity of benthic invertebrates in the nearshore portion of the lake and in the river below the dam and negligible change in trout population numbers. There would be a decrease in trout recruitment as a result of reduced trout spawning habitat, which would be beneficial to native fish. There would be a potential increase in warmwater non-native fish habitat due to more uniform monthly releases. There also would be a slight increase in average temperature suitability for non-native fish.

Non-native Fish Threat – The implementation of FS-1 as part of the Proposed Action would result in the emergency treatment of warm-water non-native fish species in response to invasions of non-native fish in areas that are negatively affecting the federally listed humpback chub and razorback sucker. The removal of non-native fish at selected sites would result in a reduction in non-native fish numbers. The project effect would be in combination and support eradication and removal efforts for non-native fish species, as defined in the Grand Canyon Fisheries Management Plan (NPS 2013). These cumulative actions would reduce non-native fish numbers at selected sites and benefit native fish in the Colorado River below Lake Powell.

Mining – Based on a renewed interest in uranium, there could be increased mining on lands that drain into the Colorado River, which could increase the amount of uranium, arsenic, and other trace elements in local surface water and groundwater. Aquatic species and habitat most likely to be affected by mining would be those associated with small ephemeral and intermittent streams. A spill of uranium ore or other mining material that reached a perennial stream could affect water quality in the Colorado River. However, the timing and extent of such an accidental spill is unpredictable, and spill control and containment requirements would likely minimize any long-term effect on fish species or their habitat.

Human Activities – The increase in recreation activities involving fishing, boating, camping, and vehicle use would result in angling pressure, non-point pollution, fire threat, introduction of non-native fish species, and potential disturbance to native fishes.

Six additional sources have been identified, which have the potential to contribute to cumulative impacts in the San Juan River area. These include climate change, water diversions, the San Juan River Basin Recovery Implementation Program, Four Corners Power Plant Operations, non-native fish threats, and other human activities.

The cumulative emissions analysis for the San Juan River showed that the combination of the Proposed Action operations and other cumulative emissions with baseline conditions would represent negligible risks to aquatic species from mercury and arsenic. Other cumulative sources added 30 to 90 percent to the mercury dissolved concentrations, although HQs remained below 1 (i.e., negligible risk). The ERA results indicate no potential risks to fish as fish tissue HQs were 1 or below 1 for each species evaluated, with baseline conditions contributing most to total cumulative risk HQs.

Other Cumulative Actions

Climate Change – Climate change may have contributed to additional depletions to the San Juan River. The magnitude and timing of the depletions cannot be predicted with certainty at this time. Several studies project a decrease in stream flow from eight to 45 percent depending on the model used, the time frame, and the methods (Christensen and Lettenmaier 2007; Hoerling et al. 2013; Ray et al. 2008; Seager et al. 2007; Udall 2007). Although the San Juan River was not modeled independent of the entire Colorado River basin in these studies, based on the projections of the Intergovernmental Panel on Climate Change (Christensen et al. 2007) for warmer temperatures and an increase in the frequency of hot extremes and heat waves, it is reasonable to expect that there will be a decrease in stream flow in the future. The analysis of Bluff river flow gaging data indicates an annual reduction of some 9,200 acre-feet per year as a long-term linearized trend in the San Juan River basin. This pattern is consistent with the data for the Colorado River Basin; however, the reductions as a percent of the annual total is double that of the Colorado River (0.44 percent per year, versus 0.22 percent per year for the Colorado River). Although the year-to-year variability is substantial, the ongoing reduction in river flows at this site is clear. Changes in flow patterns or flow volumes could affect key biological activities such as fish spawning and early stage development of eggs and young fish, as well as increasing the colonization of non-native or invasive aquatic species (Garfin et al. 2013). Higher air temperatures also may increase the water temperatures resulting in local range expansions for species that can adapt to higher water temperatures. Higher water temperatures also could cause positive or negative changes in food supply for fish by affecting invertebrate development (Garfin et al. 2013).

Water Diversions – Cumulative water diversions would include coalbed methane development, irrigation/canal withdrawals, livestock grazing, and water use for urban development. Other foreseeable non-federal Colorado San Juan River drainage water storage projects (documented by applications to the Colorado State Engineer) include the Long Hollow Reservoir (proposed capacity of 5,300 acre-feet) and the Dry Gulch Water Storage Project (proposed capacity of 11,000 acre-feet). These projects could contribute to cumulative reductions in Navajo Reservoir River storage, which could influence the volume of water available for release for fish habitat maintenance purposes.

San Juan River Basin Recovery Implementation Program – The San Juan River Basin Recovery Implementation Program was established in 2000 and continues to be implemented for the purpose of assisting in the recovery the Colorado pikeminnow and the razorback sucker while allowing water development and management activities to continue in the San Juan River Basin. Program elements consist of protection of genetic integrity and augment Colorado pikeminnow and razorback sucker populations and their habitat; water quality protection and enhancement; management of native and non-native fish species; and data management. Activities implemented by the San Juan River Basin Recovery Implementation Program provide beneficial effects to aquatic species. One program element, control of non-native fish, has resulted in reduction in numbers of selected fish species at selected sites.

Four Corners Power Plant Operations – Conservation measures implemented for the operation of the Four Corners Power Plant involve habitat improvements and removal of non-native fish species for the

purpose of benefitting Colorado pikeminnow and razorback sucker. These measures would combine with the NGS-KMC Proposed Action and the San Juan River Basin Recovery Implementation Program. Emission and deposition effects from the Four Corners Power Plant were included in the emission and deposition cumulative analysis discussed above.

Non-native Fish Threat – A future threat of non-native fish movement from Lake Powell could occur during wet years when the waterfall barrier is inundated. Striped bass, channel catfish, walleye, and other non-native fish species would move into to the San Juan River and compete with Colorado pikeminnow and razorback sucker for food sources and habitat.

Human Activities – The increase in recreation activities involving fishing, boating, camping, and vehicle use would result in angling pressure, non-point pollution, fire threat, introduction of non-native fish species, and potential disturbance to native fishes.

3.12.4.3.5.2 Proposed Kayenta Mine Complex

The combination of NGS and proposed KMC emissions under the 3-Unit Operation and 2-Unit Operation together with other cumulative emission sources and baseline conditions would represent a potential for impacts to aquatic receptors exposed to total concentrations of aluminum and selenium, and dissolved concentrations of cadmium and manganese in surface water. The potential risk or effect from these metals would be due to baseline conditions which contributes the majority of the risk to aquatic receptors. The proposed future KMC emissions by themselves would not contribute to the potential metal effects on aquatic species.

The overall cumulative effect of groundwater pumping in the N-Aquifer area would be substantial in Polacca and Chinle washes and Laguna Creek with reductions in annual flow of 32 to 48 percent of 2020 rates. These reductions would substantially reduce the amount of aquatic habitat in these washes where surface water is present and cause reductions in the abundance and diversity of aquatic invertebrates and plants. The cumulative effect is caused by pumping activities other than the proposed project. The project would contribute to a future reduction in baseflows in these drainages after 2020 of 0.7 percent to 0.9 percent based on the results of the groundwater modeling.

3.12.4.3.5.3 Transmission Systems and Communication Sites

The minor effect on aquatic species in perennial streams crossed by the Proposed Action would combine with other cumulative actions consisting of the Transwest Express Transmission Project, Southern Nevada Intertie, and the Lake Powell Pipeline for the WTS. These projects are briefly described in Section 3.0 of this EIS. Future road use and recreation activities also could disturb areas adjacent to perennial streams crossed by both the WTS and STS. Total cumulative actions would potentially affect habitat in 11 perennial streams located within the ROWs. The project contribution to overall cumulative impacts would be minor, because activities would be limited to operation and maintenance activities with limited disturbance, and inspection activities would occur infrequently (ordinarily 2 times a year on the WTS and STS).

3.12.4.4 Natural Gas Partial Federal Replacement Alternative

This discussion focuses on the impacts to aquatic species from reducing the power generated at NGS, with consequent reductions in coal production at the Kayenta Mine. There is limited discussion of the alternative site because it is assumed that surface water and perennial waterbodies would be limited when considering the arid characteristics of region.

Under the Natural Gas PFR Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to currently exist, prior disturbance

impacts to aquatic biological resources are not evaluated. Key assumptions about aquatic biological resources related to such an existing site are listed below.

- A combined-cycle natural gas power plant would typically be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Potential surface disturbance could occur at scattered locations within the entire site.
- Perennial waterbodies are assumed to be limited within the alternative site due to the arid characteristics of the general region.
- Natural gas combustion to generate power would not result in deposition to surface water of the trace metal associated with coal combustion under the Proposed Action. This difference in emissions is addressed in the Air Quality resource section.

Impact issues for this PFR Alternative are discussed across the range of NGS unit operations (3-Unit and 2-Unit) and associated alternative power reductions (100 MW and 250 MW) from the least NGS power reduction to the greatest. Reductions in NGS power generation would proportionally reduce the quantity of coal delivered from the Kayenta Mine.

The focus of this discussion is to distinguish differences in impacts within the replacement alternative operational range to provide a basis for comparison with the Proposed Action.

3.12.4.4.1 Navajo Generating Station

The following information describes impacts to aquatic species for the Natural Gas PFR Alternative. This alternative would reduce the power output at NGS for the 3-Unit Operation and 2-Unit Operation by 100 MW to 250 MW due to alternative power purchased from an unknown source at an existing site. Because the site is assumed to be an existing facility, prior disturbance and associated impacts to aquatic species are not evaluated in this EIS.

3.12.4.4.1.1 Emissions and Deposition

The Natural Gas PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 5 and 13 percent for the 3-Unit Operation and 8 and 19 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the reported risk indicator or HQ for aquatic species would be slightly reduced in each of the analysis areas. For example, a comparison of the mercury HQs for the Proposed Action and a modeled 1,400-MW scenario using ERA analyses (Ramboll Environ 2016c) showed a very small reduction in adult sport fish HQ values (**Table 3.12-15**). The 1,400-MW scenario was modeled for the ERA to depict a data point between the values presented for the smallest change (3-Unit Operation/100-MW Replacement) and largest change (2-Unit Operation and 250-MW Replacement). A similar slight reduction in mercury and selenium HQs is shown for other aquatic groups such as water column plants and invertebrates and benthic invertebrates. The point of this comparison is show that there would be a very slight reduction in risk to aquatic species from mercury or selenium under this alternative for both the 3-Unit Operation and 2-Unit Operation. The risk resulting from this Natural Gas PFR Alternative would negligible for the 3-Unit Operation and 2-Unit Operation, which is the same as discussed for the Proposed Action.

The combination of this PFR Alternative with baseline conditions would represent potential risks to several non-special status fish species in the San Juan River and Southwest Gap Region of the Colorado River, because HQs are greater than 1. The potential risk is dictated by baseline fish tissue concentrations from mercury and selenium rather than the project contribution under the PFR

Alternative. Species that would be affected include rainbow trout, fathead minnow, mosquitofish, and redside shiner. The impact level would be considered minor, because the injury effect or potential loss of individuals from mercury or selenium tissue concentrations would be small and within the natural population variability over the 2020 to 2074 timeframe of the project.

Table 3.12-15 Comparison of Mercury Hazard Quotients in Adult Fish Tissue

ERA Analysis Areas / Species	Proposed Action 3-Unit Operation	Proposed Action 2-Unit Operation	1,400-MW ERA-modeled Scenario *
Northeast Gap Region			
Sport fish species (average)	0.0004	0.0003	0.0002
Southwest Gap Region			
Sport fish species (average)	0.0007	0.0005	0.0002
San Juan River			
Sport fish species (average)	0.0002	<0.0002	<0.0002

* Source: Ramboll Environ (2016b,c) ERAs.

3.12.4.4.1.2 Water Use

The effects of NGS water use on aquatic species under this alternative would be negligible, as described for the Proposed Action. Water use would result in very small change in the water levels in Lake Powell and the Colorado River below Glen Canyon Dam.

3.12.4.4.1.3 Effects of Implementation of Fish Conservation Measures

The effects of implementing the conservation measures for federally listed species in the San Juan River and Colorado River below Lake Powell on aquatic species would be the same as described for the Proposed Action. Effects of the FSs are summarized as follows:

- FS-1 (Non-native Fish Management in the Grand Canyon Grand Canyon Area) – This measure would result in reduced numbers for species or groups such as black bullhead, channel catfish, striped bass, trout, and sunfishes in treatment areas. There would be a beneficial effect on native fish species in the treatment areas by reducing predation and competition factors.
- FS-2 (Razorback Sucker Translocations) – This measure could result in minor effects on aquatic species in areas where razorback sucker are translocated as a result in feeding in invertebrates and plant materials.
- FS-4 (Transport of Colorado Pikeminnow and Razorback Sucker above the Waterfall Barrier in the San Juan River) – The transport of these species into areas above the waterfall barrier would result in competition for food sources with other fish species. Razorback sucker would reduce invertebrate numbers and plant debris in areas. Colorado pikeminnow feeds on fish species such as bluehead sucker, flannelmouth sucker, red shiner, sand shiner, and fathead minnow, which could result in reduced numbers at scattered locations. The effects would be minor when considering the mobility of Colorado pikeminnow and razorback sucker and the abundance of food sources.
- FS-5 (Funding Support for a Habitat Improvement in the San Juan River) – This measure would be beneficial to aquatic species in general, because it would enhance existing habitat in the river.

3.12.4.4.2 Proposed Kayenta Mine Complex

The following discusses the impacts to aquatic biological resources if 100 MW to 250 MW of power generation were replaced at NGS by alternative sources and the proposed KMC would mine less coal 8.1 million tpy production (NGS 3-Unit Operation) and 5.5 million tpy production (NGS 2-Unit Operation). Under the Renewable PFR, alternative power would be purchased by Reclamation from an unknown, but existing source. Therefore, prior disturbance impacts to aquatic biological resources are not evaluated.

3.12.4.4.2.1 Operations, Reclamation, and Realignment of Navajo Route 41

The Natural Gas PFR Alternative would result in minor effects on aquatic species and habitat within the proposed KMC as a result of mining and surface disturbance. The effect is considered minor due to the relatively small amount of potential sediment input to sediment ponds and intermittent streams within the mining and road alignment areas. The affected habitat also is considered to be marginal quality because the ponds are not used for the development of fish populations and the intermittent streams lack flow during most of the year.

3.12.4.4.2.2 Emissions and Deposition

Proposed KMC emissions under the Natural Gas PFR Alternative would be reduced as a result of less coal being burned. There would be a slight reduction in risks to aquatic species as indicated by slightly lower HQs. The combination of proposed KMC emissions under this alternative with baseline conditions would represent negligible risks, as although HQs for some metals were greater than 1 for the aquatic community, the observed concentrations were comparable to reference locations (ponds), and the aquatic species that are present in these waterbodies are adapted to the local (natural) hydrogeologic conditions and flow regimes within the proposed KMC ERA study area (Ramboll Environ 2016d). All HQs were less than 1 for benthic community and fish evaluations. The impact level would be considered minor to aquatic and benthic communities, fish, and amphibians based on the low level risks. Effects from this alternative would be the same as described for the Proposed Action.

3.12.4.4.2.3 Groundwater Pumping

Groundwater pumping would be the same as the Proposed Action, with less than 1 percent potential reduction in stream and spring flows. This small change would represent a negligible effect to northern leopard frog habitat.

3.12.4.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.12.4.4.3.1 Operations and Maintenance

There would be negligible impacts to the existing transmission systems and communication sites because no changes in the operations of the WTS, STS, or communications sites would occur due to the implementation of the Natural Gas PFR Alternative. Impacts would be negligible to fish species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. BMPs and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for special status fish species.

3.12.4.4.4 Project Impact Summary

In summary, the Natural Gas PFR Alternative would result in 5 to 19 percent power reduction compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for aquatic species would be

slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The combination of NGS emissions and baseline conditions also would represent negligible risks to aquatic species in the study area, as indicated by the HQs being less than 1 for NGS and baseline emissions. The effects of the Natural Gas PFR Alternative on the aquatic community, benthic invertebrates, and most fish species would be negligible, based on the low number of individuals that could be injured and the small percentage of population numbers potentially affected. There would be potential risks and minor effects on individual fish species in the Southwest Gap Region and San Juan River (e.g., rainbow trout, fathead minnow, mosquitofish, and redside shiner). The impact level would be considered minor because the injury effect or potential loss of individuals from mercury or selenium tissue concentrations would be small and within the natural population variability.

The effects of NGS water use would result in negligible effects on aquatic species in Lake Powell and the Colorado River below Lake Powell.

Implementation of conservation measures for federally listed species would result in both minor negative and beneficial effects on aquatic species in the San Juan River and Colorado River below Lake Powell depending on the measure.

In terms of the analysis for the proposed KMC, there would be negligible effects from metals on aquatic species from overall cumulative emissions. Groundwater pumping for the KMC Proposed Action would contribute less than 0.1 percent reduction in Begashibito Wash flow.

The operation and maintenance of the transmission systems would result in negligible effects on special status species, because access road use and potential vegetation treatment would be short-term in duration and limited in terms of surface disturbance. By following BMPs for operation and maintenance activities in combination with additional conservation measures, effects on species and their habitat would be minimized.

3.12.4.4.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Natural Gas PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to aquatic species. The effects on the special status aquatic species are dictated by baseline fish tissue concentrations and deposition from other cumulative sources. Risks and effects would negligible to aquatic species in the NGS Near-field and Northeast Gap Region of the Colorado River. Risks and effects to water column plants and invertebrates, benthic invertebrates, and most fish species in the Southwest Gap Region of the Colorado River and the San Juan River also would be negligible, as indicated by HQs below 1. There would be potential risks and minor effects on fish species such as rainbow trout, fathead minnow, mosquitofish, and redside shiner. The impact level would be considered minor, because the injury effect or potential loss of individuals from mercury or selenium tissue concentrations would be small and within the natural population variability.

Other cumulative actions that would adversely affect aquatic species and their habitat in the NGS Near-field are in Lake Powell, San Juan River, Northeast Gap Region, and Southwest Gap Region include climate change, water use, urban development, mining, and other human activities such as recreation. These activities and effects on aquatic species would be the same as discussed in the Proposed Action cumulative impact discussions for the San Juan River and humpback chub for the Southwest Gap Region.

Cumulative effects of the Natural Gas PFR Alternative in combination with other cumulative actions in the proposed KMC and transmission system areas would be the same as discussed in the Proposed Action cumulative impacts sections.

3.12.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. Therefore, prior disturbance impacts to aquatic biological resources are not evaluated.

3.12.4.5.1 Navajo Generating Station

3.12.4.5.1.1 Emissions and Deposition

The Renewable PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 3 and 7 percent for the 3-Unit Operation and 4 and 11 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in Project risks from mercury and selenium, the combination of Renewable PFR Alternative with baseline conditions would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas PFR Alternative.

3.12.4.5.1.2 Water Use

The effects of NGS water use on aquatic species under this alternative would be negligible, as described for the Proposed Action. Water use would result in very small change in the water levels in Lake Powell and the Colorado River below Glen Canyon Dam.

3.12.4.5.1.3 Effects of Implementation of Fish Conservation Measures

The effects of implementing the conservation measures for federally listed species in the San Juan River and Colorado River below Lake Powell on aquatic species would be the same as described for the Proposed Action and the Natural Gas PFR Alternative.

3.12.4.5.2 Proposed Kayenta Mine Complex

3.12.4.5.2.1 Operations, Reclamation, and Realignment of Navajo Route 41

The effects of mining disturbance and realignment of Route 41 on aquatic species would be minor, as described for the Proposed Action and Natural Gas PFR Alternative.

3.12.4.5.2.2 Emissions, Deposition, and Groundwater Pumping

The effects of the Renewable PFR Alternative from emissions and groundwater pumping on northern leopard would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on aquatic resources proposed KMC emissions and groundwater pumping in relation to the 8.1 million tpy (3-Unit Operation) and 5.5 million tpy (2-Unit Operation) coal production operations.

3.12.4.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.12.4.5.3.1 Operations and Maintenance

There would be no changes in the operations of the WTS, STS, or communications sites if the Natural Gas PFR Alternative were implemented. Impacts would be negligible aquatic species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. BMPs and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for aquatic species.

3.12.4.5.4 Project Impact Summary – All Project Components

In summary, the Renewable PFR Alternative would result in 3 to 11 percent power reduction compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The effects of the Renewable PFR Alternative in combination with baseline conditions would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. The reason for same effects is that the baseline fish tissue concentrations dictate the risks for aquatic species in all portions of the study area.

3.12.4.5.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Renewable PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to aquatic species.

3.12.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate National Environmental Policy Act process once a facility location is identified.

3.12.4.6.1 Navajo Generating Station

3.12.4.6.1.1 Emissions and Deposition

The Tribal PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 2 and 5 percent for the 3-Unit Operation and 3 and 8 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in Project risks from mercury and selenium, the combination of Tribal PFR

Alternative with baseline conditions would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas PFR Alternative.

3.12.4.6.1.2 Water Use

The effects of NGS water use on aquatic species under this alternative would be negligible, as described for the Proposed Action. Water use would result in very small change in the water levels in Lake Powell and the Colorado River below Glen Canyon Dam.

There is a potential for surface water withdrawal from rivers and streams, or reservoirs for the purpose of providing water source for the project. There is a potential for effects on aquatic species if they occur in water sources used for withdrawals. The location of water sources and the water volumes have not been identified at this time. The potential occurrence of special status species would have to be considered, and withdrawal timing restrictions could be required. During preliminary feasibility studies, options to use groundwater, or municipal water should be considered to avoid direct effects on aquatic communities.

3.12.4.6.1.3 Effects of Implementation of Fish Conservation Measures

The effects of implementing the conservation measures for federally listed species in the San Juan River and Colorado River below Lake Powell on aquatic species would be the same as described for the Proposed Action and the Natural Gas PFR Alternative.

3.12.4.6.2 Proposed Kayenta Mine Complex

3.12.4.6.2.1 Operations, Reclamation, and Realignment of Navajo Route 41

The effects of mining disturbance and realignment of Route 41 on aquatic species would be minor, as described for the Proposed Action and Natural Gas PFR Alternative.

3.12.4.6.2.2 Emission, Deposition, and Groundwater Pumping

The effects of the Renewable PFR Alternative from emissions and groundwater pumping on aquatic species would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on aquatic resources proposed KMC emissions and groundwater pumping in relation to the 8.1 million tpy (3-Unit Operation) and 5.5 million tpy (2-Unit Operation) coal production operations.

3.12.4.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.12.4.6.3.1 Operations and Maintenance

There would be negligible impacts to the existing transmission systems and communication sites because no changes in the operations of the WTS, STS, or communications sites would occur due to the implementation of this alternative. Additional disturbance could occur to an unknown number of acres related to connecting a new photovoltaic generation site on tribal land to the existing transmission system and would be evaluated in a subsequent National Environmental Policy Act action. Impacts would be negligible to aquatic species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. BMPs and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for special status fish species.

3.12.4.6.4 Project Impact Summary – All Project Components

In summary, the Tribal PFR Alternative would result in 2 to 8 percent power reduction compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area.

As a result of lower deposition of metals, the risk indicator or HQ for aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The effects of the Tribal PFR Alternative in combination with baseline conditions would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. The reason for same effects is that the baseline conditions dictate the risks for aquatic species in all portions of the study area.

3.12.4.6.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Tribal PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to aquatic species.

3.12.4.7 No Action

3.12.4.7.1 Navajo Generating Station

Emissions under the No Action Alternative would be represented by the existing conditions plus the cumulative source impacts over the same time period (through 2074), but with the exclusion of current NGS emissions. The elimination of current NGS emissions would subtract a very small emission level from existing conditions. Basically, the effect of No Action emissions on aquatic species would be the same as described in the Near-field, Gap Regions, and San Juan River ERAs for baseline conditions plus other cumulative sources (Ramboll Environ 2016a,b,c). The No Action emission effects on aquatic species within each of the ERA study areas are summarized below.

- NGS Near-field and Northeast Gap Region – There would be no effects to aquatic community, benthic community and fish, as indicated by refined HQs being 1 or less than 1 for all COPECs.
- Southwest Gap Region – There would be potential adverse effects to fish species from mercury and selenium, as indicated by HQs exceeding 1. Hazard quotient results for the aquatic community indicated that there would be no effect. In addition, there would be no NGS water withdrawals and minor flow changes in the Colorado River below Lake Powell. In addition, no conservation measures as part of the NGS-KMC Project would be implemented for humpback chub and razorback sucker in the Colorado River below Glen Canyon Dam. As a result, there would be no effects on non-native fish species from control efforts.
- San Juan River – There would be no effects from mercury or selenium on the aquatic community and sediment community. However, there would be a potential effect from selenium exposure for some individual fish species such as longnose dace, red shiner, carp, and mosquitofish, as indicated by HQs equal to 1, although such effects are considered negligible as HQs are less than 1 for the fish community as whole. No effects were indicated for sport fish species under the No Action Alternative. In addition, no conservation measures as part of the NGS-KMC Project would be implemented for Colorado pikeminnow and razorback sucker in the San Juan River. As a result, there would be no effects on non-native fish species from control efforts or habitat enhancements.

Under the No Action Alternative, there would be a reduction in water usage and pumping of up to 40,000 acre-feet per year in Lake Powell due to the subtraction of NGS operations. This reduction would provide additional aquatic habitat in Lake Powell, which would be beneficial to aquatic species. The increase in habitat would be relatively small, but most evident in bays where shallower water is present.

3.12.4.7.2 Proposed Kayenta Mine Complex

The No Action Alternative would consist of existing activities within the proposed KMC with the exclusion of mining and emissions from the facilities and their associated activities, as well as proposed future

mine dewatering. Under the No Action Alternative there would be about 165 ponds and internal draining impoundments at the proposed KMC after 2019; 115 of these would be removed by reclamation, leaving the 50 permanent impoundments at proposed KMC. However, existing ponds located within the reclamation area do not support fish, so the loss of habitat would not adversely affect aquatic resources. The No Action Alternative also consists of ongoing groundwater pumping of community wells, pumping from Peabody Western Coal Company wells to complete reclamation activities and to supply local resident and Manymules water needs, and the remnant effects of previous Peabody Western Coal Company pumping. Pumping under the No Action Alternative would result in flow reductions relative to 2020 flow rates of approximately 18 to 47 percent in Polacca, Chinle, and Begashibito washes and Laguna Creek, primarily caused by community pumping. No future mine dewatering from the proposed KMC facilities would occur under the No Action Alternative. The effect of emissions from the No Action Alternative would be the same as baseline conditions combined with other cumulative sources analyzed in the proposed KMC ERA. Emissions under the No Action Alternative would subtract the very small contribution from the proposed KMC facilities. Because the elimination of emission effects from the proposed KMC facilities would be very small, the resulting metal concentrations in waterbodies would be nearly the same as baseline conditions in combination with other cumulative sources characterized in the proposed KMC ERA (Ramboll Environ 2016d).

3.12.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

Under the No Action Alternative, the WTS and STS would continue to be operated and maintained in terms of infrastructure maintenance, vegetation management, and the use and maintenance of access roads. The impacts of these activities on perennial streams that are near or crossed by the transmission line ROWs generally would be the same as discussed for the Proposed Action. The continuing ROW operator would be responsible for the operation and maintenance activities.

3.12.4.7.4 No Action Impact Summary – All Project Components

In summary, the No Action Alternative would result in emissions resulting from existing conditions plus the cumulative source impacts over the same time period (through 2074), but with the exclusion of current NGS emissions. The elimination of current NGS emissions would subtract a very small emission level from existing conditions. There would be no effects of No Action emissions on plant and invertebrate communities in any of the ERA analysis areas. However, there would be a low effect of mercury and selenium in the Southwest Gap Region and selenium in the San Juan River on some non-sport fish species. Because the elimination of emission effects from the proposed KMC facilities would be very small, the resulting metal concentrations in waterbodies would be nearly the same as baseline conditions in combination with other cumulative sources characterized in the proposed KMC ERA. Pumping under the No Action Alternative would result in flow reductions of approximately 18 to 47 percent relative to 2020 rates in Polacca, Chinle, and Begashibito washes and Laguna Creek, which would reduce aquatic habitat and invertebrate and plant abundance when water is present. These reductions are primarily caused by local community pumping. No future mine dewatering from the proposed KMC facilities would occur under the No Action Alternative. The impacts of No Action on

perennial streams and aquatic species that are near or crossed by the transmission line ROWs generally would be the same as discussed for the Proposed Action.

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Section 3.13

Special Status Aquatic Resources

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
AGFD	Arizona Game and Fish Department
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CBR	critical body residue
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPEC	chemical of potential ecological concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
mg/kg	millogram/kilogram
MW	megawatt
N-Aquifer	Navajo Aquifer
NAC	Nevada Administrative Code
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
NPS	National Park Service
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less

$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PFR	Partial Federal Replacement
PIT	Passive Integrated Transponder
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
U.S.	United States
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WTS	Western Transmission System

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3.13 Special Status Aquatic Species

3.13.1 Regulatory Framework

Laws, regulations, and policies that directly influence management decisions for the special status aquatic species within the project study area primarily are implemented by the U.S. Fish and Wildlife Service (USFWS), Navajo Nation, Hopi Tribe, Bureau of Land Management (BLM), U.S. Forest Service, and state fish and wildlife agencies (Arizona, Nevada, New Mexico, and Utah). A summary of prominent laws, regulations, directives, and agreements relevant to the Proposed Action are listed in **Table 3.13-1**.

Table 3.13-1 Relevant Statutes, Regulations, and Policies for Aquatic Species

Statutes, Regulations, or Policies	Summary
Arizona Game and Fish Title 17, Game and Fish, Wildlife Habitat Protection, Aquatic Invasive Species	The State of Arizona's Title 17 – Game and Fish Revised Statutes establish policies and programs for the management, preservation, and harvest of wildlife including aquatic species. Policies directed at managing and conserving aquatic species include invasive species programs and lists, funding/fiscal provisions, rules regarding taking and handling wildlife, and other prohibitions.
Utah Code 23-14-1and Rule R657-48	Section 23-14-1 of the Utah State Code directs the Utah Division of Wildlife Resources to protect, propagate, manage, conserve, and distribute protected wildlife throughout the state. This statute also authorizes Utah Division of Wildlife Resources to identify and delineate crucial seasonal wildlife habitats. R657-48 establishes wildlife species of concern and habitat designation; defines the Utah Sensitive Species List; defines the procedure for the designation of wildlife species of concern as part of the a process to preclude listing under the Endangered Species Act (ESA); and defines the procedure for review, identification and analysis of wildlife habitat designation and management recommendations relating to significant land use development projects.
New Mexico Title 19 – Natural Resources and Wildlife, Chapter 33, Endangered and Protected Species	Rule 19 New Mexico Administrative Code 33.2 provides protection for species classified as threatened and endangered by the New Mexico Game Commission through rules involving the removal, capture or destruction of their habitat. Rule 19 New Mexico Administrative Code 33.6 provides a list of New Mexico threatened and endangered species.
Nevada Administrative Code (NAC) NAC 503.072, NAC 503.074, and NAC 503.075.	NAC classifies protected, endangered, and threatened fish species in Nevada. NAC 503.072 classifies injurious aquatic species. NAC 503.074 classifies aquatic invasive species. NAC 503.075 classifies amphibians as game, protected, threatened, sensitive, endangered, and unprotected.
Surface Mining Control and Reclamation Act of 1977	The Surface Mining Control and Reclamation Act of 1977 establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement. The law establishes minimum requirements for all coal surface mining on Federal and State lands, including exploration activities and the surface effects of underground mining. Mine operators are required to minimize disturbance and adverse impacts to biological resources and achieve enhancement of these resources where practicable.
Endangered Species Act of 1973	The ESA provides broad protection for species of fish, wildlife, and plants listed as threatened or endangered by the USFWS. Provisions are made for listing species, as well as for recovery plans, and the designation of critical habitat for listed species. All federal agencies in consultation with the USFWS also must use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species. All federal agencies, in consultation with, and assistance of, the USFWS must ensure any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of an endangered,

Table 3.13-1 Relevant Statutes, Regulations, and Policies for Aquatic Species

Statutes, Regulations, or Policies	Summary
	threatened, or proposed listed species, or result in destruction or adverse modification of critical habitat of a species. Agencies are required to use the best scientific and commercial data available to fulfill this objective.
Navajo Nation Endangered Species compliance: Navajo Nation Biological Resource Land Use Clearance Policies and Procedures, Code RCS-44-08 and RCS-41-08 [1]	RCS-44-08: The purpose of the Navajo Nation Biological Resource Land Use Clearance Policies and Procedures is to assist the Navajo Nation government and chapters to ensure compliance with federal and Navajo laws which protect wildlife resources, including plants, and their habitat resulting in an expedited land use clearance process. The Navajo Nation Biological Resource Land Use Clearance Policies and Procedures assists in directing development to areas where impacts to wildlife and/or their habitat will be less significant. Development includes but is not limited to human activities that result in permanent structures, temporary, long-term, or repetitive disturbance to wildlife or habitat as defined by Navajo Nation Code 17 Navajo Nation Code 500 et. section. RCS-41-08: establishes the Navajo Endangered Species List, last updated on September 10, 2008.
BLM Sensitive Species Management (BLM Manual 6840)	BLM Manual 6840 contains BLM's special status species management policy and guidance for the conservation of special status species and their habitats. Under this policy, special status species include animal and plant species listed as threatened or endangered, proposed for listing, and candidates for listing under the provisions of the ESA; those listed as sensitive species by a state; and those listed by the BLM State Director as sensitive. The objective of this policy is to ensure actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list any special status species, under provisions of the ESA.
Sensitive Species Lists for Arizona, Utah, New Mexico, and Nevada	AZ-2011-005 identifies BLM Sensitive plant and animal species on BLM-administered lands in Arizona. By Administrative Rule R657-48, the Utah Division of Wildlife Resource maintains the *Utah Sensitive Species List* which contains wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place. Additional species are added to the list as "wildlife species of concern" where there is credible scientific evidence to substantiate a threat to continued viability of populations of such species. Nevada Division of Wildlife's listed species are "protected" under the authority of NAC 501.100 - 503.104 (wildlife). New Mexico Department of Game and Fish listed species are protected under Rule 19 NMAC 33.6.
Forest Service Sensitive Species Compliance	Section 2670 of the U.S. Forest Service Manual directs each Regional Forester to designate sensitive species on lands managed by the U.S. Forest Service. A sensitive species is defined as: a "plant or animal species identified by a Regional Forester for which population viability is a concern, as evidenced by a significant current or predicted downward trend in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution." The National Forest Management Act requires the U.S. Forest Service to identify certain vertebrate and/or invertebrate species as Management Indicator Species. Management Indicator Species are used to establish forest plan objectives for important wildlife and fish habitats, and to estimate the effects of forest plans and projects on fish and wildlife populations.

[1] Applies to the Proposed KMC only. Under the 1969 Lease, the Navajo Nation agreed not to regulate the construction, maintenance or operation of NGS facilities, including the BM&LP Railroad, as well as the WTS and STS on Navajo Nation land.

3.13.2 Study Areas

3.13.2.1 Proposed Action and Action Alternatives

The study area for special status aquatic species was determined by relating species occurrences to the three project components, Navajo Generating Station (NGS), proposed Kayenta Mine Complex (KMC), and the Western and Southern transmission line systems (WTS and STS) (**Figures 3.13-1** and **3.13-2**). The NGS portion of the study area was further divided geographically into three deposition impact areas with each focused on special status aquatic species occurrence and habitat parameters within the ecological risk assessments (ERAs) conducted for this Environmental Impact Statement (EIS) (Ramboll Environ 2016a,b,c). The areas were delineated based on an iterative process during the development of the risk assessments and in coordination with the USFWS and cooperating agencies. Coordination for the emission study areas was completed as part of the process for defining sampling locations, data review, and methodologies for the ERAs (Ramboll Environ 2016a,b,c,d).

As discussed in Section 3.0.3, Ecological and Human Health Risk Assessments, three ERAs were conducted to analyze the effects of NGS emissions and the resulting deposition of chemicals on ecological receptors in Lake Powell (NGS Near-field ERA), the Colorado River (Northeast and Southwest Gap Regions), and the San Juan River (San Juan River ERA). The NGS Near-field study area consists of a 20-kilometer (km) radius from the NGS Facility that overlaps with a portion of Lake Powell. The Northeast Gap Region extends from Lake Powell upstream to the confluence with the Green River. The Southwest Gap Region extends from the Glen Canyon Dam downstream to the confluence with the Little Colorado River. The San Juan River study area extends from the San Juan River arm in Lake Powell upstream in the San Juan River to the Farmington area.

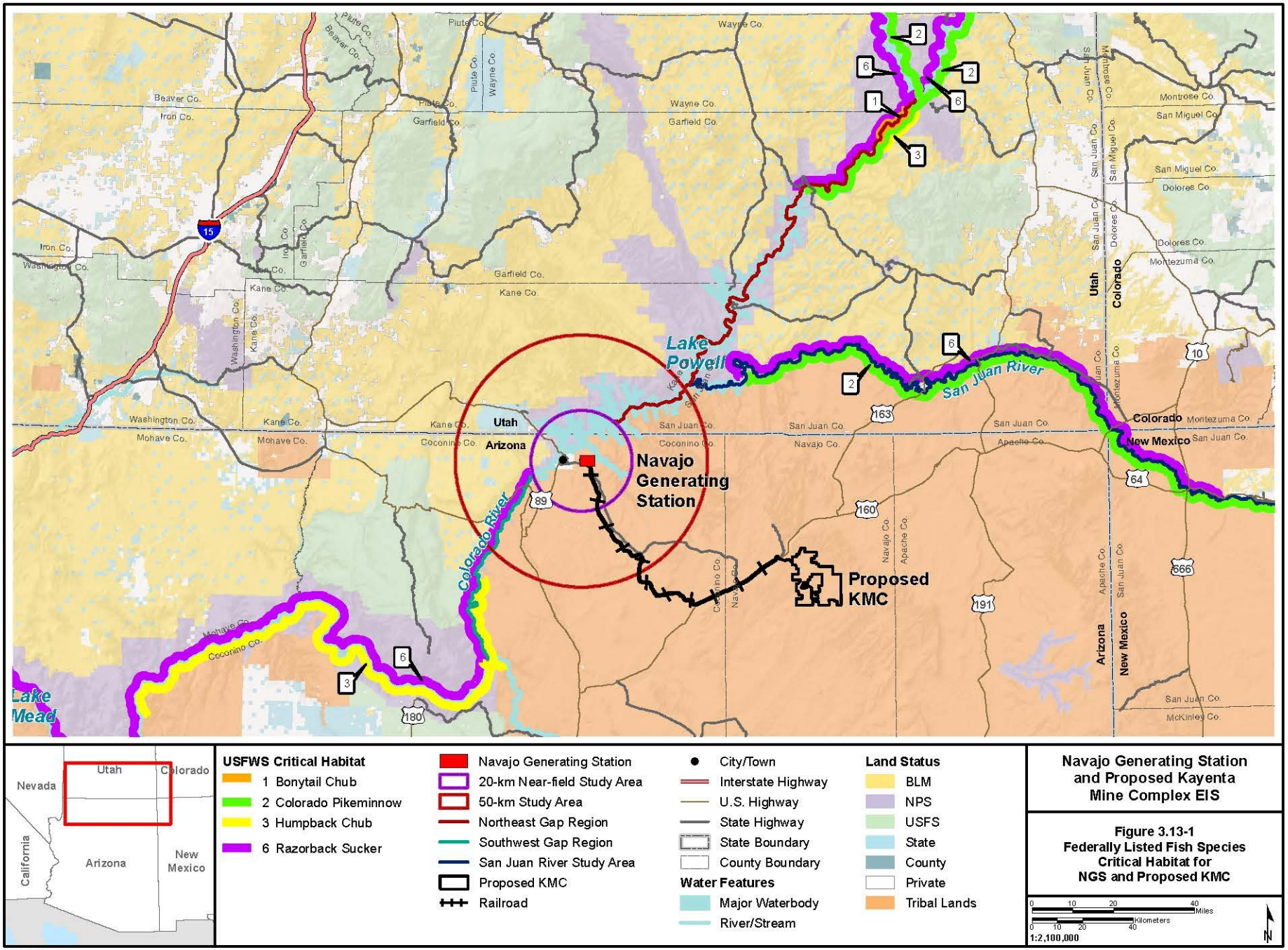
Due to lack of perennial aquatic habitat, no special status aquatic species occur in the study area for the Black Mesa & Lake Powell (BM&LP) Railroad.

The proposed KMC portion of the project study area included the intermittent drainages within the proposed KMC boundary and Navajo Aquifer (N-Aquifer) groundwater study area (**Figure 3.7-3** in Water Resources). An ERA also was conducted for the proposed KMC, with the study area consisting of the proposed KMC boundary plus areas related to the occurrence of federally listed species, Navajo sedge and Mexican spotted owl (Ramboll Environ 2016d). These species are discussed in Sections 3.9 and 3.11, respectively.

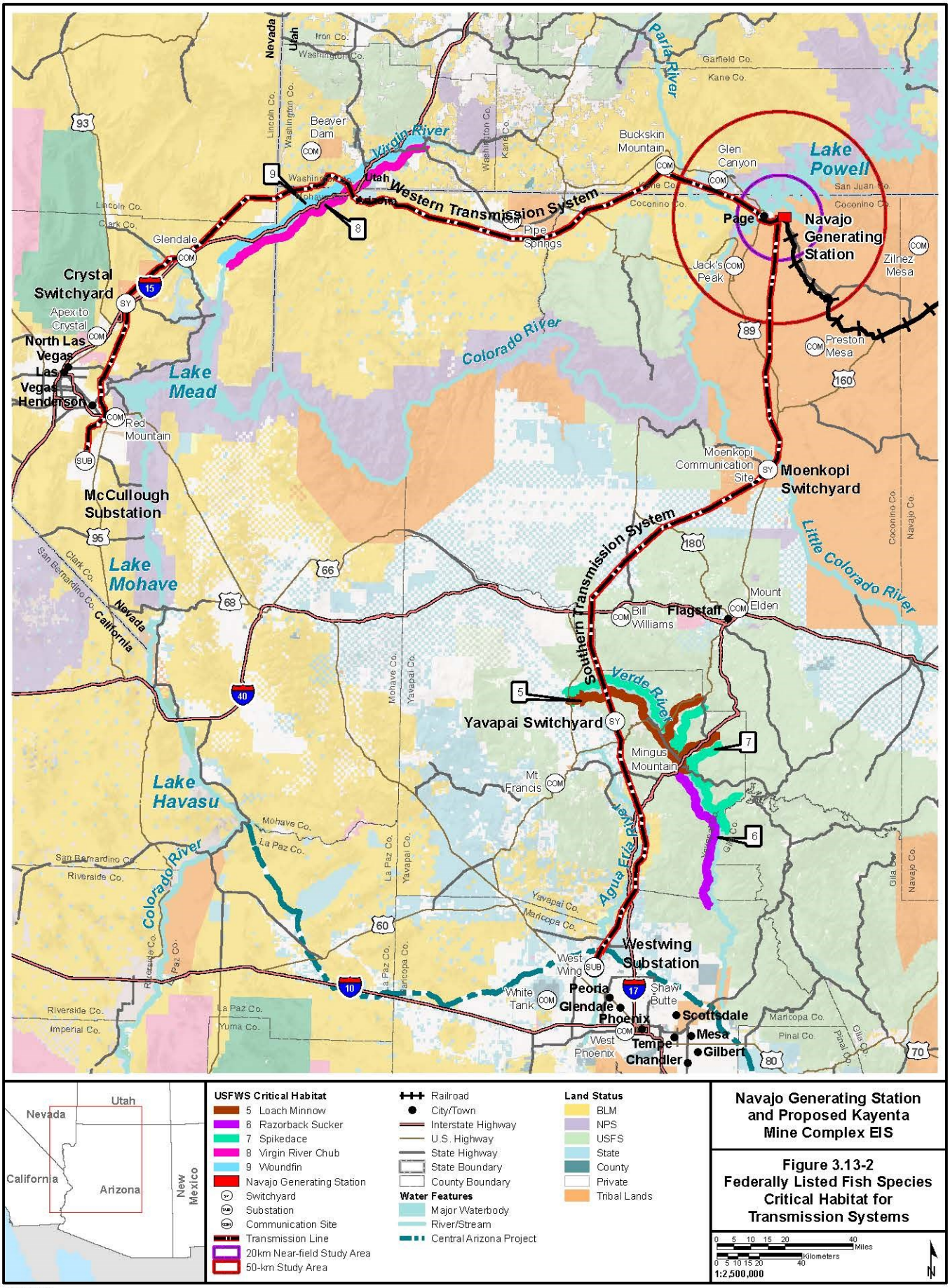
The portion of the project study area involving transmission lines consisted of perennial streams that are crossed by the WTS and STS rights-of-way (ROWs), which potentially support special status aquatic species and their habitat (**Figure 3.13-2**). The study area for the transmission systems included the ROW and an additional 500-foot width on either side of the ROW to cover access roads. The streams included the Verde and Aqua Fria rivers for the STS ROW and the Colorado, Paria, Virgin, and Muddy rivers and Meadow Valley and Gypsum washes for the WTS ROW. No special status aquatic species occur within the transmission line communication sites.

3.13.2.2 Cumulative Effects

The cumulative effects study area for the NGS project component is expanded to include the effects of activities in the Upper Colorado River Basin and the upstream portion of the San Juan River to the Navajo Dam. The portion of the Colorado River below Glen Canyon Dam is extended downstream to the inflow to Lake Mead.


Navajo Generating Station
Proposed KMC
Lake Powell
Lake Mead
San Juan River
Colorado River
Utah
Arizona
Colorado
New Mexico
Nevada
California
USFWS Critical Habitat
1 Bonytail Chub
2 Colorado Pikeminnow
3 Humpback Chub
6 Razorback Sucker
Navajo Generating Station
20-km Near-field Study Area
50-km Study Area
Northeast Gap Region
Southwest Gap Region
San Juan River Study Area
Proposed KMC
Railroad
City/Town
Interstate Highway
U.S. Highway
State Highway
State Boundary
County Boundary
Water Features
Major Waterbody
River/Stream
Land Status
BLM
NPS
USFS
State
County
Private
Tribal Lands
Navajo Generating Station and Proposed Kayenta Mine Complex EIS
Figure 3.13-1
Federally Listed Fish Species Critical Habitat for NGS and Proposed KMC
Miles
Kilometers
1:2,100,000
N

7/20/2016



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.13-2 Federally Listed Fish Species Critical Habitat for Transmission Systems

X:\0Projects\SRP_NGS_KMC_60288037\FIGs\DOC\EIS\1_PDEIS\Letter_Sized\Special\StatusSpecies\FIG_03_13_02_CritHab4FedListSpp_TLines.mxd

7/20/2016

3.13.2.3 Ecological Risk Assessment - Role in Assessing Baseline Risk and Environmental Consequences

The potential for risk to special status aquatic species was evaluated under current conditions (referred to as baseline or baseline conditions), and potential future conditions that considers the deposition of chemicals from NGS emissions. The evaluation of special status aquatic species initially included a screening of areas potentially affected by NGS and KMC emissions. The analysis focused those study areas where such species are known or expected to occur. Specific evaluation of risk to special status aquatic species was conducted only for the NGS Near-field, Gap Regions, and San Juan River study areas and KMC area (Ramboll Environ 2016a,b,c,d).The ERAs were intended to (1) investigate whether the combination of site-specific exposure scenarios and chemicals of potential ecological concern (COPECs) may pose current or potential future risks to ecological receptors, and (2) provide information necessary to support the EIS process. ERA involves four key components: problem formulation, analysis (exposure/toxicity assessment), risk characterization, and uncertainty analysis. Section 3.0.3 provides an overview of the ERA process and key risk assessment concepts. **Appendix 3RA** provides further detail of the process and a summary of the ERAs conducted for the project. The reader is directed to each of the ERAs (Ramboll Environ 2016a,b,c) for specific detail and rationale for the data evaluated and analyses conducted regarding special status aquatic species.

The outcome of the problem formulations (conceptual site model) for the ERAs identified the known or expected occurrence of four federally listed fish species (bonytail, Colorado pikeminnow, humpback chub, and razorback sucker) within one or more of the three NGS study areas (Ramboll Environ 2016a,b,c). One special status species, northern leopard frog, was analyzed for the KMC area (Ramboll Environ 2016d). Ecological receptors are described in the context of assessment endpoints (explicit expression of the environmental value to be protected), and measures of effect (ecological characteristic(s) that quantify the assessment endpoint) as defined by the U.S. Environmental Protection Agency (USEPA) guidance (USEPA 1997). The following assessment endpoint and measures of effect were defined for special status fish in each of defined study areas for the project (NGS Near-field, Gap Regions, and San Juan River study areas):

- Special Status Species Fish
  - Assessment Endpoint: protection and maintenance of individual fish within the defined study area.
  - Measures of Effect: comparison of measured (based on available literature) and/or modeled fish tissue concentrations to no effect tissue-based critical body residue (CBR) thresholds identified in available literature.

The Analysis/Exposure Assessment (USEPA 1998, 1997) phase of the NGS ERAs (Ramboll Environ 2016a,b,c,) presents the assumptions and parameters used to develop estimates of exposure, which specifically include determination of environmental concentrations to which a given receptor may be exposed (exposure point concentrations). For special status fish species, exposure is based on the integration of all exposure routes including exposure via respiration (gills), food intake and direct contact with aquatic media. To the extent possible exposure (tissue) data obtained for a given special status fish species was used. However, these data are generally limited and so in the absence of such data, data for surrogate fish species were used. Surrogates were selected during development of the ERAs and were based on similarity of life history factors, most importantly habitat preference, diet, and feeding strategy. The specific surrogates are defined subsequently in the context of each specific study area in Section 3.13.4, as the use of species as surrogates was constrained by the availability of data and so may differ between study areas.

The Analysis/Effects Assessment (USEPA 1998, 1997) phase of the ERAs compiles available toxicity information and correlates receptor exposure to the potential for an undesirable effect to organism

health, where a medium-specific screening benchmark or CBR is identified and subsequently used to characterize the potential for risk. The quantitative metric used to characterize risk, conducted within the context of the Risk Characterization phase, is the Hazard Quotient (HQ). Information regarding how HQs are calculated, and interpretation of the HQ was summarized in Section 3.0.3 and is detailed in **Appendix 3RA** and the individual ERA reports (Ramboll Environ 2016a,b,c,d).

The HQ used for evaluation of special status fish was based on comparison of literature-derived fish tissue concentrations (whole body concentrations) from studies conducted in study area waterbodies to established CBRs protective of fish health. Baseline mercury-tissue based HQs were estimated for special status fish using available fish tissue data from the literature and the 0.2 milligram/kilogram (mg/kg) wet weight (whole body) no effect threshold (Beckvar et al. 2005). This study identified a whole body threshold effect level to be protective of juvenile and adult fish, based primarily on sublethal effects such as growth, reproduction, development, and behavior. Below this threshold, adverse effects in fish are unlikely. Dillon et al. (2010) reported mercury dose-response curves for early life stage and juvenile or adult fish, based on published tissue-residue toxicity studies, including those considered by Beckvar et al. (2005). Dillon et al. (2010) identified 0.77 mg/kg wet weight as the lowest observable effect level.

As described in Section 3.0.3, HQs were calculated for each NGS operational scenario to account for current and potential future conditions: baseline, 3-Unit Operation, 2-Unit Operation, 2-Unit Operation with Partial Federal Replacement (PFR), and other cumulative sources. Given the number of scenarios evaluated, all COPECs and receptors were carried forward throughout the ERA process, such that a "total cumulative sources" risk estimate could be determined that incorporates baseline, a given NGS production option (deposition-related contributions) and other cumulative sources (e.g., baseline + 3-Unit Operation + OCS) (Ramboll Environ 2016a,b,c). For each of these scenarios, HQs were developed for the maximum, refined, and average exposure scenarios for all receptors. For evaluation of special status species, both maximum and refined HQs were used. While refined HQs are considered to be a realistic estimate of exposure, the ERA convention is to include maximum concentrations as a highly conservative measure when evaluating potential risk to individuals. The refined HQ results are based on comparison of the exposure point concentration represented by the 95 percent upper confidence limit on the arithmetic average wherever it could be calculated, as described in Section 3.0.3. Use of this value generally represents a more realistic estimate of exposure versus use of a maximum concentration and resulting maximum HQ, as ecological receptors are unlikely to be exposed to the highest level of all COPECs at all times (an unrealistic and highly conservative assumption). Although both maximum and refined HQs are provided, the environmental consequences section for each species focuses on the refined HQs as an indicator of risk to special status species. Section 3.0.3 provides an overview of the interpretation of HQs.

3.13.3 Affected Environment

3.13.3.1 Navajo Generating Station

3.13.3.1.1 Habitat

Habitats for special status aquatic species for the NGS portion of the project study area consist of Lake Powell, the Colorado River above Lake Powell to the Green River confluence, the Colorado River below Glen Canyon Dan downstream to the Little Colorado River confluence, and San Juan River. Descriptions of Lake Powell and the riverine habitats associated with the Northeast and Southwest Gap Regions of the Colorado River and the San Juan River are provided in Section 3.12.1.1, Aquatic Resources/ Analysis Areas.

3.13.3.1.2 Federally Listed, Candidate, and Proposed Aquatic Species

Five federally listed aquatic species occur in portions of the NGS Near-field study area (i.e., the 20-km deposition area), Gap Regions, and San Juan River from Lake Powell to the Farmington area. Federally listed species include four fish species (bonytail, Colorado pikeminnow, humpback chub, and razorback

sucker) and one snail (Kanab ambersnail). All of these species also are considered Arizona Species of Greatest Conservation Need. The occurrence of these species and their critical habitat is listed in **Table 3.13-2**. Critical habitat for the listed fish species is shown in **Figure 3.13-1**. The following information provides a summary of their occurrence, critical habitat, habitat preferences, life history, listing status, recovery efforts, and factors affecting their environment and critical habitat.

Table 3.13-2 Federally Listed Fish Species Occurrence in the Lake Powell, Colorado River Gap Regions, and Lower San Juan River Study Areas

Species	Federal Status	Lake Powell Near the Colorado River Inflow	Lake Powell Near San Juan River Inflow	Colorado River Above Lake Powell Northeast Gap Region	Colorado River Below Lake Powell Southwest Gap Region	San Juan River
Bonytail	Endangered	X[1]		X (CH)[2]		
Colorado pikeminnow	Endangered	X[1]	X	X (CH)		X (CH)
Humpback chub	Endangered			X	X (CH)	
Razorback sucker	Endangered	X	X	X (CH)	X (CH)	X (CH)
Kanab ambersnail	Endangered				X	

[1] Rare occurrence in Lake Powell.

[2] CH = Designated Critical Habitat.

3.13.3.1.2.1 Bonytail

Species Occurrence

Bonytail were once widespread in the large rivers of the Colorado River Basin (USFWS 2002a). Currently, no self-sustaining populations of bonytail exist in the wild and very few individuals have been captured throughout the Upper and Lower River Colorado basins (USFWS 2002a). The total adult population size is unknown, but it is considered to be small due to the limited numbers that have been collected. Significant numbers of bonytail were last captured in the Upper Colorado River Basin (lower Yampa and Green rivers) in the 1960s and early 1970s shortly after the closure of Flaming Gorge Dam (NatureServe 2013a). Since 1977, only 11 bonytail have been captured (USFWS 2002a). Captures of wild bonytail have occurred in three lakes in the lower basin (Powell, Mohave, and Havasu), but the numbers were less than 50 total fish (USFWS 2002a). Today bonytail are considered functionally extirpated from the lower Colorado River. Bonytail stocking has occurred in the upper and lower basins, but self-sustaining populations have not been established (USFWS 2012a). In the Upper Colorado River Basin, a recovery goal of establishing a self-sustaining population of 4,400 adults over a 5-year period in the Green River subbasin has been set, but the criterion has not been met (USFWS 2012a). One of the recovery goals in the Lower Colorado River Basin is to establish two self-sustaining populations where naturally produced fish exceed the mean annual adult mortality. Abundance information for the portions of the action area analyzed for bonytail is provided below.

Lake Powell

The occurrence of bonytail in Lake Powell is rare. Four fish were captured in Lake Powell at the Colorado River inflow during 2014 (Francis 2014). The fish were stocked in the Colorado and San Rafael

rivers and traveled approximately 143 to 277 miles, respectively, to the inflow area. Bonytail have not been detected in the 20-km Near-field ERA analysis area including the lower portion of Lake Powell near the NGS pump station and intakes. The Colorado River inflow area to Lake Powell is considered part of the Northeast Gap area, since the Near-field ERA analysis area does not extend to the arms of the lake.

Northeast Gap Region

Bonytail occurs in the Cataract Canyon portion of the Colorado River, which also has been designated as critical habitat for the species. Population estimates in 2003 indicated a population size of 264 individuals in Cataract Canyon (Badame 2008). All bonytail were stocked fish that originated from the Green River.

Life History and Habitat Association

The general types of habitat used by bonytail consist of mainstem riverine areas and impoundments in the Colorado River system. Deep pools and eddies with slow to fast currents are characteristic of the riverine habitat (Kaeding et al. 1986). Based on five specimens captured in the Upper Colorado Basin, four were captured in deep, swift, rocky canyon areas (i.e., Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid) (USFWS 2002a). The fifth specimen was collected in Lake Powell. All fish collected in the Lower Colorado River Basin since 1974 were in reservoir habitats. Critical habitat includes river channels and flooded, ponded, or inundated riverine areas, especially where competition from non-native fishes is absent or reduced (USFWS 1994).

As discussed in USFWS (1994), Principal Constituent Elements for the critical habitat of the four Colorado River federally endangered fish species include the following components:

1. Water – This component includes a quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, nutrients, turbidity, lack of contaminants, etc.) that is delivered to a specific location in accordance with the hydrologic regime that is required for a particular life stage for each species.
2. Physical Habitat – This component includes areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas. In addition to river channels , these areas also include bottom lands, side channels, oxbows, backwaters, and other areas in the 100-year floodplain., which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats.
3. Biological Environment – Food, predation, and competition elements of the biological environment are considered important components. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although normal components of the biological environment, can be out of balance due to introduced non-native fish species.

It is assumed that spawning occurs in June or July, based on fish being observed in reproductive condition at 18ºC in the Green River (USFWS 2002a). Spawning has been observed in reservoirs over rocky shoals and shoreline areas (USFWS 2002a). A recent documentation of wild bonytail spawning in 2015 was reported for a wetland (Stewart Lake) in Utah, based on the collection of young-of-the-year (Breen 2016). Flooded bottomland habitats are considered important growth and conditioning areas, particularly as nursery areas for young. This species is a broadcast spawner that scatters adhesive eggs over gravel substrate at depths up to 30 feet. Newly hatched larvae and young bonytail develop in flooded bottomlands.

Listing and Conservation Status

Bonytail was listed as endangered under the ESA on April 23, 1980 (45 Federal Register 27710). On March 21, 1994, the USFWS designated seven reaches of the Colorado River system as critical habitat for bonytail (USFWS 1994). Critical habitat is designated in portions of the Colorado, Green, and Yampa rivers in the Upper Colorado River Basin and the Colorado River in the Lower Colorado River Basin. In total, 312 miles of critical habitat for bonytail exists in these seven reaches. One of these reaches overlaps with portions of the action area that were analyzed for this species, which includes 12.8 miles of bonytail critical habitat in the Northeast Gap Region.

A recovery plan for bonytail was completed in 1984, revised in 1990, and then updated in 2002 (USFWS 2002a). The upper basin subunit is composed of the Green River and Upper Colorado River, and the lower basin unit includes the mainstem and tributaries of the Colorado River from Lake Mead downstream to the International Boundary with Mexico. The most recent recovery review in 2012 indicated that bonytail has not yet achieved demographic recovery goals that are indicative of a healthy, viable, and sustainable population level (USFWS 2012a). The review also concluded that the most meaningful threats to bonytail include habitat availability, protection from predation, and degraded water quality. Bonytail will be considered eligible for downlisting from endangered to threatened and for removal from ESA protection when all of the following conditions are met:

- Self-sustaining fish populations reach the required numbers in the areas of the Green and Upper Colorado river subbasins and the Lower Colorado River Basin, and a genetic refuge is established in the Lower Basin;
- Essential habitats, including required instream flows, are legally protected; and
- Other identifiable threats that could significantly affect the population are removed.

Factors Affecting Species

Habitat occupied by bonytail is within Cataract Canyon, which is located in the upper portion of the Northeast Gap Region. Cataract Canyon begins 4 miles downstream of the confluence with the Green River and extends approximately 37 miles (Badame 2008). The upper 10 miles of the canyon is within Canyonlands National Park and the lower 27 miles is within the Grand Canyon National Recreation Area. Habitat in the upper section of the canyon mainly consists of large eddy/pool complexes interspersed between large rapids. Some of the larger pools are 75 feet deep. The lower 32 miles of Cataract Canyon are inundated by Lake Powell at full-pool elevation (Badame 2008).

Limiting factors for bonytail in the Northeast Gap Region include streamflow reductions due to water diversions; habitat fragmentation; competition with and predation by non-native fish species; and water quality changes due to pesticides and pollutants (USFWS 2002a). In the Upper Colorado River Basin, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively (Holden 1999 as cited in USFWS 2015a). Increasing air temperatures and decreasing flows in the Colorado River have been documented, based on information provided in Hoerling et al. (2013). Temperature and water flow and/or volume are key components of habitat quality for aquatic species. The construction of 14 major dams in the Colorado River has fragmented habitat and blocked migration corridors for bonytail and other federally endangered fish species (USFWS 2002a). A large number of non-native fishes are found in the current occupied habitat of bonytail. Many of these non-native fish are considered predators, competitors, and vectors of disease and parasites. Previous accounts of hybridization of bonytail also have been reported in Cataract Canyon (USFWS 2002a). A discussion of the baseline water quality conditions with a focus on metals in the Gap Region ERA (Ramboll Environ 2016c) is provided in Water Resources Section 3.7.3.2, NGS and Associated Facilities.

Ecological Risk

Bonytail were evaluated in the Gap Region ERA by comparison of measured fish tissues concentrations, where available, to CBRs protective of fish health. Modeled fish tissue concentrations also were considered in the absence of measured values. The CBRs used for evaluation of special status species included: mercury 0.2 mg/kg wet weight (Beckvar et al. 2005), selenium 2 mg/kg wet weight (USEPA 2016), and arsenic 5.5 mg/kg wet weight (Jarvinen and Ankley 1999), as cited in the ERAs. In the Northeast Gap, tissue data were available for mercury only. Tissue data for the other metals was modeled from surface water data.

Based on the Gap Region ERA results regarding ecological risk, there is negligible risk from mercury and selenium exposure to bonytail present within the Northeast Gap Region under baseline or existing conditions. The maximum and refined tissue-based HQs were less than 1 for the surrogate fish species (rainbow trout) in the ERA (Ramboll Environ 2016c) (**Table 3.13-3**). The tissue concentration for mercury in rainbow trout was 0.1 mg/kg wet weight (maximum) and 0.09 mg/kg wet weight (refined)resulting in a maximum HQ of 0.6 and a refined HQ of 0.5. Measured selenium in fish tissue was not available for the Northeast Gap Region, but the maximum HQ for selenium modeled into representative fish was 0.4 and the refined HQ was 0.2 resulting in a conclusion that risk to fish is highly unlikely. Based on the negligible risk to bonytail in the Northeast Gap Region, the effect of mercury and selenium on baseline fish tissue concentrations are expected to be negligible.

Table 3.13-3 Northeast Gap Risk Results for Bonytail Using Surrogate Species Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Mercury	0.12	0.09	0.6	0.5
Selenium	*0.84*	*0.33*	0.4	0.2

Note: Values presented in italicized text indicate that measured tissue data are not available; concentrations are based on modeled result using site-specific uptake factor and surface water concentration.

3.13.3.1.2.2 Colorado Pikeminnow

Species Occurrence

Colorado pikeminnow were once widespread in the large rivers of the Colorado River Basin and its major tributaries (Gunnison, White, Yampa, Dolores, San Juan, Uncompahgre, Animas, and Green rivers), from Mexico and Arizona to Wyoming) (USFWS 2016a, 2002b). By the mid-1980s Colorado pikeminnow occurred only in Upper Colorado River basin of Colorado, Utah, New Mexico, and Wyoming; mainly in the Green River in Utah and in the Yampa and Colorado rivers in Colorado and portions of Utah. The species has not been collected below Glen Canyon Dam since 1968. Adults predominate in the White and Yampa rivers, while young fish is the most abundant life stage in the Green River (USFWS 2016a).

Colorado pikeminnow is represented by three wild populations, which occur in the Green River, upper Colorado River, and the San Juan River subbasins (NatureServe 2013b). The species is found in approximately 1,029 miles of riverine habitat in these three subbasins (USFWS 2011a). The population estimate for the Green River is approximately 4,500 adults in 2009, while the Colorado River estimate in 2006 was approximately 750 fish (USFWS 2011a). The wild population in the San Juan River subbasin is relatively small with 19 to 50 wild fish (Bestgen et al. 2010). The population trend over the last 10 years has been relatively stable (NatureServe 2013b). The self-sustaining population estimates are 2,600 adults for the Green River and 700 adults for the Upper Colorado River (USFWS 2011a). A target

of 1,000 age 5 fish or older has been established for the San Juan River through augmentation and/or natural reproduction (USFWS 2011a). Abundance information for the portions of the action area analyzed for Colorado pikeminnow is provided below.

Lake Powell

Two Colorado pikeminnow were captured in the Colorado River arm of Lake Powell in 2014. The fish traveled 143 and 144 miles to Lake Powell from their stocking locations (Francis 2014). In 2011 and 2012, 25 Colorado pikeminnow were captured in the San Juan River arm of Lake Powell below the waterfall. A large waterfall exists where the river enters Lake Powell when the elevation is below 3,661 feet, which prevents upstream movement of fish after they have entered the lake. Sampling below the waterfall in 2015 captured 15-Passive Integrated Transponder (PIT) tagged pikeminnow (McKinstry et al. 2016). Both marked (stocked) and unmarked (stocked or wild) fish have been captured; however, capture efforts are not targeting Colorado pikeminnow because they usually do not survive capture by nets. Captured fish usually are in poor condition. Colorado pikeminnow have not been detected in the 20-km Near-field ERA analysis area including the lower portion of Lake Powell near the NGS pump station and intakes. The Colorado River inflow area to Lake Powell is considered part of the Northeast Gap area, since the Near-field ERA analysis area does not extend to the arms of the lake.

Northeast Gap Region

Based on abundance information provided in the recovery goals document (USFWS 2002b), 600 to 900 Colorado pikeminnow individuals are estimated to occur in the Colorado River subbasin. Recent estimates of Colorado pikeminnow in the Colorado River indicated an upward trend, with adult abundance increasing from approximately 200 to 890 adult fish in the period from 1992 to 2005 (Osmundson and White 2009; USFWS 2011a). In years when surveys were conducted, the population estimate was more than 700 in 1993, 2000, and 2005.

San Juan River

The Colorado pikeminnow population in the San Juan River primarily consists of stocked juvenile fish; adults are rare in occurrence (Durst and Franssen 2014). Approximately 3.2 million pikeminnow were stocked between 2002 and 2011 (USFWS 2015a). The duration of pikeminnow that have been in the river for one or more winters has shown an increasing trend since 2003. This trend is the result of fish ages dominated by 1st year or 1-year or older fish. The number of larger fish is small, although their numbers have increased. Schleicher and Ryden (2013) estimated approximately 1,000 pikeminnow with total lengths greater than 300 millimeters. The wild population in the San Juan River subbasin is relatively small, with 19 to 50 wild fish (Bestgen et al. 2010).

Verde River

An experimental, non-essential Colorado pikeminnow population has been designated in the Verde River below Sullivan Lake to Beasley Flat in Arizona. This section of the river is located upstream of the STS ROW crossing of the Verde River. There is no evidence of a self-sustaining population of Colorado pikeminnow in the Verde River. Sporadic stockings have occurred over the past several decades, but there has never been evidence of reproduction or survival of stocking individuals past a year or two post-stocking.

Life History and Habitat Association

Habitat requirements of Colorado pikeminnow vary depending on the life stage and time of year. Young-of-year and juveniles prefer shallow backwaters, while adults use pools, eddies, and deep runs that are maintained by high spring flows (USFWS 2002b). During peak runoff in the spring and early summer, fish usually move into backwater areas of flooded riparian zones to avoid swift velocities, feed, and

prepare for the upcoming spawning period. Survey efforts for Colorado pikeminnow in the Green River during high flow periods consisted of nearshore areas, flooded tributary mouths, canyon washes, and large backwater areas (Bestgen et al. 2010).

Adults are highly mobile during the spawning period, which occurs after peak runoff in mid-June to mid-August. Movements have been documented up to 400 miles and involved multiple rivers within the Upper Colorado River Basin (i.e., Green and Colorado rivers) (Osmundson and White 2009). In the San Juan River, Colorado pikeminnow move long-distances upstream from spring to summer, and then move back downstream in the winter (Durst and Franssen 2014). Spawning activity begins after the peak of spring runoff at water temperatures typically 16°C or higher (USFWS 2002b).

Listing and Conservation Status

Colorado pikeminnow was listed as endangered on March 11, 1967 (32 Federal Register 4001). With the passage of the ESA in 1973, this fish species retained its endangered status. On March 21, 1994, the USFWS designated six reaches of the Colorado River system as critical habitat for the species (59 Federal Register 13374). Critical habitat consists of three primary constituent elements: water (temperature, turbidity, and lack of contaminants), physical (areas used for spawning, feeding, rearing within the 100-year floodplain), and biological environment (adequate food supply and ecologically appropriate levels of predation and competition (USFWS 1994).Critical habitat is designated in portions of the Colorado, Green, Yampa, White, and the San Juan rivers. In total, 1,148 miles of critical habitat for Colorado pikeminnow exists in these six reaches. Two of these reaches overlap with portions of the action area that were analyzed for this species. This includes the Northeast Gap Region, which contains 48.8 miles of critical habitat. The other reach is the San Juan River, which contains 233.3 miles of critical habitat. In addition, two reintroduced Colorado pikeminnow populations have been designated as Experimental/Non-essential in the Verde and Salt rivers in Arizona under 10(j) of the ESA (50 Federal Register 12 30188).

A recovery plan for Colorado pikeminnow was published in 2002 (USFWS 2002b). As part of the recovery process, 5-year reviews have been conducted to evaluate whether the status of the species has changed since its original listing in 1967. The most recent recovery review in 2011 indicated that there is a moderate degree of threat and a high degree of recovery potential at the species level taxonomically (USFWS 2011a). Recovery of the species is considered necessary only in the Upper Colorado Basin (Green River, upper Colorado River, and San Juan River subbasins); historic populations for this species in the Lower Colorado River Basin are extirpated. Colorado pikeminnow will be considered eligible for downlisting from endangered to threatened and for removal from ESA protection when all of the following conditions are met:

- Self-sustaining fish populations reach the required numbers in the areas of the Green River, Upper Colorado River, and San Juan River subbasins;
- Essential habitats, including required instream flows, are legally protected; and
- Other identifiable threats that could significantly affect the population are removed.

Factors Affecting Species

Colorado pikeminnow occurs throughout the Northeast Gap Region, which includes Lake Powell upstream to the Colorado River confluence with the Green River). Habitat in this area consists of Lake Powell, slow-moving inflow areas in the Colorado arm, and relatively narrow riverine reaches with flow. A major portion of the Northeast Gap Region consists of Cataract Canyon, where the upper section of the canyon consists of large eddy/pool complexes interspersed between large rapids. Some of the larger pools are 75 feet deep. The lower 32 miles of Cataract Canyon are inundated by Lake Powell at full-pool elevation (Badame 2008). Limiting habitat factors in the Northeast Gap Region would be the same as discussed for bonytail.

Habitat types in the San Juan River below Navajo Dam vary in terms of channel characteristics. From Navajo Dam in New Mexico downstream to Farmington, the river is restricted to a single, moderately incised channel with a mixture of riffles, deep runs, and large pools (New Mexico Department of Game and Fish 2006). As the river progresses from Farmington to Shiprock, the gradient diminishes but flow primarily remains in a single channel. Downstream of Shiprock, the river frequently is divided among two to four channels with a more complex habitat diversity including backwaters, embayments, and shoals in combination with riffle, run, and pool habitats. The San Juan River flows approximately 120 miles in Utah before it enters Lake Powell. The portion of the river from the Arizona state line to Chinle Creek is characterized as a relatively broad and braided channel. From Chinle Creek to the San Juan arm of Lake Powell, the river channel meanders and cuts through steep canyons.

Factors affecting existing conditions in the San Juan River are described in the Four Corners Power Plant and Navajo Mine Energy Biological Opinion (USFWS 2015a). A summary of these factors is provided below. These factors are applicable to the Colorado pikeminnow and its critical habitat in the San Juan River. It is important to note that the Proposed Action's potential effects to the San Juan River are limited to water quality effects from the deposition of stack releases.

Water Quality – This factor applies to Colorado pikeminnow and the water element of its critical habitat. Water quality issues in the San Juan River include metals, sediment, salinity, temperature, fecal matter, and dissolved oxygen. A discussion of the baseline water quality conditions with a focus on metals from the San Juan River ERA (Ramboll Environ 2016b) is provided in Water Resources Section 3.7.3.2, NGS and Associated Facilities. Land uses within the basin contribute metals, salts, fossil fuel residuals (e.g., polycyclic aromatic hydrocarbons), and pesticides to the San Juan River and its tributaries. Irrigation and mineral development have been identified as major sources of pollution. Fish consumption advisories for mercury in fish tissue have been issued for Navajo Reservoir and other smaller reservoirs in the basin (New Mexico Environment Department 2012; fishadvisoryonline.epa.gov/Advisories.aspx). Reviews by the USFWS (2012c; 2011a) have identified pesticides and other pollutants as potential contaminants to Colorado pikeminnow and razorback sucker. Osmundson and Lusk (2011), AECOM (2013), and Electric Power Research Institute (2014) identified mercury and selenium as moderately elevated contaminants of concern in biota and fish tissues collected from the San Juan River Basin.

Water Temperature – This factor applies to Colorado pikeminnow and the water element of its critical habitat. Navajo Reservoir affects water temperatures in the San Juan River as a result of cold-water releases. Summer water temperatures are colder and winter temperatures are warmer in comparison to pre-dam construction. The cold water released from Navajo Reservoir limits the potential spawning habitat of the endangered fishes in the San Juan River. Although Colorado pikeminnow currently occurs in the San Juan River from near the confluence of the Animas River downstream to Lake Powell, temperatures are rarely over 59ºF during pikeminnow spawning season, which is too cold for successful spawning. Spawning is unlikely to occur from Navajo Dam to the confluence of the Animas River (approximately 72 km [45 miles] below the dam) and also may be delayed for 2 weeks or more from the confluence with the Animas River down to Shiprock, New Mexico.

Fish Passage Blockage – This factor applies to the species and the physical element of its critical habitat. Colorado pikeminnow can navigate throughout the San Juan River from a waterfall in the San Juan arm upstream to Hammond Diversion Dam. The waterfall barrier is a blockage to upstream fish movement during most years when Lake Powell water levels do not inundate the sandstone ledge. During a wetter year, which occurs approximately once every 10 years, the waterfall is inundated and fish can pass above this barrier at a Lake Powell water surface elevation of 3,661 feet (USFWS 2015a). The Navajo Dam represents the furthest upstream blockage in the San Juan River. Within the San Juan River, fish passage was once impeded by five instream structures. One of these structures (Cudei Diversion at river mile 142) has been removed, two have been equipped with fish passage structures (Hogback Diversion at river mile 158.7 and Public Service Company of New Mexico Weir at river mile 166), and the Fruitland Irrigation Canal at river mile 178.5 remain as impediments to fish passage for part of the year depending on flow. The Four Corners Power Plant Project included fish passage around the

Four Corners Power Plant Diversion at river mile 163.3. However, no remaining structures are complete barriers within critical habitat.

Water Diversions and Withdrawals – Flow changes from diversions and withdrawals in the San Juan River apply to Colorado pikeminnow and the physical element of its critical habitat. Significant depletions and redistribution of flows of the San Juan River have occurred because of other major water development projects, including the Navajo Indian Irrigation Project and the San Juan-Chama Project. In addition, the Navajo-Gallup Water Supply Project would divert 35,893 acre-feet per year, with diversions to be initiated in 2024. At the current level of development, average annual flows at Bluff, Utah, already have been depleted by 30 percent. Water depletion projects that were in existence prior to November 1, 1992, are considered to be historic depletions because they occurred before the initiation of the San Juan River Recovery Implementation Program. The depletions associated with the Four Corners Power Plant and Navajo Mine are considered historic depletions, as diversion and consumptive use associated with Permit 2838 have been part of the basin depletions since the 1960s. Projects that began after this date are considered new projects. On May 21, 1999, the USFWS determined through Section 7 consultation that new depletions of 100 acre-feet or less, up to a cumulative total of 3,000 acre-feet per year, would not: 1) limit the provision of flows identified for the recovery of the Colorado pikeminnow and razorback sucker; 2) be likely to jeopardize the endangered fish species; or 3) result in the destruction or adverse modification of their critical habitat. Consequently, any new depletion under 100 acre-feet per year, up to a cumulative total of 3,000 acre-feet per year, may be incorporated under the 1999 Biological Opinion but would still require ESA consultation. Consultations contributing to the baseline depletions used reoperation of Navajo Reservoir in accordance with the flow recommendations as part of their Section 7 compliance. Some of these projects have been completed (e.g., Public Service Company of New Mexico Water Contract with Jicarilla Apache Nation), some are partially complete (e.g., Navajo Indian Irrigation Project), and some have not been fully implemented (e.g., Animas-La Plata Project). One Navajo Nation project that has been completed is the Farmington to Shiprock Pipeline Project, which diverts 4,680 acre-feet per year.

Flow Changes – The construction of Navajo Dam decreased peak discharges in the San Juan River by more than 50 percent and elevated base flows by about 168 percent on average. The USFWS (2006, as cited in USFWS 2015a) estimated that flows in the San Juan River at Bluff, Utah were reduced by 30 percent, which contributed to the decline of Colorado pikeminnow and razorback sucker. Flow recommendations were developed through the San Juan River Recovery Implementation Program during the 1990s to support habitat for native fish species. Navajo Dam has been operated to meet these flow recommendations since the completion of an EIS and Biological Opinion in 2006 (Reclamation 2006; USFWS 2006). The Biological Opinion indicated that the reoperation of the dam provides native fish with the proper cues at the proper times to trigger spawning and appropriate habitat at the appropriate time to support young fish.

Transformation of Riverine Habitat to Lake Habitat – This factor applies to Colorado pikeminnow and the physical element of its critical habitat. The addition of Navajo Reservoir and Lake Powell inundated approximately 54 and 27 miles, respectively, of the San Juan River. The inundated area reduced the total available habitat by over 30 percent.

Channel Morphology – This factor applies to Colorado pikeminnow and the physical element of its critical habitat. The San Juan River channel has narrowed considerably since the 1930s as a result of habitat degradation and erosion. The lack of flood flows also has resulted in the development of non-native riparian vegetation, which encroaches on the river and contributes to further channel narrowing. The amount of backwater habitat has decreased since 1992. The operation of Navajo Dam has been modified to include flows that would assist in maintaining channel morphology and the formation of backwaters. However, some of the flow recommendation targets have not been met since 2005 due to droughts in the basin. The last time the target number of days of flow of 8,000 and 5,000 cubic feet per second were met was in 2008. The 2,500-cubic feet per second flow target has been met consistently since 2003 (Reclamation 2012).

Entrainment/Impingement – This factor applies to Colorado pikeminnow, but there is no connection with elements of its critical habitat. Colorado pikeminnow early life stages have been adversely affected from water diversions that entrain or impinge fish on intake screens. This was an impact issue for the Four Corners Power Plant and the Arizona Public Service Company Weir, as well as other irrigation and water withdrawal structures. Arizona Public Service Company and all withdrawal structures are required to undertake all appropriate measures to reduce impacts from impingement and entrainment at the intake facilities. As an existing facility, Arizona Public Service Company also is required to comply with one of seven options to reduce entrainment, and must meet site-specific entrainment standards as required by the Director of USEPA.

Four Corners Power Plant Conservation Measures – As part of the Biological Opinion for the Four Corners Power Plant and the Navajo Mine Energy Project, conservation measures were required to offset project effects on Colorado pikeminnow, razorback sucker, and yellow-billed cuckoo in the San Juan River (USFWS 2015a). A summary of these measures is provided in Section 3.0 of this EIS in the Four Corners Power Plant and Navajo Mine discussion. These measures are relevant to Colorado pikeminnow and razorback sucker, because they are being implemented to offset project impacts related to water quality (mercury, selenium, and temperature), entrainment and impingement, and biological factors involving non-native fish competition and predation. The measures also involve the following actions to assist in the recovery of the species: propagation of endangered fish, removal of non-native fish, protection and augmentation of fish habitat, funding of fish passage at the Arizona Public Service Company Weir, Colorado pikeminnow mercury tissue studies, water temperature effects study on Colorado pikeminnow, and support of the San Juan River Basin Recovery Implementation Program.

Ecological Risk

Colorado pikeminnow were evaluated in the Gap Regions ERA by comparison of measured fish tissues concentrations, where available, to CBRs protective of fish health. Modeled fish tissue concentrations also were considered in the absence of measured values. The CBRs used for evaluation of special status species included: mercury 0.2 mg/kg wet weight (Beckvar 2005), selenium 2 mg/kg wet weight (USEPA 2016), and arsenic 5.5 mg/kg wet weight (Jarvinen and Ankley 1999), as cited in the ERAs. In the Northeast Gap, tissue data were available for mercury only. Tissue data for the other metals was modeled from surface water data.

Based on the Gap Regions ERA, there is a negligible risk from NGS metals deposition of mercury and selenium exposure to Colorado pikeminnow present within the Northeast Gap Region. Under existing (baseline) conditions, maximum and refined tissue-based HQs were less than 1 for the surrogate fish species (largemouth bass) in the ERA (Ramboll Environ 2016c) (**Table 3.13-4**). The measured tissue concentration for mercury was 0.1 mg/kg wet weight resulting in a maximum and refined HQ of 0.6. Measured selenium in fish was not available for the Northeast Gap Region, but maximum and refined HQs for representative fish (based on modeled tissue concentrations) exposed to selenium were less than 1, indicating that potential risk to fish exposed to selenium in the Northeast Gap Region is highly unlikely.

Table 3.13-4 Northeast Gap Risk Results for Colorado Pikeminnow Using Surrogate Species Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Mercury	0.12	0.09	0.6	0.6
Selenium	*0.84*	*0.33*	0.4	0.2

Note: Values presented in italicized text indicate that measured tissue data are not available; concentrations are based on modeled result using site-specific uptake factor and surface water concentration.

The San Juan River ERA analysis evaluated Colorado pikeminnow exposure to metals (mercury, arsenic, selenium) emissions under existing conditions using surrogate fish species tissue data (striped bass) and species-specific tissue data, where available (Ramboll Environ 2016b). The analysis based on surrogate fish tissue data for striped bass indicated that existing conditions in the San Juan River do not represent a potential risk from arsenic and selenium, based on a maximum and refined HQs less than or equal to 1 (Ramboll Environ 2016b). Maximum and refined HQs for mercury were 2 and 1, respectively (**Table 3.13-5**). When considering the results of species-specific tissue analyses for Colorado pikeminnow (**Table 3.13-6**) with maximum and refined HQs less than 1, this line of evidence indicates negligible risk to the species.

Table 3.13-5 San Juan River Risk Results for Colorado Pikeminnow Using Surrogate Species Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Arsenic	0.37	0.37	0.07	0.07
Mercury	0.49	0.21	2	1
Selenium	1.30	1.30	0.7	0.7

The ERA analysis considered Colorado pikeminnow tissue data in addition to surrogate fish tissue concentrations (Ramboll Environ 2016b). This ancillary analysis showed a negligible risk to Colorado pikeminnow from existing conditions, based on HQs less than 1 for arsenic, mercury, and selenium (**Table 3.13-6**). It is notable that the Colorado pikeminnow data used for this latter analysis were from stocked fish. While use of these data are appropriate, these data may underestimate baseline fish tissue concentrations for the small wild (non-stocked) fish populations, as stocked fish would have less exposure time to instream conditions compared to wild fish that have spent their entire life in the San Juan River and tissue concentrations may not be in equilibrium with current exposures. For this reason, existing conditions assessed using surrogate fish species for Colorado pikeminnow are considered more relevant to evaluate risk.

Table 3.13-6 San Juan River Risk Results for Colorado Pikeminnow Using Colorado Pikeminnow Tissue Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Arsenic	0.37	0.37	0.07	0.07
Mercury	0.25	0.11	1	0.5
Selenium	1.1	0.78	0.5	0.4

3.13.3.1.2.3 Humpback Chub

Species Occurrence

The historic distribution of the humpback chub is unknown, although early records reported this species in the Upper Colorado River Basin and Colorado River below Lee's Ferry (USFWS 2002c). It is estimated from various reports and collections that indicate the species presently occupies about 68 percent of its historic habitat. Six humpback chub populations are currently identified: (1) Black Rocks, Colorado; (2) Westwater Canyon, Utah; (3) Little Colorado River and Colorado rivers in Grand Canyon, Arizona; (4) Yampa Canyon, Colorado; (5) Desolation/Gray Canyons, Utah; and (6) Cataract Canyon, Utah. Each population consists of a discrete group of fish, geographically separated from the other populations, but with some exchange of individuals. River length occupied by each population varies from 2.3 miles in Black Rocks to 46 miles in Yampa Canyon.

Humpback chub is represented by six populations. Five of the populations occur in the upper basin recovery units listed above. The only population in the lower basin recovery unit occurs in the mainstem of the Colorado River in Marble and Grand Canyons and the Little Colorado River. The species is found in approximately 470 miles of riverine habitat in these population areas (USFWS 2011b). The estimated number of adults in the upper basin recovery units included approximately 400 at Black Rocks (Francis et al. 2016), 1,300 at Westwater Canyon (Hines et al. 2015), 1,600 at Desolation-Gray Canyons (Badame 2011), and 300 at Cataract Canyon (Badame 2008). Core populations in the upper basin include Black Rocks/Westwater Canyon and Desolation-Gray Canyon with recovery criteria of 2,100 adults. The lower basin recovery unit is a self-sustaining population, with the Grand Canyon adult population estimate of 11,000 adults (Yackuic et al 2014). The Grand Canyon and Little Colorado River population is considered a core population. Recent estimates indicate that the Grand Canyon and Little Colorado River population is stabilizing after a decade of decline (USFWS 2011b). Abundance information for the portions of the action area analyzed for humpback chub is provided below.

Northeast Gap Region

Humpback chub occurs in the Cataract Canyon portion of the Colorado River immediately upstream of Lake Powell. Population estimates in 2003 through 2005 ranged from 273 to 468 individuals in Cataract Canyon (Badame 2008). Growth rates and condition factors for humpback chub in these Cataract Canyon surveys were the lowest values observed for any of the populations in the Colorado River Basin.

Southwest Gap Region

Humpback chub occurs from river mile 30 downstream and throughout the Colorado River in the Grand Canyon, with the highest densities within and adjacent to the Little Colorado River at approximate river mile 62. It is noted that these river mileages start at 0 at Lees Ferry, which is approximately 16 river miles below Glen Canyon Dam. Thus, the first recognized chub population begins at river mile 30 is actually approximately 46 river miles below Glen Canyon Dam. The Grand Canyon humpback chub

population has shown increasing trends in numbers since 2001 (Bureau of Reclamation and National Park Service [NPS] 2015). The population is currently estimated at 11,000 adults compared to a population low of 5,000 in 2001 (Yackulic et al. 2014). Approximately 300 humpback chub are estimated to be present at the river mile 30 aggregation.

Life History and Habitat Association

Humpback chub mainly occurs in river canyons where they utilize a variety of habitats including deep pools, eddies, upwells near boulders, and areas near steep cliff faces (NatureServe 2014). As young humpback chub mature, they shift toward deeper and swifter offshore habitats (USFWS 2002c). Within the Grand Canyon, humpback chub occurs primarily in the vicinity of the Little Colorado River confluence, with adults being associated with large eddy complexes. Converse et al. (1998) reported that subadult humpback chub in the Colorado River downstream of the Little Colorado River showed higher densities along shoreline areas with vegetation, talus slopes, and debris fans.

Humpback chub are broadcast spawners with a relatively low fecundity rate compared to other minnow species of similar size (USFWS 2002c). Spawning primarily occurs in March through May in the lower basin and during April through June in the upper basin. Spawning temperatures typically range from 16ºC to 22ºC. The main spawning area for humpback chub in the Grand Canyon is the Little Colorado River, which provides warm water temperatures and shallow velocity pools for larvae (Gorman 1994). In the mainstem portion of the Colorado River, young-of-the-year fish are found in backwater and other nearshore areas that serve as nursery habitats (Valdez and Ryel 1995).

Listing and Conservation Status

Humpback chub was listed as endangered on March 11, 1967. On March 21, 1994, the USFWS designated seven reaches of the Colorado River system as critical habitat for humpback chub (USFWS 1994). As previously mentioned, critical habitat consists of three primary constituent elements: water (temperature, turbidity, and lack of contaminants), physical (areas used for spawning, feeding, rearing within the 100-year floodplain), and biological environment (adequate food supply and ecologically appropriate levels of predation and competition) (USFWS 1994). Critical habitat is designated in portions of the Colorado, Green, and Yampa rivers in the Upper Colorado River Basin and the Colorado and Little Colorado rivers in the Lower Colorado River Basin. In total, 379 miles of critical habitat exists for humpback chub in these seven reaches. Two of these reaches overlap with portions of the action area that were analyzed for this species. This includes 12.9 miles in the Northeast Gap Region and 34.2 miles in the Southwest Gap Region. The upper end of the habitat is located approximately 27 miles upstream of the confluence with the Little Colorado River.

A recovery plan for humpback chub was first published in 1990 and then amended in 2002 (USFWS 2002c). Five-year reviews of the recovery goals were initiated in 2007 for the humpback chub and the other three Colorado River system endangered fish species (72 Federal Register 19549-19551). For the purposes of recovery goals for humpback chub, the upper and lower basins are divided at the Glen Canyon Dam in Arizona. Separate objective, measurable recovery criteria were developed for each of the recovery units (i.e., the upper basin including the Green River and Upper Colorado River subbasins; and the lower basin including the mainstem of the Colorado River and its tributaries downstream to the Lake Mead National Recreation Area) for the purpose of addressing the unique threats and using site-specific management actions necessary to minimize or remove these threats. The recovery units encompass three management areas under three separate recovery or conservation programs: Upper Colorado River Endangered Fish Recovery Program, the Glen Canyon Dam Adaptive Management Program, and the Lower Colorado River Multi-Species Conservation Program. Humpback chub will be considered eligible for downlisting from endangered to threatened and for removal from ESA protection when all of the following conditions are met:

- Maintain six self-sustaining populations;
- Essential habitats, including required instream flows, are legally protected; and
- Other identifiable threats that could significantly affect the population are removed.

Factors Affecting Species

The types of aquatic habitat in the Southwest Gap Region (Glen Canyon Dam downstream to the confluence with the Little Colorado River) are influenced by geological conditions and a river with highly regulated flows and water temperatures that are perennially colder than Lake Powell inflows. Reclamation and the NPS divide the Colorado River below Glen Canyon Dam into three segments (Reclamation and NPS 2015). Beginning at Glen Canyon Dam, the first portion of the river is the 15-mile stretch that runs downstream through Glen Canyon to just upstream of the Paria River at Lees Ferry (river mile 0). Glen Canyon has a substantially different geomorphic structure compared to the reaches farther downstream, and it has a limited sediment supply. The next section of river is the approximately 62-mile stretch that runs through Marble Canyon. This stretch starts at the mouth of the Paria River at Lees Ferry (river mile 0) and extends to just upstream of the Little Colorado River confluence (river mile 61.5). The sediment load of this reach is dominated by Paria River inputs. The third section runs through the Grand Canyon and comprises the remainder of the river downstream of the Little Colorado River. The sediment load of this third portion is the cumulative supply provided by contributions from the Paria River reach, the Little Colorado River, and various other small tributaries**.**

Factors affecting baseline conditions in the Southwest Gap Region of the Colorado River for humpback chub are described in the draft document entitled *Glen Canyon Dam Long-term Experimental and Management Plan* (Reclamation and NPS 2015). A summary of these factors is provided below. These factors are applicable to the humpback chub and its critical habitat in the Southwest Gap Region. It is important to note that the Proposed Action's potential effects to the Colorado River below Glen Canyon Dam are limited to water quality effects from the deposition of stack releases.

Water Quality – This factor applies to humpback chub and the water element of its critical habitat. Current water quality conditions in the Colorado River below Glen Canyon Dam reflect post-dam and ongoing conditions. A discussion of the baseline water quality conditions with a focus on metals from the Gap Region ERA (Ramboll Environ 2016c) is provided in Water Resources Section 3.7.3.2, NGS and Associated Facilities. In the post-dam era, the extent of variations in temperature, salinity, turbidity, and nutrient concentrations have moderated and shown an overall improvement in water quality. The primary water input that affects the water quality below Glen Canyon Dam includes the deep water releases from Lake Powell and several large tributaries such as the Little Colorado and Paria rivers. The release of water from Lake Powell results in cooler temperatures as well as slight increases in salinity until mixing occurs in the river from larger tributaries. In general, these tributaries tend to carry water at higher temperatures than the mainstem river, thus warming the regions where they join. In addition, tributaries, such as Paria River and Little Colorado River, can carry large amounts of fine sediment and organic materials during flood events. Sediment levels in the river near the confluence with these tributaries range from 20 to 133,000 milligrams per liter depending on the season and year.

Dams and Reservoirs – This factor applies humpback chub and the water and physical elements of its critical habitat. The construction of Lake Powell and Glen Canyon Dam altered riverine habitat and resulted in coldwater releases that have affected water temperatures. Cold water temperatures in the main channel are below the temperature for spawning, egg incubation, and growth of humpback chub. The survival of humpback chub young in the mainstem portion of the river is considered to be low because of cold water temperatures. However, water temperatures in the mainstem Colorado River have generally increased over the past 10 years (approximately 1 to 4ºC maximum water temperature increase depending on the river location). Although the current water temperatures are not optimal for humpback chub, juvenile fish can now successfully rear to the adult stage. Population estimates for humpback chub in the Grand Canyon have been increasing since 2000, with suggested reasons being

experimental water releases, drought-induced warming, and trout declines due to removal. This warmer water appears to have benefited the humpback chub and other native fish, but they also may have benefited non-native warmwater species (e.g., channel catfish, striped bass, and green sunfish) that are more abundant farther downstream in the Grand Canyon.

Water Diversions – Flow changes from diversions and withdrawals in the Colorado River apply to humpback chub and the physical element of its critical habitat. Numerous non-federal diversions are currently in place on the mainstem Colorado River and tributaries in Colorado and Utah, and on the San Juan River in Colorado, Utah, and New Mexico. Collectively, these ongoing diversions reduce flows in the Upper Colorado River Basin, which reduce the volume of water stored in Lake Powell.

Non-native Fish – This factor applies to humpback chub and the biological environment element of its critical habitat. The occurrence of non-native fishes in the Colorado River affects humpback chub due to predation and competition. The threat of both warmwater and coldwater non-native fish species is an issue to native fish species in Grand Canyon National Park (NPS 2013; Reclamation and NPS 2015). Green sunfish was discovered in a backwater slough below Glen Canyon Dam in 2015. Treatment was administered by the NPS and Arizona Game and Fish Department (AGFD), but some fish escaped downstream (NPS 2016). Mechanical removal of non-native rainbow and brown trout also is occurring as a multi-year project in the lower reach of Bright Angel Creek, a tributary to the Colorado River within Grand Canyon. Predation by rainbow trout and brown trout in the Little Colorado River confluence area is considered to be a mortality threat to humpback chub survival, reproduction, and recruitment. Channel catfish and black bullhead prey on humpback chub in the Grand Canyon. Because of their size, adult humpback chub are less likely to be preyed on by trout. Experimental removal of non-native brown and rainbow trout was conducted in the Colorado River in Grand Canyon between 2003 and 2006. Twenty-three trips to remove trout from the vicinity of the confluence of the Little Colorado River (river miles 56–66) resulted in the removal of more than 23,000 non-native fish (mostly rainbow trout). During this time, the rainbow trout population in the Colorado River in the vicinity of the Little Colorado River was decreased by more than 80 percent. An experimental non-native fish suppression flow regime was implemented by Reclamation in 2003 and 2004 to assist in the reduction of rainbow trout abundance. However, it was concluded that the experimental flows were not effective in limiting trout recruitment (Korman et al. 2011). In addition, the Colorado River now includes non-native fish parasites, such as the Asian tapeworm and anchor worm, which may infect some humpback chub and affect survival.

Ecological Risk

Humpback chub were evaluated in the Gap Region ERA by comparison of measured fish tissues concentrations, where available, to CBRs protective of fish health. Modeled fish tissue concentrations also were considered in the absence of measured values. The CBRs used for evaluation of special status species included: mercury 0.2 mg/kg wet weight (Beckvar 2005), selenium 2 mg/kg wet weight (USEPA 2016), and arsenic 5.5 mg/kg wet weight (Jarvinen and Ankley 1999), as cited in the Gap Region ERA (Ramboll Environ 2016c). In the Northeast Gap, tissue data were available for mercury only. Tissue data for the other metals was modeled from surface water data.

Based on the Gap Regions ERA, there is a negligible risk from mercury and selenium concentrations to humpback chub present within the Northeast Gap Region under existing conditions (Ramboll Environ 2016c). The refined tissue-based HQs were less than 1 for the surrogate fish species roundtail chub (Ramboll Environ 2016c). Tissue concentrations and the HQ was the same as listed for bonytail. Similarly, negligible risks were indicated for humpback chub in the Southwest Gap Region under existing conditions, because the tissue-based HQs for selenium and mercury were less than 1 (**Table 3.13-7**).

Table 3.13-7 Gap Region Risk Results for Humpback Chub Using Surrogate Species and Baseline Fish Tissue Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Northeast Gap Region				
Mercury	0.12	0.094	0.6	0.5
Southwest Gap Region				
Mercury	0.17	0.15	0.8	0.7
Selenium	0.74	0.73	0.4	0.4

3.13.3.1.2.4 Razorback Sucker

Species Occurrence

Historically, the razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado, and New Mexico (USFWS 2002d). In the late 19th and early 20th centuries, it was reported that razorback sucker occurred in the Lower Colorado River Basin and common in parts of the Upper Colorado River Basin.

Existing populations of razorback sucker occur in the Green River, upper Colorado River, San Juan River subbasins; lower Colorado River between Lake Havasu and Davis Dam; Lake Mead and Lake Mohave; and in small tributaries of the Gila River subbasin (Verde and Salt rivers and Fossil Creek (USFWS 2002d). Fish in most of the populations consist of aged fish with little or no recruitment to reproductive age. Two spawning populations able to recruit to adults exist in Lake Mead and the middle Green River. In the lower basin a population occurs in Lake Mohave with approximately 2,500 fish (Wisenall et al. 2015). The Green River subbasin population is estimated to be approximately 2,500 fish (Bestgen et al. 2012). The population is very small in the Upper Colorado River, with no evidence of spawning since the 1960s (NatureServe 2013c). It is estimated that the 60-mile reach of the lower Colorado River between Davis Dam and Lake Havasu contains nearly 5,000 fish (Ehlo et al. 2016). The population estimate in Lake Mead is approximately 500 to 600 fish (Lower Colorado River Multi-species Conservation Program 2015). The Gila River subbasin populations are small and consist of stocked hatchery fish. The minimum viable population size for razorback is estimated to be 5,800 adults (USFWS 2012b, 2002d). The razorback sucker is still declining from historical records in all of the subbasins (NatureServe 2013c).

Occurrence and abundance information for the portions of the action area that were analyzed for razorback sucker is provided below. The study areas included Lake Powell, Northeast Gap Region (Colorado River above Lake Powell), Southwest Gap Region (Colorado River below Lake Powell), San Juan River, and the Verde River. The first four waterbodies are associated with the NGS deposition areas, while the Verde River is crossed by the STS.

Lake Powell

A total of 247 razorback suckers were captured in the Colorado River inflow area of Lake Powell in 2014 (Ryden 2014). Razorback sucker has been collected in Lake Powell over a large span of years (1972 to 2014 in the Colorado River arm). Many of these fish originated from stocking events in rivers upstream of the reservoir. Fish are almost always in good condition and biologists believe that they use these areas because they are productive and because increased turbidity provides protection from predators. Razorback sucker comprised approximately 3 percent of the larval fish numbers in the Colorado River

arm of Lake Powell in 2014 (Brandenburg 2014). Razorback sucker also have been collected in the San Juan River arm of Lake Powell over a large span of years (1982 to 2012) (Francis et al. 2014; Travis et al. 2013). Many of these fish originated from stocking events upstream in the San Juan River. Razorback sucker do not occur in the Near-field ERA analysis area including the lower portion of Lake Powell near the NGS pump station and intakes. The Colorado River inflow is considered part of the Northeast Gap area, while the San Juan River inflow is part of the San Juan River analysis area. The Near-field ERA analysis area does not extend into the Colorado and San Juan river arms of the lake.

Northeast Gap Region

Based on monitoring surveys conducted in Cataract Canyon, razorback sucker were collected in relatively low numbers in 2008 and 2009 (Badame and Lund 2009). The species was less abundant than humpback chub.

Southwest Gap Region

Prior to 2012, razorback sucker was considered extirpated from Grand Canyon. Historic records of razorback sucker in the Southwest Gap Region includes the mouth of the Paria River (1963 and 1978), river mile 39 (1993), and the Little Colorado River inflow (1989 and 1990) (NPS 2013). However, razorback sucker currently is known to occur at scattered locations in the Colorado River from river mile 90 to river mile 260. All of these current locations are located downstream of the Southwest Gap Region study area. Cold water releases from Lake Powell likely limit razorback sucker occurrence in the segment between Glen Canyon Dam and the Little Colorado River confluence.

San Juan River

The San Juan River razorback sucker population is sustained by stocking hatchery-reared fish, with over 130,000 stocked fish since the mid-1990s (USFWS 2015a). Currently, 14,000 razorback suckers with a 300-millimeter total length are stocked annually in the San Juan River. Recent mark-recapture data indicate an increasing trend in razorback abundance. Recent population estimates were 2,000 in 2009 and 3,000 in 2010 (Duran et al. 2013). All razorback sucker collected in 2014 were stocked fish, with ages ranging from 2 to 15 years (Schleicher 2015). There is limited documented evidence that spawning and recruitment of wild fish is occurring in the San Juan River (USFWS 2015a).

Verde River

Razorback sucker have been stocked in the Verde River since 1981 in a section of the river between Perkinsville, Arizona and Horseshoe Reservoir (Hyatt 2004; Robinson 2007). Monitoring efforts recaptured introduced razorback sucker near the introduction sites. Population data are not available, but the hatchery-stocked fish usually do not persist after several years. It is unlikely that razorback sucker is present in the section of the Verde River crossed by the STS.

Life History and Habitat Association

The types of habitat used by razorback sucker vary depending on the life stage and time of year. Adults use eddies, pools, and backwaters during the nonbreeding period from July through March (Maddux et al. 1993). Seasonal habitat use includes pools and eddies from November through April, runs and pools from July through October, runs and backwaters in May, and backwaters and flooded gravel pits during June. Juveniles prefer shallow water with minimal flow in backwaters, tributary mouths, off-channel impoundments, and lateral canals (Maddux et al. 1993). In the upper basin, bottomlands, low-lying wetlands, and oxbow channels flooded and ephemerally connected to the main channel by high spring flows are important habitats for all life stages of razorback sucker. Flow recommendations have been developed to enhance habitat complexity and restore and maintain ecological processes. In the Lower Colorado River Basin, adult razorback sucker utilize open-water areas except in the breeding season

when they congregate in shallow, nearshore areas (USFWS 2002d). Larval razorback sucker in Lake Mohave occupied vegetated areas near the shore.

Spawning occurs in February through mid-June when adult razorback sucker congregate in flooded bottomlands and gravel pits, backwaters, and impounded tributary mouths near spawning sites (USFWS 2002d). Thermal preference for spawning is 22ºC to 25ºC. Razorback sucker typically migrate a long distance in large numbers during the spawning period.

Listing and Conservation Status

The razorback sucker was first proposed for listing as a threatened species under the ESA in 1978 (43 Federal Register 17375). In 1980, the USFWS withdrew the proposal because it was not finalized within the 2-year time limit from the initial publication in the Federal Register (45 Federal Register 35410). In 1989, the USFWS received a petition requesting that the razorback sucker be added to the list of endangered species. A positive finding was made and subsequently published by the USFWS in 1991 (56 Federal Register 54957). In 1994, the USFWS designated 15 reaches of the Colorado River system as critical habitat (USFWS 1994). Critical habitat consists of three primary constituent elements: water (temperature, turbidity, and lack of contaminants), physical (areas used for spawning, feeding, rearing within the 100-year floodplain), and biological environment (adequate food supply and ecologically appropriate levels of predation and competition) (USFWS 1994). Critical habitat is designated in portions of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan rivers in the Upper Colorado River Basin and the Colorado and Little Colorado rivers in the Lower Colorado River Basin. Critical habitat in the Colorado River includes reaches in the Upper Colorado River Basin (above and below Westwater Canyon in Colorado and Utah and the Lower Colorado River Basin from the confluence with the Paria River to Hoover Dam). In total, 1,724 miles of critical habitat for razorback sucker has been designated. Critical habitat overlaps with portions of the action area that were analyzed for this species. This includes 48.8 miles in the Northeast Gap Region, 68.4 miles in the Southwest Gap Region, and 211.1 miles in the San Juan River. Critical habitat in the Verde River extends between Perkinsville, Arizona and Horseshoe Reservoir. The Verde River critical habitat for razorback sucker is located approximately 10 miles downstream of the STS ROW crossing of the Verde River.

A recovery plan for razorback sucker was first published in 1990 and then amended in 2002 (USFWS 2002d). Recovery of razorback sucker in the Colorado River Basin is considered necessary in both the upper and lower basins because of the present status of populations and existing information on razorback sucker biology. The upper basin recovery unit is composed of the Green River, Upper Colorado River, and San Juan River subbasins. The lower basin recovery unit includes the mainstem and tributaries of the Colorado River from Lake Mead downstream to the International Boundary with Mexico (USFWS 2002d). Razorback sucker will be considered eligible for downlisting from endangered to threatened and for removal from ESA protection when all of the following conditions are met:

- Maintain self-sustaining populations in the Green River subbasin and either the Upper Colorado River subbasin or the San Juan River subbasin in the upper basin recovery unit;
- Maintain two genetically and demographically self-sustaining populations in the lower basin recovery unit;
- Maintain a genetic refuge in Lake Mohave;
- Essential habitats, including required instream flows, are legally protected; and
- Other identifiable threats that could significantly affect the population are removed.

Factors Affecting Species

Habitat conditions in areas inhabited by razorback sucker in the Northeast Gap Region, Southwest Gap Region, and San Juan River are discussed above in the baseline characterization section for bonytail, humpback chub, and Colorado pikeminnow, respectively, for these study areas. Additional information regarding factors affecting razorback sucker in the Southwest Gap Region is provided below.

Based on information in the Glen Canyon Dam Long-term Experimental and Management Plan (Reclamation and NPS 2015), the decline of the razorback sucker throughout its range has been related primarily to habitat loss due to dam construction, loss of spawning and nursery habitats as a result of diking and dam operations, and alteration of flow hydrology. It is estimated that approximately 80 percent of the reduction in the historical distribution of this species has been attributed to the construction of Hoover, Parker, Davis, and Glen Canyon Dams on the Colorado River and Flaming Gorge Dam on the Green River. In addition, competition with and predation by non-native fishes also have been identified as important factors in the decline of this species, as discussed for humpback chub. In the Grand Canyon, the decline of native fish, including razorback sucker, has been attributed in large part to an increased diversity and abundance of non-native fishes along with the effects of Glen Canyon Dam on water temperatures, flow, and sediment (Gloss and Coggins 2005).

Ecological Risk

Razorback sucker were evaluated in the Gap Regions ERA by comparison of measured fish tissues concentrations, where available, to CBRs protective of fish health. Modeled fish tissue concentrations also were considered in the absence of measured values. The CBRs used for evaluation of special status species included: mercury 0.2 mg/kg wet weight (Beckvar 2005), selenium 2 mg/kg wet weight (USEPA 2016), and arsenic 5.5 mg/kg wet weight (Jarvinen and Ankley 1999), as cited in the ERAs. In the Northeast Gap, tissue data were available for mercury only. Tissue data for the other metals was modeled from surface water data.

There is a negligible risk from mercury and selenium baseline concentrations present in fish tissue within the Northeast Gap Region for razorback sucker, as indicated by the maximum and refined tissue-based HQ being less than 1 for the surrogate species, channel catfish (Ramboll Environ 2016c) (**Table 3.13-8**). The maximum and refined tissue concentration for mercury was 0.1 mg/kg wet weight with a maximum and refined HQ of 0.5. Measured selenium in fish was not available for the Northeast Gap Region, but the maximum and refined HQs for representative fish exposed to selenium was 0.4 and 0.2, respectively.

Table 3.13-8 Northeast Gap Risk Results for Razorback Sucker Using Surrogate Species Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Mercury	0.1	0.09	0.5	0.5
Selenium	*0.84*	*0.33*	0.4	0.2

Note: Values presented in italicized text indicate that measured tissue data are not available; concentrations are based on modeled result using site-specific uptake factor and surface water concentration.

Baseline fish tissue concentrations in the Southwest Gap Region represent a potential risk to razorback sucker from mercury concentrations, based on tissue-based HQs exceeding 1 (Ramboll Environ 2016c). Razorback sucker maximum (HQ = 5) and refined (HQ = 3) methyl mercury HQs exceeded 1 using flannelmouth sucker as a surrogate species; however, the maximum and refined HQs were less than or equal to 1 using an alternate surrogate, the bluehead sucker (**Table 3.13-9**). Baseline selenium concentrations indicated negligible potential risks to razorback sucker because measured selenium tissue-based HQs were equal to 1 for the surrogate, flannelmouth sucker; and the HQ was below 1 using an alternate surrogate, the bluehead sucker.

Table 3.13-9 Southwest Gap Region Risk Results for Razorback Sucker Using Surrogate Species and Baseline Fish Tissue Data (Existing Conditions)

	Tissue Concentration (mg/kg wet weight)				HQs			
	Bluehead Sucker		Flannelmouth Sucker		Bluehead Sucker		Flannelmouth Sucker	
Metal	Maximum	Refined	Maximum	Refined	Maximum	Refined	Maximum	Refined
Mercury	0.21	0.16	0.98	0.67	1	0.8	5	3
Selenium	1.5	1.3	2.9	2.5	0.8	0.7	1	1

In the San Juan River, there is negligible risks from arsenic, mercury, or selenium under existing conditions using flannelmouth sucker and bluehead sucker as surrogates for razorback sucker, because the tissue-based HQs were less than 1 (Ramboll Environ 2016b) (**Table 3.13-10**).

Table 3.13-10 San Juan River Risk Results for Razorback Sucker Using Surrogate Species and Baseline Fish Tissue Data (Existing Conditions)

	Tissue Concentration (mg/kg wet weight)				HQs			
	Bluehead Sucker		Flannelmouth Sucker		Bluehead Sucker		Flannelmouth Sucker	
Metal	Maximum	Refined	Maximum	Refined	Maximum	Refined	Maximum	Refined
Arsenic	0.36	0.20	0.32	0.10	0.06	0.04	0.06	0.02
Mercury	0.10	0.05	0.27	0.11	0.5	0.2	1	0.6
Selenium	1.60	0.61	2.50	0.81	0.8	0.3	1	0.4

The ERA analysis also included an analysis using razorback sucker tissue data rather than surrogate fish tissue concentrations (Ramboll Environ 2016b). This analysis also showed negligible risks to the species, based on HQs less than 1 for arsenic, mercury, and selenium (**Table 3.13-11**). It is notable that the razorback sucker data used for this latter analysis were from stocked fish. While use of these data are appropriate, these results may underestimate baseline tissue concentrations for wild (non-stocked) fish populations, as stocked fish would have less exposure time to instream conditions compared to wild fish that have spent their entire life in the San Juan River. For this reason, baseline conditions assessed using surrogate fish species for razorback sucker may be of equal relevance to “frame” the potential risk outcome.

Table 3.13-11 San Juan River Risk Results Using Razorback Sucker Tissue and Baseline Fish Tissue Data (Existing Conditions)

Metal	Tissue Concentration (mg/kg wet weight)		HQ	
	Maximum	Refined	Maximum	Refined
Arsenic	0.34	0.22	0.06	0.04
Mercury	0.15	0.09	0.7	0.4
Selenium	2.30	0.95	1	0.5

3.13.3.1.2.5 Kanab Ambersnail

Species Occurrence

The historic distribution of the terrestrial snail Kanab ambersnail (*Oxyloma haydena kanabensis*) is limited to Kanab and Three Lakes canyons near Kanab, Utah ((Meretsky et al. 2002). Currently the species is known to exist at two locations within the Southwest Gap Region. One wild or natural population is present in a riverside spring called Vasey's Paradise within Grand Canyon National Park (AGFD 2013a). One introduced extant population also occurs in Upper Elves Canyon within Grand Canyon National Park. Critical habitat has not been designated for the species. The estimated population size at Vasey's Paradise ranged from approximately 3,100 to 104,000 individuals (USFWS 2011c). Population counts were highly variable due to temporal and spatial population densities, sampling error, and variability in sampling methods (USFWS 2011c). Occupied and potential habitat for the Vasey's Paradise population also has varied, with the maximum estimated area of 9,699 feet^2 (USFWS 2011c). The AGFD translocated 340 Kanab ambersnails from Vasey's Paradise to Upper Elves Canyon in 1998 and 2002.

Life History and Habitat Association

Kanab ambersnail is associated with vegetation in spring areas. Habitat at the Vasey's Paradise site consists of a cool spring that flows directly from limestone down a steep gradient to the mainstem of the Colorado River (USFWS 2011c). Within large patches of mixed vegetation composed primarily of crimson monkeyflower (*Mimulus cardinalis*), watercress (*Nasturtium officinale*), and sedge (*Carex aquatilus*), the snail inhabits dead and decaying monkeyflower litter and live watercress. The Upper Elves Canyon site is a spring area dominated by monkeyflower and maidenhair fern (*Adiantum cappillus-veneris*).

Listing and Conservation Status

Kanab ambersnail was proposed for federal endangered listing in November 1991 (56 Federal Register 58020-58025). The final rule for endangered status was published in April 1992 (57 Federal Register 13657-13662), although a correction was made in September 1992 (57 Federal Register 44340).

A recovery plan for the Kanab ambersnail was issued in October 1995, with the first 5-year review completed in 2011 (USFWS 2011c). The review indicated that the Kanab ambersnail faces a high degree of threat from the modification of wetland habitat, and the recovery potential is low due to conflict with private land development projects.

Factors Affecting Species

Factors affecting Kanab ambersnail include the modification of wetland habitats and private land development activities that reduce or alter habitat for this species.

Ecological Risk

Ecological risk from NGS and the proposed KMC emissions is not expected because Kanab ambersnail occurs in wetland or spring areas located outside of the Colorado River channel. These areas are not impacted by deposition or runoff into the mainstem of the Colorado River.

3.13.3.1.3 Other Special Status Aquatic Species

Other special status aquatic species that occur within the NGS Near-field deposition area, Gap Regions, and San Juan River are listed in **Table 3.13-12**. The additional species include three fish (bluehead sucker, flannelmouth sucker, and speckled dace) and one amphibian (northern leopard frog). Three federally listed fish species (Colorado pikeminnow, humpback chub, and razorback sucker), also are Navajo endangered species and Arizona Species of Special Concern. Other native fish species that occur in the NGS study areas include roundtail chub (Colorado and San Juan rivers), speckled dace (Gap Regions and San Juan River), and redside shiner (Colorado River Northeast Gap Region). The roundtail chub is a Navajo endangered species.

Table 3.13-12 Other Special Status Aquatic Species in the Lake Powell, Colorado River Gap Regions, and San Juan River Analysis Areas

Species	Status[1]	Lake Powell	Colorado River Northeast Gap Region	Colorado River Southwest Gap Region	Lower San Juan River
Fish					
Bluehead sucker	SGCN, NME		X	X	X
Flannelmouth sucker	SGCN	X	X	X	X
Roundtail chub	NESL G2		X[2]		X
Speckled dace	BLMS, SGCN		X	X	X
Amphibians					
Northern leopard frog	BLMS, NESL G2, SGCN			X	

[1] Status = BLMS = BLM Sensitive; NESL = Navajo Endangered Species List (G2 and G3); SGCN = Arizona Species of Greatest Conservation Need; NME = New Mexico Endangered Species.

[2] Species occurrence in study area; however, the study area is not within or adjacent to Navajo Nation land.

3.13.3.2 Proposed Kayenta Mine Complex

No federally listed, proposed, or candidate aquatic species occur within the proposed KMC and N-Aquifer groundwater study area. Potential habitat for one special status aquatic species (Navajo Nation endangered), northern leopard frog, is present within the proposed KMC N-Aquifer groundwater study area. Historic records exist for northern leopard frog in Cow Springs; however, no recent occurrence has been documented (Smith and Hazelton 2014).

3.13.3.3 Transmission Systems and Communication Sites

Table 3.13-13 provides a list of special status fish, amphibians, and aquatic invertebrate species that have habitat crossed by the WTS and STS ROWs. Eight federally listed fish species (desert pupfish, Gila chub, Gila topminnow, loach minnow, razorback sucker, spikedace, Virgin River chub, and woundfin) and one proposed for listing (roundtail chub) occur in streams crossed by the transmission lines. Critical habitat is crossed by the transmission system ROWs for four fish species (loach minnow, spikedace, Virgin River chub, and woundfin) (**Figure 3.13-2**). Twelve additional aquatic species (desert sucker, flannelmouth sucker, Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace, Moapa speckled dace, speckled dace, Virgin spinedace, Arizona toad, Great Plains toad, western boreal toad, northern leopard frog, and Niobrara ambersnail) with special status related to either BLM sensitive, Forest sensitive, Navajo endangered, or Arizona or Nevada protected have known or potential habitat within the ROWs for the WTS and STS. The following information provides a summary of occurrence, critical habitat, habitat preferences, life history, and conservation status for the federally listed species.

Table 3.13-13 Special Status Aquatic Species Occurring in Streams Crossed by the Transmission Systems

Common Name	Scientific Name	Status[1]	WTS	STS	Streams
Fish					
Colorado pikeminnow	*Ptychocheilus lucius*	EXP/NE		K	Verde River
Desert pupfish	*Cyprinodon macularius*	FE		K	Agua Fria River
Desert sucker	*Catostomus clarkii*	BLMS	K		Virgin River
Gila chub	*Gila intermedia*	FE		K	Agua Fria River
Gila topminnow	*Poeciliopsis occidentalis*	FE		K	Agua Fria River
Flannelmouth sucker	*Catostomus latipinnis*	BLMS, FS	K		Colorado and Virgin rivers
Loach minnow	*Rhinichthys cobitis*	FE		K (CH)	Verde River
Meadow Valley Wash desert sucker	*Catostomus clarkia* subspecies	BLMS, NV-P	K		Meadow Valley Wash and Muddy River
Meadow Valley Wash speckled dace	*Rhinichthys osculus* subspecies	BLMS, NV-P	K		Meadow Valley Wash and Muddy River
Moapa speckled dace	*Rhinichthys osculus moapae)*	NV-P	K		Muddy River
Razorback sucker	*Xyrauchen texanus*	FE		K	Verde River
Roundtail chub	*Gila robusta*	FPT, NESL G2		K	Verde River
Speckled dace	*Rhinichthys osculus*	BLMS	K	P	Colorado, Paria, Verde, and Virgin rivers
Spikedace	*Meda fulgida*	FE		K (CH)	Verde River
Virgin River chub	*Gila seminuda*	FE	K (CH)		Muddy and Virgin rivers
Virgin spinedace	*Lepidomeda mollispinis mollispinis*	BLMS, NV-P, CA	K		Virgin River
Woundfin	*Plagopterus argentissimus*	FE	K (CH)		Virgin River
Amphibians					
Arizona toad	*Anaxyrus microscaphus*	BLMS	K		Muddy and Virgin rivers (breeding period)
Great Plains toad	*Anaxyrus cognatus*	BLMS	K		Streams, floodplains

Table 3.13-13 Special Status Aquatic Species Occurring in Streams Crossed by the Transmission Systems

Common Name	Scientific Name	Status[1]	WTS	STS	Streams
Northern leopard frog	*Lithobates pipiens*	BLMS, FS, NESL G2	K		Paria River
Western (boreal) toad	*Anaxyrus boreas*	BLMS	K		Wetlands, floodplain (breeding period)
Invertebrates					
Desert springsnail	*Pyrgulopsis deserta*	BLMS	K		Virgin River
Niobrara ambersnail	*Oxyloma haydeni haydeni*	BLMS	K		Gypsum Wash

[1] Status: FE = Federally Endangered; FT = Federally Threatened; FPT = Federally Proposed Threatened; EXP/NE = Experimental/Non-essential population; BLMS = BLM Sensitive; FS = Forest Sensitive; NESL = Navajo Endangered Species List (G2 and G3); NV-P = Nevada Protected; CA = Conservation Agreement species.

[2] CH = Designated Critical Habitat; K = known occurrence.

3.13.3.3.1 Federally Listed, Candidate, and Proposed Aquatic Species

Colorado pikeminnow and razorback sucker are described above in Section 3.13.3.1.

3.13.3.3.1.1 Desert Pupfish

Species Occurrence

Desert pupfish were once common in the lower Gila and Colorado River drainages in Arizona, California, and Mexico. They also formerly occurred in reaches of some large rivers including the Colorado, Gila, San Pedro, and Santa Cruz rivers (Federal Register 49(96): 20740). As of 2010, naturally occurring populations of desert pupfish were limited to two tributaries and shoreline pools and irrigation drains of the Salton Sea in California. Although numerous reintroductions have been attempted, approximately 16 transplanted populations of the desert pupfish exist in the wild at present, all in Arizona (Tier 2 populations in the Recovery Plan) (USFWS 2010). There is a total of 47 captive or refuge desert pupfish populations (that do not qualify for the Tier 3 category), which include 34 sites in Arizona. Potential occurrence for desert pupfish is listed in Maricopa and Yavapai counties, Arizona. Desert pupfish is known to occur within the Agua Fria River drainage; however, there are no extant populations present in the mainstem of the Agua Fria or the Verde River (Weedman 2016).The closest known occurrence is located approximately 0.5 mile from the STS ROW. Critical habitat has been designated for desert pupfish in Imperial County, California and Pima County, Arizona, but none is present within the STS study area.

Life History and Habitat Association

Desert pupfish occurs in a wide variety of habits including springs, cienagas, small streams, and the margins of larger waterbodies (USFWS 1993). Occurrence in most of these habitats was characterized as having shallow water, soft bottom substrates, and clear water clarity. The habitats also typically contain rooted or unattached vegetation. This species can tolerate high salinities, high water temperatures, and lower oxygen content compared to most other fish species. The spawning period for desert pupfish ranges from early spring into winter.

Listing and Conservation Status

Desert pupfish was proposed as federally endangered with critical habitat in 1984 (49 Federal Register 20739-20744). The final determination of endangered species status and critical habitat was

made in 1986 (51 Federal Register 10842-10851). A recovery plan was prepared for desert pupfish in 1993 (USFWS 1993). The goal of the recovery plan is to describe actions necessary to eliminate threats to extant populations and successfully establish additional populations in secure habitats within the species' historical range. Once the actions are successfully completed and meet specific criteria, downlisting from federally endangered to threatened would be considered. Based on a recent 5-year review for the species, no change in the recovery status was recommended (USFWS 2010). The recovery status continues to be a high degree of threat and a high potential for recovery.

Factors Affecting Species

Although aerial photo interpretation indicates that aquatic habitat is largely intact in the portions of the Agua Fria River that are traversed and paralleled by the STS, the proximity of these areas to human development suggests that desert pupfish habitat in the action area may be affected by recreational activities, road use and maintenance, and environmental contaminants such as pesticides. The presence of harmful non-native species also may be a factor affecting desert pupfish and their habitat in these portions of the study area.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.2 Gila Chub

Species Occurrence

Small remnant populations of Gila chub are known to occur in the Verde River drainage, with the mainstem portion of the Verde River being crossed by the STS ROW (USFWS 2008a). There currently are about 25 populations in tributaries of seven drainages in Arizona. This species has been eliminated from approximately 85 to 90 percent of its formerly occupied habitat, and much of the loss is unrecoverable. Population numbers in the Verde River are unknown. The trend over the past 10 years or three generations indicates that this species is expected to be slowly declining (NatureServe 2013d). The closest current population in the Verde River drainage is located in a tributary located approximately 20 miles east of the STS ROW. The Verde River would be considered potential habitat for Gila chub. Habitat for Gila chub also occurs in the Agua Fria River, which is crossed by the STS. Critical habitat is located in the Agua Fria River drainage, with the closest segments located in Lousy Canyon and Larry Creek. These critical habitat segments are located northeast and upgradient from the STS ROW at distances of 0.9 and 2.4 miles, respectively. Critical habitat also is located in the Verde River drainage, but the closest segment is approximately 18 miles east of the STS ROW.

Life History and Habitat Association

Gila chub typically inhabit pools in creeks and small streams, cienegas, and artificial impoundments at elevations from approximately 2,000 to 5,550 feet (USFWS 2008a). Gila chub often use aquatic habitat that contains cover such riparian vegetation or boulders and submerged logs. Adult fish are associated with deep pools and eddies below areas with swift currents. Young-of-year fish inhabit shallow water among plants or debris, while juvenile fish use areas with higher velocities. Gila chub breeds in late spring to summer (USFWS 2015b).

Listing and Conservation Status

Gila chub was proposed for federally endangered listing in August 2002 (67 Federal Register 51948-51985). The final rule for endangered status and critical habitat designation was published in November 2005 (70 Federal Register 66664-66721). A 5-year review was initiated for Gila chub in February 2009 to

ensure that the federal listing status was accurate or needed to be changed (74 Federal Register 6917-6919). A public review draft of a recovery plan for Gila chub was made available on October 27, 2015 (80 Federal Register 65793-65795). Critical habitat has been designated in the Agua Fria and Verde rivers, but they are outside of the STS study area.

Factors Affecting Species

The establishment of non-native fishes within the Gila River basin is a primary threat to the persistence of Gila chub. Secondary threats are habitat alteration, destruction, and fragmentation. The influence of factors affecting Gila chub likely varies by location, with relatively few factors affecting potential Gila chub habitat at the Verde River crossing and a greater number of factors affecting critical habitat at the Agua Fria River crossings, which are in closer proximity to human development and therefore at greater risk of direct and indirect impacts from recreation within riparian corridors; livestock grazing; road construction, use, and maintenance; and environmental contaminants.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.3 Gila Topminnow

Species Occurrence

Gila topminnow is endemic to the Gila River system of Arizona, New Mexico, and northern Sonora, Mexico (Nico et al. 2015). Eleven of the naturally occurring populations are in the Santa Cruz River system, while the other two are in the Gila River drainage (Weedman 1998). Gila topminnow has been stocked in several sites in Arizona within their native range, including a tributary to the Agua Fria River (Nico et al. 2015). The Agua Fria River is crossed by the STS ROW; however, Gila topminnow has never been documented in the mainstem of the river (Weedman 2016). Gila topminnow has been stocked outside of its native historic range in a number of locations in Arizona including Cochise, Gila, Graham, Pima, Pinal, Santa Cruz, and Yavapai counties (Nico et al. 2015). Maricopa and Yavapai counties are crossed by the STS ROW. No critical habitat has been designated for Gila topminnow.

Life History and Habitat Association

Gila topminnow prefers shallow, warm, relatively quiet waters in a wide range of aquatic habitats including ponds, cienegas, tanks, pools, springs, small streams, and the margins of larger streams (USFWS 2015c). Dense mats of algae and debris along the margins of the habitats usually are an important component for cover and foraging areas. Organic muds and detritus also are used for foraging. The breeding period for Gila topminnow is from January through August, with some populations capable of breeding throughout the year.

Listing and Conservation Status

Gila topminnow was listed as federally endangered in March 1967 (32 Federal Register 2007). A 5-year review was initiated in 2007. A revised recovery plan was prepared for Gila topminnow in 1998 (Weedman 1998). The short-term goal of the plan is to prevent extirpation of the species from its natural locations in the U.S. and reintroduce it into suitable habitat within its former range.

Factors Affecting Species

Factors affecting Gila topminnow and its habitat within the study area are the same as listed for Gila chub. Potential habitat in the portions of the Agua Fria River that are traversed by the STS, is in close

enough proximity to development that it is likely subject to some level of direct and indirect impacts associated with recreation within riparian corridors; livestock grazing; road construction, use, and maintenance; and environmental contaminants such as pesticides, as well as potential fuel and oil spills from cars and recreational vehicles.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.4 Loach Minnow

Species Occurrence

Historical records of loach minnow exist for the Verde River, but no current populations exist for this species (USFWS 2012c, 1990a). However, the species is considered to be extirpated from the Verde River. Due to declining populations of loach minnow, AGFD and the USFWS, in coordination with other agencies, established refuge populations and breeding stock at the AGFD Aquatic Research and Conservation Center. Since 2007, these agencies have stocked loach minnow in streams within their historic range. Critical habitat for loach minnow has been designated for the Verde River, which is crossed by the STS ROW.

Life History and Habitat Association

Loach minnow is a bottom-dwelling fish that occurs in small to large perennial creeks and rivers (USFWS 2012b). Habitat consists of shallow depths in turbulent riffles over cobble-dominated substrates up to elevations of approximately 8,000 feet. Some habitat used by this species contains dense filamentous growth (USFWS 1990a). Loach minnow spawn as 1-year-old fish in the winter through early spring (USFWS 1990a). The same riffles occupied by adults in the non-spawning period are used.

Listing and Conservation Status

The loach minnow was listed as a threatened species without critical habitat in 1986 (51 Federal Register 39468). Loach minnow was proposed for federal endangered status and critical habitat in October 2011 (75 Federal Register 66482-66552). The final rule for endangered status and critical habitat designation was made in February 2012 (77 Federal Register 10810-10932). The latest 5-year status review for this species was initiated in 2012. A recovery plan was prepared for the loach minnow in 1991 (USFWS 1990a). The recovery objective is to protect existing populations, restore populations in portions of historic habitat, and eventual delisting, if possible.

Factors Affecting Species

Threats to loach minnow include dams, water diversions, watershed degradation, channel modifications, and introduction of non-native fish species. Although flows in the reach of the Verde River that is crossed by the STS are likely controlled to some extent by Sullivan Dam, aerial photo interpretation indicates that aquatic and riparian habitats are intact in the action area with little or no evidence of watershed degradation and channel modification.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.5 Roundtail Chub

Species Occurrence

The Lower Colorado River distinct population segment of the roundtail chub is proposed for threatened status in Arizona and New Mexico. The current roundtail chub distinct population segments are found in five separate drainages that are isolated from one another (Little Colorado River, Bill Williams River, Gila River, Salt River, and Verde River).

Life History and Habitat Association

The roundtail chub occurs in cool to warm water over a wide range of rivers and streams throughout the Colorado River basin. The species typically occurs in open areas of the deepest pools and eddies of mid-sized to large rivers (USFWS 2009).

Listing and Conservation Status

On December 30, 1982 (47 Federal Register 58455), the roundtail chub was placed on a list of candidate species as a category 2 species. Roundtail chub retained this category candidate status until the practice identifying category 2 candidates was discontinued in 1996. In 1996, roundtail chub was removed from the candidate list. On April 14, 2003, the USFWS received a petition from the Center for Biological Diversity to list a distinct population segment of the roundtail chub in the Lower Colorado River Basin. A 90-day finding was published on July 12, 2005 (70 Federal Register 39981), which indicated that the petition presented substantial scientific information to warrant consideration for listing. Subsequent 12-month findings were published in May 2006 and July 2009 (71 Federal Register 26007 and 74 Federal Register 32352, respectively) regarding the definition of distinct population segment and whether the roundtail chub met the definition. The 2009 finding indicated that the population satisfied the discreteness and significance elements of the Interagency Policy Regarding the Recognition of Distinct Vertebrate Population Segments and qualified as a distinct population segment. From 2009 through 2014, the USFWS concluded that the listing of the lower Colorado River distinct population segment was warranted but precluded due to higher priority listing actions. The distinct population segment of the roundtail chub was proposed for federal threatened status on October 7, 2015 (80 Federal Register 60753-60783).

Currently, roundtail chub occupy approximately 43 percent of their historic range (80 Federal Register 60753-60783). The risk of extirpation in the Verde River is considered to be moderate. Past conservation efforts include the establishment of new populations for roundtail chub in the Lower Colorado Basin distinct population segment and the renovation or securing of currently occupied areas. There are currently four newly established sites for this species, with two being in the Verde River drainage (Gap and Roundtree creeks). There is a statewide conservation agreement for roundtail chub.

Factors Affecting Species

The primary factor affecting habitat for the roundtail chub within the action area is likely the presence of non-native fish species, which may compete with and prey upon the roundtail chub.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.6 Spikedace

Species Occurrence

Historically, spikedace was common throughout much of the Gila River drainage located north of Phoenix, Arizona, including the Verde River, which is crossed by the STS ROW (USFWS 2012d). By 2009, spikedace had not been collected in the Verde River in a decade (AGFD 2013b). Due to declining populations of spikedace, AGFD and the USFWS, in coordination with other agencies, established refuge populations and breeding stock at the AGFD Aquatic Research and Conservation Center. Since 2007, these agencies have stocked spikedace in streams within their historic range. Critical habitat for spikedace has been designated in the Verde River, which is crossed by the STS ROW.

Life History and Habitat Association

Spikedace occur in moderate to large perennial streams with moderate to high velocities and depths, usually less than about 3 feet (USFWS 2012d, 1990b). Adult fish often concentrate along gravel-sand bars; quiet eddies on the downstream edge of eddies; or broad, shallow areas above gravel-sand bars (USFWS 1990b). Recurrent flooding helps the spikedace maintain its competitive edge over invasion from exotic species in a stream (USFWS 2012d). Fish tend to use areas with higher flows in the springtime. Spikedace spawn in the spring (April through June) in response to a combination of stream discharge and water temperature (USFWS 1990b). Spawning habitat consists of shallow areas that are dominated by sand substrate.

Listing and Conservation Status

The spikedace was listed as a threatened species with critical habitat in 1986 (51 Federal Register 23769). Spikedace was proposed for federal endangered status and critical habitat in October 2011 (75 Federal Register 66482-66552). The final rule for endangered status and critical habitat designation was made in February 2012 (77 Federal Register 10810-10932). The latest 5-year status review for this species was in 2012. A recovery plan was prepared for the spikedace in 1991 (USFWS 1990b). The recovery objective is to protect existing populations, restore populations in portions of historic habitat, and eventual delisting, if criteria are met.

Factors Affecting Species

The primary factors affecting potential habitat for the spikedace within the study area are the presence of non-native fish species and groundwater pumping. Although flows in the reach of the Verde River that is crossed by the STS are likely controlled to some extent by Sullivan Dam, aerial photo interpretation indicates that aquatic and riparian habitats are intact in this portion of the action area with little or no evidence of watershed degradation and channel modification.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.7 Virgin River Chub

Species Occurrence

The Virgin River chub occurs in the Muddy and Virgin rivers, which are crossed by the WTS ROW. Virgin River chub is endemic to the Virgin River system in southwestern Utah, southern Nevada, and northwestern Arizona, and the Muddy (Moapa) River in Nevada. The current range for this species includes the Muddy River and the Virgin River near the Nevada-Arizona border to the southwestern

corner of Utah. Although critical habitat has been designated for this species in the Virgin River, the Muddy River is not considered to be part of the federal listing or critical habitat designation at this time.

Life History and Habitat Association

Adult and juvenile Virgin River chub prefer deep runs and pools with slow to moderate velocities containing boulders or instream cover over sand or gravel substrate (65 Federal Register 4141; USFWS 2012e, 1994). Generally, larger fish occur in deeper portions of the stream. The species is very tolerant of high salinity and turbidity. Virgin River chub spawns during late spring and early summer over gravel and rock substrates.

Listing and Conservation Status

The Virgin River chub was officially listed as federally endangered in 1989, but designation of critical habitat was postponed (54 Federal Register 35305). In 2000, 87.5 miles of the Virgin River in Utah, Arizona, and Nevada was designated as critical habitat (65 Federal Register 4140). When the species was listed, the USFWS recognized that a closely related species was found in the Moapa (Muddy) River in Nevada, but it was affected by the listing in 1989. The Muddy River population is not considered part of the federal listing at this time. However, a proposed rule change regarding federal listing is under review by the USFWS.

The Virgin River Fishes Recovery Plan was prepared in 1994, which included Virgin River chub as one of the species that was addressed (USFWS 1994). The objective of recovery for Virgin River chub and woundfin for downlisting from federally endangered to threatened status. This recovery objective is based on the following criteria: 1) the Virgin River flows essential to survival of all life stages are protected; 2) degraded habitat in the Virgin River from Pah Tempe Springs to Lake Mead is upgraded; and 3) barriers are established to limit movement of non-native fish species and red shiner is eliminated from the Virgin River.

Factors Affecting Species

Threats to Virgin River chub include alteration of flows due to dam construction and water diversions, water quality degradation, and the introduction of non-native fish species.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.3.3.1.8 Woundfin

Species Occurrence

Historically, the woundfin occupied most of the lower Colorado River and Gila River basins in Arizona, Nevada, and Utah. Over the past 30 years, woundfin generally have declined throughout their occupied range (NatureServe 2013e). Except for the mainstem portion of the Virgin River, woundfin are extirpated from most of its historical range. Current distribution for woundfin extends from Pah Tempe (also called La Verkin Springs) on the mainstem of the Virgin River to Halfway Wash, Nevada (65 Federal Register 4141). Although the species was collected in the middle portion of the Muddy (Moapa) River in the 1960s, no additional specimens have been collected in the last 50 years. Critical habitat has been designated for woundfin, which includes portions of the Virgin River and its associated 100-year floodplain. The Virgin River is crossed by the WTS ROW.

Life History and Habitat Association

Woundfin adults and juveniles are most often collected from runs and quiet waters with adjacent riffles (65 Federal Register 4141; USFWS 2008b). Juvenile fish tend to be associated with habitats that contain slower and quieter water compared to adults. Larvae are found in backwater areas and stream margins. Spawning occurs during late spring when flows are declining (65 Federal Register 4141).

Listing and Conservation Status

Woundfin was listed as federally endangered in October 1970 for its entire range of occurrence in Arizona and New Mexico except the Gila River (35 Federal Register 16047-16048). Critical habitat was designated for woundfin in January 2000 (65 Federal Register 4140-4156). The most recent 5-year review for woundfin was completed in April 2006 (71 Federal Register 54922-54923). The original recovery plan for woundfin was prepared in 1979 and revised in 1985. The Virgin River Fishes Recovery Plan was prepared in 1994, which included woundfin as one of the species that was addressed (USFWS 1994). The objective and criteria of recovery for woundfin are the same as described for Virgin River chub. The Virgin River Habitat Conservation and Recovery Program was completed in July 2007 (72 Federal Register 54922-54923).

Factors Affecting Species

Threats to woundfin include alteration of flows due to dam construction and water diversions, water quality degradation, and the introduction of non-native fish species.

Ecological Risk

Ecological risk from existing emissions has not been evaluated for this species as the transmission line systems are located outside of the area affected by emissions from NGS and the proposed KMC.

3.13.4 Environmental Consequences

3.13.4.1 Issues

3.13.4.1.1 Navajo Generating Station

Issue 1 – Emissions and Deposition - special status aquatic species within the NGS Near-field, Gap Regions, and the San Juan River ERA areas were analyzed for emission and deposition effects. Critical habitat for federally listed fish species in the Gap Regions and the San Juan River ERA areas were analyzed for emission and deposition effects.

3.13.4.1.2 Proposed Kayenta Mine Complex

Issue 1 – Emissions and Deposition - potential impacts of emission and deposition caused by KMC future operations were analyzed for effects on northern leopard frog.

Issue 2 – Groundwater Pumping - mine well pumping was modeled to determine potential effects on groundwater and connected surface waters, ultimately affecting northern leopard frog.

3.13.4.1.3 Transmission Systems and Communication Sites

Issue 1 – Operation and Maintenance - effects of operation and maintenance of the transmission systems were analyzed for special status aquatic species in perennial streams crossed by the WTS and STS ROWs.

3.13.4.2 Assumptions and Impact Methodology

3.13.4.2.1 Assumptions

The following assumptions were used in the impact analysis for special status aquatic species.

- Known or recent records of special status species occurrences within portions of the study area were considered to represent "presence."
- Surrogate species identified in the ERAs are representative of special status fish species that occur in the study area. Surrogate species that were used for federally listed fish species are mentioned in the impact discussions.
- Assumptions used in the emission and deposition analyses are described in the ERAs (Ramboll Environ 2016a,b,c,d).
- Potential surface disturbance from operation and maintenance activities could occur within the WTS and STS ROWs. However, there would be no direct disturbance within the stream perennial stream channels by vehicles or equipment.

3.13.4.2.2 Impact Methodology

The impact methodologies used to analyze project effects on special status aquatic species are the same as those listed in Section 3.12.3, Aquatic Biological Resources. Impacts are organized by each of the federally listed species followed by a combined section for other special status species with BLM, U.S. Forest Service, Navajo Nation, Hopi Tribe, or state designations. Impact discussions are organized by federally listed species so that the information tracks with the Biological Assessment. A summary of the methodologies for the ERAs is provided in **Appendix 3RA**, Ecological and Human Health Risk Assessments and full detail is provided in the ERA reports (Ramboll Environ 2016a,b,c,d).

Fish species for which mercury concentration data were available were used as surrogate species as being representative of the fish species of interest in the ERAs. Special status species fish include humpback chub, bonytail chub, razorback sucker and Colorado pikeminnow.

Impacts are discussed for all project components. However, due to a lack of perennial aquatic habitat along the BM&LP Railroad ROW, no special status species occur in this study area. As a result, there would be no impacts from the railroad operation on special status aquatic species and no further analysis was conducted for the BM&LP Railroad ROW.

Impact parameters and toxicity thresholds were used in combination with effects information for the purpose of estimating the intensity of impacts to special status aquatic species. The impact parameters vary depending on the project component, as listed below. Threshold values were not used for the transmission systems because the nature of the impacts from operation and maintenance activities would not involve direct disturbances to perennial stream habitat.

- NGS Deposition Risks to Special Status Aquatic Species – Both maximum and refined HQ values resulting from the ERAs (Ramboll Environ 2016a,b,c,d) were used as indicators of risk to special status aquatic species from metals (mainly arsenic, mercury, and selenium). Maximum HQs were used in the analysis as a conservative estimate of the highest exposure level for individual species. The environmental consequences section focused on the refined HQs, since they are considered to be a realistic estimate of exposure. Refined HQ values of 1 or greater were indicators of potential risk to aquatic species. Refined HQs less than 1 were considered to represent negligible risk to aquatic species. The effect thresholds for special status fish were based on literature-derived CBRs including 0.2 mg/kg wet weight for mercury (Dillon et al. 2010); 2 mg/kg wet weight for selenium (USEPA 2016); and 1 mg/kg wet weight for arsenic (McGeachy and Dixon 1990). Additional detail on this analysis is provided in Section 3.0.3 of this EIS and in the ERA reports.

- NGS Deposition Effects on Critical Habitat for Federally listed Fish Species – The effect on critical habitat was analyzed in the San Juan River and Gap Region (Colorado River) for federally listed fish species. Impact parameters used for the critical habitat analysis are described in further detail below.
- Injury Effects to Federally Listed Fish Species – The effect on federally listed fish species was estimated using the USFWS methodology and expressed as the number of individuals affected for various life stages. The impact methodology used for the injury effects analysis is described in further detail below.
- Proposed KMC Groundwater Pumping – The percent change in stream flows compared to baseline conditions was used as an indicator of effects on the special status species, northern leopard frog.
- Transmission Systems – Perennial streams crossed by the WTS and STS ROW and access road system were used as an indicator of areas where potential operation and maintenance activities needed to be assessed.

3.13.4.2.2.1 Injury Effect Quantification for Federally Listed Fish Species

Quantification of injury effects on individual fish was made for two federally listed species in the San Juan River (Colorado pikeminnow and razorback sucker) and Southwest Gap Region (humpback chub and razorback sucker). The injury effect analyses were conducted by the USFWS. Results are considered to be preliminary at this time. Based on magnitude of impacts, evaluation of the best available science, and discussions with USFWS during informal consultation, the preliminary estimates are considered to be a reasonable estimate of anticipated impacts to the fish species. Injury effects will be finalized in the Biological Opinion for this project. Additional details on the methodology for the quantification analysis are provided in **Appendix 3.13-A** of this EIS. A summary of the Southwest Gap Region and San Juan River analyses are described below.

The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence as to whether the listed fish would be affected by the project, and it is distinct from what was conducted for the ERAs, which identified potential risk of effects to species. The ERA results were used in determining whether an injury effect analysis should be completed. The ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of the number of individuals affected.

- Southwest Gap Region – The injury estimate for the Southwest Gap Region was done using population data for humpback chub and the recovery population number for razorback sucker (5,600 adults). Toxicity dose-response curves for the various life stages of these species (eggs/embryos, larvae, juveniles, and adults) were applied to the population estimates for adults. The total number of individuals injured was estimated for the entire period of 2020 to 2074. The estimate was for the total combination of baseline, project emissions, and other cumulative emission sources.
- San Juan River – The injury estimate for the San Juan River was done using (1) population data for Colorado pikeminnow and razorback sucker in combination with (2) mercury toxicity dose-response curves for the various life stages of the species (eggs/embryos, larvae, juveniles, and adults) and (3) estimated total cumulative dose from baseline, NGS emissions and other cumulative sources. Injury was estimated for subadults (juveniles) and adults based on effects most likely to impact individuals including reproduction, survival, and growth. Behavior also was considered. Injury was expressed as the number of individuals affected. The total number of individuals potentially injured was estimated for the entire period of 2020 to 2074. The estimate

was for the total combination of baseline, project emissions, and other cumulative emission sources.

Species effects also were evaluated in terms overall population numbers to determine the context of the impact. This consideration of impact context was then used to determine the relative magnitude of the impact. Impacts to special status aquatic species were evaluated in terms of four categories: none, negligible, minor, or moderate. These categories are defined in Section 3.0 of this EIS. There were no major effects on special status aquatic species, as defined in Section 3.0. The categories used for the various effects are further explained in the species discussions.

3.13.4.2.2.2 Critical Habitat Analysis

The critical habitat analysis was conducted following direction from the USFWS to evaluate potential impacts to critical habitat in the San Juan River and Colorado River Gap Regions (Northeast Gap and Southwest Gap). The ERA evaluated potential for adverse effects to the aquatic community by comparison of surface water concentrations to applicable water quality standards and evaluated fish by comparison of fish tissue concentrations to protective tissue concentrations. The outcomes of those evaluations serve as a point of departure to evaluate potential effects on the water element of critical habitat. Per USFWS direction, critical habitat was conservatively analyzed in the San Juan River, Northeast Gap Region (Colorado River above Lake Powell), and Southwest Gap Region (lower Colorado River), because maximum and refined tissue-based total cumulative HQs were1 or greater for all four listed fish species (bonytail chub, Colorado pikeminnow, humpback chub and razorback sucker) in the Northeast Gap Region (Colorado River above Lake Powell), humpback chub and razorback sucker in the Southwest Gap Region (Colorado River below Lake Powell), and Colorado pikeminnow and razorback sucker in the San Juan River.

The deposition effects on critical habitat for federally listed fish species was analyzed using two primary methods for assessing potential effects. Evaluation was based on comparison of measured surface water concentrations to: 1) applicable state and/or federal water quality criteria; and/or 2) species specific protective surface water concentration developed by the USFWS. The latter comparison was performed by establishing a protective water concentration for methylmercury, for which adequate species data and dose-response data are available. For evaluation of arsenic and selenium, comparison was done by comparing dissolved (filtered) surface water concentrations for arsenic and selenium to applicable chronic ambient water quality criteria as listed in the USEPA National Ambient Water Quality Criteria (National Ambient Water Quality Criteria [USEPA 2009, 2016]), which are 3.1 µg/L for selenium (based on recent finalization of the criteria by USEPA) and 150 µg/L for arsenic. For mercury, the National Ambient Water Quality Criteria is 0.77 µg/L (dissolved), which is inclusive of inorganic and organic mercuric compounds, was considered in addition to the protective methylmercury level developed by USFWS; a National Ambient Water Quality Criterion for methylmercury is not available. State-specific and/or Navajo Nation Water Quality Standards are also considered, as applicable, to assess critical habitat effects. Because tissue-based HQs and comparison of surface water concentrations resulted in no exceedance of applicable ecological screening values for arsenic, arsenic exposure to special status species is negligible.

The USFWS methylmercury surface water concentration protective of piscivorous fish was estimated as 0.0002 µg/L based on back-calculation of a protective water concentration using the no observed effect concentration CBR of 0.2 milligrams per kilogram, wet weight (mg/kg ww) per Beckvar et al. (2005) and the bioconcentration factor of 1,300,000 based on literature-derived surface and fish tissue concentrations for predatory fish in the NGS Near-field study area, that includes Lake Powell and Colorado River water data and fish tissue data (Ramboll Environ 2016a). Per USFWS methodology, a conclusion of an “effect” on critical habitat was made if surface water concentrations exceeded the respective criterion or species-specific protective water concentration.

3.13.4.2.2.3 Conservation Measures

Conservation measures are described in the impact discussions for Colorado pikeminnow, humpback chub, and razorback sucker to mitigate the effects of NGS emissions and deposition of mercury and selenium in the Southwest Gap Region (Colorado River downstream of Glen Canyon Dam) and San Juan River. The conservation measures also are described in **Appendix 4A** of this EIS. Mitigation for special status fish species that occur in the transmission system ROWs and road systems would be implemented as best management practices in combination with several additional measures to protect critical habitat for Gila topminnow, loach minnow, spikedace, Virgin River chub, and woundfin.

A monitoring measure also would be implemented to address data uncertainty and evaluate the effectiveness of water quality and tissue sampling or reporting of ongoing efforts of the proposed fish conservation measures for the purpose of assuring that air modeling assumptions and ERA results were within the range analyzed in the EIS and Biological Assessment, and that conservation measures implementation are effective. The monitoring measure is described in **Appendix 4A** of this EIS.

3.13.4.3 Proposed Action

The following information describes impacts of the Proposed Action on special status species. The section is organized by federally listed species followed by other special status aquatic species. Organization by federally listed species is parallel with the structure of the Biological Assessment. The overall goal is to ensure that the EIS process and the USFWS Section 7 consultation are consistent to the extent possible. Within each species section, impacts are discussed for the project components relevant to the species. An overall summary of Proposed Action impacts are provided at the end of the section. The discussion of impacts first describes effects from the various project components followed by the Proposed Action effects in combination with baseline fish tissue concentrations. Applicant-committed protection measures and best management practices are discussed as part of the impact discussions.

3.13.4.3.1 Navajo Generating Station

3.13.4.3.1.1 Federally Listed Aquatic Species

Bonytail

The impact issue analyzed for bonytail is the potential effect of NGS emissions on the species and its critical habitat. Bonytail and its critical habitat were analyzed for the Northeast Gap Region.

Northeast Gap Region

The NGS 3-Unit Operation and 2-Unit Operation would represent a negligible risk to bonytail tissue from mercury, as indicated by refined HQs of 0.002 and 0.001, respectively (**Table 3.13-14**). Tissue concentrations also would be considerably below the threshold level of 0.2 mg/kg wet weight. The addition of NGS emissions with baseline conditions would result in a negligible risk from mercury, as the refined HQ was less than 1 (i.e., the tissue concentration was less than the tissue threshold). Measured arsenic and selenium concentrations in fish tissue were not available for the Northeast Gap Region; therefore, surface water concentrations were used in modeling uptake into fish tissue. The refined HQ for the modeled 3-Unit Operation and 2-Unit Operation for the bonytail surrogate was 5 orders of magnitude below an HQ of 1 for selenium and arsenic, respectively, indicating a negligible risk to bonytail in the Northeast Gap Region. The project contribution to the total effect of the project and baseline fish tissue would be less than 1 percent.

Table 3.13-14 Mercury and Selenium Tissue Concentrations for Bonytail Surrogate (Rainbow Trout) in the Northeast Gap Region

Metal	CBR (mg/kg wet weight)	Baseline [1]		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [2] (%)	
Mercury									
Maximum	0.2	0.12	0.6	0.0006	0.003	0.0004	0.002	0.5%	0.3%
Refined	0.2	0.09	0.5	0.0003	0.002	0.0002	0.001	0.3%	0.2%
Selenium									
Maximum	2	*0.84*	0.4	0.0001	0.00005	0.00007	0.00004	0.01%	0.01%
Refined	2	*0.33*	0.2	0.00007	0.00003	0.00005	0.00002	0.02%	0.01%

[1] Baseline values presented in italicized text indicate measured tissue data not available; concentration based on modeled result using site-specific uptake factor and surface water concentration.

[2] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

CBR = critical body residue.

Critical habitat is limited to the Upper Colorado River near the Green River confluence (Northeast Gap Region study area), more than 100 miles from the NGS plant. Project-related effects to critical habitat would be limited to those resulting from emissions and depositions from operation of the NGS plant. The effect of Proposed Action emissions on water quality and critical habitat in the Northeast Gap Region study area would be negligible. Based on the USFWS methodology described in Section 3.13.4.2, the analysis of the water element of critical habitat involved an evaluation of mercury and selenium concentrations. The maximum baseline concentration of mercury (0.24 µg/L, dissolved) in surface water in the Northeast Gap Region study area was less than the National Ambient Water Quality Criteria (0.77 µg/L), but it exceeded the conservative Utah Water Quality Standard (0.012 µg/L). The mean and refined concentrations (0.017 and 0.034 µg/L, respectively) also exceeded the Utah standard, with the refined concentration exceeding by 2.8-fold above the standard. However, the USFWS “back-calculated” a surface water concentration protective of fish from the CBR for methylmercury (0.2 mg/kg ww) using site-specific bioconcentration factors for predatory fish as indicated in Section 3.13.4.2 for comparison to water concentrations. Conservative bioconcentration factors for methylmercury were developed from literature-derived piscivorous fish tissue data and surface water concentrations as reported in Ramboll Environ (2016a) and were used to calculate the water concentrations corresponding to the CBR, protective of piscivorous fish species. The dissolved surface water methylmercury concentration protective of fish was estimated to be 0.0002 µg/L. Based on comparison of this value to the total (unfiltered) maximum methylmercury surface water concentration (0.00003 µg/L) and refined (0.000017 µg/L) baseline surface water concentrations (dissolved concentrations were not available) in the Northeast Gap Region study area no exceedance is noted. The maximum surface water concentration for methylmercury due to the Proposed Action is 0.00000013 µg/L and refined is 0.00000007 µg/L, which are well below the protective CBR-based concentration alone or in combination with the Proposed Action; NGS contributes as much as 0.8% to the methylmercury surface water concentration assuming maximum (3-Unit) operation.

For selenium, the maximum concentration in the Northeast Gap Region study area of 5.1 µg/L (total) was in excess of the Utah water quality standard. The Utah selenium standard is expressed as a dissolved (filtered) value (4.6 µg/L) and comparison to the maximum dissolved concentration for selenium (6.5 µg/L results in a minimal exceedance of 1.4-fold above the standard. However, both the

refined concentration (95% upper concentration limit) and average concentration were less than the water quality standard.

For both mercury and selenium, based on Proposed Action (maximum) deposition concentrations, the project contribution results in a very small addition to the baseline concentration (less than 0.8 percent) and does not substantively affect the baseline condition. Therefore, the Proposed Action would represent a negligible effect on the water element of critical habitat for bonytail in the Northeast Gap Region study area.

No applicant-committed protection measures or additional mitigation would be required for the bonytail, because there is negligible risk to the species in the Northeast Gap Region. NGS emissions and baseline conditions would result in a negligible effect to bonytail.

Colorado Pikeminnow

The impact issue analyzed for Colorado pikeminnow was the potential effect of NGS emissions to Colorado pikeminnow in the Northeast Gap Region and the San Juan River. Largemouth bass was the surrogate species for Colorado pikeminnow in the Northeast Gap Region ERA, while striped bass represented the species in the San Juan River ERA (Ramboll Environ 2016b,c). The rationale for using surrogate species was to use species that are representative of Colorado pikeminnow in terms of diet and feeding strategy, as well as fish that are exposed to similar environmental/habitat conditions. Mercury and selenium tissue data for Colorado pikeminnow also were used in the analysis for this species, but the samples used were from stocked fish. Critical habitat is located in both of these areas. Results from these study areas are summarized below. The primary constituent elements for Colorado pikeminnow critical habitat also were analyzed using mercury and selenium concentrations for the water element and ERA results for forage fish as part of the biological environment element using the USFWS methodology. Because the Near-field ERA study area does not extend to the arms of the lake, Colorado pikeminnow use of Lake Powell was analyzed in the Northeast Gap Region and San Juan River ERA study areas.

Northeast Gap Region

The effect of the NGS emissions on Colorado pikeminnow would be the same as discussed for bonytail (**Table 3.13-15**). There would be a negligible risk to Colorado pikeminnow from either the 3-Unit Operation or 2-Unit Operation from mercury, as indicated by refined HQs of 0.002 and 0.001, respectively. Tissue values also would be considerably less than the tissue threshold of 0.2 mg/kg wet weight. The addition of NGS emissions with baseline conditions would result in a negligible risk from mercury, as the refined HQ was less than 1 and the tissue concentration was less than the tissue impact threshold. Refined tissue-based HQs for selenium and arsenic also were considerably less than 1, which indicates a negligible risk of NGS emissions on Colorado pikeminnow. Based on these results for the NGS Proposed Action, a negligible effect is expected for Colorado pikeminnow in the Northeast Gap Region. There would be no injury or loss of individual fish from arsenic, mercury, and selenium exposure in this study area. The project contribution would be less than 1 percent of the total effect from the project and baseline fish tissue concentrations.

Table 3.13-15 Mercury and Selenium Tissue Concentrations for Colorado Pikeminnow Surrogate (Largemouth Bass) in the Northeast Gap Region

Metal	CBR (mg/kg wet weight)	Baseline [1]		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [2] (%)	
Mercury									
Maximum	0.2	0.12	0.6	0.00058	0.003	0.00039	0.002	0.50%	0.33%
Refined	0.2	0.12	0.6	0.00031	0.002	0.00021	0.001	0.0.3%	0.2%
Selenium									
Maximum	2	*0.84*	0.4	0.00011	0.00005	0.00007	0.00004	0.01%	0.01%
Refined	2	*0.33*	0.2	0.000068	0.00003	0.00005	0.00002	0.02%	0.01%

[1] Baseline values presented in italicized text indicate measured tissue data not available; concentration based on modeled result using site-specific uptake factor and surface water concentration.

[2] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

CBR = critical body residue.

The critical habitat analysis for Colorado pikeminnow in the Northeast Gap Region related Project effects to the principal constituent elements (water, physical habitat, and biological environment). The Proposed Action would not affect the physical habitat component of critical habitat, because there is no direct disturbance or alteration of the river flow or substrate. There would be no effect on the biological environment, because the ERA results indicated HQs less than 1 for all fish and other aquatic community receptors that may be potential food sources of Colorado pikeminnow.

Based on the USFWS methodology described in Section 3.13.4.2, the analysis of the water element of critical habitat involved an evaluation of mercury and selenium concentrations in relation to the National Ambient Water Quality Criteria and Utah water quality standards. The evaluation of mercury and selenium is the same as discussed for bonytail. For both mercury and selenium, based on 3-Unit Operation (maximum) deposition concentrations, the project contribution results in a very small addition to the baseline concentration (less than 0.8 percent) and does not substantively affect the baseline condition. Therefore, the Proposed Action would represent a negligible effect on the water element of critical habitat in the Northeast Gap Region.

San Juan River

ERA analyses for Colorado pikeminnow in the San Juan River were completed for a surrogate species (striped bass) (**Table 3.13-16**) and pikeminnow tissue data (**Table 3.13-17**) (Ramboll Environ 2016c). Both the surrogate and Colorado pikeminnow results for the Proposed Action showed very low HQs, which indicate a negligible risk to the species. The combination of NGS emissions from the 3-Unit Operation and 2-Unit Operation with baseline surrogate fish tissue concentrations showed maximum HQs slightly greater than 0.07 for arsenic, 2 for mercury, and 0.7 for selenium (**Table 3.13-16**). Refined HQs were the same as the maximum values for arsenic and selenium, but the refined mercury HQ was 1. The HQ for mercury indicates a negligible potential risk to Colorado pikeminnow, arsenic and selenium. The combination of NGS emissions from the 3-Unit Operation and 2-Unit Operation with baseline conditions for the pikeminnow tissue analysis showed HQs that are slightly greater than 0.07 for arsenic, 0.5 for mercury, and 0.4 for selenium (**Table 3.13-17**). The pikeminnow tissue analysis indicated a negligible risk for all three metals, as indicated by HQs less than 1. The surrogate analysis results were considered to be a more conservative approach to estimate potential exposure because

stocked fish reared in a hatchery in different water quality conditions and with different food base may not bioaccumulate at the same levels of mercury as wild Colorado pikeminnow. Both the species-specific and surrogate analyses indicated that the project contribution would be less than 1 percent of the total effect from the project and baseline fish tissue concentrations.

Table 3.13-16 Arsenic, Mercury, and Selenium Tissue Concentrations for Colorado Pikeminnow Surrogate (Striped Bass) in the San Juan River

Metal	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Arsenic[2]									
Maximum	5.5	0.37	0.07	0.00010	0.00002	<0.00010	<0.00002	0.03%	<0.03%
Refined	5.5	0.37	0.07	0.000086	0.00002	<0.000086	<0.00002	0.02%	<0.02%
Mercury[2]									
Maximum	0.2	0.49	2	0.00029	0.001	<0.00029	<0.001	0.06%	<0.06%
Refined	0.2	0.21	1	0.00018	0.0009	<0.00018	<0.0009	0.09%	<0.09%
Selenium									
Maximum	2	1.3	0.7	0.00026	0.0001	0.00018	0.00009	0.02%	0.01%
Refined	2	1.3	0.7	0.00024	0.0001	0.00016	0.00008	0.02%	0.02%

[1] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

[2] For the 2-Unit Operation, arsenic and mercury concentrations were less than the 3-Unit Operation but below the computational limit of the Electric Power Research Institute (2016) model, and so could not be calculated. Therefore, tissue concentrations from the 3-Unit Operation concentrations were conservatively used for the 2-Unit Operation.

CBR = critical body residue.

Table 3.13-17 Arsenic, Mercury, and Selenium Tissue Concentrations for Colorado Pikeminnow Tissue in the San Juan River

Metal	CBR (mg/kg wet weight)	Baseline[1]		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [2] (%)	
Arsenic[3]									
Maximum	5.5	0.37	0.07	0.00010	0.00002	<0.0001	<0.00002	0.03%	<0.03%
Refined	5.5	0.37	0.07	0.000086	0.00002	<0.000086	<0.00002	0.02%	<0.02%
Mercury[3]									
Maximum	0.2	0.25	1	0.00029	0.0010	<0.00029	<0.0010	0.11%	<0.11%
Refined	0.2	0.11	0.5	0.00018	0.0008	<0.00018	<0.0008	0.16%	<0.16%

Table 3.13-17 Arsenic, Mercury, and Selenium Tissue Concentrations for Colorado Pikeminnow Tissue in the San Juan River

Metal	CBR (mg/kg wet weight)	Baseline[1]		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [2] (%)	
Selenium									
Maximum	2	1.1	0.5	0.00026	0.0001	0.00018	0.00009	0.02%	0.02%
Refined	2	0.78	0.4	0.00024	0.0001	0.00016	0.00008	0.03%	0.02%

[1] Baseline tissue values presented for arsenic are for surrogate species (striped bass). Measured tissue concentrations not available for arsenic.

[2] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

[3] For the 2-Unit Operation, arsenic and mercury concentrations were less than the 3-Unit Operation but below the computational limit of the Electric Power Research Institute (2016) model and so could not be calculated. Therefore, tissue concentrations the 3-Unit Operation concentrations were conservatively used for the 2-Unit Operation.

CBR = critical body residue.

Based on population and toxicity data, the injury effects were estimated for Colorado pikeminnow in the San Juan River by the USFWS methodology, which is described in **Appendix 3.13-A**. The results are considered an initial estimate, which will be finalized as part of the Biological Opinion. The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence as to whether the listed fish would be affected by the project, and it is distinct from what was conducted for the ERAs, which identified potential risk of effects to species. The ERA results were used in determining whether an injury effect analysis should be completed. The ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of number of individuals affected. The analysis estimated that up to one adult or subadult would be injured by the NGS Proposed Action emissions (**Table 3.13-18**). The impact on Colorado pikeminnow is considered to be minor because less than 1 percent of the current Colorado pikeminnow (1,000 stocked fish less than 300 mm total length) would be affected by the Proposed Action emissions and deposition.

Table 3.13-18 Mercury Injury Effects to Colorado Pikeminnow in the San Juan River, 2020 to 2074

Metal	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Reproduction	Juveniles (<400 mm)	Adults (>400 mm)	Subadult Behavioral Injury	Adult Behavioral Injury
Mercury	593	12	1	1	1	1	1

[1] Values less than 1 rounded to 1.

Critical Habitat Effects – To evaluate the effects of the Proposed Action on Colorado pikeminnow critical habitat, Project actions were related to the Principal Constituent Elements (water, physical habitat, and biological environment). The Proposed Action would not affect the physical habitat component of critical habitat, because there is no direct disturbance or alteration of the river flow or substrate. There could be

a potential effect on the biological environment because the ERA analysis indicted a potential for risk (refined HQ exceeding 1) from selenium on one of the forage species (red shiner) that represents a food potential source for Colorado pikeminnow. However, it is important to note that the ERA analysis indicated negligible risk for other forage species such as bluehead sucker, flannelmouth sucker, and fathead minnow.

Based on the USFWS methodology described in Section 3.13.4.2, the effect of the Proposed Action on the water element of critical habitat for Colorado pikeminnow would represent a minor effect in the San Juan River. The minor effect was determined based on calculations performed by USFWS that "back-calculated" a surface water concentration protective of fish from the CBR for methylmercury (0.2 mg/kg ww) using site-specific bioconcentration factors as indicated in Section 3.13.4.2. Conservative bioconcentration factors for methylmercury were developed from literature-derived piscivorous fish tissue data and surface water concentrations as reported in Ramboll Environ (2016a) and were used to calculate the water concentrations corresponding to the CBR, protective of piscivorous fish species. The dissolved surface water methylmercury concentration protective of fish was estimated to be 0.0002 µg/L. Based on comparison of this value to the maximum (1.6 µg/L) and refined (0.21 µg/L) baseline surface water concentrations for mercury (total mercury, which accounts for methylmercury and inorganic mercury forms) in the San Juan River, exceedance is noted; the maximum surface water concentration for total mercury due to the Proposed Action is 0.0000008 µg/L and refined is 0.00000014 µg/L, well below the protective CBR-based concentration alone or in combination with the Proposed Action. NGS contributes less than 0.0001% to the methylmercury surface water concentration assuming maximum (3-Unit) operation.

For selenium, maximum surface water concentrations due to the Proposed Action (5 µg/L, unfiltered) exceeds the 2 µg/L Navajo Nation Water Quality Standard for total selenium (Navajo Nation Environmental Protection Agency 2004). The maximum dissolved (filtered) surface water due to the Proposed Action (12 µg/L) also exceeds the water quality criteria for lotic systems (3.1 µg/L, dissolved) per *USEPA Selenium Ambient Water Quality Criteria* (USEPA 2016). However, no exceedances for selenium are noted based on consideration of refined (95% upper concentration limit) or average surface water concentrations. Critical habitat would not be affected by selenium, because the baseline selenium concentrations plus the small contribution from NGS emissions (which would contribute up to about 0.2% to the refined total selenium concentration) does not exceed the National Ambient Water Quality Criteria Water Quality Standard or Navajo Nation Water Quality Standard.

Applicant-committed protection measures would be implemented to mitigate for the potential minor effect of the Proposed Action, and provide additional conservation and recovery benefits to the Colorado pikeminnow in the San Juan River. The Conservation Program and the conservation and monitoring measures for federally listed fish species are described in **Appendix 4A** of this EIS. Monitoring also would be implemented as part of the Proposed Action to evaluate the effectiveness of water quality and tissue sampling or reporting of ongoing efforts of the proposed conservation measures for the purpose of assuring that air modeling assumptions and ERA results are correct over time and that the conservation measures are effective. Monitoring would focus on mercury and selenium concentrations in the water column, sediment, and fish tissue in the San Juan River and Southwest Gap Region. Details of the monitoring measure are described in **Appendix 4A** of this EIS. The following measures are applicable to Colorado pikeminnow in the San Juan River or its overall population in the Upper Colorado River. Benefits to the species also are discussed for each measure.

FS-3: Support Activities at the USFWS Southwest Native Aquatics Research and Recovery Center (formerly known as the Dexter Fish Hatchery)

Goals: The objective of this measure is to provide financial support to Southwestern Native Aquatic Resources and Recovery Center (SNARRC) for the purpose of augmenting the genetic diversity of the four federally listed Colorado River fish species. Funding to support SNARRC's activities will be used to support research, propagation, and conservation activities for all of these species. This measure will

offset Project-related impacts to razorback sucker, Colorado pikeminnow, and bonytail by improving the genetic diversity of the broodstock and numbers of these fish that will be available for stocking efforts in the San Juan River and potentially other areas to support the general species recovery.

Conservation Need: Effects from mercury deposition impact all life stages of fish, from larvae to adults. Effects range from reduced fecundity to disruption of various physiological processes. While the effects of mercury have been found to be more prevalent in fish species that feed at the top of the food chain, all species may be impacted from increased mercury loading. Increasing the number of fish in an aquatic system through rearing and stocking is one of the primary methods that is used to conserve and recover endangered fish populations in the Colorado River Basin, including within the action area. The USFWS SNARRC has been conducting research and propagation efforts for all four of the Colorado River endangered fish for decades. SNARRC has all four species on station and is actively propagating razorback sucker, Colorado pikeminnow, and bonytail for various recovery programs. While SNARRC is not engaged in active propagation activities for humpback chub, it is the only refuge population in the world for these fish species.

Implementation: SNARRC has identified a need to bring in more Colorado pikeminnow broodstock from the Upper Colorado River, from known locations, to augment genetic diversity of the fish. They also have identified a need to do genetics work on any new broodstock and existing fish. This measure will involve fish collection and genetic analysis in producing genetically healthy fish for their stocking program in the San Juan River. The benefit of this measure is to ensure a more diverse and robust genetic stock, thereby providing for higher survival rates in the wild population (Furr 2010; Ryden 2005).

The estimated cost for this measure would be $50,000 to $100,000 in the initial year to cover fish collection and genetics work. Reclamation, with input from the Science Team, would determine if the goal in FS-3 is met or if additional efforts are needed over the life of the action.

Expected Benefits: This measure will augment wild populations of Colorado pikeminnow and razorback sucker by offsetting the low recruitment rates for these species in the San Juan River. This measure also will assist in improving the genetic diversity of the brood stock and numbers of Colorado pikeminnow that would be used in stocking efforts in the San Juan River including areas affected by the NGS/proposed KMC Project, as well as in the Upper Colorado River. The benefit level will be quantified by the number Colorado pikeminnow with new genetics that would be available for future stocking. In addition, past stocking efforts will be evaluated to assist in determining the benefits of this measure.

FS-4: Support Transport of Colorado Pikeminnow and Razorback Sucker Above the Waterfall Barrier in the San Juan River

Goals: The objective of this measure is to provide financial support to capture and transport Colorado pikeminnow and razorback sucker upstream of a waterfall barrier in the San Juan River arm of Lake Powell to allow the fish access to habitat in the San Juan River. Funding to support the capture and transportation of these fish around this barrier would offset the effects of mercury and selenium by increasing the number of potentially spawning fish in the San Juan River and serve as a mechanism to connect the river and lake below the waterfall with fish and habitat in the river upstream of the barrier.

Conservation Need: For over 20 years a large waterfall (about 30 feet high) has existed in the San Juan River near Paiute Farms, Utah, where the river enters Lake Powell. The waterfall is present when Lake Powell reservoir elevations are below 3,660 feet, which has been continuous since 2000, except for a 1-month period in 2011. This waterfall serves as a barrier to movement for all fish species. While the waterfall effectively keeps nonnative fish from moving upriver, it also prevents native fish, especially Colorado pikeminnow and razorback sucker, from moving back upstream after they have drifted over the waterfall as larvae, juveniles, or adults. Ryden and Ahlm (1996) identified this barrier as a major impediment to migrating fish. In the spring of 2015, crews sampled below the waterfall on several occasions and encountered numerous endangered fishes, as described in the *Fiscal Year 2016 Annual*

Budget and Work Plan for San Juan River Basin Recovery Implementation Program (SJRRIP) (USFWS (2016b). One trip captured four untagged razorback suckers immediately below the waterfall via castnets (Chris Cheek, unpublished data cited in UDWR [2015]). A second trip deployed submersible and floating PIT-tag antennae and detected 338 individual fish, which included 319 razorback sucker, one bonytail, one Colorado pikeminnow, and 19 unidentified tags (Cathcart et al. unpublished data cited in UDWR [2015]).

In the spring of 2016 a one-time pilot program was conducted by Reclamation to relocate Colorado pikeminnow and razorback sucker over the waterfall using buckets to move PIT-tagged fish. Approximately 170 razorback sucker and 4 Colorado pikeminnow were collected and transported from this effort. Mobilizing equipment below the falls and moving the fish directly above the falls resulted in no fish mortality and less overall cost (McKinstry et al. 2016).

A fish ladder at the waterfall on NPS land was considered but the site was determined to be unsuitable due to a shifting river bed, lake level variability, high velocity flows, and accessibility. A fish ladder also would allow predatory nonnative fish from Lake Powell to move up into the San Juan River.

Implementation: This measure will provide funding to continue capture and transport of Colorado pikeminnow and razorback sucker upstream of a waterfall that blocks fish movement in the San Juan River. This measure will be implemented three times a year in March, April, and June, for a minimum of 3 years after 2019. Implementation of this measure will continue if determined to be appropriate by Reclamation with input from the Science Team. Effectiveness of this measure will be based largely on numbers of fish translocated above the falls which will therefore be provided the opportunity to seek out adequate habitat for a spawning in the river. The estimated cost for this measure is approximately $50,000 per year to cover trapping and netting fish at the waterfall, and holding PIT- and radio-tagged fish prior to transport around the waterfall three times per year.

Expected Benefits: The benefit of this measure will be to facilitate movement of wild, breeding adult razorback sucker and Colorado pikeminnow that are otherwise unable to reach their spawning areas in most years. Moving 1,000 razorback sucker per year for 5 years could result in millions of larval fish being produced, as these fish live as long as 40 years and reproduce at 3 to 4 years of age. The idea for this measure was developed in discussions for the implementation of the recovery plan for these species. Although Colorado pikeminnow numbers are not as large compared to razorback sucker, if even 10 fish were relocated into their critical habitat areas, this could contribute to recovery of the species. The recovery plans have identified barriers to movement and this would alleviate that situation during drought years. The San Juan Basin Recovery Implementation Program monitors these fish populations in the San Juan River and will be assessing movement of the PIT-tagged fish. The Science Team will assess the success rates of moving the listed fish species, and determine with the San Juan Basin Recovery Implementation Program and other experts how long to implement this conservation measure.

FS-5: Funding Support for a Habitat Improvement Project in the San Juan River

Goals: The objective of this measure is to provide funding to improve and provide habitat for Colorado pikeminnow and razorback sucker in the San Juan River, which would be used for nursery or recruitment areas for these species. This measure will offset Project-related impacts to Colorado pikeminnow and razorback sucker by providing habitat that currently is limited in the San Juan River, which will improve species recruitment, and by augmenting the physical habitat element of critical habitat for the species.

Conservation Need: The channel of the San Juan River has become incised and channelized from the following: 1) reductions in high flows due to construction and operation of Navajo Dam; and 2) the introduction and almost complete coverage of the riparian area with nonnative Russian olive. The Russian olive prevents higher flows from reworking the channel and reduces complexity along the

channel margins. Furthermore, this non-native vegetation armors the bank and prevents the development of native vegetation. Due largely to these conditions, complex habitats such as secondary channels and backwaters, which are important to early life stages of native fish, are limited within the San Juan River.

Ecological restoration of the San Juan River has been ongoing since 2009. Phase 1 of this effort, known as *The San Juan River Ecosystem Restoration Initiative Project,* was completed in 2013; Phase 2 was completed in 2015. The Nature Conservancy has managed and coordinated the effort with government agencies and the Navajo Nation on water flow management, restoring secondary channels and backwaters and removing nonnative fish and vegetation (McKinstry et al. 2016). Agencies provide input on specific site selection and design of the habitats through the San Juan Recovery Implementation Plan. Fish biologists from the New Mexico Department of Game and Fish and The Nature Conservancy are monitoring the Phase II restoration site for wild-spawned razorback suckers and Colorado pikeminnow, and have a remote PIT Tag antenna at the outflow of the restored channel. They have been detecting about 30 larval Colorado pikeminnow each year since the restoration was completed. In 2015, the remote antenna detected 300 individual pikeminnow and razorback suckers using the restored site (Zeigler 2016).

Implementation: This conservation measure will provide funding so that the habitat improvement effort could be continued after Phase 2 of the current program. Study locations and methods for the habitat improvement work will be based on previous restoration efforts in the San Juan River, as described in Bliesner et al. (2007). A three-step process will be followed to identify sites for constructing backwater areas. The initial step will involve screening of potential sites to meet the following criteria: 1) capable of providing stable site with flows ranging from 500 to 1,550 cubic feet per second; 2) external, controllable water source for flushing sediment; 3) accessible to stocking trucks; and 4) reasonable probability of land-owner permission for construction. The next step will be to conduct a field investigation of the potential sites to confirm that site criteria can be met. The last step in the site selection will be to conduct an evaluation of the potential sites for a ranking to meet site criteria and costs. After the site is selected, the restoration project will be constructed following previous methods used in the Phase 1 and Phase 2 work.

Approximately $50,000 per year would be set aside and made available to The Nature Conservancy to conduct habitat restoration for Colorado pikeminnow and razorback sucker. The average cost for channel restoration is approximately $25 per linear foot, and the $50,000 would produce 1,500 to 2,000 linear feet of habitat. This funding could contribute to other planned side-channel creation projects.

Expected Benefits: This measure will benefit razorback sucker and Colorado pikeminnow by improving and providing habitats that are currently limited in the San Juan River. The restoration habitats provide breeding and recruitment areas for Colorado pikeminnow, razorback sucker, and other sensitive native fish species, which increase reproduction and survival of eggs, larvae, and young. The benefit level will be quantified in terms of the area of improved habitat for the species in relation to similar type of habitat available for the species at the current time. Based on Phase 1 efforts or other similar projects, the amount of habitat improvement is estimated to be approximately 1,500 to 2,000 linear feet of backwater habitat per $50,0000 funding.

Humpback Chub

The impact issues analyzed for humpback chub include the potential effect of NGS emissions on the species and its critical habitat. Humpback chub was analyzed for NGS emission effects in the Northeast and Southwest Gap Regions. Critical habitat is located in both Gap Regions. Results for these study areas are summarized below.

Northeast Gap Region

The effect of the NGS emissions on humpback chub would be the same as discussed for bonytail. Tissue and HQ values are the same as those listed in **Table 3.13-14**.There would be a negligible effect on humpback chub tissue concentrations from either the 3-Unit Operation or 2-Unit Operation for mercury, as indicated by refined HQs of 0.002 and 0.001, respectively. The HQs for arsenic and selenium also would be considerably less than 1. Based on refined HQs being less than 1 for the NGS Proposed Action, a negligible effect is expected for humpback chub in the Northeast Gap Region. There would be no injury or loss of individual fish from arsenic, mercury, and selenium exposure.

The critical habitat analysis for humpback chub in the Northeast Gap Region related Project effects to the principal constituent elements (water, physical habitat, and biological environment). The Proposed Action would not affect the physical habitat component of critical habitat, because there is no direct disturbance or alteration of the river flow or substrate. There would be a negligible effect on the biological environment, because the ERA results indicated negligible risks to food sources for humpback chub (Ramboll Environ 2016c).

Based on the USFWS methodology described in Section 3.13.4.2, the analysis of the water element of critical habitat involved an evaluation of mercury and selenium concentrations in relation to the National Ambient Water Quality Criteria and Utah water quality standards. The evaluation of mercury and selenium is the same as discussed for bonytail. For both mercury and selenium, based on 3-Unit Operation (maximum) deposition concentrations, the project contribution results in a very small addition to the baseline concentration (less than 0.05 percent) and does not substantively affect the baseline condition. Therefore, the Proposed Action would represent a negligible effect on the water element of critical habitat in the Northeast Gap Region.

Southwest Gap Region

The NGS emission scenarios would contribute a negligible risk to humpback chub tissue concentrations from mercury, as indicated by refined HQs of 0.003 for the 3-Unit Operation and 0.002 for the 2-Unit Operation (**Table 3.13-19**). The combination of NGS and baseline conditions showed a refined mercury HQ of 0.7003 and 0.7002, respectively, for the two emission operations, which indicates a negligible risk to humpback chub. The NGS contribution to selenium concentrations in the Southwest Gap Region also is a negligible risk, with refined tissue-based HQs of 0.0003 and 0.002 for the two emission operations. The addition of NGS selenium emissions with baseline conditions showed refined HQs of 0.4003 and 0.4002 for the 3-Unit Operation and 2-Unit Operation, respectively. The NGS and baseline tissue concentrations also are less than the CBRs. The project contribution would be less than 1 percent of the total effect from the project and baseline fish tissue concentrations.

Table 3.13-19 Mercury and Selenium Tissue Concentrations for Humpback Chub in the Southwest Gap Region

		Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
Metal	**CBR (mg/kg wet weight)**	**Conc. (mg/kg wet weight)**	**HQ**	**Conc. (mg/kg wet weight)**	**HQ**	**Conc. (mg/kg wet weight)**	**HQ**	**Contribution of Operation [1] (%)**	
Mercury									
Maximum	0.2	0.17	0.8	0.0010	0.005	0.00070	0.003	0.0.12%	0.08%
Refined	0.2	0.15	0.7	0.00056	0.003	0.00038	0.002	0.10%	0.07%

Table 3.13-19 Mercury and Selenium Tissue Concentrations for Humpback Chub in the Southwest Gap Region

Metal	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Selenium									
Maximum	2	0.74	0.4	0.00082	0.0004	0.00055	0.0003	0.11%	0.07%
Refined	2	0.73	0.4	0.00052	0.0003	0.00035	0.0002	0.07%	0.05%

[1] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

CBR = critical body residue.

Species Effects – Based on population and toxicity data, the injury effects were estimated for humpback chub in the Southwest Gap Region by the USFWS methodology, which is described in **Appendix 3.13-A**. The results are considered an initial estimate by the USFWS, with final numbers to be finalized as part of the Biological Opinion. The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence as to whether the listed fish would be affected by the project, and it is distinct from what was conducted for the ERAs, which identified potential risk of effects to species. The ERA results were used in determining whether an injury effect analysis should be completed. The ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of number of individuals affected. The analysis estimated that up to one adult or subadult would be injured by the NGS Proposed Action emissions (**Table 3.13-20**). The impact on humpback chub is considered to be minor because less than 1 percent of the current humpback chub population within the Southwest Gap Region (11,300 adults) would be affected.

Table 3.13-20 Mercury and Selenium Injury Effects to Humpback Chub in the Southwest Gap Region, 2020 to 2074, 3-Unit Operation

Metal	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Reproduction	Juveniles Behavioral	Adults Behavioral	Subadult Survivor-ship	Adult Survivor-ship
Mercury	325	4	1	1	1	1	1
Selenium	41,415	2,238	13	NA[1]	NA[1]	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

Critical Habitat Effects – The Proposed Action would not affect the physical habitat component of critical habitat for humpback chub, because there is no direct disturbance or alteration of the river flow or substrate. There could be a potential effect on the biological environment because the ERA analysis indicted the potential for risk from selenium on aquatic community (plant and invertebrate) food sources, as discussed in Section 3.12.4.3 of this EIS and the Gap Regions ERA (Ramboll Environ 2016c).

Based on the USFWS methodology described in Section 3.13.4.2, the effect of Proposed Action emissions on water quality on critical habitat in the Southwest Gap Region study area would be minor based on selenium exposure only. The maximum selenium surface water concentration in the Southwest Gap Region study area was 12 µg/L (total or unfiltered) and the refined concentration was 4.0 µg/L (based on the average, as the 95 % upper concentration limit exceeded the maximum). Ramboll Environ (2016c) estimated that the maximum NGS contribution would be 0.000838 µg/L (total selenium). The National Ambient Water Quality Criteria Water Quality Standard is 3.1 µg/L (dissolved basis), and the Arizona and Navajo Nation Water Quality Standards for selenium is 2 µg/L expressed on an unfiltered (total) basis. The dissolved selenium maximum surface water concentration (3 µg/L) was comparable to but below the water quality criteria for lotic systems (3.1 µg/L, dissolved) per *USEPA Selenium Ambient Water Quality Criteria* (USEPA 2016). Critical habitat would be affected by selenium, because the baseline selenium concentrations plus the small contribution from NGS emissions (which would contribute about 0.02% to 03% to refined and maximum total selenium concentration, respectively) would exceed the Navajo Nation and Arizona Water Quality Standards.

For mercury, maximum baseline dissolved concentrations in water were 0.00297 µg/L for total mercury and 0.00004 µg/L for methylmercury. Ramboll Environ (2016c) estimated that the maximum NGS contribution would be 0.000000486 µg/L (total mercury) and 0.00000013 µg/L (methylmercury). These mercury concentrations are well below the National Ambient Water Quality Criteria and the Arizona Water Quality Standard dissolved chronic water quality criteria of 2.4 µg/L. In addition, comparison of methylmercury concentrations to the CBR-based protective surface water concentration developed by the USFWS (0.0002 µg/L, dissolved) indicates no exceedance of maximum concentrations due to the baseline alone or in combination with the Proposed Action, with NGS contributing about 0.02% to the total mercury concentration and 0.3% for methyl mercury assuming maximum (3-Unit) operation. Therefore, there is no effect to humpback chub critical habitat due to mercury in surface water in the Southwest Gap Region study area.

In summary, the combination of the Proposed Action and baseline conditions would result in a minor effect on critical habitat for humpback chub from exposure to selenium. The effect would be considered minor, because the exceedance of the selenium water quality standards is minimal (2-fold based on refined concentration).

Applicant-committed protection measures would be implemented to mitigate for the potential minor effect of the Proposed Action, and provide additional conservation and recovery benefits to the humpback chub in the Southwest Gap Region. The Conservation Program and the conservation and monitoring measures for federally listed fish species are described in **Appendix 4A** of this EIS. Monitoring would be conducted and focus on mercury and selenium concentrations in the water column, sediment, and fish tissue in the San Juan River and Southwest Gap Region. For humpback chub, monitoring would be applicable only to the Southwest Gap Region. Details of the monitoring measure are described in **Appendix 4A** of this EIS. The following measures are applicable to humpback chub in the Colorado River below Glen Canyon Dam or its overall population in the Upper Colorado River. Benefits to the species also are discussed for each measure.

FS-1: Non-native Fish Management in the Colorado River Grand Canyon Area

Goals: The objective of this measure is to finance projects which offset Project-related impacts to humpback chub and razorback sucker by monitoring and removing nonnative fish within the action area. This measure will reduce adverse biological impacts of competitive and predatory nonnative fish on populations of listed fish species.

Conservation Need: Nonnative fish negatively impact populations of endangered humpback chub and razorback sucker within the action area through predation and competition. For example, in 2015, AGFD discovered green sunfish in the slough below Glen Canyon Dam. These sunfish may have been

reproducing. The AGFD alerted the Grand Canyon National Park and Glen Canyon National Recreation Area of the presence of the sunfish. Despite a quick response time by the NPS staff, green sunfish were able to move elsewhere within the slough and potentially further downstream. The measure would ensure a rapid response to nonnative fish detections within the action area to prevent nonnative fish escapement to other riverine habitats. AGFD, USFWS and NPS currently monitor the Colorado River below Glen Canyon Dam, and the USFWS monitors critical areas of the watershed (e.g., Little Colorado River) that act as a conduit or source for nonnative fish. These agencies could provide a rapid response, dependent on availability of staff and materials.

Implementation: Reclamation would provide funds to augment detection monitoring for nonnative species, conducted by U.S. Geological Survey, NPS, AGFD, and USFWS, and to ensure availability of materials to those agencies engaged in nonnative fish removal. Funds will be provided to agencies annually (or as needed for rapid responses) for the purchase of chemicals, nets, and other equipment. Field implementation of nonnative fish removal will be as needed in response to detections.

Expected Benefits: The control of non-native fish in the Grand Canyon portion of the Colorado River would reduce predation on humpback chub and razorback sucker. The measure would help protect the entire mainstem Colorado River from Lees Ferry to the inflow to Lake Mead. The specific level of benefit to this reach will be determined from a qualitative analysis of the number of non-native fish removed and relative reduction in non-native fish predation in the area that is treated.

Razorback Sucker

The impact issue analyzed for razorback sucker is the potential effect of NGS Proposed Action emissions. Razorback sucker was analyzed for both Gap Regions and the San Juan River. Critical habitat for this species occurs in the San Juan arm of Lake Powell, San Juan River, and the Southwest Gap Region. It is known that that razorback sucker occurs in the Colorado and San Juan arms of Lake Powell and likely uses portions of the lake. Because the Near-field ERA study area does not extend to the arms of the lake, razorback sucker use of Lake Powell was analyzed in the Northeast Gap Region and San Juan River ERA study areas. Results for these areas are summarized below.

Northeast Gap Region

The effect of the NGS emissions on razorback sucker would be the same as discussed for bonytail. Tissue and HQ values are the same as those listed in **Table 3.13-11**.There would be a negligible effect on razorback sucker tissue concentrations from either the 3-Unit Operation or 2-Unit Operation for mercury, as indicated by refined HQs of 0.002 and 0.001, respectively. The HQs for arsenic and selenium also would be considerably less than 1. Based on refined HQs being less than 1 for the NGS Proposed Action, a negligible effect is expected for razorback sucker in the Northeast Gap Region. There would be no injury or loss of individual fish from arsenic, mercury, and selenium exposure or effect on critical habitat.

The critical habitat analysis for razorback sucker in the Northeast Gap Region related Project effects to the principal constituent elements (water, physical habitat, and biological environment). The Proposed Action would not affect the physical habitat component of critical habitat, because there is no direct disturbance or alteration of the river flow or substrate. There would be no effect on the biological environment, because the ERA results indicated HQs less than 1 for all fish and other aquatic community receptors that may be potential food sources of razorback sucker.

The USFWS analysis of the water element of critical habitat involved an evaluation of mercury and selenium concentrations in relation to the National Ambient Water Quality Criteria and Utah water quality standards. The evaluation of mercury and selenium is the same as discussed for bonytail. For both mercury and selenium, based on 3-Unit Operation (maximum) deposition concentrations, the project contribution results in a very small addition to the baseline concentration (less than 0.05 percent) and

does not substantively affect the baseline condition. Therefore, the Proposed Action would represent a negligible effect on the water element of critical habitat in the Northeast Gap Region.

Southwest Gap Region

The Proposed Action would represent a negligible risk to razorback sucker tissue concentrations from mercury, as indicated by refined HQs well below 1 (0.003 for the 3-Unit Operation and 0.002 for the 2-Unit Operation) (**Table 3.13-21**). There also would be a negligible risk from selenium and arsenic on razorback sucker, as indicated by a refined HQ of 0.0003. When the small contribution from the NGS Proposed Action is added to baseline conditions, there would be a potential risk from mercury on razorback sucker in the Southwest Gap Region, as indicated by maximum and refined HQs that are slightly greater than 5 and 3, respectively. Using bluehead sucker, the maximum and refined HQs were 1 and 0.8, respectively, for mercury. The selenium analysis indicated a potential risk to flannelmouth sucker for both maximum and refined HQs, which were slightly greater than 1 when combining baseline conditions with NGS emissions. Although the maximum HQ was slightly greater than 1 for bluehead sucker, the refined HQ was less than 1. ERA results using stocked razorback sucker showed HQs less than 1. However, the surrogate analysis results were considered to be a more conservative approach to estimate potential exposure because stocked fish reared in a hatchery in different water quality conditions and with different food base may not bioaccumulate at the same levels of mercury as wild razorback sucker. The project contribution would be less than 1 percent of the total effect from the project and baseline fish tissue concentrations.

Table 3.13-21 Mercury and Selenium Tissue Concentrations for Razorback Sucker in the Southwest Gap Region

Metal/ Surrogate	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Mercury									
Flannelmouth sucker									
Maximum	0.2	0.98	5	0.0010	0.005	0.00070	0.003	0.11%	0.07%
Refined	0.2	0.67	3	0.00056	0.003	0.00038	0.002	0.08%	0.06%
Bluehead sucker									
Maximum	0.2	0.21	1	0.0010	0.005	0.00070	0.003	0.49%	0.33%
Refined	0.2	0.16	0.8	0.00056	0.003	0.00038	0.002	0.35%	0.23%
Selenium									
Flannelmouth sucker									
Maximum	2	2.9	1	0.00082	0.0004	0.00055	0.0003	0.03%	0.02%
Refined	2	2.5	1	0.00052	0.0003	0.00035	0.0002	0.02%	0.01%
Bluehead sucker									
Maximum	2	1.5	0.8	0.00082	0.0004	0.00055	0.0003	0.05%	0.04%
Refined	2	1.3	0.7	0.00052	0.0003	0.00035	0.0002	0.04%	0.03%

[1] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

CBR = critical body residue.

Species Effects – Based on population and toxicity data, the injury effects were estimated for razorback sucker in the Southwest Gap Region by the USFWS methodology, which is described in **Appendix 3.13-A**. The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence as to whether the listed fish would be affected by the project, and it is distinct from what was conducted for the ERAs, which identified potential risk of effects to species. The ERA results were used in determining whether an injury effect analysis should be completed. The ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of number of individuals affected. The results are considered an initial estimate by the USFWS, with final numbers to be finalized as part of the Biological Opinion. The analysis estimated that up to one adult or subadult would be injured by the NGS Proposed Action emissions (**Table 3.13-22**). The impact on razorback sucker is considered to be minor because less than 1 percent of the minimum viable razorback sucker population (5,800 adults as identified in USFWS [2002d] would be affected).

Critical Habitat Effects –Based on the USFWS methodology described in Section 3.13.4.2, the effects of the Proposed Action on critical habitat for razorback sucker in the Southwest Gap Region would be the same as discussed for humpback chub. There would be an effect from selenium on critical habitat, but there would be no expected effect from mercury. The effect from selenium would be considered minor, because the exceedance of the selenium water quality standards would be small (about 2-fold).

Table 3.13-22 Mercury and Selenium Injury Effects to Razorback Sucker in the Southwest Gap Region, 2020 to 2074, 3-Unit Operation

	Life Stages[1] (number of individuals)						
Metal	**Eggs/ Embryos**	**Larvae**	**Adult Repro.**	**Juveniles Behavioral**	**Adults Behavioral**	**Subadult Survivor-ship**	**Adult Survivor-ship**
Mercury	45	1	1	1	1	1	1
Selenium	20,403	1,249	1	NA[1]	NA[1]	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

San Juan River

The Proposed Action would represent a negligible risk to razorback sucker in the San Juan River for arsenic, mercury, and selenium. The fish tissue HQs for the surrogate fish species are provided in **Table 3.13-23**. This analysis is based on bluehead and flannelmouth suckers as surrogates. ERA results using stocked razorback sucker are listed in **Table 3.13-24**. Both the surrogate and razorback tissue analyses showed very low HQs, which indicate a negligible risk to razorback sucker. As mentioned above, the surrogate HQs were used as a more conservative indicator of risks. The combination of NGS emissions from the 3-Unit Operation and 2-Unit Operation with baseline tissue concentrations showed refined HQs of slightly greater than 0.04 for arsenic, 0.6 for mercury, and 0.4 for selenium when using the highest surrogate HQs. These results indicated a negligible risk to razorback sucker for all three metals, as indicated by refined HQs less than 1. Both the species-specific and surrogate analyses indicated the project would contribute less than 1 percent of the total effect from the project and baseline fish tissue concentrations.

Table 3.13-23 Arsenic, Mercury, and Selenium Tissue Concentrations for Razorback Sucker Surrogates in the San Juan River

Metal / Species	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Arsenic[2]									
Flannelmouth sucker									
Maximum	5.5	0.32	0.06	0.00010	0.00002	<0.00010	<0.00002	0.002%	<0.002%
Refined	5.5	0.10	0.02	0.000086	0.00002	<0.000086	<0.00002	0.08%	<0.08%
Bluehead sucker									
Maximum	5.5	0.36	0.06	0.00010	0.00002	<0.00010	<0.00002	0.03%	<0.03%
Refined	5.5	0.2	0.04	0.000086	0.00002	<0.00008	<0.00001	0.04%	<0.04%
Mercury[2]									
Flannelmouth sucker									
Maximum	0.2	0.27	1	0.00012	0.0006	<0.00012	<0.0005	0.04%	<0.04%
Refined	0.2	0.1	0.6	0.000080	0.0004	<0.0008	<0.0004	0.08%	<0.08%
Bluehead sucker									
Maximum	0.2	0.096	0.5	0.00012	0.0006	<0.00012	<0.0006	0.12%	<0.12%
Refined	0.2	0.05	0.2	0.000080	0.0004	<0.0001	<0.0004	0.16%	<0.16%
Selenium									
Flannelmouth sucker									
Maximum	2	2.5	1	0.00026	0.0001	0.00018	0.00009	0.01%	0.01%
Refined	2	0.81	0.4	0.00024	0.0001	0.00016	0.00008	0.03%	0.02%
Bluehead sucker									
Maximum	2	1.6	0.8	0.00026	0.0001	0.00018	0.00009	0.02%	0.01%
Refined	2	0.61	0.3	0.00024	0.0001	0.00016	0.00008	0.04%	0.03%

[1] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

[2] For the 2-Unit Operation, arsenic and mercury concentrations were less than the 3-Unit Operation but below the computational limit of the Electric Power Research Institute model and so could not be calculated. Therefore, tissue concentrations the 3-Unit Operation concentrations were conservatively used for the 2-Unit Operation.

CBR = critical body residue.

Table 3.13-24 Arsenic, Mercury, and Selenium Tissue Concentrations for Razorback Sucker in the San Juan River

Metal	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Arsenic[2]									
Maximum	5.5	0.34	0.06	0.00010	0.00002	<0.00010	<0.00002	0.03%	<0.03%
Refined	5.5	0.22	0.04	0.000086	0.00002	<0.000086	<0.00002	0.04%	<0.04%

Table 3.13-24 Arsenic, Mercury, and Selenium Tissue Concentrations for Razorback Sucker in the San Juan River

Metal	CBR (mg/kg wet weight)	Baseline		3-Unit Operation		2-Unit Operation		3-Unit	2-Unit
		Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Conc. (mg/kg wet weight)	HQ	Contribution of Operation [1] (%)	
Mercury[2]									
Maximum	0.2	0.15	0.7	0.00012	0.0005	<0.00012	<0.0005	0.08%	<0.08%
Refined	0.2	0.09	0.4	0.00008	0.0004	<0.00008	<0.0004	0.09%	<0.09%
Selenium									
Maximum	2	2.3	1	0.00026	0.0001	0.00018	0.00009	0.01%	0.01%
Refined	2	0.95	0.5	0.00024	0.0001	0.00016	0.00008	0.02%	0.02%

[1] Contribution of operation is the contribution of 3-Unit Operation and 2-Unit Operation to the Proposed Action (the sum of baseline and NGS operations).

[2] For the 2-Unit Operation, arsenic and mercury concentrations were less than the 3-Unit Operation but below the computational limit of the Electric Power Research Institute model and so could not be calculated. Therefore, tissue concentrations the 3-Unit Operation concentrations were conservatively used for the 2-Unit Operation.

CBR = critical body residue.

Species Effects – Based on population and toxicity data, the injury effects were estimated for razorback sucker in the San Juan River by the USFWS methodology, which is described in **Appendix 3.13-A**. The results are considered an initial estimate by the USFWS, with final numbers to be finalized as part of the Biological Opinion. The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence as to whether the listed fish would be affected by the project, and it is distinct from what was conducted for the ERAs, which identified potential risk of effects to species. The ERA results were used in determining whether an injury effect analysis should be completed. The ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of number of individuals affected. The analysis estimated that up to 1 adult and 5 subadults would be injured by the NGS Proposed Action emissions (**Table 3.13-25**). The impact on razorback sucker is considered to be minor because less than 1 percent of the minimum viable razorback sucker population (5,800 adults as identified in USFWS [2002d] would be affected).

Table 3.13-25 Mercury and Selenium Injury Effects to Razorback Sucker in the San Juan River, 2020 to 2074

Metal	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Repro.	Juveniles/ Adults (<400 mm)	Juveniles/ Adults (>400 mm)	Subadult Behavioral Injury	Adult Behavioral Injury
Mercury	4,510	72	1	5	2	1	1
Selenium	291,510	301	NA[1]	NA[1]	6	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

mm = millimeter.

Critical Habitat Effects –The Proposed Action would not affect the physical habitat component of critical habitat, because there is no direct disturbance or alteration of the river flow or substrate. Based on the ERA analysis, the biological environment related to food sources for razorback sucker (benthic invertebrates and algae) would not be affected by arsenic, mercury, or selenium concentrations in the water or sediment.

Based on the USFWS methodology described in Section 3.13.4.2, the effect of Proposed Action emissions on water quality in the San Juan River could result in a potential for adverse effects on razorback sucker critical habitat, based on selenium surface water concentrations in excess of the applicable water quality standards. The results are the same as those discussed for Colorado pikeminnow in the San Juan River. The effect would be considered minor, because the exceedance of the selenium Navajo Nation Surface Water Quality Standard was small.

Colorado River below Glen Canyon Dam

Conservation and monitoring measures for razorback sucker in the Colorado River below Glen Canyon Dam would include two measures that were discussed for humpback chub. These include FS-1 (Non-native Fish Management in the Colorado River Grand Canyon Area) and Monitoring-1 (Mercury and Selenium Monitoring to Confirm NGS/proposed KMC Project Model Predictions). In addition, the following measure also would apply to razorback sucker.

FS-2: Razorback Sucker Translocations

Goals: The objective of this measure is to augment razorback sucker numbers in the Grand Canyon portion of the Colorado River through translocations, if the NPS and USFWS determine the species needs augmentation. If translocations are determined by NPS and USFWS to be needed, this measure will offset Project-related impacts to razorback sucker by increasing razorback sucker numbers in the Grand Canyon.

Conservation Need: Recruitment of razorback sucker in the lower Grand Canyon appears to be limited, despite the presence of larvae in 2014 and 2015. Factors limiting recruitment are uncertain. Reclamation funded a review and summary of razorback sucker habitat in the Colorado River System in 2012. This summary presents a preliminary evaluation of potential razorback sucker habitat in the lower Grand Canyon. The study identifies the complex habitat that razorback suckers require, such as backwaters, islands and percent vegetation cover that was a deciding factor for NPS to consider a translocation effort (Valdez et al. 2012). This conservation measure would support two potential outcomes for razorback sucker in the Grand Canyon portion of the Colorado River, as discussed in the NPS Comprehensive Fisheries Management Plan (NPS 2013): RBS2, which states that *razorback sucker are present in substantial numbers in the Colorado River Fish Management Zones, but are not reproducing*; and RBS3 stating that *suitable razorback sucker habitat is available, but few individuals are present and no reproduction.*

Implementation: Reclamation and the Science Team will coordinate with the Lower Colorado River Multi-species Conservation Program, USFWS, and NPS regarding any proposed translocation effort. Translocation efforts will be determined by an NPS assessment of the availability of suitable habitat for razorback sucker in the action area. If NPS and USFWS determine that the razorback sucker needs augmentation, then the Science Team will support that effort by assisting in the capture, rearing, stocking, translocation or augmentation as appropriate for the species. If NPS and the USFWS determine that the canyon habitat is unsuitable for razorback sucker, then no translocations would occur, FS-2 would not be implemented, and funds would be diverted to FS-1 to further augment nonnative fish removal. As a result of this scenario, listed fish species will continue to benefit from nonnative fish removal under FS-1.

FS-2 will use wild spawned larvae which are currently being raised in ponds. In addition to using wild-spawned larvae, larval fish could be collected from Lake Mead and other areas and then PIT-tagged and released at a tributary mouth or mainstem portion of the Colorado River or the Lake Mead inflow area.

The estimated cost for this measure is $75,000 per year to cover capturing of larvae, rearing fish in ponds, harvesting fish for stocking, transporting fish to stocking locations, and additional monitoring of fish (radio- and PIT-tagging). Reclamation, in coordination with NPS and the Science Team, will determine through monitoring if translocations should continue, for how long and if this is succeeding, or be discontinued. Implementation of these activities will be conducted in close coordination with the USFWS.

Expected Benefits: This measure would be related to the razorback sucker outcomes identified above by the NPS. Benefits of FS-2 are related to the razorback sucker outcomes and NPS phased adaptive management strategies described in the NPS Comprehensive Fisheries Management Plan. Depending on the outcomes for razorback sucker, NPS will implement the following studies:

- Phase I (Years 1-3) – Conduct fish community survey of the Colorado Fish Management Zones including larval fish and large-bodies fish;
- Phase II (End of Year 3) – Evaluate data collected in years 1-3 to identify whether sonic-tagged fish remained in the area, and razorback sucker presence/absence; and
- Phase III (Year 4) – If Phase II results show substantial numbers (25 percent) of sonic-tagged razorback sucker remain, or razorback sucker presence (larvae or other unmarked adults), or evidence of Lake Mead's population expanding into Grand Canyon, then establish a long-term monitoring program in the Colorado River Fish Management Zones. Plans to augment razorback sucker in the Colorado River Fish Management Zones would be suspended if evidence of increasing abundance or expansion of Lake Mead into the Colorado River Fish Management Zones. The established workgroup could convene to recommend continuing augmentation and implementation when there is a presence in the Lake Mead area but no evidence of expansion.

The benefit to razorback sucker will be expressed in terms of the percent increase in the expanded range for razorback sucker as a result of the translocation efforts compared to the current miles of occupied habitat. This measure may result in new breeding, spawning, and young-of-the-year nursery areas.

San Juan River

Conservation and monitoring measures for razorback sucker in the San Juan River would include three measures that were discussed for Colorado pikeminnow. These include FS-3 (Support Activities at the USFWS Southwest Native Aquatics Research and Recovery Center); FS-4 (Support Transport of Colorado Pikeminnow and Razorback Sucker above the Waterfall Barrier in the San Juan River); and FS-5 (Funding Support for a Habitat Improvement Project in the San Juan River). Benefits to razorback sucker in the San Juan River from these measures would be the same as discussed for Colorado pikeminnow. Monitoring also would be conducted and focus on mercury and selenium concentrations in the water column, sediment, and fish tissue in the San Juan. Details of the monitoring measure are described in **Appendix 4A** of this EIS.

Kanab Ambersnail

The impact issue analyzed for Kanab ambersnail is the potential effect of NGS and other cumulative emissions on the species. This species was analyzed for the Southwest Gap Region where it occurs in a riverside spring called Vasey's Paradise and Upper Elves Canyon within Grand Canyon National Park. Because the Kanab ambersnail is located in spring habitats that are located outside of the Colorado

River channel, and because these habitats would be unaffected by direct or indirect emission deposition (i.e., no surface water runoff from the watershed which could contain NGS pollutants) there is no direct linkage and therefore no potential of NGS to effect this species.

3.13.4.3.1.2 Other Special Status Aquatic Species

Bluehead Sucker and Flannelmouth Sucker

The impact issue analyzed for bluehead sucker and flannelmouth sucker is the potential effect of NGS on these species in Lake Powell, the Gap Regions, and the San Juan River. Flannelmouth sucker occurs in these portions of the overall study area. Bluehead sucker is present in all areas except Lake Powell.

Lake Powell

One non-federal listed special status species, flannelmouth sucker, was analyzed for Lake Powell. The ERA results for all fish species in Lake Powell indicated a negligible effect from the Proposed Action by themselves or in combination with baseline conditions, based on maximum and refined HQs being less than 1 as discussed in Section 3.12.4.3 of this EIS and ERA results presented in Ramboll Environ (2016a).

Gap Regions

The effect of the NGS emissions on these sucker species in the Northeast Gap Region would be the same as discussed for bonytail, humpback chub, Colorado pikeminnow, and razorback sucker. There would be a negligible effect on these species from either the 3-Unit Operation or 2-Unit Operation for mercury fish tissue concentrations, as indicated by HQs less than 1. The combination of NGS emissions and baseline tissue concentrations also would be negligible, based on maximum and refined HQs less than 1 (Ramboll Environ 2016c).

The Southwest Gap Region analysis indicated that the NGS emission scenarios would contribute a negligible effect on these species' tissue concentrations from mercury (**Table 3.13-21**). The combination of NGS and with baseline conditions for flannelmouth sucker showed HQs slightly greater than 3 for mercury and 1 for selenium, which indicates that there would be a potential minor effect. There also would be a potential selenium effect on flannelmouth sucker tissue concentrations, as indicated by HQs exceeding 1. HQs for bluehead sucker were below 1 for both mercury and selenium, which indicates a negligible effect. Potential effects on flannelmouth sucker are considered minor because the injury or loss of individuals would be less than the overall population numbers.

San Juan River

The San Juan River analysis indicated that NGS emission scenarios would contribute a negligible effect on bluehead and flannelmouth sucker tissue concentrations from mercury and selenium. NGS emissions by themselves would represent a negligible effect on these species. The combination of NGS and baseline fish tissue concentrations for bluehead sucker and flannelmouth sucker would result in a negligible effect on the species, because HQs were less than 1 (**Table 3.13-23**).

Speckled Dace

The impact issue analyzed for speckled dace is the potential effect of NGS in the Gap Regions and the San Juan River.

Gap Regions

Emissions and deposition from the Proposed Action would result in a negligible effect on speckled dace tissue in the Northeast and Southwest Gap Regions, as indicated by refined HQs less than 0.01 for mercury and selenium in the Northeast Gap Region and less than 0.001 for arsenic, mercury, and selenium in the Southwest Gap Region. Project emissions by themselves would not result in injury effects on the species. The combination of the Proposed Action emissions in the Southwest Gap Region would result in a minor effect on speckled dace for mercury and selenium, as indicated by a maximum and refined HQ of 2. There could be injury effects on the species; however, the magnitude would be low when considering the relatively large population numbers assumed for this species in the Southwest Gap Region.

San Juan River

Emissions from the Proposed Action also would contribute a negligible on speckled dace tissue in the San Juan River, as indicated by refined HQs of 0.0005 for arsenic, 0.0002 for mercury, and 0.0001 for selenium. The combination of NGS with baseline emissions would result in a minor effect on speckled dace from selenium (HQ of 1). There would be a negligible effect to speckled dace from mercury, because the HQ was less than 1. There could be injury effects to the species, however, the magnitude would be low when considering the relatively large population numbers for this species in the San Juan River.

Northern Leopard Frog

Northern leopard frog also was analyzed for the Southwest Gap Region qualitatively due to a general lack of toxicity data for amphibians. The line of evidence used for this species was a comparison of metal concentrations in the Colorado River downstream of Glen Canyon Dam compared to National Ambient Water Quality Criteria and literature-based toxicity data protective of the larval (tadpole) development stage (Sparling et al. 2010). The food pathway for juvenile and adult stages is primarily insects, which is similar to fish species such as rainbow trout. The qualitative analysis for northern leopard frog concluded a negligible effect from mercury, based on the negligible contributions from NGS emissions (Ramboll Environ 2016c).

3.13.4.3.2 Proposed Kayenta Mine Complex

Northern leopard frog also was evaluated within the proposed KMC portion of the study area. Northern leopard frog was analyzed for the potential effect of emissions from the proposed KMC facilities. The qualitative analysis used largemouth bass as an indicator of potential effects for northern leopard frog. When considering that the maximum concentrations of COPECs resulted in HQs below 1 for fish emissions from the proposed KMC facilities, effects on northern leopard frog would be considered negligible.

Groundwater modeling was conducted to determine if N-Aquifer pumping could affect flows in streams and springs within the study area for the proposed KMC facilities. Modeling indicated that there would only be a reduction in stream base flow relative to 2020 flow rates for the Proposed Action (3-Unit Operation and 2-Unit Operation) in Begashibito Wash, which provides water for potential northern leopard frog habitat in Cow Spring. Modeling also indicated that there could be a small reduction in groundwater levels (less than 0.02 feet) at spring features in the nearby Cow Springs locale. Based on the model simulations, Proposed Action pumping would result in very small effects on potential habitat for northern leopard frog. The small magnitude of the potential reduction in spring flow would be a negligible effect northern leopard frog. Over the projected 2020 through 2110 model simulation period, proposed pumping at proposed KMC would comprise less than 1 percent of the total projected cumulative pumping. There would be less than a 1 percent reduction in stream flow relative to 2020 rates within the cumulative study area from project pumping.

3.13.4.3.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.13.4.3.3.1 Federally Listed Aquatic Species

Colorado Pikeminnow

An experimental-non-essential Colorado pikeminnow population exists in the Verde River downstream of the STS crossing. Fish are present due to stocking efforts but individuals do not persist after 1 or 2 years. Recent stocking in January 2016 included 266 pikeminnow at the Beasley Flat location, which is approximately 45 miles downstream of the STS ROW. No effects of transmission line operation or maintenance would be expected because the distance from any individuals/suitable habitat to the ROW is great enough that any minimal additional sedimentation into the river from the access road would be indistinguishable from baseline levels in the river. In addition, best management practices would be applied to avoid or minimize impacts on special status fish species, as described in the U.S. Forest Service Phase II Biological Assessment and Biological Opinion (USFWS 2008c; U.S. Forest Service 2008).

Desert Pupfish

The impact issue analyzed for desert pupfish is the potential effect of maintenance and operation of the STS on the species at the Agua Fria crossing. No desert pupfish occur in the STS crossing of the Agua Fria crossing. Although apparently suitable aquatic habitat occurs along the STS ROW, these areas are limited, and are likely degraded due to human activity or the persistence of nonnative species. Operation and maintenance activities within riparian habitat associated with the Agua Fria River would not occur, as no transmission structures or access roads are located within the riverbed. Occupied habitat for desert pupfish are located in a remote drainage upstream of the project study area, further precluding sediment or runoff effects to habitat.

Furthermore, the implementation of conservation measures for the survey, flagging, and avoidance of known populations. Operation and maintenance activities would not occur within known occupied habitat, given that no transmission infrastructure or roads are located in suitable aquatic habitat for desert pupfish. In addition, the implementation of sediment control, spill control and containment, and an agency-approved herbicide treatment plan, would further ensure that impacts to aquatic habitats are avoided. As a result of the applicant-committed protection measures listed below, there would be no effect of the operation and maintenance activities on desert pupfish.

- Biologically sensitive areas identified by the USFWS and other federal land managers would be mapped prior to maintenance activities. Appropriate measures would be implemented to avoid and/or minimize impacts to known populations of federally listed or other special status species.
- Conservation measures would be implemented on National Forest System lands to minimize impacts to federally listed species and their critical habitat. Aquatic species would include loach minnow, Gila topminnow, and Gila chub. The relevant National Forest crossed by the STS is Coconino.
- Standard Best Management Practices involving spill prevention and capture, storm water runoff control, and erosion control would be implemented during repairs to prevent degradation of surface waters.
- Staging areas for loading and unloading equipment would be located in previously disturbed areas and outside of floodplains and wet areas.

During repairs and maintenance of project infrastructure, standard BMPs to prevent degradation of surface waters (i.e., spill prevention and capture plans, storm water runoff controls, silt fencing and straw bales, and sediment and erosion controls) would be implemented.

Gila Chub

The impact issue analyzed for Gila chub is the potential effect of maintenance and operation of the STS on the species at the Verde and Agua Fria river crossings. No Gila chub records are known from within the action area. Although suitable habitat may occur within the Verde and Agua Fria rivers, Project-related activities would not affect these habitats. In the area where the STS crosses the Verde River, the transmission line spans the river canyon approximately 400 feet above the river itself, no vegetation management or other maintenance activities would be required in or adjacent to the river. The Verde River in this segment is narrow, incised, and more than 300 feet below the STS conductors; therefore, the need to conduct maintenance or vegetation management within the Verde River riparian corridor is unlikely. No access roads or other STS equipment occur within 100 feet of the cut bank of the canyon.

At the northern and middle Agua Fria crossings, the STS spans the river canyon. The lines are approximately 100 feet above the active floodplain at the northern crossing and 200 feet above the active floodplain at the southern crossing. The portion of the line that parallels the river is located within 600 feet of the river bottom, but the towers are located on bluffs ranging from 50 to over 300 vertical feet above the active floodplain. The height of these two crossings precludes the need to manage riparian vegetation along the river bottom. Similarly, the topography along the portion of the line that parallels the river, combined with the relatively low stature of upland vegetation in this area, would prevent the need to clear or trim vegetation or perform any surface-disturbing maintenance activities that could affect Gila chub or its habitat. In addition, the same conservation measures listed for desert pupfish also would be applicable to Gila chub. Based on the Phase II Utility Maintenance in Utility Corridors on Arizona Forests, July 17, 2008, (AESO/SE 22410- 2007-F-0365), the following measure also would be implemented: utilities would implement the BMPs measures to reduce ground disturbance and the spread of noxious weeds, which would reduce impacts and ensure that effects to listed fish and their designated critical habitat would be minimized. Consequently, continued operation and maintenance of the STS would not affect the Gila chub or its habitat.

Gila Topminnow

The impact issue analyzed for Gila topminnow is the potential effect of maintenance and operation of the STS on the species at the Agua Fria River crossing. No Gila topminnow occur in the project study area. Although apparently suitable aquatic habitat occurs along the STS ROW, these areas are limited, and are likely degraded due to human activity or the persistence of nonnative species. As discussed previously for Gila chub, Operation and maintenance activities within riparian habitat associated with the Agua Fria River would not occur, as no transmission structures or access roads are located within the riverbed. Occupied habitat for Gila topminnow is located in a remote drainage upstream of the action area, further precluding sediment or runoff effects to habitat. Furthermore, conservation measures would be implemented for the survey, flagging, and avoidance of known populations. Operation and maintenance activities would not occur within known occupied habitat, given that no transmission infrastructure or roads are located in suitable aquatic habitat for Gila topminnow. In addition, the implementation of sediment control, spill control and containment, and an agency-approved herbicide treatment plan, would further ensure that impacts to aquatic habitats are avoided. Finally, conservation measures applicable to Gila chub also would provide protection to Gila topminnow, as the two species are often found in the same springs, wetlands, and refugia.

Loach Minnow

The impact issue analyzed for loach minnow is the potential effect of maintenance and operation of the STS on critical habitat for loach minnow at the Verde River crossing. No loach minnow are known to occur in the action area. The Verde River contains suitable and critical habitat for the species. As discussed previously for numerous species (see Gila Chub section, above), the Proposed Action would have no effect on suitable or designated critical habitat within the riparian area of the Verde River. The conservation measures listed above further ensure that BMPs for fueling and habitat disturbance would avoid impacts to the species.

Razorback Sucker

The Verde River crossing by the STS is located approximately 10 miles upstream of critical habitat for razorback sucker. In the area where the STS crosses the Verde River, the transmission line spans the river canyon approximately 400 feet above the river itself, no vegetation management or other maintenance activities would be required in or adjacent to the river. The Verde River in this segment is narrow, incised, and more than 300 feet below the STS conductors; therefore, the need to conduct maintenance or vegetation management within the Verde River riparian corridor is unlikely. No access roads or other STS equipment occur within 100 feet of the cut bank of the canyon. As discussed in the Phase II Maintenance in Utility Corridors on Arizona Forests (U.S. Forest Service 2008), best management practices would be required to reduce impacts to razorback sucker and its critical habitat to a level that is insignificant and discountable. When considering that critical habitat for razorback sucker is located 10 miles downstream of the crossing in combination the fact that vegetation management and disturbance would not occur at or near the Verde River crossing , there would be no impacts to razorback sucker or its critical habitat (USFWS 2008c; U.S. Forest Service 2008).

Roundtail Chub

The impact issue analyzed for roundtail chub (i.e., distinct population segment) is the potential effect of maintenance and operation of the STS on the species at the Verde River crossing. Potential impacts would be the same as discussed for spikedace, except no critical habitat is designated for roundtail chub. By implementing best management practices, applicant-committed protection measures, and additional conservation measures, operation and maintenance activities would result in negligible effects on roundtail chub because effects are not measurable.

Spikedace

The impact issue analyzed for spikedace is the potential effect of maintenance and operation of the STS on the species at the Verde River crossing. No spikedace are known to occur in the action area, although the STS crossing at the Verde River is presumed occupied. The Verde River contains suitable and critical habitat for the species. As discussed previously for numerous species (see desert sucker and Gila chub above), the Proposed Action would have no effect on suitable or designated critical habitat within the riparian area of the Verde River. Additional conservation measures involving fuel restrictions and coordination with the USFWS regarding vegetation treatment within critical habitat would be required as described for loach minnow. One additional conservation measure will be implemented for spikedace: low water crossings will not be used in the Upper Verde River. Best management practices would be required to avoid impacts to spikedace and its critical habitat to a level that is insignificant and discountable (U.S. Forest Service 2008). Because the spikedace and loach minnow critical habitat both occur at the STS crossing at the Verde River, the conservation measures proposed for the loach minnow also would be protective of spikedace. Therefore, impacts to critical habitat would be avoided.

Virgin River Chub

The impact issue analyzed for Virgin River chub is the potential effect of maintenance and operation of the WTS on the species at the Virgin and Muddy river crossings. For clarification, the Virgin River chub population in the Muddy River is not part of the federal listing or critical habitat designation for this species at this time. However, the Virgin River is part of the federal listing and contains critical habitat for this species. The WTS spans the Virgin River at a height of more than 300 feet, and transmission structures are located outside of the riparian habitat. Therefore, there would be no effect to stream habitat because no routine maintenance or vegetation management activities would occur within the stream corridor crossed by the WTS. Although operation and maintenance of the WTS ROW near the Muddy River could result in potential sedimentation and vehicles and equipment activity from herbicide treatment, the conservation measures described above for other fish species would avoid the potential for these effects.

Woundfin

The impact issue analyzed for woundfin is the potential effect of maintenance and operation of the WTS on the species at the Virgin River crossing. The WTS spans the Virgin River at a height of more than 300 feet, and transmission structures are located outside of the riparian habitat. Therefore, there would be no effect to stream habitat because no routine maintenance or vegetation management activities would occur within the stream corridor crossed by the WTS. The conservation measures described above in combination with the site conditions at the WTS crossing would avoid effects to woundfin and its critical habitat at the Virgin River crossing.

3.13.4.3.3.2 Other Special Status Aquatic Species

Non-federally listed special status species that were analyzed for the transmission lines included the following:

- WTS – desert sucker (Virgin River), flannelmouth sucker (Colorado and Virgin rivers), Meadow Valley Wash desert sucker (Meadow Valley Wash and Muddy rivers), Meadow Valley Wash speckled dace (Meadow Valley Wash and Muddy rivers), Moapa speckled dace (Muddy River), western (boreal) toad (Muddy River), speckled dace (Colorado, Paria, and Virgin rivers), Virgin spinedace (Virgin River), Arizona toad (Muddy and Virgin rivers), Great Plains toad, northern leopard frog (Paria River), and Niobrara ambersnail (Gyspum Wash); desert springsnail (Virgin River); and
- STS – speckled dace (Verde River).

The types of impacts on these special status species would be the same as discussed for Gila chub for species occurring along STS and for Virgin River chub for species occurring along the WTS. Operation and maintenance activities for streams adjacent to or crossed by transmission line ROWs could result in potential sedimentation, spill risks from vehicles and equipment, and herbicide treatment, which could adversely affect these species for a short-term duration. As discussed for desert pupfish, applicant-committed protection measures would be implemented to avoid or reduce effects on aquatic species. A key measure would involve mapping of biologically sensitive areas prior to maintenance activities, with appropriate measures implemented to avoid and/or minimize impacts to known populations of special status aquatic species. Impacts would be considered minor as a result of the protection measures.

3.13.4.3.4 Project Impact Summary – All Project Components

In summary, the effects of the Proposed Action on special status aquatic species were considered minor based on the low number of fish that could be injured and the small percentage of fish population numbers potentially affected. In addition, there would be minor effects on critical habitat for Colorado pikeminnow and razorback sucker in the San Juan River and humpback chub and razorback sucker in

the Southwest Gap Region, because the level of exceedance of water quality standards for mercury and selenium was small. NGS emissions by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The combination of NGS emissions and baseline conditions would result in potential risks to Colorado pikeminnow in the San Juan River and razorback sucker in the Southwest Gap Region. Effects on all special status species in the Northeast Gap Region would be negligible, as indicated by the HQs being less than 1 for NGS and baseline emissions. The implementation of conservation measures for the San Juan River and the Colorado River below Glen Canyon Dam would be used to benefit the species in terms of control of non-native species (Colorado River below Glen Canyon Dam), translocation efforts (San Juan River and Colorado River below Glen Canyon Dam), and habitat enhancements (San Juan River). Conservations measures would be implemented to offset impacts of the Proposed Action and enhance and assist in the recovery of affected species in the Southwest Gap Region and San Juan River. The following summary is provided for federally listed species.

- Bonytail – There would be a negligible risk to bonytail in the Northeast Gap Region from the Proposed Action emissions and baseline conditions because the baseline fish tissue concentrations of mercury and selenium are below impact thresholds and the project contributes a negligible amount of mercury and selenium to this area. There would be a negligible effect on critical habitat, because the project and baseline mercury and selenium concentrations do not exceed the National Ambient Water Quality Criteria.
- Colorado Pikeminnow – The Proposed Action would contribute very small metal concentrations to Colorado pikeminnow tissue and its critical habitat in the Northeast Gap Region and San Juan River. The Proposed Action contribution would combine with baseline fish tissue concentrations, which would result in a minor effect from mercury on Colorado pikeminnow in the San Juan River, with an estimated injury of up to 1 adult over the 2020 to 2074 time frame of the project. The impact on the species is considered to be minor because less than 1 percent of the current Colorado pikeminnow adult population in the San Juan River would be affected by the Proposed Action in combination with baseline fish tissue concentrations. There would be a negligible effect in the Northeast Gap Region from the project and baseline conditions because the baseline fish tissue concentrations for mercury and selenium are below impact thresholds and the project contributes a negligible amount of mercury and selenium to this area. There would be a negligible effect on critical habitat in the Northeast Gap Region, because the project and baseline mercury and selenium concentrations do not exceed the National Ambient Water Quality Criteria. There would be a minor effect on the water element of critical habitat in the San Juan River. Although the conservative Navajo Nation mercury water quality standard was exceeded, no measured surface water concentration (including the maximum) was in excess of the National Ambient Water Quality Criteria.
- Humpback Chub – The Proposed Action would contribute small metal concentrations to humpback chub tissue and its critical habitat in the Northeast and Southwest Gap Regions. The Proposed Action contribution combined with baseline conditions would result in a minor effect on humpback chub in the Southwest Gap Region, as indicated by an estimated injury effect of up to 1 adult over the 2020 to 2074 time frame of the project. The impact on the species is considered to be minor because less than 1 percent of the current humpback chub adult population within the Southwest Gap Region would be affected by the Proposed Action in combination with baseline fish tissue concentrations. There would be a negligible effect in the Northeast Gap Region from the project and baseline conditions because the baseline fish tissue concentrations of mercury and selenium are below impact thresholds and the project contributes a negligible amount of mercury and selenium to this area. There would be a negligible effect on critical habitat in the Northeast Gap Region, because the project and baseline mercury and selenium concentrations do not exceed the National Ambient Water Quality Criteria. There would be a minor effect on the water element of critical habitat in the Southwest Gap Region, based on exceedance of selenium (1.2-fold above standard, using refined concentration) water quality standards.

- Razorback Sucker – The Proposed Action would result in small amounts of mercury and selenium to razorback sucker tissue and result in small increases in water concentrations in its critical habitat in the Northeast and Southwest Gap Regions and the San Juan River. The Proposed Action contribution combined with baseline emissions would result in a minor effect on razorback sucker in the Southwest Gap Region and San Juan River, as indicated by an estimated injury effect of up to 1 adult in each of the study areas over the 2020 to 2074 time frame of the project. The impact on the species is considered to be minor because less than 1 percent of the minimum viable razorback sucker adult population within the Southwest Gap Region and San Juan River would be affected by the Proposed Action in combination with baseline fish tissue concentrations. There would be a negligible effect in the Northeast Gap Region from the project and baseline conditions because the baseline levels of mercury and selenium are below impact thresholds and the project contributes a negligible amount of mercury and selenium to this area. There would be a minor effect on the water element of critical habitat in the Southwest Gap Region and the San Juan River, based on exceedances of water quality standards. The critical habitat effect was based on the estimate that the water quality exceedance would be small in the Southwest Gap Region (2-fold above Navajo Nation selenium standard, using a refined concentration). Similarly, there would be a minor effect on critical habitat in the San Juan River. Although the conservative Navajo Nation mercury water quality standard was exceeded, no measured mercury surface water concentration (including the maximum) was in excess of the National Ambient Water Quality Criteria.
- Bluehead Sucker – Proposed Action emissions by themselves would result in a negligible risk to bluehead sucker in the Northeast Gap Region, Southwest Gap Region, and the San Juan River. There would be minor effect when the Proposed Action is combined with baseline fish tissue concentrations in the Southwest Gap Region and San Juan River. The impact on the species is considered to be minor because less than 1 percent of the adult population in these areas would be affected. The combined effect of the Proposed Action and baseline conditions in the Northeast Gap Region would be negligible, as summarized for razorback sucker.
- Flannelmouth Sucker – Proposed Action emissions by themselves would result in a negligible risk to flannelmouth sucker in Lake Powell, Northeast Gap Region, Southwest Gap Region, and the San Juan River. There would be minor effects on flannelmouth sucker in the Southwest Gap Region and the San Juan River, as discussed for razorback sucker. There would be negligible effects on this species in Lake Powell and the Northeast Gap Region, as summarized for the razorback sucker.
- Speckled Dace – The effects would be the same as summarized for bluehead sucker.
- Northern Leopard Frog – In terms of the analysis for the proposed KMC, there would be negligible effects of metals on northern leopard frog from NGS and KMC combined emissions. Groundwater pumping for the proposed KMC Proposed action would contribute less than 0.03 percent reduction in Begashibito Wash.
- Special Status Fish and Transmission Systems – The operation and maintenance of the transmission systems would result in no effects to special status species because vegetation management and stream disturbance would not occur in or near the stream crossings transmission lines being 300 to 400 feet above the streams. In addition, best management practices for operation and maintenance activities in combination with additional conservation measures would avoid effects to species and their habitat.

3.13.4.3.5 Cumulative Impacts

The cumulative effects study area is expanded to include cumulative sources in the Upper Colorado River Basin and the upstream portion of San Juan River to the Navajo Dam. Actions involving changes in flow and water quality changes in the Upper Colorado River Basin would be evident at the Colorado and Green River confluence, which is the upper portion of the Proposed Action study area. In addition, changes in flow and water quality in the upper portion of the San Juan River would be evident the

Farmington area, which is the upper portion of the Proposed Action in the San Juan River. The portion of the Colorado River below Glen Canyon Dam is extended downstream to the inflow to Lake Mead. The following discussion is divided into cumulative emissions and other cumulative actions for each of the federally listed species and other special status aquatic species.

The relative trace metals impact contributions from the Proposed Action, baseline, and other cumulative sources are discussed by species. Each species discussion is then followed by other cumulative actions that also could contribute additional effects.

3.13.4.3.5.1 Bonytail

Cumulative Emission Effects

The combination of NGS and associated facilities and the proposed KMC emission plus other cumulative deposition sources with baseline fish tissue concentrations showed maximum and refined tissue-based HQs of 2 and 1, respectively, for mercury, which indicates a potential risk to bonytail due to other cumulative emissions (**Appendix 3.13-B, Tables 1A** and **1B**). The potential injury on bonytail individuals is considered minor, although it cannot be quantified due to the low number of bonytail in the Northeast Gap Region. The refined fish tissue HQs for total selenium and arsenic cumulative emissions were less than 1 (0.2 and 0.04, respectively), which indicates negligible risk to bonytail from these metals. The project contribution to total cumulative fish tissue concentrations would be less than 0.2 percent for each of the metals. There would be a negligible effect on critical habitat because of no exceedance of the National Ambient Water Quality Criteria standards and only a slight exceedance of the conservative Utah standard for mercury.

Other Cumulative Sources

Climate change and water diversions in the Upper Colorado Basin would contribute additional effects to the bonytail and its critical habitat in the Northeast Gap Region. Currently, the magnitude of global climate change is such that its effect on freshwater fisheries and other aquatic species could easily be masked by or attributed to other anthropogenic causes such as overexploitation, deforestation, and land use (Ficke et al. 2007).

3.13.4.3.5.2 Colorado Pikeminnow

Cumulative Emission Effects

Northeast Gap Region

There would be negligible risk from mercury on Colorado pikeminnow and its critical habitat from the combination of NGS and associated facilities and other cumulative emission sources plus baseline fish tissue concentrations, because the mercury CBR HQ is 2 (maximum) and 1 (refined) (**Appendix 3.13-B, Tables 2A** and **2B**). The selenium and arsenic fish tissue analysis showed a negligible risk to Colorado pikeminnow, because the HQs were less than 1. The project contributions to total cumulative fish tissue concentrations would be less than 0.2 percent for each of the metals. There would be a negligible effect on critical habitat in the Northeast Gap Region because of no exceedance of the National Ambient Water Quality Criteria standards and only a slight exceedance of the conservative Utah standard for mercury.

San Juan River

Using measured Colorado pikeminnow data for mercury, the combination of baseline fish tissue concentrations with the contribution from NGS emissions plus other cumulative emission sources showed a maximum HQ of 2 and refined HQ of 1 (**Appendix 3.13-B, Tables 3A** and **3B**). Using surrogate tissue data for Colorado pikeminnow, the total cumulative HQs were 3 (maximum) and 2 (refined). These results indicate a potential risk to the species from total cumulative emissions

(**Appendix 3.13-B, Tables 4A** and **4B**). The effect was due to an equal contribution from baseline conditions and other cumulative source. The combination of NGS arsenic and selenium emissions with baseline fish tissue concentrations and other cumulative sources using modeled (surrogate) fish tissue data would result in a HQ less than 1, which indicates a negligible risk from arsenic or selenium on Colorado pikeminnow. The ERA also included an analysis using Colorado pikeminnow tissue data rather than surrogate fish tissue concentrations (Ramboll Environ 2016b). The results were similar to those noted using surrogate species, and generally showed lower HQs compared to the surrogate analysis. Use of species-specific tissue data is appropriate to give species-specific relevance to the results and reduce uncertainty. However, these data were based on stocked fish released to the river and may underestimate baseline tissue concentrations for wild (non-stocked) fish populations, as stocked fish are expected to have less exposure time to instream conditions compared to wild fish that have spent their entire life in the San Juan River. For this reason, baseline fish tissue concentrations assessed using surrogate fish species for Colorado pikeminnow may be of equal relevance to "frame" the potential risk outcome. A potential risk to Colorado pikeminnow from mercury was indicated in both the surrogate fish species and pikeminnow fish tissue analyses for total cumulative emissions. The project contributions to total cumulative fish tissue concentrations would be less than 0.1 percent for each of the metals.

Species Effects – When the small contribution from the Proposed Action is added to baseline fish tissue concentrations and other cumulative emission sources, there would be a minor effect of mercury on Colorado pikeminnow in the San Juan River (**Table 3.13-26**). The effect is considered to be minor, because the estimated number of individuals affected by total cumulative emissions would be within the natural population variability. The NGS effect from mercury would be less than 1 adult or subadult Colorado pikeminnow for any of the injury categories, which represents less than 1 to 33 percent of the total cumulative emission effect categories. The higher percentages occur when relatively low injury effects are estimated for total cumulative emissions. The NGS effect from mercury emissions and deposition on eggs and larvae would represent an even smaller percentage of the total cumulative emission effects (less than 0.2 percent for mercury). The effect of total selenium emissions on Colorado pikeminnow would be 3,020 adults over the timeframe of the project, which is considered a moderate effect on the population. The NGS effect from selenium on Colorado pikeminnow would represent a small percentage of the total cumulative emission effects (less than 0.3 percent for eggs and less than 0.1 percent for larvae and adults).

Table 3.13-26 Mercury and Selenium Injury Effects to Colorado Pikeminnow in the San Juan River, 2020 to 2074

Emission Sources	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Reproduction	Juveniles (<400 mm)	Adults (>400 mm)	Subadult Behavioral Injury	Adult Behavioral Injury
Mercury							
NGS	593	12	1	1	1	1	1
Total Cumulative	309,617	73,263	12	156	3	7,872	158
Selenium							
NGS	41,118	76	NA[2]	NA[2]	1	NA[2]	NA[2]
Total Cumulative	151,002,145	552,375	NA[2]	NA[2]	3,020	NA[2]	NA[2]

[1] Values less than 1 rounded to 1.

[2] NA = Toxicity literature is not available to provide an estimate for this category.

mm = millimeter.

Critical Habitat Effects – Cumulative emissions also would affect critical habitat for Colorado pikeminnow in the San Juan River. The combination of the Proposed Action and other cumulative emissions would result in refined mercury surface water concentrations below National Ambient Water Quality Criteria but would exceed the conservative Navajo Nation Surface Water Quality Standard for total (unfiltered) mercury (0.012 microgram per liter).

Other Cumulative Sources

Climate change, water use, urban development, and other human activities also would affect Colorado pikeminnow individuals and its critical habitat. These activities are discussed in the Four Corners Power Plant and Navajo Mine Energy Biological Opinion (USFWS 2015a), as summarized below.

Climate change may contribute to additional depletions to the San Juan River. The magnitude and timing of the depletions cannot be predicted with certainty at this time. Several studies project a decrease in stream flow from eight to 45 percent depending on the model used, the time frame, and the methods (Christensen and Lettenmaier 2007; Hoerling et al. 2013; Ray et al. 2008 as cited in USFWS 2015a; Seager et al. 2007; Udall 2007). Although the San Juan River was not modeled independent of the entire Colorado River basin in these studies, based on the projections of the Intergovernmental Panel on Climate Change (Christensen et al. 2007) for warmer temperatures and an increase in the frequency of hot extremes and heat waves, it is reasonable to expect that there will be a decrease in stream flow in the future. The analysis of Bluff river flow gaging data indicates an annual reduction of some 9,200 acre-feet per year as a long-term linearized trend in the San Juan River Basin. This pattern is consistent with the data for the Colorado River Basin; however, the reduction as a percent of the annual total is double that of the Colorado River (0.44 percent per year, versus 0.22 percent per year for the Colorado River). Although the year-to-year variability is substantial, the ongoing reduction in river flows at this site is clear. Changes in flow patterns or flow volumes could affect key biological activities such as fish spawning and early stage development of eggs and young fish, as well as increasing the colonization of non-native or invasive aquatic species (Garfin et al. 2013). Higher air temperatures also may increase the water temperatures preferred by pikeminnow, resulting in local range expansions. Higher water temperatures also could cause positive or negative changes in food supply for fish by affecting invertebrate development (Garfin et al. 2013).

Water Diversions – Cumulative water diversions would include coalbed methane development, irrigation/canal withdrawals, livestock grazing, and water use for urban development. Other foreseeable non-federal Colorado San Juan River drainage water storage projects (documented by applications to the Colorado State Engineer) include the Long Hollow Reservoir (proposed capacity of 5,300 acre-feet) and the Dry Gulch Water Storage Project (proposed capacity of 11,000 acre-feet). These projects could contribute to cumulative reductions in Navajo Reservoir River storage, which could influence the volume of water available for release for fish habitat maintenance purposes.

Human Activities – The increase in recreation activities involving fishing, boating, camping, and vehicle use would result in angling pressure, non-point pollution, fire threat, introduction of non-native fish species, and potential disturbance to native fishes.

Non-native Fish Threat – A future threat of non-native fish movement from Lake Powell could occur during wet years when the waterfall barrier is inundated. Striped bass, channel catfish, walleye, and other non-native fish species would move into to the San Juan River and compete with Colorado pikeminnow and razorback sucker for food sources and habitat.

The role of conservation measures proposed for Colorado pikeminnow is to offset impacts of the Proposed Action and enhance and assist in the recovery the species by addressing cumulative effects. Measures which apply to Colorado pikeminnow are listed below.

- FS-3 would augment wild populations of Colorado pikeminnow and razorback sucker by offsetting the low recruitment rates for these species in the San Juan River. This measure also would assist in improving the genetic diversity of the brood stock and numbers of Colorado pikeminnow that would be used in stocking efforts in the San Juan River including areas affected by the project, as well as in the Upper Colorado River.
- FS-4 would benefit Colorado pikeminnow by facilitating movement of wild, breeding adult Colorado pikeminnow that are otherwise unable to reach their spawning areas in most years due to the waterfall barrier on the San Juan River arm of Lake Powell.
- FS-5 would benefit Colorado pikeminnow by improving and creating habitats that currently do not exist in the San Juan River. The restored habitats would provide breeding and recruitment areas for Colorado pikeminnow and other federally listed and sensitive native fish species that currently do not exist, which would increase reproduction and the survival of eggs, larvae, and young.

3.13.4.3.5.3 Humpback Chub

Cumulative Emission Effects

Northeast Gap Region

There would be a potential risk from mercury on humpback chub from the combination NGS and associated facilities and other cumulative emission sources with baseline fish tissue concentrations, because the mercury fish tissue is the HQ is 1. Tissue and HQ values would be the same as shown in **Appendix 13.3-B**, **Tables 1A** and **1B**. The selenium fish tissue analysis indicated a negligible risk to humpback chub as indicated by a HQ less than 1. There would be a negligible effect on critical habitat in the Northeast Gap Region because of no exceedance of the National Ambient Water Quality Criteria and only a slight exceedance of the conservative Utah standard for mercury.

Southwest Gap Region

The combination of NGS and associated facilities and other cumulative emissions with baseline fish tissue concentrations showed maximum and refined HQs of 4 and 3, respectively, for mercury, which indicates a potential risk to humpback chub (**Appendix 13.3-B**, **Tables 5A** and **5B**). The effect is due to baseline conditions and other cumulative emission sources. The addition of NGS selenium emissions with other cumulative sources and baseline conditions showed a HQ of less than 1, which indicates a negligible risk to humpback chub from selenium. The project contribution to total cumulative fish concentrations would be less than 0.2 percent for mercury and selenium. It is important to note that the ERA analysis is most comparable to the USFWS injury effect quantification because both take into account baseline, Proposed Action, and cumulative effects.

Species Effects – When the small contribution from the NGS Proposed Action is added to baseline conditions and other cumulative emission sources, there would be a minor effect of mercury on humpback chub in the Southwest Gap Region. The effect is considered to be minor because number of individuals (3 adults and 331 subadults) potentially injured due to mercury is likely within the natural variability of the population. The estimated injury effects are provided in **Table 3.13-27**. The total cumulative effect would be up to 3 adults and 331 subadults for mercury. The estimated Proposed Action injury would be less than 0.1 percent of the total cumulative emission effect from mercury. Toxicity literature is not available to make an injury estimate to adult and juvenile humpback chub from selenium.

Critical Habitat Effects – Cumulative emissions also would affect critical habitat for humpback chub in the Southwest Gap Region. The combination of the Proposed Action and other cumulative emissions would result in refined selenium surface water concentrations that exceed the National Ambient Water Quality Criteria Water Quality Standard and Arizona Water Quality Standard during the period 2020 to 2074.

Table 3.13-27 Mercury and Selenium Injury Effects to Humpback Chub in the Southwest Gap Region, 2020 to 2074

Emission Sources	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Repro.	Juveniles Behavioral	Adults Behavioral	Subadult Survivor-ship	Adult Survivor-ship
Mercury							
NGS	325	4	1	1	1	1	1
Total Cumulative	73,676	876	ND[2]	331	3	8	1
Selenium							
NGS	76,621	2,238	22	NA[1]	NA[1]	NA[1]	NA[1]
Total Cumulative	55,534,425	974,894	16,662	NA[1]	NA[1]	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

mm = millimeter.

Other Cumulative Sources

Climate change, water use, urban development, mining, and other human activities would affect humpback chub and its critical habitat in the Gap Regions. These activities are discussed in the Glen Canyon Dam Long-term Experimental and Management Plan (Reclamation and NPS 2015), as summarized below.

Climate Change – Based on the SECURE Water Act Report (Reclamation 2016) and Reclamation and NPS (2015), climate changes in the Colorado River Basin include the following:

- Colorado River Basin temperature is projected to increase by an average of 5 to 6ºF during the 21st Century;
- Precipitation is expected to increase by 2.1 percent in the upper basin and decline by 1.6 percent in the lower basin;
- Mean annual runoff is projected to decrease by 3.5 to 8.5 percent by 2050;
- Warmer conditions might cause changes in fisheries habitat, shifts in species geographic ranges, increased water demands for instream ecosystems and thermoelectric power production, increased power demands for municipal uses (including cooling) and increased likelihood of invasive species infestations. Endangered species issues might be exacerbated although warmer water may increase spawning success for native species; and
- Increases in the water temperature of Colorado River mainstem and its tributaries in Grand Canyon due to climate change could expand the distribution of warmwater-adapted non-native fishes (Eaton and Scheller 1996; Rahel and Olden 2008), which can prey on and compete with native fishes such as endangered humpback chub or disadvantaged coldwater non-native species.

Water Use and Diversions – Other private water diversions in the Upper Colorado River Basin likely would occur in the future, although the total water diversions are not known at this time. These future water diversions would contribute new depletions to the Upper Colorado River Basin, which would reduce flows into Lake Powell. However, flow releases from Lake Powell would follow the future long-term operation and management plan, which is being evaluated in an EIS (Reclamation and NPS 2015).

Mining – Based on a renewed interest in uranium, there could be increased mining on lands that drain into the Colorado River, which could increase the amount of uranium, arsenic, and other trace elements in local surface water and groundwater. Aquatic species and habitat most likely to be affected by mining would be those associated with small ephemeral and intermittent streams. A spill of uranium ore or other mining material that reached a perennial stream could affect water quality in the Colorado River. However, the timing and extent of such an accidental spill is unpredictable, and spill control and containment requirements would likely minimize any long-term effect on fish species or their habitat.

Human Activities – Increased human activities in the Colorado River below Glen Canyon Dam to Lake Mead. Although urban runoff, industrial releases, and municipal discharges are considered some of the leading nonpoint sources of contaminants to surface waters, the 2007 Reclamation Interim Guidelines have improved water supply conditions through increased water conservation efforts, which in turn are providing more predictability in water supply to users in the Basin States (especially the Lower Basin). Although fishing pressure and recreational activities would likely increase in the future, the Comprehensive Fisheries Management Plan and the Non-native Fish Control Program would protect and benefit recreational fishing below Glen Canyon Dam.

The role of conservation measures proposed for humpback chub is to offset impacts of the Proposed Action and enhance and assist in the recovery the species by addressing cumulative effects. The following measures apply to humpback chub:

The control of nonnative fish in the Grand Canyon portion of the Colorado River would reduce predation on humpback chub and razorback sucker. The measure would help protect the entire mainstem Colorado River from Lees Ferry to the inflow to Lake Mead. The specific level of benefit to this reach will be determined from a qualitative analysis of the number of nonnative fish removed and relative reduction in nonnative fish predation in the area that is treated.

3.13.4.3.5.4 Razorback Sucker

Cumulative Emission Effects

Northeast Gap Region

The combination of NGS and associated facilities and other cumulative emissions with baseline fish tissue concentrations showed maximum and refined HQs of 2 and 1, respectively, which indicates a potential risk to razorback sucker from mercury due to other cumulative emissions. Tissue and HQ values would be the same as shown in **Appendix 3.13-B**, **Tables 1A** and **1B**. There would be a negligible risk from selenium on razorback sucker from future NGS and other cumulative sources in the Northeast Gap Region because HQs were less than 1. The project contribution to total cumulative fish tissue concentrations would be less than 0.2 percent. There would be a negligible effect on critical habitat in the Northeast Gap Region because of no exceedance of the National Ambient Water Quality Criteria and only a slight exceedance of the conservative Utah standard for mercury.

Southwest Gap Region

The combination of the NGS Proposed Action and other cumulative emissions with baseline fish tissue concentrations showed mercury HQs of 8 (maximum) and 5 (refined) using the flannelmouth sucker as a surrogate and 5 (maximum) and 3 (refined) based on the surrogate, bluehead sucker (**Appendix 3.13-B**, **Tables 6A** and **6B**). Both HQs indicate a potential risk to razorback sucker, which is mainly due to baseline conditions and other cumulative emission sources. The NGS contribution to selenium concentrations in the Southwest Gap Region also is very small, with a tissue-based refined HQ of 0.0003. The addition of NGS selenium emissions with other cumulative sources showed refined HQs of 1 (maximum and refined for flannelmouth sucker surrogate) and 0.7 (maximum and refined for bluehead sucker surrogate). Based on the flannelmouth sucker HQ, there is a potential risk from

selenium on razorback sucker due to baseline fish tissue concentrations. The project contribution to total cumulative fish tissue concentrations in the Southwest Gap Region would be less than 0.2 percent. It is important to note that the ERA analysis is most comparable to the USFWS injury effect quantification because both take into account baseline, Proposed Action, and cumulative effects.

San Juan River

The combination of the NGS Proposed Action and other cumulative emissions with baseline fish tissue concentrations indicated a negligible risk to razorback sucker from mercury and selenium. Mercury maximum and refined HQs were 2 and 0.8, respectively, using the flannelmouth sucker as a surrogate and 0.7 and 0.5, respectively, based on the surrogate, bluehead sucker (**Appendix 3.13-B**, **Tables 7A** and **7B**). Selenium refined HQs were 1 (maximum) and 0.4 (refined) for flannelmouth sucker and 0.8 (maximum) and 0.3 (refined) for bluehead sucker. HQ values below 1 indicate that the risk of effect from total cumulative emissions on razorback sucker in the San Juan River would be negligible. Similarly, low refined HQs were shown for arsenic (0.02 for the flannelmouth sucker surrogate and 0.04 for the bluehead sucker surrogate). Maximum HQs for stocked razorback sucker were 1 for mercury and selenium, and <0.1 for arsenic, while refined HQs were 0.7 for mercury, 0.5 for selenium, and <0.1 for arsenic (**Appendix 3.13-B**, **Tables 8A** and **8B**). As mentioned above for Colorado pikeminnow, HQs based on surrogate fish species were used as a more conservative indicator of cumulative effects to frame the risk results. The project contribution to total cumulative fish tissue concentrations would be less than 0.1 percent for both the species-specific and surrogate analyses. Although the HQs indicated a low risk level, an injury effect was determined based on toxicity data as discussed below.

Species Effects – Based on population and toxicity data, the injury effects were estimated for razorback sucker in the Southwest Gap Region and San Juan River by the USFWS methodology (**Tables 3.13-28** and **3.13-29**, respectively). The effect is considered to be moderate because the number of individuals potentially injured (i.e., 2,653 in the Southwest Gap Region due to mercury and 3,085 and 15,182 adults in the San Juan River due to mercury and selenium, respectively) is likely outside of the natural variability of the population. The methodology used in the injury effects analysis is provided in **Appendix 3.13-A.** The total cumulative effect in the Southwest Gap Region would be up to 4 adults for mercury. The estimated Proposed Action injury would be less than 0.1 percent of the total cumulative emission effect from mercury in the Southwest Gap Region and from mercury and selenium in the San Juan River. Toxicity literature is not available to make an injury estimate to adult razorback sucker from selenium in the Southwest Gap Region. The effect quantification for the federally listed fish species was a separate analysis that provided an estimate of the number of individuals by life stage that could be affected by project emissions and deposition. The effect analysis also provides a separate line of evidence (i.e., compared to the ERAs) as to whether the listed fish would be affected by the project. It is a separate analysis compared to the ERAs, which identified potential risk of effects to species. The ERA results were helpful in determining whether an injury effect should be completed. However, the ERAs do not quantify the effect on individuals. Both analyses used some of the same toxicity information such as threshold effect levels for mercury and selenium. However, the effect quantification applied toxicity information to population and life stage numbers to provide an estimate of individuals affected.

Table 3.13-28 Mercury and Selenium Injury Effects to Razorback Sucker in the Southwest Gap Region, 2020 to 2074

Emission Sources	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Repro.	Juveniles Behavioral	Adults Behavioral	Subadult Survivorship	Adult Survivorship
Mercury							
NGS	45	1	1	1	1	1	1
Total Cumulative	10,212	162	1	10	4	3	2
Selenium							
NGS	21,611	1,259	1	NA[1]	NA[1]	NA[1]	NA[1]
Total Cumulative	723,936	548,519	295	NA[1]	NA[1]	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

Table 3.13-29 Mercury and Selenium Injury Effects to Razorback Sucker in the San Juan River, 2020 to 2074

Emission Sources	Life Stages[1] (number of individuals)						
	Eggs/ Embryos	Larvae	Adult Reproduction	Juveniles	Adults	Subadult Behavioral Injury	Adult Behavioral Injury
Mercury							
NGS	4,510	72	1	5	2	1	1
Total Cumulative	9,282,671	148,042	286	9,137	3,085	224	1,084
Selenium							
NGS	485,154	301	NA[1]	NA[1]	7	NA[1]	NA[1]
Total Cumulative	1,176,895,548	3,915,091	NA	NA[1]	15,282	NA[1]	NA[1]

[1] Toxicity literature is not available to provide an estimate for this category.

Critical Habitat Effects – Based on the USFWS methodology, total cumulative emissions and deposition could result in a minor effect on the primary constituent water element of critical habitat for razorback sucker in the Southwest Gap Region and San Juan River, because surface water concentrations exceeded water quality standards for mercury and selenium. The effect is considered minor because the percent of critical habitat potentially affected would be approximately 4 percent in the Southwest Gap Region and 12 percent in the San Juan River. In addition, the estimated surface water concentrations using refined values only slightly exceeded the water quality standards.

Other Cumulative Sources

Other cumulative actions that would adversely affect razorback sucker individuals and its critical habitat in the San Juan River and Southwest Gap Region include climate change, water use, urban development, mining, and other human activities such as recreation. These activities and effects on

razorback sucker would be the same as discussed for the Colorado pikeminnow for the San Juan River and humpback chub for the Southwest Gap Region.

The role of conservation measures proposed for razorback sucker is to offset impacts of the Proposed Action and enhance and assist in the recovery the species by addressing cumulative effects. Measures which apply to razorback sucker are listed below.

- FS-1 would involve the control of nonnative fish in the Grand Canyon portion of the Colorado River would reduce predation on humpback chub and razorback sucker. The measure would help protect the entire mainstem Colorado River from Lees Ferry to the inflow to Lake Mead. The specific level of benefit to this reach will be determined from a qualitative analysis of the number of nonnative fish removed and relative reduction in nonnative fish predation in the area that is treated.
- FS-2 would augment razorback sucker numbers in the Grand Canyon portion of the Colorado River through translocations, if the NPS determines that the species needs augmentation. If translocations are determined by NPS to be needed, this measure will offset Project-related impacts to razorback sucker by increasing razorback sucker numbers in the Grand Canyon.
- FS-3 would augment wild populations of Colorado pikeminnow and razorback sucker by offsetting the low recruitment rates for these species in the San Juan River. This measure also would assist in improving the genetic diversity of the brood stock and numbers of Colorado pikeminnow that would be used in stocking efforts in the San Juan River including areas affected by the project, as well as in the Upper Colorado River.
- FS-4 would involve provide financial support to capture and transport Colorado pikeminnow and razorback sucker upstream of a waterfall and allow access to habitat in the San Juan River. Funding to support the capture and transportation of these fish around this barrier would offset the effects of mercury by increasing the number of potentially spawning fish in the San Juan River and serve as a mechanism to connect the river and lake below the waterfall with fish and habitat in the river upstream of the barrier.
- FS-5 would provide funding to improve and provide habitat for Colorado pikeminnow and razorback sucker in the San Juan River, which could be used for nursery or recruitment areas for these species. This measure will offset project-related impacts to Colorado pikeminnow and razorback sucker by providing habitat that currently does not exist in the San Juan River, which will improve species recruitment.

3.13.4.3.5.5 Northern Leopard Frog

<u>Cumulative Emission Effects</u>

The NGS 3-Unit Operation and 2-Unit Operation would contribute very small concentrations to the baseline conditions and other cumulative sources. The 2-Unit Operation would reduce mercury and selenium levels by approximately 35 percent. There would be negligible effects of metals on northern leopard frog from overall cumulative emissions.

<u>Other Cumulative Sources</u>

Groundwater pumping for the proposed KMC Proposed action would contribute less than 0.03 percent reduction in Begashibito Wash. Other cumulative pumping (communities) would reduce flow in Begashibito Wash by approximately 18 percent of 2020 rates, which is a substantial reduction in habitat. This reduction level would remove potential habitat for northern leopard frog, which is considered to be potential breeding habitat.

3.13.4.3.5.6 Desert Pupfish, Gila Chub, Gila Topminnow, Loach Minnow, Spikedace, and Roundtail Chub

Other Cumulative Effects

The NGS Proposed Action effects would combine with other cumulative actions at a few locations within the transmission line ROWs where special status species are present. These cumulative actions include road use and recreation activities. Streams that overlap with other cumulative actions include the Verde and Aqua Fria rivers for the STS. Relatively few factors affect fish habitat at the Verde River crossing in comparison to the Agua Fria crossing, because it is located in closer proximity to human development. Therefore, the Agua Fria crossing is at greater risk of cumulative effects from recreation within riparian corridors; livestock grazing; road construction, use, and maintenance; and environmental contaminants. The total cumulative impact on special status species in these streams would be considered negligible based on effects from other cumulative activities. However, there would be no effects to these fish species due to the project.

3.13.4.3.5.7 Virgin River Chub and Woundfin

Other Cumulative Effects

The NGS Proposed Action effects would combine with other cumulative actions at a few locations within the transmission line ROWs where special status species are present. These cumulative actions include road use and recreation activities and the TransWest Express Transmission Project, Southern Nevada Intertie project, and the Lake Powell Pipeline for the WTS. Streams that overlap with other cumulative actions include Meadow Valley Wash and Muddy River for the WTS. Project activities in the Virgin and Muddy river drainages would result in no effects on Virgin River chub and woundfin. Vehicle use from overall cumulative activities poses some risk of fuel spills on Virgin and Muddy rivers occupied and critical habitat areas. The total cumulative impact on special status species would be low based on other cumulative activities for these areas.

3.13.4.4 Natural Gas Partial Federal Replacement Alternative

This discussion focuses on the impacts to aquatic species from reducing the power generated at NGS, with consequent reductions in coal production at the Kayenta Mine. There is limited discussion of the alternative site because it is assumed that surface water and perennial waterbodies would be limited when considering the arid characteristics of region.

Site Characteristics and Resource Impacts

Under the Natural Gas PFR Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Key assumptions about aquatic biological resources related to such an existing site are listed below.

- A combined-cycle natural gas power plant typically would be located on a site of approximately 100 acres. No additional surface disturbance would be required over time.
- Potential surface disturbance could occur at scattered locations within the entire site.
- Perennial waterbodies are assumed to be limited within the alternative site due to the arid characteristics of the general region.
- Natural gas combustion for power generation would not result in COPECs emissions and deposition that would overlap with the coal combustion emissions and deposition from NGS; therefore, there would be no deposition from natural gas combustion to surface water in the

study area. The description of emission calculations for the PFR is described in Chapter 2.0 and Section 3.1, Air Quality.

- An existing gas plant would have been permitted by USEPA to operate and thus meet all air quality standards protective of environment including aquatic species.
- Because the Proposed Action results for the 2,250-MW coal plant emissions impacts are very small/negligible for aquatic species, and that the anticipated emissions from NGCC plant (see Section 3.1 appendices) would be a fraction of NGS emissions, then the impacts would likely be negligible as well.

Impact issues for this PFR Alternative are discussed across the range of NGS operations and associated alternative power reductions (100 MW and 250 MW) from the least NGS power reduction to the greatest. Reductions in NGS power generation would proportionally reduce the quantity of coal delivered from the Kayenta Mine. The focus of this discussion is to distinguish differences in impacts within the replacement alternative operational range to provide a basis for comparison with the Proposed Action.

3.13.4.4.1 Navajo Generating Station

The Natural Gas PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 5 and 13 percent for the 3-Unit Operation and 8 and 19 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas. For example, a comparison of the mercury HQs for the Proposed Action and a modeled 1,400-MW scenario using ERA analyses (Ramboll Environ 2016c) showed a very small reduction in adult sport fish HQ values (**Table 3.13-30**). The 1,400-MW scenario was modeled for the ERA to depict a data point between the values presented for the smallest change (3-Unit Operation/100-MW Replacement) and largest change (2-Unit Operation and 250-MW Replacement). A similarly slight reduction is shown for selenium. The point of this comparison is to show that there would be a very slight reduction in risk to special status aquatic species from mercury or selenium under this alternative for both the 3-Unit Operation and 2-Unit Operation. The difference in risk resulting from this Natural Gas PFR Alternative would negligible as compared to the 3-Unit Operation and 2-Unit Operation, and the effects are therefore practicably (albeit very slightly less) the same as discussed for the Proposed Action.

Table 3.13-30 Comparison of Mercury HQs for the Proposed Action and Natural Gas PFR Alternative

ERA Analysis Areas / Species	Proposed Action 3-Unit Operation (Refined – Maximum)	Proposed Action 2-Unit Operation (Refined – Maximum)	1,400-MW ERA-modeled Scenario (Refined – Maximum) *
Northeast Gap			
Bonytail, Colorado pikeminnow, humpback chub, razorback sucker	0.002 – 0.003	0.001 – 0.003	0.0007 – 0.001
Southwest Gap			
Humpback chub	0.003 – 0.005	0.002 – 0.005	0.001 – 0.002
Razorback sucker	0.003 – 0.005	0.002 – 0.005	0.001 – 0.002

Table 3.13-30 Comparison of Mercury HQs for the Proposed Action and Natural Gas PFR Alternative

ERA Analysis Areas / Species	Proposed Action 3-Unit Operation (Refined – Maximum)	Proposed Action 2-Unit Operation (Refined – Maximum)	1,400-MW ERA-modeled Scenario (Refined – Maximum) *
San Juan River			
Colorado pikeminnow	0.0008 – 0.001	<0.0008 – <0.001	<0.0008 – <0.001
Razorback sucker	0.0004	<0.0004	<0.0004

* Source: Ramboll Environ (2016b,c) ERAs.

The combination of this PFR Alternative with baseline conditions would represent potential risks to several special status aquatic species in the San Juan River and Southwest Gap Region of the Colorado River, because refined HQs are greater than 1. The potential risk is dictated by baseline fish tissue concentrations for mercury and selenium rather than the project contribution under the PFR Alternative. Species that would be affected include the federally listed species, Colorado pikeminnow, humpback chub, and razorback sucker, and other special status species such as flannelmouth sucker, bluehead sucker, and speckled dace. The impact level would be considered minor, because the injury effect or potential loss of individuals from mercury or selenium tissue concentrations would be small and within the natural population variability over the 2020 to 2074 timeframe of the project.

There would be a potential minor effect on critical habitat for Colorado pikeminnow and razorback sucker in the San Juan River and humpback chub and razorback sucker in the Southwest Gap Region of the Colorado River. The effect on critical habitat is based on an exceedance of the conservative Navajo Nation water quality standard for mercury in the San Juan River, and the Navajo Nation standard for selenium in the Southwest Gap area of the Colorado River.

The following risks and effects would occur for the federally listed fish and other special status species as a result of Natural Gas PFR Alternative. It is important to mention that emissions and deposition from the Natural Gas PFR Alternative by itself would represent a negligible risk to the species and their critical habitat, based on the very small HQs. Potential risks and effects to species from the combination of the Natural Gas PFR Alternative with baseline fish tissue concentrations are summarized below.

3.13.4.4.1.1 Bonytail

Risks from NGS emissions and deposition would be negligible in the Northeast Gap Region, because HQs would be less than 1. There would be a negligible effect on bonytail, because injury or loss of individuals would not be detectable. There would be a negligible effect on critical habitat in the Northeast Gap Region because refined mercury concentrations exceeded water quality standards.

3.13.4.4.1.2 Colorado Pikeminnow

Risks and effects from NGS emissions and deposition in combination with baseline fish tissue concentrations would be the same as described for bonytail. There would be negligible effects on Colorado pikeminnow and its critical habitat in the Northeast Gap Region. There would be a negligible risk to this species from selenium. There would be a potential risk from mercury in the San Juan River due to the HQ exceeding 1 for this alternative in combination with baseline fish tissue concentrations. There would be a potential small loss of individuals in the San Juan River, which would be a minor effect because less than 1 percent of the current Colorado pikeminnow population would be affected. Based on the USFWS methodology, there would be a minor effect on critical habitat for this species in the San Juan River, because the exceedance of the conservative Navajo Nation water quality standard for mercury was small. National Ambient Water Quality Criteria were not exceeded. Conservation measures FS-3 (Support Activities at the USFWS Southwest Research and Recovery Center), FS-4 (Support

Transport of Colorado pikeminnow and Razorback Sucker above the Waterfall Barrier), and FS-5 (Funding Support for a Habitat Enhancement Project in the San Juan River) would be implemented to offset impacts to Colorado pikeminnow from the PFR alternative plus cumulative emission sources.

3.13.4.4.1.3 Humpback Chub

Risks and effects from NGS emissions and deposition in combination with baseline fish tissue concentrations would be the same as described for bonytail. There would be negligible effects on humpback chub and its critical habitat in the Northeast Gap Region due to slight exceedance of Utah water quality standard. There would be a negligible risk from mercury and selenium in the Southwest Gap Region, as indicated by HQs less than 1 for this alternative in combination with baseline fish tissue concentrations. By applying the USFWS injury effect analysis for the Proposed Action to the PFR Alternative, there would be a potential small loss of individuals in the Southwest Gap Region, which would be a minor effect because less than 1 percent of the current humpback chub population. There would be a minor effect on critical habitat for this species in the San Juan River, because the exceedance of the conservative Navajo Nation water quality standard for mercury was small. National Ambient Water Quality Criteria were not exceeded. Conservation measures FS -1 (Non-native Fish Management in the Colorado River Grand Canyon Area) would be implemented to offset impacts to humpback chub from the PFR Alternative plus cumulative emission sources.

3.13.4.4.1.4 Razorback Sucker

Risks and effects from NGS emissions and deposition in combination with baseline fish tissue concentrations would be the same as described for bonytail. There would be negligible effects on razorback sucker and its critical habitat in the Northeast Gap Region. There would be a potential risk from mercury and selenium in the Southwest Gap Region due to the HQ exceeding 1 for this alternative in combination with baseline fish tissue concentrations. There would be a negligible risk from mercury and selenium in the San Juan River, as indicated by HQs less than 1 for this alternative in combination with baseline fish tissue concentrations. There would be a potential small loss of individuals in the Southwest Gap Region and San Juan River, which would be a minor effect because less than 1 percent of the minimum viable razorback sucker population would be affected. There would be a minor effect on critical habitat for this species in the Southwest Gap Region and the San Juan River, because the exceedance of the conservative Navajo Nation water quality standard for mercury was small. National Ambient Water Quality Criteria were not exceeded. Conservation measures FS-1 (Non-native Fish Management in the Colorado River Grand Canyon Area) and FS-2 (Razorback Sucker Translocations) would be implemented to offset impacts to razorback sucker from the PFR Alternative plus cumulative emission sources.

Other Special Status Species – Risks and effects on flannelmouth sucker, bluehead sucker, and speckled dace would occur in the Southwest Gap Region and the San Juan River. There would be potential risks to these species in both study areas, as well as minor effects on the species. The effects are considered minor because potential loss of individuals would comprise less than 1 percent of their overall populations.

3.13.4.4.2 Proposed Kayenta Mine Complex

The following discusses the impacts to aquatic biological resources if 100 MW to 250 MW of power generation were replaced at NGS by alternative sources and the proposed KMC would mine less coal (8.1 million tons per year [tpy] production for the NGS 3-Unit Operation and 5.5 million tpy production for the NGS 2-Unit Operation. Under the Renewable PFR, alternative power would be purchased by Reclamation from an unknown, but existing source. Therefore, prior disturbance impacts to aquatic biological resources are not evaluated.

3.13.4.4.2.1 Mine Emissions and Deposition

The Natural Gas PFR Alternative would result in the same level of effect on the northern leopard frog, which is the only special status aquatic species within the proposed KMC. This alternative would not disturb northern leopard frog habitat, because no habitat is located within the mining areas or road realignment area. Proposed KMC emissions and metal concentrations would be slightly less than the Proposed Action for both the 8.1-million tpy and 5.5-million tpy production levels associated with the 3-Unit Operation and 2-Unit Operation. There would be negligible risks to northern leopard frog due to metal concentrations, as indicated by a HQ less than 1. The impact level would be considered negligible for northern leopard frog in relation to both coal production levels.

3.13.4.4.2.2 Groundwater Pumping

Groundwater pumping would be the same as the Proposed Action, with less than 1 percent potential reduction in stream and spring flows. This small change would represent a negligible effect to northern leopard frog habitat.

3.13.4.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

There would be negligible impacts to the exiting transmission systems and communication sites because no changes in the operations of the WTS, STS, or communications sites would occur due to the implementation of the Natural Gas PFR Alternative. Impacts would be negligible to special status fish species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. Best management practices and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for special status fish species.

3.13.4.4.4 Project Impact Summary

In summary, the Natural Gas PFR Alternative would result in 5 to 19 percent power reduction at NGS compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The combination of NGS emissions and baseline conditions would result in potential risks to Colorado pikeminnow in the San Juan River and razorback sucker in the Southwest Gap Region. Effects on all special status species in the Northeast Gap Region would be negligible, as indicated by the HQs being less than 1 for NGS and baseline emissions. The effects of the Natural Gas PFR Alternative on special status aquatic species were considered minor based on the low number of fish that could be injured and the small percentage of fish population numbers potentially affected. In addition, there would be minor effects on critical habitat for Colorado pikeminnow and razorback sucker in the San Juan River and humpback chub and razorback sucker and Colorado pikeminnow in the Southwest Gap Region, because the level of exceedance of water quality standards for mercury and selenium was small. The implementation of conservation measures for the San Juan River and the Colorado River below Glen Canyon Dam would be used to benefit the species.

In terms of the analysis for the proposed KMC, there would be negligible effects from metals on northern leopard frog from overall cumulative emissions. Groundwater pumping for the proposed KMC Proposed action would contribute 0.03 percent reduction in flow in Begashibito Wash.

The operation and maintenance of the transmission systems would result in minor effects on special status species, because access road use and potential vegetation treatment would be short-term in duration and limited in terms of surface disturbance. By following best management practices for

operation and maintenance activities in combination with additional conservation measures, effects on species and their habitat would be minimized.

3.13.4.4.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Natural Gas PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described previously for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to special status species. The effects on the special status aquatic species are dictated by baseline fish tissue concentrations and deposition from other cumulative sources. A summary of the total cumulative emission effects to species is provided below.

- Bonytail – There would be a potential risk to bonytail from mercury in the Northeast Gap Region as indicated by a HQ of 1. The potential injury to the species is not quantifiable due to the low number of bonytail in the Northeast Gap Region. There would be a negligible effect on critical habitat for bonytail in the Northeast Gap Region. Although the conservative Utah water quality standard for mercury was exceeded, no measured surface water concentration was in excess of the National Ambient Water Quality Criteria.
- Colorado Pikeminnow – There would be a potential risk from mercury in the Northeast Gap Region. Species effects would be minor, as described for bonytail. There also would be a potential risk from mercury in the San Juan River, as indicated by a HQ of 2. Species effects would be minor, because the small number of adults that could be affected is within the natural population variability. There would be a minor effect on critical habitat for Colorado pikeminnow in the San Juan River. Although the conservative Navajo Nation water quality standard for mercury was exceeded, no measured surface water concentration was in excess of the National Ambient Water Quality Criteria.
- Humpback Chub – There would be a potential risk from mercury in the Northeast Gap Region. Species effects would be minor, as described for bonytail. There also would be a potential risk from mercury in the Southwest Gap Region, as indicated by a HQ of 3. Species effects would be moderate, because the number of adults that could be affected is likely outside the natural variability of the species. There would be a minor effect on critical habitat for humpback chub in the Southwest Gap Region. Although the conservative Navajo Nation water quality standard for mercury was exceeded, no measured surface water concentration was in excess of the National Ambient Water Quality Criteria.
- Razorback Sucker – There would be a potential risk from mercury in the Northeast Gap Region. Species effects would be minor, as described for bonytail. There would be potential risks from mercury and selenium in the Southwest Gap Region as indicated by HQs of 3 and 5. The ERA analysis indicated a negligible risk from mercury and selenium. Species effects would be moderate, because the number of adults that could be affected is likely outside the natural variability of the species. There would be a minor effect on critical habitat for razorback sucker in the San Juan River and Southwest Gap Region. Although the conservative Navajo Nation water quality standard for mercury was exceeded, no measured surface water concentration was in excess of the National Ambient Water Quality Criteria. Similar results were found for selenium.

Other cumulative actions that would adversely affect special status aquatic species and their habitat in the San Juan River, Northeast Gap Region, and Southwest Gap Region include climate change, water use, urban development, mining, and other human activities such as recreation. These activities and effects on razorback sucker would be the same as discussed in the Proposed Action cumulative impact discussions for the Colorado pikeminnow for the San Juan River and humpback chub for the Southwest Gap Region.

Cumulative effects of the Natural Gas PFR Alternative in combination with other cumulative actions in the proposed KMC and transmission system areas would be the same as discussed in the Proposed Action cumulative impacts section.

3.13.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. Therefore, prior disturbance impacts to special status aquatic species are not evaluated.

3.13.4.5.1 Navajo Generating Station

The Renewable PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 3 and 7 percent for the 3-Unit Operation and 4 and 11 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in Project risks from mercury and selenium, the combination of Renewable PFR Alternative with baseline fish tissue concentration would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas PFR Alternative.

3.13.4.5.2 Proposed Kayenta Mine Complex

The effects of the Renewable PFR Alternative from emissions and groundwater pumping on northern leopard would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on northern leopard frog proposed KMC emissions and groundwater pumping in relation to the 8.1 million tpy (3-Unit Operation) and 5.5 million tpy (2-Unit Operation) coal production operations.

3.13.4.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

There would be no changes in the operations of the WTS, STS, or communications sites if the Natural Gas PFR Alternative were implemented. Impacts would be negligible to special status fish species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. Best management practices and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for special status fish species.

3.13.4.5.4 Project Impact Summary – All Project Components

In summary, the Renewable PFR Alternative would result in 3 to 11 percent power reduction at NGS compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The effects of the Renewable PFR Alternative in combination with baseline fish tissue concentrations would be the same as described for the Proposed Action and the

Natural Gas PFR Alternative. The reason for same effects is that the baseline fish concentrations dictate the risks for special status aquatic species in all portions of the study area.

3.13.4.5.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Renewable PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to special status species.

3.13.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate National Environmental Policy Act process once a facility location is identified. When considering the general conditions of tribal lands that could be used, it is assumed that site would be dry with no perennial water. For this reason, there would be no effect on special status aquatic species.

3.13.4.6.1 Navajo Generating Station

The Tribal PFR Alternative would result in the following percent reductions in power output for the 100-MW and 250-MW replacements in comparison to the Proposed Action: 2 and 5 percent for the 3-Unit Operation and 3 and 8 percent for the 2-Unit Operation. The reduction in power output would result in less coal burned and lower deposition of metals and other COPECs in the portions of the study area analyzed for NGS and associated facilities (i.e., NGS Near-field, Northeast Gap Region of the Colorado River, Southwest Gap Region of the Colorado River, and the San Juan River) when compared to the Proposed Action. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. Although there is a slight reduction in Project risks from mercury and selenium, the combination of Tribal PFR Alternative with baseline fish tissue concentration would represent the same risks and effects as discussed for the Proposed Action and the Natural Gas PFR Alternative.

There is a potential for surface water withdrawal from rivers and streams, or reservoirs for the purpose of providing water source for the project. There is a potential for effects on special status aquatic species if they occur in water sources used for withdrawals. The location of water sources and the water volumes have not been identified at this time. The potential occurrence of special status species would have to be considered, and withdrawal timing restrictions could be required. During preliminary feasibility studies, operations to use groundwater, or municipal water should be considered to avoid direct effects on aquatic communities.

3.13.4.6.2 Proposed Kayenta Mine Complex

The effects of the Tribal PFR Alternative from emissions and groundwater pumping on northern leopard would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. There would be negligible effects on northern leopard frog proposed KMC emissions and groundwater pumping in relation to the 8.1 million tpy (3-Unit Operation) and 5.5 million tpy (2-Unit Operation) coal production operations.

3.13.4.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

There would be no changes in the operations of the WTS, STS, or communications sites if the Tribal Gas PFR Alternative were implemented. Impacts would be negligible to special status fish species that occur in streams crossed by the WTS and STS, as described for the Proposed Action. Best management practices and applicant-committed protection measures would be implemented to reduce impacts to a negligible level for special status fish species.

3.13.4.6.4 Project Impact Summary – All Project Components

In summary, the Tribal PFR Alternative would result in 2 to 8 percent power reduction at NGS compared to the Proposed Action, which would result in lower emissions and deposition of metals within the study area. As a result of lower deposition of metals, the risk indicator or HQ for special status aquatic species would be slightly reduced in each of the study areas compared to the Proposed Action. NGS emissions under this alternative by themselves represent a negligible risk on all species, as indicated by the very small HQ values. The effects of the Tribal PFR Alternative in combination with baseline fish tissue concentrations would be the same as described for the Proposed Action and the Natural Gas PFR Alternative. The reason for same effects is that the baseline fish concentrations dictate the risks for special status aquatic species in all portions of the study area.

3.13.4.6.5 Cumulative Impacts

The combination of NGS and proposed KMC emissions under the Tribal PFR Alternative plus other cumulative deposition sources would result in the same total cumulative emission effects as described for the Proposed Action. The only difference is that the NGS contribution to total cumulative emissions would be slightly less compared to the Proposed Action, as indicated by slightly lower HQs. However, the project risk and contribution is so small that it does not change the overall effects to special status species.

3.13.4.7 No Action

3.13.4.7.1 Navajo Generating Station

Emissions under the No Action Alternative would represent existing conditions plus other cumulative sources with the exclusion of current NGS emissions. The elimination of current NGS emissions would subtract a very small emission level from existing conditions. The effect of No Action emissions and deposition on aquatic species would be the same as described in the NGS Near-field, Gap Regions, and San Juan River ERAs for baseline conditions (Ramboll Environ 2016a,b,c). The following information describes the effects of the No Action Alternative on special status aquatic species.

- NGS Near-field – There would be negligible risks to federally listed razorback sucker or other special status species such as flannelmouth sucker from mercury and selenium because HQs for surrogate fish species were below 1. There would be no injury or loss of individual fish from arsenic, mercury, and selenium exposure due to the negligible risk indicated for mercury and selenium. There is no critical habitat located within the NGS Near-field study area.
- Northeast Gap Region – There would be negligible risks to federally listed bonytail, Colorado pikeminnow, humpback chub, and razorback sucker and other special status aquatic species such as bluehead sucker, flannelmouth sucker, and speckled dace from arsenic, mercury or selenium, as indicated by HQs being less than 1. There would be no injury or loss of individual fish from arsenic, mercury, and selenium exposure. There would be no effect on critical habitat for the federally listed fish species, because water quality standards for mercury and selenium are not exceeded.

- Southwest Gap Region – There would be potential risks to federally listed razorback sucker and special status species such as flannelmouth sucker and speckled dace from mercury and selenium, as indicated by HQs exceeding 1 due to baseline fish tissue concentrations. There would be negligible risk to humpback chub from arsenic, mercury or selenium, because the HQ is less than 1. There is the potential for minor loss of individual humpback chub, based on toxicity effects. No effect is expected for razorback sucker because it currently does not occur in the Southwest Gap Region. There would be a minor effect on the water element of critical habitat for humpback chub and razorback sucker in the Southwest Gap Region, based on exceedance of selenium water quality standards.
- San Juan River – There would be potential risk to federally listed Colorado pikeminnow and other special status species such as speckled dace from mercury and selenium, because HQs were greater than 1. There would be a negligible risk to razorback sucker as indicated by HQs being less than 1. There is the potential for minor loss of individual Colorado pikeminnow and razorback sucker, based on toxicity effects. There would be a minor effect on the water element of critical habitat for Colorado pikeminnow and razorback sucker in the Southwest Gap Region, based on exceedance of selenium water quality standards.

3.13.4.7.2 Proposed Kayenta Mine Complex

One special status species, northern leopard frog, occurs within the study area for the proposed KMC N-Aquifer. The effect of emissions from the No Action Alternative would be the same as baseline conditions analyzed in the proposed KMC ERA (Ramboll Environ 2016d). Emissions under the No Action Alternative would subtract the very small contribution from the proposed KMC facilities. Because the elimination of emission effects from the proposed KMC facilities would be very small, the resulting metal concentrations in waterbodies would be nearly the same as baseline conditions characterized in the proposed KMC ERA. There would be no effect of emissions from the proposed KMC facilities on northern leopard frog. Groundwater pumping under the No Action Alternative would reduce flow into Begashibito Wash by approximately 18 percent from 2020 rates, which represents potential habitat for the northern leopard frog.

3.13.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.13.4.7.4 No Action Impact Summary – All Project Components

The No Action Alternative would result in slightly lower level effects to special status aquatic species compared to the Proposed Action. The impact level would be reduced by eliminating NGS emissions, proposed KMC mining disturbance and groundwater pumping, and operation and maintenance activities for the transmission systems. However, the elimination of current NGS emissions would subtract a very small emission level from existing baseline conditions. Potential risks to special status species would occur in the Southwest Gap Region and San Juan River due to baseline fish tissue concentrations. There would be a minor effect on the water element of critical habitat for humpback chub and razorback sucker in the Southwest Gap Region and Colorado pikeminnow and razorback sucker in the San Juan

River, based on exceedance of mercury or selenium water quality standards. There would be no effect of emissions from the proposed KMC facilities on northern leopard frog. Groundwater pumping under the No Action Alternative would reduce flow into Begashibito Wash, which represents potential habitat for the northern leopard frog, by approximately 18 percent from 2020 rates. Continued operation of all or part of the WTS and STS under the No Action Alternative would result in negligible effects to special status fish species.

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Section 3.14

Land Use

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PFR	Partial Federal Replacement
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SO_2	sulfur dioxide

SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
U.S.	United States
USEPA	U.S. Environmental Protection Agency
WTS	Western Transmission System

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3.14 Land Use

This section describes the current state of Federal and Tribal Trust Land for tribal residential and commercial land ownership and land uses, including livestock grazing, and recreational resources in and around the Navajo Generating Station (NGS) and associated facilities, the proposed Kayenta Mine Complex (KMC), and the transmission systems and communication sites. The potential impacts to these resources due to the Proposed Action, action alternatives, and No Action Alternative also are described.

3.14.1 Regulatory Framework

3.14.1.1 Navajo Generating Station

The NGS and associated facilities 1) include the plant site, ash disposal site, coal transportation and handling facilities, and the Lake Powell pumping station (Section 1.7). Rights-of-way (ROWs) include those for the Black Mesa & Lake Powell (BM&LP) Railroad, the pipeline and the road between Lake Powell and the plant, and the 230-kilovolt (kV) tie line.

Applicable regulations for the NGS include those for ash disposal; which is regulated by the United States Environmental Protection Agency (USEPA) under subtitle D of the Resource Conservation and Recovery Act as published in the Federal Register on April 17, 2015. The asbestos landfill is regulated by the USEPA under 40 Code of Federal Regulations (CFR) Part 61.150. The portion of the water intake pipe located on National Park Service (NPS) land is regulated by 36 CFR Part 14 (Rights-of-Way) and 16 USC Section 1248 (Easements and Rights-of-Way). The water pumped from Lake Powell is regulated by the United States (U.S.) Bureau of Reclamation (Reclamation) Contract No. 14-06-300-5033.The maximum volume of water allowed by the terms of the contract is 40,000 acre-feet per year. In the event of a chemical spill or accidental release remedial actions would be regulated by the Comprehensive Environmental Response, Compensation, and Liability Act and the Superfund Amendments and Reauthorization Act.

The BM&LP Railroad is a privately owned, closed-loop system without connection any other railroad; therefore, it is not subject to Federal Railroad Commission jurisdiction. It must however, comply with the terms and conditions of 25 CFR Part 169, which governs ROWs over Indian lands, as the railroad is entirely located on tribal trust lands.

3.14.1.2 Proposed Kayenta Mine Complex

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) (30 USC Section 1265) is the primary federal law that regulates the environmental effects of coal mining in the U.S. One of several regulations is relevant, depending on the date that mining began. Generally, reclamation and release of reclaimed land from regulatory authority are controlled under Pre-Law regulations or are administered under Initial Program regulations (30 CFR Part 710 to 725), or Permanent Program regulations (30 CFR Part 810 to 828). (**Appendix 1D**).

SMCRA regulations do not require that Pre-Law lands receive reclamation or regulatory release from bonding or permit coverage; however, the leases for Kayenta and the former Black Mesa mines do require grading and seeding of Pre-Law lands. A total of 1,294 acres of Pre-Law lands on Kayenta Mine and a total of 1,266 acres of Pre-Law lands on the former Black Mesa Mine have been disturbed, graded and seeded.

Lands disturbed under the Initial Program are required to be restored so that these lands are capable of supporting the land uses existing prior to mining, or better uses as determined by Office of Surface Mining Reclamation and Enforcement (OSMRE) evaluation. Although there is no bond held by OSMRE for reclamation of Initial Program lands, the reclamation must be reviewed by OSMRE to obtain release from coverage under the Initial Program in a process called Termination of Jurisdiction. Release by

OSMRE under a Termination of Jurisdiction does not constitute a release from any liabilities associated with the leases through the Bureau of Indian Affairs (BIA).

SMCRA requires mining companies to post a reclamation performance bond sufficient to cover the cost of reclaiming the lands covered by the SMCRA Permanent Program permit. Successful reclamation is defined as the restoration of land and water resources and the environment impacted by coal mining practices including measures for the conservation and development of soil, water (excluding channelization), woodland, fish and wildlife, recreation resources, and agricultural productivity (SMCRA 2012). The bond is based on the cost of having a third-party contractor complete the required mitigation and reclamation work if the permittee, Peabody Western Coal Company (PWCC) in this situation, does not fulfill those requirements for any reason. The bond is made payable to OSMRE and covers completion of all requirements contained in SMCRA, the permanent program regulations, the permit document, and the reclamation plan.

Since the former Black Mesa Mine currently is administered through the Initial Program, any lands affected from December 16, 1977, through to the present time are subject to the Initial Program regulations. There is no OSMRE bond coverage for the former Black Mesa Mine areas as all affected lands are Pre-Law or covered under the Initial Program; however, the former Black Mesa Mine area is covered by a bond for $47,862,000 held by BIA related to the coal leases for this area. Of the 4,891 acres of Initial Program lands that have been affected at the former Black Mesa Mine, there are 1,608 acres of lands that have been reclaimed in accordance with Initial Program regulatory requirements and been released from coverage by OSMRE through a Termination of Jurisdiction determination.

The bond held by OSMRE for the Kayenta Mine is $245,192,000 in the form of a corporate surety. As part of the 2010 permit renewal process, OSMRE reviewed the reclamation costs and associated bonding and determined that the current (2010 to 2015) 5-year permit term bond exceeds the cost of reclamation by more than $20 million and is sufficient to ensure completion of the approved reclamation plan by OSMRE in the event of bond forfeiture. The actual reclamation costs are evaluated as part of the permit renewal every 5 years and as part of the mid-term review. If changes occur in the operations that would necessitate a bond review, such as request for bond release, the bond is evaluated prior to approval. In addition, beginning in 2011 the bond amount is subject to an annual inflation adjustment. Permit renewals would include an evaluation of reclamation costs and associated bonding with any adjustments made as needed. Demolition of Kayenta Mine structures is included as part of the OSMRE reclamation bond.

3.14.1.3 Transmission Systems and Communication Sites

The Western and Southern Transmission Systems (WTS and STS, respectively) were built and operate under the following federal and industry standards:

- Federal Energy Regulatory Commission Mandatory Reliability Standards;
- Arizona Corporation Commission regulations;
- Rural Utilities Service regulations (U.S. Department of Agriculture 7 CFR Part 1738);
- National Electrical Safety Code;
- Occupational Safety and Health Administration Regulations for Electric Power Generation, Transmission, and Distribution (29 CFR Part 1910.269);
- American National Standards Institute Z133.1 Standard for Tree Care Operations: Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush – Safety Requirements;

- American National Standards Institute A300 Standards for Tree Care Operations: Tree Shrub, and other Woody Plant Maintenance;
- 25 CFR Part 169 where on tribal lands;
- Public Law 96-491 where the WTS passes through the Moapa Corridor;
- Any portions of USC Title 16 that pertain to operation and maintenance within ROWs in the Kaibab or Prescott National Forests (NF);
- Decisions contained within the Kaibab and Prescott NF Land Resource Management Plans;
- Decisions contained within the Bureau of Land Management (BLM) Arizona Strip, Hassayampa, Kanab, St. George, Caliente, and Las Vegas field offices Resource Management Plans (RMPs);
- Decisions contained within the Aqua Fria RMP; and
- Standards and Guidelines contained within the Kaibab and Prescott Land Resource Management Plans.

The communications that are located within the Navajo Nation are subject to the rules and regulations of the Navajo Nation Telecommunications Regulatory Commission including:

- Navajo Telecommunications Regulatory Act as codified in Chapter 5 Title 21 of the Navajo Nation Code; and
- Navajo Telecommunications Regulatory Commission Chapter 5 Title 2 of the Navajo Nation Code. The STS and Moenkopi Switchyard are operated by the Arizona Public Service Company and the WTS is operated by NV Energy.

3.14.2 Study Areas

The study area for land use for the Proposed Action, action alternatives, and cumulative analysis includes the NGS site and associated facilities (as defined in Section 3.14.1), the proposed KMC, and the WTS and STS ROWs including a 1-mile buffer on each side. The study area for the Proposed Action, action alternatives, and cumulative analysis for recreation is the viewshed surrounding project facilities.

3.14.3 Affected Environment

The NGS and associated facilities are located in northern Arizona in Coconino and Navajo counties, largely within the Navajo Nation; a small segment of the water intake pipeline is located on NPS land. The proposed KMC is located on Navajo Nation and Hopi Tribe lands, in Navajo County. The WTS and associated communication sites are located within Coconino and Mohave counties, Arizona; Kane and Washington counties, Utah; and Lincoln and Clark counties, Nevada. The STS and associated communication sites are located within Coconino, Yavapai, and Maricopa counties in Arizona. The primary land use in this area is livestock grazing by the Navajo people (PWCC 2012 et seq.). The majority of the area is sparsely populated with dispersed residential dwellings or small communities. Commercial uses include small retail outlets and gas stations located along major transportation routes and in or adjacent to local communities.

The transmission systems and associated facilities (substations, switchyards and communication sites) are part of the western electric grid. The WTS and STS cross through a variety of lands ranging from tribal (Navajo Nation) to federally managed lands (BLM, Forest Service, and U.S. Bureau of Reclamation [Reclamation]) lands. The primary use of tribal lands would be the same as for the NGS and proposed KMC sites. The federally managed lands are managed for multiple uses including mineral extraction, preservation of wildlife and habitat, and recreation.

The 19 project communication sites are located within the plant or substation boundaries or off-site in remote locations.

3.14.3.1 Navajo Generating Station

3.14.3.1.1 Land Use

The NGS and associated facilities were constructed in the 1970s. The NGS is located in Coconino County approximately 3 miles east of Page, Arizona, within the LeChee Chapter of the Navajo Nation. The 1997 LeChee Community-Based Land Use Plan (LeChee 2004) emphasizes the desire to develop emergency response facilities, schools, senior and youth facilities, and housing developments and infrastructure. The developable area of LeChee extends about 10 miles south of Page. Agriculture including livestock grazing, farming, enhancing rangelands, and designing water capture systems are signs of a successful community and are important land uses for all communities including the LeChee.

The NGS and associated facilities occupy approximately 3,485 acres and contain the power plant, various landfills including an ash disposal site and an asbestos landfill. There also is a water pump station; two associated pipelines; a 230-kV transmission line; and the BM&LP Railroad and turnaround loop (see **Figure 1-3**). Access to the NGS site is via federal, state, county, private and Navajo Nation roads outside of leased lands.

The asbestos landfill is a USEPA-regulated landfill that occupies 3 acres within the NGS site partitioned into 24-foot by 30-foot cells approximately 4 feet deep. Less than half of the designated site is disturbed. From 2008 to 2014, NGS disposed of 124 cubic feet of asbestos containing material (**Appendix 1B**). Asbestos containing material deposited at the land fill is covered by six inches of compacted non-asbestos-containing material every 24 hours. Once a cell has been covered with soil it cannot be disturbed without USEPA notification. The NGS environmental department conducts monthly inspections of the asbestos landfill and applies corrective actions as necessary.

The ash disposal site is located approximately 1.5 miles to the east of the NGS site and is regulated as a Coal Combustion Residuals (CCR) landfill. CCRs include bottom ash, fly ash, boiler slag, and flue gas desulfurization materials. NGS is required to regularly post documents of compliance to an operating record, publicly accessible internet site, and submit notification to the Navajo Nation. It is required for a qualified inspector to inspect the landfill every seven day for structural weaknesses. The boundary of the ash disposal site is approximately 765 acres with a disposal capacity of 38 million cubic yards (**Appendix 1B**). Approximately 50 to 90 percent (depending on market demand) of the fly ash generated at the NGS is sold to Headwaters Inc. to be used in manufacturing concrete. In 2014 an estimated 18 million cubic yards of ash had been disposed of in the ash landfill, leaving an additional capacity of 19 million cubic yards.

The water intake system includes the pump station, two 30-inch pipelines and power lines to supply power for the pumps. The pump station occupies approximately 4.5 acres and the pipelines and power lines are located within a 2.9-mile-long ROW, all on Navajo Tribal Trust and NPS land.

The BM&LP Railroad is a private and closed loop system operated and maintained by the NGS with the sole purpose of transporting coal from the proposed KMC silo complex to the NGS. The railroad is powered by a 50-kV overhead electric line and is approximately 80 miles in length, including the loops at each end (see **Figure 1-8**). The entire length of the railroad is located on the Navajo Nation. When the NGS is operating at full capacity, the train makes 3 trips per day and operates 24 hours per day, 7 days a week.

3.14.3.1.2 Recreation

The residents of the LeChee Community enjoy dispersed recreation in the canyon areas where they hike and hunt. Other recreation in the vicinity of the NGS involves the large number of visitors to Lake Powell,

Glen Canyon National Recreation Area, Horseshoe Bend Overlook, the Antelope Canyon Tribal Park, and the Grand Canyon. The tourism industry is a large contributor to the economy of Page, Arizona.

Antelope Canyon Tribal Park is immediately to the south of the NGS. Navajo guided tours of the canyon are popular with tourists. It is known as the most visited and most photographed slot canyon in the Southwest.

Vermilion Cliffs National Monument and Paria Canyon—Vermilion Cliffs Wilderness Area are west of the NGS. The monument is approximately 280,000 acres and is bounded on the north, east, and south by the 112,500-acre Paria Canyon–Vermilion Cliffs Wilderness Area. The monument and wilderness area offer visitors the opportunity to experience towering cliff walls streaked with desert varnish, huge red rock amphitheaters, sandstone arches, wooded terraces, and hanging gardens. This wilderness area also contains archaeological sites.

The majority of the railroad ROW passes through areas that provide opportunities for dispersed recreation. However, the recreational opportunities between the State Highway 98 crossing and the NGS include Lake Powell and the Antelope Point Marina.

3.14.3.2 Proposed Kayenta Mine Complex

3.14.3.2.1 Land Use

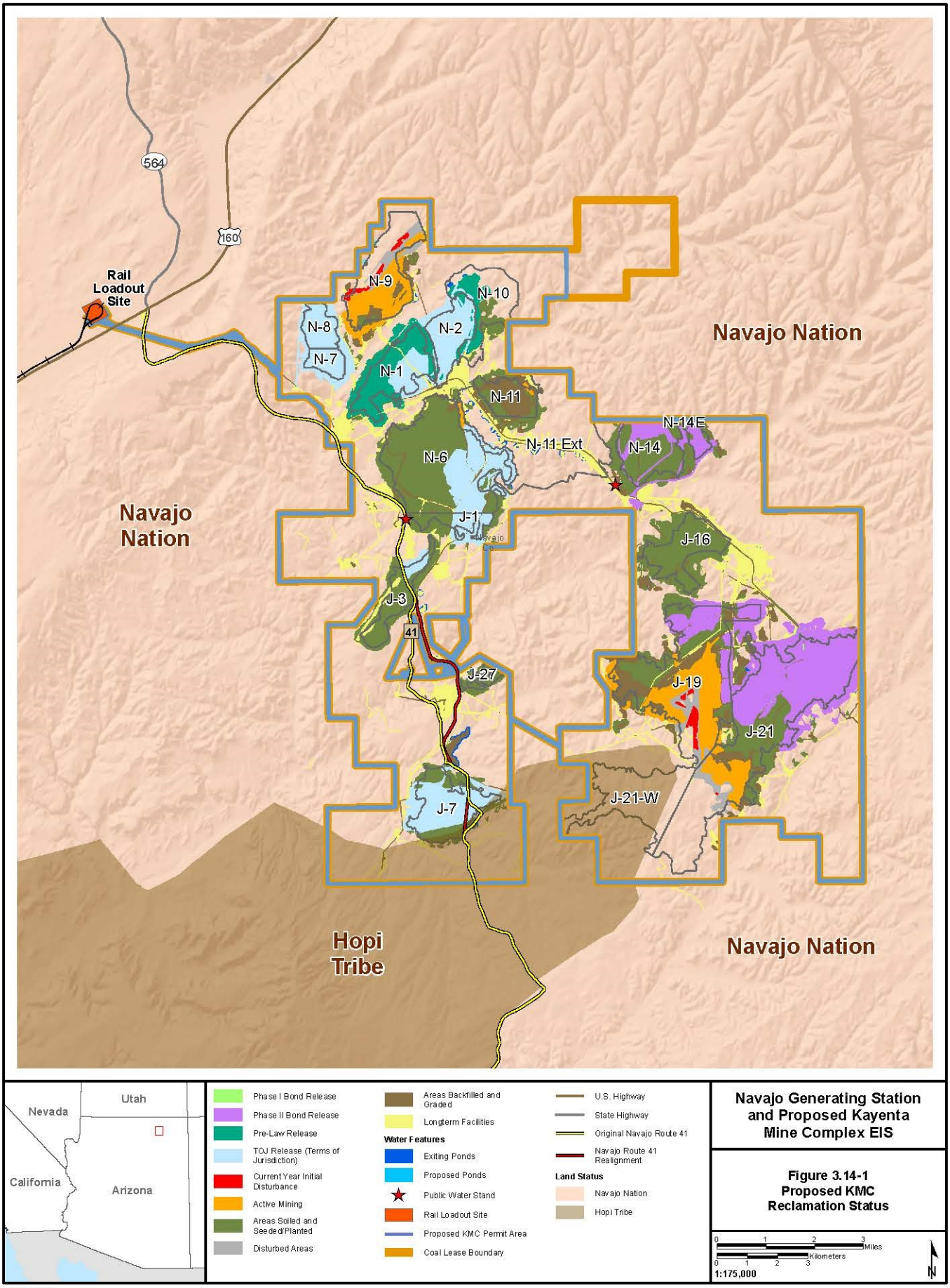
The proposed KMC is located approximately 15 miles south of Kayenta, Arizona, in Navajo County on the Hopi Reservation and the Navajo Nation Chapters of Chilchinbeto, Forest Lake, Kayenta, and Shonto (**Figure 3.14-1**). The proposed KMC would consist of the former Black Mesa Mine (18,857 acres) and the Kayenta Mine (44,073 acres). Native undisturbed areas exist within the proposed KMC where mining has not taken place. These areas consist primarily of Pinyon-juniper woodland, Big Sagebrush shrubland, and reclaimed lands (see **Table 3.8-5**).

3.14.3.2.1.1 Habitation

Approximately 150 Navajo residents live in dispersed houses within or adjacent to the proposed KMC permit boundary (PWCC 2012 et seq.). Frequently, multiple families or multiple generations reside in a single dwelling. As the mine areas are developed, residents occasionally need to be relocated to different areas. PWCC incurs the expense to move or construct housing at a location agreed to by the residents. All relocations planned for the 2015-2020 time period were completed by the end of 2015 (PWCC 2015a).

3.14.3.2.1.2 Livestock Grazing

Many residents graze livestock (mainly cattle, sheep, and goats) on reclaimed and undisturbed lands within the proposed KMC permit boundary for a food source and for economic and cultural reasons. Livestock grazing is the primary pre-mine use of the land and occurs year-round. Wildlife habitat and harvest of cultural plants also are recognized post-mining land uses. Grazing permits issued by the BIA prescribe the units and number of animals that can be grazed. Historically the project area has been grazed year-round; a practice that has proven to be not sustainable for the region. PWCC first allowed livestock grazing on initial program reclaimed lands in 1998 under a grazing plan that required deferred or rest rotation grazing utilizing multiple pastures. Planting with cool season grasses has proved to be successful at extending the grazing period throughout all seasons provided adequate precipitation is received. Multiple water sources and mineral blocks have been used to draw livestock to various areas, reducing grazing pressure throughout the pastures. PWCC has been successful at educating local residents on rangeland carrying capacities and appropriate stock rates and has assisted the ranchers by developing a holding pasture and providing transportation to deliver the cattle to market (PWCC 2005).



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At the request of residents in the vicinity of the N-14 coal resource area, PWCC reclaimed approximately 84 acres to be less sloped and have greater infiltration to benefit forage vegetation. The improved pastures were seeded with cicer milkvetch, pubescent wheatgrass, Russian wildrye, and thickspike wheatgrass which have responded well in reclaimed areas in this region.

PWCC is proposing to leave 51 sediment control ponds available as water sources for livestock and wildlife in the proposed KMC; 19 currently exist and are available for livestock and wildlife, 1 exists and is proposed for post-mining retention, and 31 are a combination of existing and future sediment control ponds. All of these 31 ponds meet, or would be upgraded to meet, permanent pond design criteria (PWCC 2012 et seq.). It is recognized that livestock and wild horse trespass occurs throughout the mine area and can result in areas (particularly near water sources) that receive excessive pressure. Proper management of grazing on reclaimed lands has presented challenges and PWCC acknowledges that grazing typically has been conducted on the honor system where PWCC has the responsibility of monitoring pastures for over-utilization and notifying residents when they need to move their livestock (PWCC 2012 et seq.). Drought conditions and over-grazing have compromised the overall condition of certain reclaimed areas where grazing historically was allowed and in 2015 a temporary moratorium was placed on livestock grazing on reclaimed areas.

3.14.3.2.1.3 Agriculture

Other uses of the land by residents living within the permit boundary include the gathering of plants for food, medicine, and cultural purposes; gathering firewood for home heating fuel, and farming small agricultural plots (approximately 4 to 5 acres in size). The plots typically are used for growing corn (PWCC 2012 et seq.). Irrigation is not practiced in these plots on the proposed KMC permit area. Due to variable precipitation events it is not uncommon for plots to have low or no production. There are no designated Prime Farmland soils or alluvial valley floors within the purposed KMC permit area.

3.14.3.2.1.4 Mine Reclamation

Reclamation of mine areas primarily is intended to achieve vegetation communities that support livestock grazing and wildlife habitat. Section 3.6.2, Soils, and **Appendix 1D** detail the parameters for suitable overburden. Per the draft Land Use Plan for the former Black Mesa Mine developed by the BIA and Navajo Nation, all pre-mine customary use areas would be recognized after reclamation and returned to the Navajo Nation. The purpose of reclamation is to restore the affected lands to the approximate landforms that existed prior to mining and to establish a diverse, effective, and permanent vegetative cover similar in seasonal variety, diversity, and plant composition to the native vegetation on undisturbed lands surrounding the mining operation. Mine reclamation is accomplished by grading; sampling and evaluating spoil/overburden for suitability as a subsoil; placement of suitable subsoil if needed; replacement of topsoil, and seeding and planting. After seeding and planting, the site is monitored for vegetative success and the presence of erosional issues such as rills and gullies. PWCC conducts monitoring twice a year on select reclaimed sites to ensure adequate reclamation and identification of noxious or invasive weed species. Successful reclamation can increase forage vegetation by ten times compared to the pre-disturbance condition (PWCC 2012 et seq.). Maintenance, including reseeding and repair of erosional issues with subsequent re-seeding, is performed on the revegetated areas as needed. Additional maintenance of reclaimed areas includes fencing and fence maintenance, drainage maintenance, and grazing. PWCC has established the following reclamation goals (PWCC 2015b):

- Manage reclaimed areas to meet reclamation standards;
- Use grazing to remove standing dead litter and promote new growth;
- Aid in establishing new seedings; and
- Demonstrate the utility of reclaimed lands for various seasons of use.

The seeding used at Kayenta Mine and former Black Mesa Mine was designed to support post mining land uses of rangeland grazing, wildlife habitat, and the establishment of populations of culturally significant plants and has restored an element of habitat diversity. The standard rangeland mix for revegetation consists of 12 cool and warm season grasses, 2 legumes, 4 forbs, and 5 shrubs or subshrubs (PWCC 2005). The majority of these plants are native to the area. Overall, the reclaimed areas produce greater amounts of forage vegetation than the surrounding undisturbed pinyon/juniper and sagebrush communities. For this reason livestock stocking rates have tended to be significantly higher on the reclaimed areas than on the native rangelands. Reclamation of non-vegetated habitat areas such as rock slopes also is conducted (for additional information on mine reclamation see **Appendix 1D**).

Per SMCRA, all disturbed areas shall be restored to the conditions that were supported before mining or to higher or better uses. As described previously, the post-mining land use for the proposed KMC is livestock grazing and wildlife habitat as it was prior to disturbance from mining-related activities. According SMCRA, an alternative post mining land use can be approved by OSMRE after the permittee has received written approval from the landowners. Alternative post mining land uses, including uses for heavy or light industry (solar or wind power facilities), for the areas disturbed by mining at the KMC are at the discretion of the Navajo and Hopi Tribes for their respective lands and can be revised under an active Permit Application Package at the Tribes request.

Of the 6,157 acres of Pre-Law and Initial Program affected land at the former Black Mesa Mine, 5,263 acres have been backfilled and graded; of those, 3,857 acres have been topsoiled and seeded, and 1,266 acres have been seeded without being topsoiled (Pre-Law reclamation). PWCC has received Termination of Jurisdiction for 1,608 acres from OSMRE.

Of the 19,330 acres of affected Pre-Law, Initial, and Permanent Program land at Kayenta Mine, 14,546 acres have been backfilled and graded; of those, 11,328 acres have been topsoiled and seeded, and 1,294 have been seeded without being topsoiled (Pre-Law reclamation). On the Kayenta Mine, there are 2,450 acres that have been released through Termination of Jurisdiction, 3,710 acres that have been released from Phase I bonding, and 3,694 acres that have been released from Phase II bonding (**Figure 3.14-1**). There are no lands for which Phase III bond release has occurred.

Under 30 USC Section 1265(b)(16) and 30 CFR Part 816.100, reclamation is required to be initiated as close as practible to the same time period as the surface coal mining operations. Typically, the amount of time required for backfilling, topsoiling and seeding is approximately equal to the time between initiating mining activities and initiating grading (PWCC 2012 et seq.). Factors that affect the mine reclamation schedule include annual mining operations, coal production requirements, and the availability of areas ready to be graded (PWCC 2012 et seq.).

Planned post-mining land use specifies that facilities would be reclaimed unless they have been approved as a component of the post-mining land use plan. Facilities not be left as part of the post-mine land use would be decommissioned when no longer needed to support mining activities. Activities on the reclaimed mine areas through the end of 2019 include continued monitoring of mine reclamation, reseeding as needed, and repair of any erosional features that have developed on reclaimed areas. PWCC's existing reclamation program, including ongoing monitoring and repair for the reclaimed areas at the former Black Mesa Mine, is included in **Appendix 1D**. Environmental monitoring and reclamation activities are reported annually by PWCC to the OSMRE in a joint report prepared for the Kayenta Mine and former Black Mesa Mine. Compliance with OSMRE regulations and the Reclamation Plan can be found by reviewing the reclamation status in the annual reports. Reclamation on mine areas would continue at the Kayenta Mine through 2019. **Table 3.14-1** provides an estimate of acreage in each stage of reclamation from 2015 through 2019 for each active mine area. **Appendix 1D** contains additional details on existing disturbance and reclamation. Active reclamation is occurring in mine areas J-19, J-21, N-6, N-9, and N-11 (see **Figure 3.14-1** and **Table 3.14-1** for reclamation status). Between 2015 and

2019 the reclamation schedule estimates 1,521 acres would be backfilled and graded and 1,752 acres would be topsoiled and seeded.

Table 3.14-1 Anticipated Mine Reclamation through 2019 for Permanent Program Affected Lands

	Total Land Disturbed (acres)[1]	Total Current Land Graded (acres)[1]	Total Current Land Topsoiled and Seeded (acres)[1]
Mine Area N-9	1,331	270	60
Mine Area N-11	877	786	393
Mine Area J-19	3,927	2,493	1,727
Mine Area J-21	4,262	3,676	3,353

[1] Data as of December 15, 2015.

3.14.3.2.1.5 Cultural Planting Areas

Many of the north-facing slopes have been reclaimed as cultural planting areas. North facing slopes are selected because they represent an environment with a moderate or well-balanced supply of moisture. The plant species for cultural planting areas were selected through consultation with the Hopi Cultural Preservation Office, Black Mesa residents, Navajo medicine men, and herbalists. Culturally significant plants are established through a combination of seeding, planting from nursery stock, and transplanting from nearby areas. In the Black Mesa portion of the proposed KMC, approximately 90 acres have been reclaimed with cultural plantings in the J-7 and N-6 coal resource areas and approximately 383 acres at Kayenta Mine J-16, J-19, J- 21, N-6, N-7, N-11, and N-14 coal resource areas. Plant types selected for inclusion in cultural plantings are listed in **Table 3.14-2**. New plant species are added to the list as necessary through ongoing consultation.

Table 3.14-2 Plant Species Selected for Cultural Planting

Vegetation Type	Species
Forbs	Baker cryptantha, barestem larkspur, beardlip penstemon, blue loco, bottlebrush squirreltail, brickelia spp., Colorado, four o' clock, common spectaclepod, common sunflower, desert globemallow, desert Indian paintbrush, Fendler's spurge, field morning glory, firecracker penstemon, filaree, Fort Wingate milkvetch, golden crownbeard, golden fleece, golden sego lilly, goosefoot, hoary townsendia, Hopi tea greenthread, littleleaf globemallow, mid bladderpod, narrowleaf paintbrush, Navajo tea, palmer penstemon, Parry bellflower, prairie spiderwort, prostrate pigweed, redroot wildbuckwheat, rocky mountain beeplant, scrambled eggs, scarlet globemallow, sego lilly, spike verbena, spring parsley, stemless four-nerve daisy, stemless townsendia, sulfur-flower buckwheat, Texas doveweed, thistle, toadflax beardtongue, torrey milkvetch, white prairie clover, whorled milkweed, wild onion, winged buckwheat, wooton sandpuff, yarrow
Grasses	Alkali sacaton, blue grama, false buffalograss, galleta, indian ricegrass, letterman's needlegrass, little bluestem, needle and thread grass, sand dropseed, side oats grama, spike muhly, western wheatgrass
Shrubs	Antelope bitterbrush, Apache plume, banana yucca, big sagebrush, blackbrush, broom snakeweed, cliff fendlerbush, four-wing saltbrush, fringed sagebrush, greasewood, green mormon tea, green rabbitbrush, Mexican cliffrose, mountain mahogany, narrowleaf yucca, New Mexico privet, pale desert-thorn, roundleaf buffaloberry, rubber rabbitbrush, shadscale, skunkbush sumac, small soapweed, Spanish bayonet, sticky-leaved rabbitbrush, threadleaf groundsel, Torrey Mormon tea, wild buckwheat, winterfat, wolfberry
Succulents	Hedgehog cactus, pincushion cactus, plains pricklypear, pricklypear, whipple cholla
Trees	Boxelder, freemont cottonwood, Gamble oak, one-seed juniper, pinyon pine, two needle pinyon, Utah juniper

Source: PWCC 2012 et seq.

Emphasis has been placed on plant materials collected from nearby reference sites due to their adaptability to climatic conditions. PWCC conducted research on germination treatments, propagation techniques, and nursery practices for those species with little historical information. Some species are injected with commercially available mycorrhizal strains prior to transplanting to stimulate root functions (PWCC 2012 et seq.). Cultural plant sites are continuously monitored to assess the success of site establishment, development, and successional change.

3.14.3.2.2 Recreation

Recreation activities in the vicinity of the proposed KMC consist primarily of dispersed recreation on Black Mesa, which is a prominent geographic feature of the Colorado Plateau. Typical activities include hiking, small game hunting, bird watching, and photography. Big game hunting is not permitted in the Black Mesa near the leasehold area; however, small game hunting may occur to a limited extent north of the leasehold area near the rim of Black Mesa (PWCC 2012 et seq.). No developed recreation is present in this area. Non-Navajo people are restricted to designated trails or routes unless they are accompanied by a tour guide or have a valid permit issued by the Navajo Parks and Recreation Department. Rock climbing, off-trail hiking, and off-road travel also are prohibited and considered trespassing (Discover Navajo 2015).

3.14.3.3 Transmission Systems and Communication Sites

The power generated by the NGS is delivered through the WTS and the STS. The transmission systems and associated facilities (transmission lines, substations, and communication sites) are part of the western electric grid. **Table 3.14-3** identifies land ownership for the two transmission systems and the number of miles that fall within each jurisdiction

Table 3.14-3 Land Ownership Crossed by the WTS and STS

Ownership	WTS (miles)	STS (miles)	Total Miles
BIA/Tribal (Navajo, Hopi, Kaibab, Moapa	20	96	116
Navajo Nation	2	94	96
Hopi Tribe	0	0	0
Kaibab Reservation	4	0	4
Moapa Tribe	14	0	14
BLM	201	27	228
Reclamation	7	1	8
National Park Service	3	0	3
Private	20	20	40
State	24	47	71
U.S. Forest Service	0	65	65
Total	**275**	**256**	**531**

Source: GIS analysis.

The NGS and associated facilities and the WTS and STS are supported by 19 communication sites that occur within the plant or substation boundary or off-site in remote locations (**Figure 1-14**). The Navajo Nation has issued permits for the Zilnez Mesa, Preston Mesa, and the Jack's Peak communication sites. The Salt River Project (SRP) is applying to the BIA for Section 323 grants for the continued use of the sites. The areas are cleared of vegetation periodically and are fenced for security purposes. **Table 3.14-4** lists the communication sites and their approximate locations.

Table 3.14-4 Location and Size of Communication Sites

Site Name	Approximate Location	Acres	Service
Apex to Crystal	7 miles northeast of Ellis Air Force Base in Clark County, Nevada	<1	WTS
Beaver Dam	17 miles west-northwest of St. George, in Washington County, Utah	Site Leased – No Acreage	WTS
Bill Williams	3.5 miles south of the City of Williams in Coconino County, Arizona	Site Leased – No Acreage	STS
Buckskin Mountain	33 miles northwest of Page in Kane County, Utah	Site Leased – No Acreage	WTS
Glen Canyon	14 miles northwest of Page in Kane County, Utah	Site Leased – No Acreage	WTS
Glendale	24 miles southwest of Mesquite in Clark County, Nevada	Site Leased – No Acreage	WTS
Jack's Peak	18 miles southwest of NGS in rural Coconino County, Arizona	1.75	STS
Moenkopi Substation	Moenkopi Switchyard yard in Coconino County, Arizona	Acreage Exists within Switchyard Site	STS
Mount Elden	1 mile north of Flagstaff in Coconino County, Arizona	Site Leased – No Acreage	STS
Mount Francis	5 miles southwest of Prescott in Yavapai County, Arizona	Site Leased – No Acreage	STS
Navajo and NGS	NGS site in Coconino County, Arizona	Acreage Exists within NGS Site	BM&LP Railroad, WTS, STS, and the APS Switchyard
Pipe Springs	1 mile north of Flagstaff in Coconino County Reservation, Mohave County, Arizona	<1	WTS
Preston Mesa	36 miles south of NGS in rural Coconino County, Arizona	<1	BM&LP Railroad and STS
Red Mountain	2 miles north of Boulder City in Clark County, Nevada	Site Leased – No Acreage	WTS
West Phoenix	APS West Phoenix Generating Station in Maricopa County, Arizona	Site Leased – No Acreage	STS
Westwing	Westwing receiving station in Maricopa County, Arizona	Acreage Exists within the Westwing Substation Site	STS
White Tank	6 miles west of Waddell in Maricopa County, Arizona	Site Leased – No Acreage	STS
Zilnez Mesa	40 miles southeast of NGS in rural Navajo County, Arizona	2.4	BM&LP Railroad

3.14.3.3.1 Western Transmission System

3.14.3.3.1.1 Land Use

The WTS is a 275-mile-long ROW that passes through the following states and counties; Arizona – Coconino and Mohave, Utah – Kane and Washington, and Nevada – Lincoln and Clark (see **Figure 3.14-2** and **Figure 1-14**). It originates at the NGS and terminates at the McCullough Substation southwest of Boulder City in Nevada. The WTS consists of a single 500-kV transmission line and two substations. **Table 3.14-5** details the jurisdictions and mileage crossed by the ROW.

Table 3.14-5 Special Designation Areas Crossed by WTS

Special Designation Areas	Area Name	Location	WTS Crossed (miles)
ACECs	Beaver Dam Slope	Washington County, Utah Lincoln County, Nevada Mohave County, Arizona	19
	Kanab Creek	Coconino and Mohave County, Arizona	1
	Lower Virgin River	Washington County, Utah	<1
	Mormon Mesa	Lincoln and Clark County, Nevada	24
	Rainbow Gardens	Clark County, Nevada	9
	River Mountains	Clark County, Nevada	1
National Monuments	Grand Staircase-Escalante	Kane County, Utah	20
National Recreation Area	Glen Canyon	Coconino County, Arizona	3

The existence of the transmission line is consistent with the Coconino, Mohave, Kane, Washington, Lincoln, and Clark County General/Comprehensive plans and the large majority of the ROW is located within the West Wide Energy Corridor (West Wide Energy Corridor 2015). The WTS crosses through seven BLM special designation areas, as indicated in **Table 3.14-5**.

Areas of Critical Environmental Concern (ACECs) are designated by the BLM through land use plans to protect areas that have been identified as having unique cultural, historic, scenic, or biological values. National monuments are designated presidentially or congressionally to protect areas with historic or scientific values.

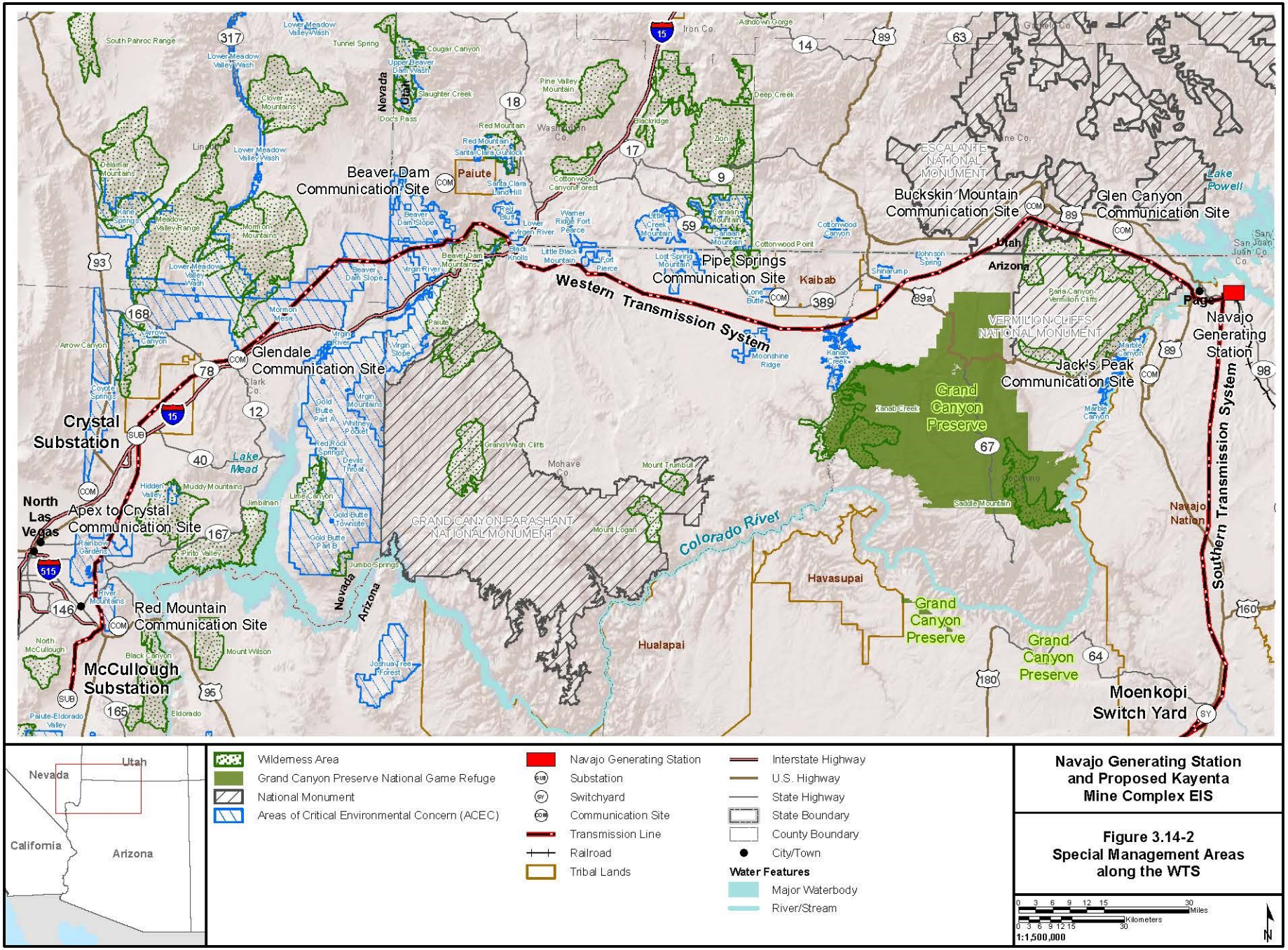

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Figure 3.14-2
Special Management Areas along the WTS

Seven special BLM designation areas are intersected by the WTS ROW.

1. Beaver Dam Slope ACEC. This ACEC encompasses a total of 136,616 acres in Arizona (51,197 acres), Nevada (36,900 acres), and Utah (48,519 acres). In Mohave County, the WTS crosses 10 miles of the ACEC, which was designated in the 2008 Arizona Strip RMP to protect desert tortoise and Mojave Desert ecological zone values. The ACEC was designated after construction of the WTS. The RMP also designated a utility corridor within which the WTS is located. Areas outside the designated corridor are considered ROW avoidance areas. The ACEC also extends southwest into Lincoln County, Nevada; that portion is managed under the Ely District RMP.
2. Kanab Creek ACEC. This ACEC encompasses 13,148 acres and was designated to protect habitat for the endangered southwestern willow flycatcher, riparian and scenic values, and cultural resources. It also provides habitat for desert bighorn sheep.
3. Lower Virgin River ACEC. This ACEC encompasses 1,822 acres along the Virgin River just north of the Utah/Arizona state line and was managed to improve and maintain riparian habitat for the endangered woundfin minnow and Virgin River chub, and provide habitat for various migratory and non-game birds as well as protecting numerous cultural rock art sites of the Anasazi and Southern Paiute tribes.
4. Mormon Mesa ACEC. This ACEC encompasses 151,360 acres and was designated to protect desert tortoise and desert tortoise habitat. It is managed by BLM under the Ely District RMP and Las Vegas RMP. The WTS was built prior to designation of the ACEC and falls within a designated utility corridor. Under the Las Vegas RMP, the WTS corridor is managed as an exclusion area for site-type ROWs except within 0.5 mile of federal highway centerlines.
5. Rainbow Gardens ACEC. This 37,620-acre ACEC was designated for its cultural, geologic, scenic, and sensitive plant values. It contains the Great Unconformity, an area where intervals of the geologic record are missing. It contains cultural resources and a gypsum cave. The ACEC is managed by BLM under the Las Vegas RMP as a linear and site-type ROW avoidance area except within designated corridors.
6. River Mountains ACEC. This 5,617-acre ACEC is managed to protect habitat for the River Mountains desert bighorn sheep as well as for the viewshed it provides for the residents of Henderson and Boulder City, Nevada. It is managed by BLM under the Las Vegas RMP as a linear and site-type ROW avoidance area except within designated corridors.
7. Grand Staircase-Escalante National Monument. This national monument covers 1.9 million acres and was designated after construction of the WTS. It contains valued biological and geological resources.

The WTS passes through a ROW corridor administered by the BLM (labeled Moapa Corridor) that traverses the Moapa River Indian Reservation. This ROW corridor is administered as Indian trust lands as established pursuant to Public Law 96-491. Vegetation treatments are not routinely conducted along the ROW because the associated vegetation communities tend to be sparse and low growing. Clearing typically is not necessary and is conducted on an as-needed basis.

Two substations (Crystal and McCullough) are connected to the WTS and contain power transformers, switching devices, and circuit breakers and disconnects.

- The Crystal Substation is located less than 1 mile south of the Moapa Indian Reservation, and approximately 20 miles northeast of Nellis Air Force Base in Clark County, Nevada, on 284 acres of BLM-managed land.
- The McCullough Substation is located approximately 14 miles southwest of Boulder City in Clark County, Nevada, on 253 acres of BLM managed land.

The communication sites listed in **Table 3.14-4** associated with the WTS have little influence on land use because they are either collocated with other facilities, in the transmission ROW, or are in remote locations and occupy very little space (less than 1 acre).

The WTS ROW runs in an east-west direction through northern Arizona, southwest Utah, and southeast Nevada and primarily is located on BLM-managed lands. This area is sparsely populated with the exception of St. George, Utah, and southern Nevada in the vicinity of Las Vegas, Henderson, and Boulder City.

The WTS intersects with 40 BLM managed grazing allotments for a total of approximately 169 miles (118 miles in Arizona, 32 miles in Utah, and 19 miles in Nevada), in all intersected counties except Clark County, Nevada.

3.14.3.3.1.2 Recreation

The WTS crosses the southern portion of Glen Canyon National Recreation Area before heading northwest into Utah. Recreational activities there would be the same as discussed for the NGS. In Utah the WTS passes through Grand Staircase-Escalante National Monument and skirts the northern edge of Vermilion Cliffs National Monument adjacent to the Paria Canyon Wilderness and the western portion of Lower Virgin River ACEC and the northern portion of Beaver Dam Mountains Designated Wilderness. The Lower Virgin River ACEC receives a high level of recreational use. The Beaver Dam Mountains Designated Wilderness offers recreationists the opportunity to raft or kayak in the Virgin River, or hike, backpack, view wildlife, and star gaze. The WTS ROW also crosses through Beaver Dam Slope ACEC in the northwest corner of Arizona and Mormon Mesa ACEC in eastern Nevada. Both areas are managed to provide and protect critical habitat for desert tortoise. In southern Nevada, the WTS ROW passes through Rainbow Gardens ACEC and River Mountains ACEC. Rainbow Gardens is a scenic mountain and canyon landscape that allows recreationists the opportunity to experience a wilderness setting while still being close to Las Vegas. River Mountain ACEC is managed to protect habitat for the River Mountains desert bighorn sheep as well as for the viewshed it provides for the residents of Henderson and Boulder City.

3.14.3.3.2 Southern Transmission System

3.14.3.3.2.1 Land Use

The STS is a 256-mile ROW that contains two parallel transmission lines originating at the NGS and terminating at the Westwing Substation approximately 20 miles northwest of Phoenix (**Figure 3.14-3** and **Figure 1-14**). The STS consists of two 500-kV transmission lines (the eastern line is the Westwing line and the western line is the Moenkopi line), the Moenkopi Switchyard, and five substations. There is a portion of the ROW near Moenkopi where the two lines do not share a common ROW. The entire ROW is within the State of Arizona and passes through Coconino, Yavapai, and Maricopa counties. The ROW passes through multiple jurisdictions (**Table 3.14-3).**

The Moenkopi Switchyard is located off U.S. Highway 89 in Coconino County. It is approximately 25 acres and is contained within the existing Four Corners Power Plant transmission line ROW. It contains a control house, storage building, and a 1,000-gallon diesel tank. Four transmission lines are connected via the Moenkopi Switchyard. They are the Four Corners to Moenkopi line, the NGS to Moenkopi line, the Moenkopi to Eldorado Substation line, and the Moenkopi to Yavapai Substation line.

Vegetation treatments are conducted along the ROW according to the ROW easement agreement and BLM and Forest Service corridor management plans.

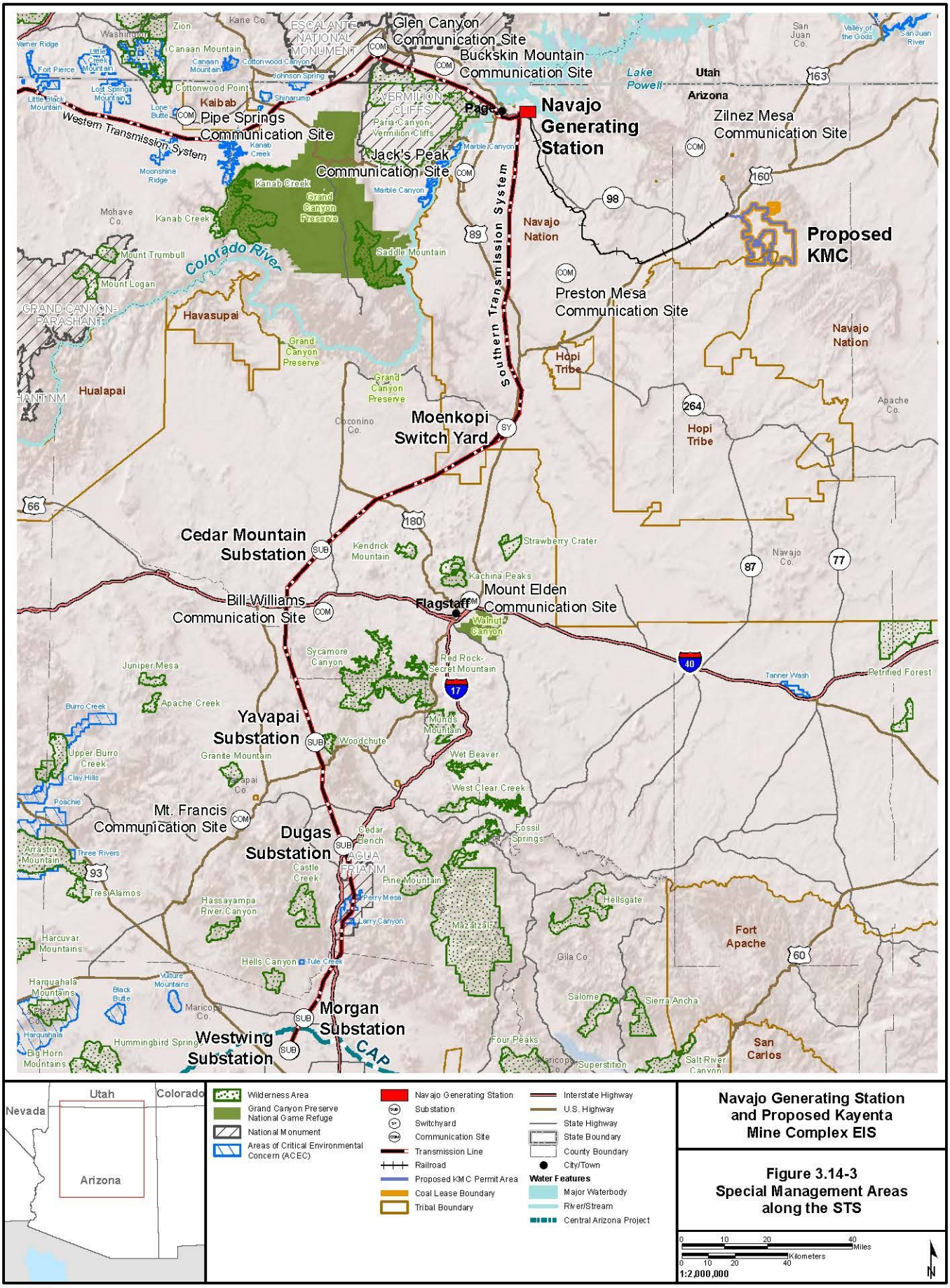

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Figure 3.14-3
Special Management Areas along the STS

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Five substations (Cedar Mountain, Yavapai, Dugas, Morgan, and Westwing) interconnect to the STS and contain similar components as those along the STS.

- The Cedar Mountain Substation is located approximately 11 miles north of the City of Williams in Coconino County on 15 acres of private land.
- The Yavapai Substation is located approximately 12 miles north of Prescott Valley in Yavapai County on 21 acres of U.S. Forest Service land.
- The Dugas Substation is located approximately 6 miles east of the City of Mayer in Yavapai County on 69 acres of state land.
- The Morgan Substation is located approximately 0.5 mile south of Arizona State Route 74 and 0.75 mile east of the Aqua Fria River in Maricopa County on 4 acres of state land.
- The Westwing Substation is the terminal point of the STS and is located approximately 3 miles northeast of Sun City West in Maricopa County on 14 acres of state land.

Similar to the communication sites discussed for the WTS, the 10 communication sites that service the STS (**Table 3.14-3**) have little influence on land use because they are either located in the transmission line ROW or are in remote locations and occupy very little (1 acre or less) space.

The STS ROW runs in a north-south direction through the western portion of the Navajo Nation. This area is sparsely populated and consistent with the discussion for NGS and the proposed KMC. South of the Navajo Nation, the STS passes through the Kaibab and Prescott National Forests and Aqua Fria National Monument, all of which attract local visitors and tourists for the recreational resources they provide. The STS passes through both national forests within the designated West Wide Energy Corridor (West Wide Energy Corridor 2015). Both forests are managed according to their respective LRMPs. The counties crossed by the STS include Coconino, Yavapai, and Maricopa (all within Arizona). No issues with the STS were identified within the Comprehensive County Plans for these counties. Additionally, within Maricopa County the New River Community has produced an area plan that was adopted in 1999. Similarly, no issues with the STS were identified within the area plan.

The STS intersects with 16 BLM managed grazing allotments for a total of approximately 51 miles, all of which are located south of Interstate 40. It is likely that the STS passes through lands used for livestock grazing on the Navajo Nation. No grazing allotments are crossed in the Kaibab or Prescott National Forests.

Two special BLM designation areas are intersected by the STS ROW: Perry Mesa ACEC and Aqua Fria National Monument. The ROW passes through approximately 9 miles of the Perry Mesa ACEC, which is located within Aqua Fria National Monument. The ACEC is a wilderness unit of approximately 16,775 acres with the Aqua Fria River defining its western border. Archaeological resources within the Perry Mesa ACEC are one of the primary factors for designating the Aqua Fria National Monument. The Aqua Fria National Monument is 70,900 acres located approximately 40 miles north of Phoenix. It is managed to offer a variety of recreational, research, and educational opportunities. The ROW passes through approximately 31 miles of the National Monument. The Perry Mesa ACEC and Aqua Fria National Monument are discussed further in the Recreation sub-section.

3.14.3.3.2.2 Recreation

Recreational resources and activities for the northern portion of the STS within the Navajo Nation are similar to the discussion for the NGS and associated facilities (excluding Lake Powell). The southern portion of the STS passes through the Kaibab and Prescott National Forests and Aqua Fria National Monument. The ROW is located approximately 10 miles to the west of the Sycamore Canyon and Pine Mountain wilderness areas within the forests. Recreational activities in the forest include camping, fishing, hang gliding, hiking, horseback riding, off-highway vehicle use, picnicking, and photography. The

ROW passes through the central portion of Aqua Fria National Monument and Perry Mesa ACEC on BLM-managed land. Visitor activities in the National Monument and ACEC include camping, hiking, hunting, scenic and four-wheel drives, and viewing and photographing cultural sites and wildlife.

3.14.4 Environmental Consequences

3.14.4.1 Issues

The issues of concern received during project scoping are listed below. Almost all of the issues identified through public scoping, except disposal of fly ash, are related to the proposed KMC. A description of the impact analysis methods follows.

3.14.4.1.1 Land Use

- Disposal of fly ash;
- Displacement of residents from their traditional lands and compensation by agreements between PWCC and tribal governments;
- Intended purpose and use of reclaimed lands (livestock grazing, wildlife habitat, cultural plants, etc.);
- Constraints to the use of reclaimed lands;
- Need for improvement of reclamation monitoring and success;
- Realignment and reclamation of Navajo Route 41; and
- Opposition to incorporating the former Black Mesa Mine area into the proposed KMC.

3.14.4.1.2 Recreation

- Dispersed recreation on Navajo and Hopi lands; recreation impacts to tribal- and federally managed lands; and
- Reduced enjoyment of recreation areas due to visible haze attributed to emissions from the power plant.

3.14.4.2 Assumptions and Impact Methodology

3.14.4.2.1 Land Use

Land Use Plans and RMPs were used to determine land use constraints and allowed uses on the lands under federal and Navajo Nation jurisdiction. These sources included applicable Navajo Chapter land use plans when available, the Aqua Fria RMP Record of Decision (2010); Prescott National Forest Land and Resource Management Plan (1986); Arizona Strip, Grand Canyon-Parashant, and Vermilion Cliffs Monuments Final Environmental Impact Statement and Record of Decision (2007 and 2008, respectively); the Ely District RMP Final Environmental Impact Statement and Record of Decision (2008); and the Las Vegas RMP Final Environmental Impact Statement and Record of Decision (1998). In addition, information from the Navajo Nation Parks and Recreation Department, the Navajo Nation Hospitality Enterprise, and the National Park Service (Glen Canyon NRA General Management Plan) were used in the discussions regarding land use on Navajo Nation and National Park Service lands.

Surface disturbance at the proposed KMC is defined by coal resource area. The difference in surface disturbance for the 2-Unit Operation is calculated based on the percentage of reduction to the annual tonnage of coal removed compared to the 3-Unit Operation. Land use agreements were analyzed using relevant PWCC permit packages and revisions submitted to the OSMRE. Current reclamation status was analyzed using the annual reports (2002 through 2014) prepared by PWCC.

3.14.4.2.2 Recreation

Recreational resources impacts were determined by analysis of documents and data produced by the Navajo Nation Parks and Recreation Department, the Navajo Nation Hospitality Enterprise, and the National Park Service.

3.14.4.3 Proposed Action

3.14.4.3.1 Navajo Generating Station

3.14.4.3.1.1 Land Use

Under the Proposed Action, the NGS and associated facilities, including the BM&LP Railroad, would continue to operate from 2020 through 2044. This analysis considers two different NGS operation conditions to capture the full range of the Proposed Action. The 3-Unit Operation would be the generation of 2,250 megawatts (MW) of power with air emission controls installed as described in Chapter 2.0. The 2-Unit Operation would be the generation of 1,500 MW of power with additional air emission controls and one less generating unit in operation as described in Chapter 2.0.

Onsite impacts to land use would be similar for either operation; however, there would be 239 acres of new surface disturbance for the 3-Unit Operation compared to 199 acres of new disturbance for the 2-Unit Operation. The 80-mile BM&LP Railroad would remain in place, traversing from the proposed KMC to the NGS site; all within the Navajo Nation.

The ash landfill would be increased by 40 acres within its existing footprint to accommodate the volume of ash disposal needed for 3-Unit Operation. The current size of the landfill is sufficient for 2-Unit Operation. The land committed for the asbestos disposal and ash disposal areas would continue to be used as discussed in Section 3.14.3.1.

The amount of solid waste likely would not change and would continue to be disposed of off-site. The volume of water needed from Lake Powell would be reduced from 29,000 acre-feet per year to 19,000 acre-feet per year under the 2-Unit Operation.

Surface disturbance related to decommissioning would not occur until decommissioning begins and would not disturb any land outside of the NGS site boundary or the BM&LP Railroad ROW (**Appendix 1B**). Unless NGS operations are continued by the Navajo Nation beyond 2044, the majority of the structures would be dismantled and demolished to ground level by December 22, 2045. Structures that would be retained, per the 1969 Lease and Lease Amendment No. 1 terms with the Navajo Nation, include the following:

- Lake Powell pump station, both suction lines, discharge lines, power supply lines, communication facilities, and roads along the pipelines;
- Administration building;
- Warehouse;
- Machine shop building;
- Visitor's building;
- Automotive maintenance building;
- Electric shop;
- Welding shop;
- Coal crusher building;
- Roads and fences;

- Switchyards; and
- 500-kV transmission lines and associated facilities.

Major components that would be demolished include the boiler, turbine, and chimneys. With the exception of hazardous materials and materials recycled, salvaged, or sold as scrap, the demolished material would be buried in an onsite landfill.

Criteria for adequate closure of the asbestos and ash landfills likely would require a final cover system designed to minimize infiltration and erosion. SRP likely would be required to install and maintain a final cover system, leachate collection system, and groundwater monitoring system. More information regarding the closure of the ash land fill can be found in **Appendix 1B**, Navajo Generating Station: Coal Combustion residuals Ash Disposal Landfill Requirements. Neither landfill would be used for the disposal of demolished infrastructure that would be buried at the NGS site.

The BM&LP Railroad also would be decommissioned. This would include the removal of all overhead lines, rails, ties, and ballast. Railroad embankments, culverts, and overpasses would be abandoned in place and the 80-mile-long ROW would be returned to the Navajo Nation as closely as possible to original condition.

Under the Proposed Action, approximately 199 to 239 acres of new surface disturbance would occur within the NGS boundary and the 80-mile BM&LP Railroad would remain in place and operational. The ash landfill would increase by 80 acres within the landfill boundary and the asbestos landfill would continue to be utilized.

3.14.4.3.1.2 Recreation

Recreation is affected by the visual presence of NGS. As the facility currently exists, its continued operation would constitute a negligible impact to recreation activities. Under the Proposed Action, visual impact of the plant would cease in 2045 when the site is decommissioned.

3.14.4.3.2 Proposed Kayenta Mine Complex

3.14.4.3.2.1 Land Use

Under the Proposed Action 3-Unit Operation, mining would occur in the N-10, N-11 Ext, and J-21-W areas, as well as portions of the N-9, J-19, and J-21 areas resulting in 5,230 acres of surface disturbance. The 2-Unit Operation would require less coal from the proposed KMC and coal resource area N-10 would not be mined; reducing the potential land disturbance at the proposed KMC by approximately 490 acres.

Under the 3-Unit Operation, an estimated eight residential relocations would occur, under the 2-Unit Operation mining would not occur in the N-10 area, potentially eliminating the need for two residential relocations.

A total of six assigned grazing areas also would be incrementally reduced or eliminated, pending final reclamation, under the 3-Unit Operation; for the 2-Unit Operation, four grazing areas would be reduced or eliminated, pending final reclamation. Most of the reclaimed mine areas now provide a greater amount of forage vegetation than was available under pre-mine conditions. Vegetation monitoring on reclaimed lands has indicated a downward trend in vegetation composition and health due to overgrazing in some areas. A temporary moratorium on grazing reclaimed lands has been placed until conditions improve. Future reclamation would continue to contribute to successful grazing and appropriate management. Ongoing monitoring and possible reseeding in areas that are less responsive to reclamation may be required. The reduction in the number of available grazing areas would be considered a minor impact because the loss of these four to six grazing areas may be partially or completely offset by increased forage created by the reclamation that has occurred on previously mined areas.

The resulting grassland communities would increase the livestock carrying capacity and improve the potential for grazing management (OSMRE 2011). The post mining uses of the reclaimed areas would be similar to pre-mining uses, including production of forage for grazing, wildlife habitat, and collection of culturally important plants (Section 3.8.).

The reclaimed areas would provide habitat for species adapted to habitat edges, early successional environments, and grassland habitats. Species that are highly adaptable could increase in abundance in reclaimed areas. These species include deer, elk, deer mice, Ord's kangaroo rats, Gunnison's prairie dogs, Navajo mountain vole, black-tailed jackrabbits, desert cottontails, red foxes, coyotes, some bats, eastern fence lizards, prairie falcons, and red-tailed hawks. In the long-term, the breeding potential for most raptors could increase as trees develop in portions of the reclaimed areas (see Section 3.10). Under the Proposed Action PWCC is proposing to leave 51 ponds available as water sources for livestock and wildlife (Section 3.14.3.2). All ponds would meet permanent pond design criteria (PWCC 2012 et seq.).

The realignment of Navajo Route 41 to its original location in two places south of mine area J-3 would eliminate some sharp turns, resulting in minor impacts due to improved road safety.

Several scoping comments indicated that some Navajo and Hopi people would prefer that the Black Mesa Mine be reclaimed and returned to the Navajo Nation and Hopi tribe rather than becoming part of the proposed KMC. Under all action alternatives, creation of the proposed KMC would constitute a major impact due to the length of time before the lands would revert to tribal governance.

3.14.4.3.2.2 Recreation

Recreational activities within the proposed KMC area consist of a very limited amount of dispersed activities. Most dispersed recreation on Black Mesa occurs to the north of the proposed KMC; however, mining activities under the Proposed Action could disrupt the recreational setting under either of the production scenarios until reclamation is complete. Impacts to recreation on the proposed KMC are negligible because the mine disturbance is a small percentage of the available area that provides opportunity for dispersed activities.

3.14.4.3.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

There would be no new impacts to land use and recreation because operation and maintenance for the existing WTS, STS, and communication sites would not change under the Proposed Action.

3.14.4.3.4 Project Impact Summary – All Project Components

Impacts to land use would occur only at the proposed KMC because none of the other components would expand beyond their current boundaries. The proposed KMC would not expand beyond the permit boundary; however, post-2019 mining would result in residential relocations. Residential relocations are considered to be a moderate impact because a compensation program is in place; however, the residents would be removed from their family lands and it is unknown if they would return. Continued mining at the proposed KMC would result in an incremental reduction or removal of four to six grazing areas. This impact would be considered minor because the vegetation in reclaimed areas is of higher forage value, offsetting the reduction in number of grazing areas. The current moratorium on grazing would be considered a moderate impact for the individuals it would affect because they would either have to stop grazing livestock or arrange for grazing elsewhere.

Proposed KMC impacts to recreation also are considered negligible because very little dispersed recreation occurs in area. The WTS and STS would not impact recreation because operations are not anticipated to change.

The BM&LP Railroad operations would not change under the 3-Unit Operation and would make fewer trips to and from the NGS under the 2-Unit Operation incrementally reducing the probability of accidents with livestock, wildlife, and vehicles. Operation of the WTS and STS is not dependent on the NGS and proposed KMC continued operations and would continue as permitted for the duration of the ROW grant/permit period. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.14.4.3.5 Cumulative Impacts

3.14.4.3.5.1 Navajo Generating Station

No reasonably foreseeable future actions (RFFAs) are anticipated that would result in cumulative impacts to land use. All surface disturbances would be confined to the existing NGS plant site and the existing railroad ROW as a continuation of operations. No RFFAs would enlarge the footprint of these facilities.

No RFFAs were identified for recreation. Cumulative impacts for land use and recreation would be none to negligible.

3.14.4.3.5.2 Proposed Kayenta Mine Complex

No RFFAs were identified. Future surface disturbance would be conducted on the proposed KMC in the mine areas previously identified.

3.14.4.3.5.3 Transmission Systems and Communication Sites

The TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada (**Figure 3.0-3**). Segments of the Lake Powell water pipeline and transmission line are proposed to overlap with the WTS utility corridor in Coconino County, Arizona west of Lake Powell (**Figure 3.0-2**). Cumulative impacts for land use and recreation would be negligible.

3.14.4.4 Natural Gas Partial Federal Replacement Alternative

Under the Natural Gas Partial Federal Replacement (PFR) Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to currently exist, prior disturbance impacts to land use and recreation are not evaluated.

3.14.4.4.1 Navajo Generating Station

Although there would be a reduction to the amount of energy produced, impacts to land use at the NGS would be negligible because operations would continue within the same established boundary and ROWs. For the same reason, there would be negligible impacts to recreational opportunities and quality.

3.14.4.4.2 Proposed Kayenta Mine Complex

Impacts to land use are expected to be similar to those described for the Proposed Action 3-Unit Operation and 2-Unit Operation because it is assumed mining would occur in the same areas but at a reduced rate. This would result in 4,968 or 3,888 acres of surface disturbance for 3-Unit Operation and 2-Unit Operation, respectively.

Impacts to recreation are considered negligible, the same as those described for the Proposed Action, as mining activities would continue to dominate this portion of the Black Mesa area.

3.14.4.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance. Impacts to land use and recreation from ongoing operation of the transmission lines and communication sites are considered negligible.

3.14.4.4.4 Project Impact Summary – All Project Components

Although energy production at the NGS, coal production at the KMC and deliveries of the BM&LP Railroad would decrease, impacts to land use and recreation would be less than the Proposed Action, which were considered to be negligible.

3.14.4.4.5 Cumulative Impacts

Cumulative impacts would be the same as described for the Proposed Action.

3.14.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation.

3.14.4.5.1 Navajo Generating Station

There would be a reduction to the amount of energy produced at the NGS under the Natural Gas PFR. Impacts to land use at the NGS would be negligible because operations would continue within the same established boundary and ROWs. As operation of the NGS would not be substantially changed under this alternative compared to the Proposed Action, there would be negligible impacts to recreational opportunities or quality.

3.14.4.5.2 Proposed Kayenta Mine Complex

Impacts to land use are expected to be similar to those described for the Proposed Action 3-Unit Operation and 2-Unit Operation because mining would occur in the same areas but at a reduced rate. Less coal would be mined compared to the Proposed Action resulting in 5,072 and 4,267 acres of surface disturbance for 3-Unit Operation and 2-Unit Operation, respectively.

Impacts to recreation would be the same as those described for the Proposed Action as mining activities would still dominate this portion of the Black Mesa area.

3.14.4.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance. Impacts to land use and recreation from ongoing operation of the transmission lines and communication sites are considered negligible.

3.14.4.5.4 Project Impact Summary – All Project Components

Impacts to land use and recreation would be negligible; however, approximately 3 to 11 percent less surface disturbance at the propose KMC would occur due to reduction in coal mined for this alternative.

3.14.4.5.5 Cumulative Impacts

Cumulative impacts would be the same as described for the Proposed Action.

3.14.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate NEPA process once a facility location is identified.

3.14.4.6.1 Navajo Generating Station

There would be a reduction to the amount of energy produced at the NGS under the Tribal PFR. Impacts to land use at the NGS would be negligible because operations would continue within the same established boundary and ROWs. As operation of the NGS would not be substantially changed under this alternative compared to the Proposed Action, there would be negligible impacts to recreational opportunities or quality.

3.14.4.6.2 Proposed Kayenta Mine Complex

Impacts to land use are expected to be similar to those described for the Proposed Action 3-Unit Operation and 2-Unit Operation but resulting in 5,124 or 4,409 acres of surface disturbance, respectively. Although less coal would be mined under both Tribal PFR Alternative operations compared to the Proposed Action, it is assumed mining would occur in the same areas but at a reduced rate. This would result in the same number of residential relocations and loss of grazing areas per operation.

Impacts to recreation would be the same as those described for the Proposed Action as mining activities would still dominate this portion of the Black Mesa area.

3.14.4.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance. Impacts to land use and recreation from ongoing operation of the transmission lines and communication sites are considered negligible.

A tie-line from the Tribal PFR facility or facilities to connect to the WTS or STS may be required, however, construction would be authorized as a separate project under a subsequent NEPA action.

3.14.4.6.4 Project Impact Summary – All Project Components

Impacts to land use and recreation would be negligible, however approximately 2 to 17 percent less surface disturbance would occur due to reduction in coal mined for this alternative. The potential exists, if this alternative is selected, for a variety of impacts to land use on tribal lands related to construction and connecting a new photovoltaic generation site on tribal land to the existing transmission system, which would require subsequent NEPA evaluation.

3.14.4.6.5 Cumulative Impacts

Cumulative impacts would be the same as described for the Proposed Action except for the construction of a photovoltaic facility and associated transmission lines.

3.14.4.7 No Action Alternative

3.14.4.7.1 Navajo Generating Station

Under the No Action Alternative, operation of the NGS would cease at the end of 2019. Consistent with the requirements of the 1969 Lease, the Lessees would undertake decommissioning activities (see Section 2.3.3.1). Structures within the plant site would be demolished to ground level with the exception of water supply facilities and some buildings in accordance with the lease agreement terms (Section 3.14.4.3). Demolished structures largely would be buried in place.

The BM&LP Railroad also would be decommissioned. This would include the removal of all overhead lines, rails, ties, and ballast. Railroad embankments, culverts, and overpasses would be abandoned in place and the 80-mile-long ROW would be returned to the Navajo Nation. The NGS site, including the BM&LP Railroad ROW would be returned to the Navajo Nation approximately 25 years earlier than under the Proposed Action.

The quality of recreational activities at Lake Powell and Glen Canyon would cease to be influenced by the view of the structures at the plant site once decommissioning is complete. It is possible that closure of the plant could result in some personnel no longer employed by SRP moving to other areas with associated impacts to local recreation businesses. This would be considered a negligible to minor impact because the number of NGS employees is small (approximately 490 workers) compared to the large number of visitors to the area. The impact of losing recreational spending from those employees, with the possible exception of some smaller “niche” businesses, would likely not be recognized by a 1.5 billion dollar industry (Section 3.18).

3.14.4.7.2 Proposed Kayenta Mine Complex

Mining at the proposed KMC would cease at the end of 2019. Final reclamation would commence approximately 25 years sooner than it would under the Proposed Action, and structures not approved as permanent facilities would be removed. No additional residents would be relocated. The ponds that have been constructed at that time would remain in place for livestock water sources.

Dispersed recreational activities on Black Mesa would include the reclaimed areas within the proposed KMC area. Local and transient wildlife populations may increase due to the lack of mining disturbance and successful reclamation.

3.14.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.14.4.7.4 No Action Impact Summary – All Project Components

Once decommissioning and reclamation activities are complete, the NGS site, BM&LP Railroad ROW, and proposed KMC totaling 29,672 acres, would be returned to the Navajo Nation and Hopi Tribe approximately 25 years earlier than under the Proposed Action.

Impacts to recreation from the No Action Alternative would be none to negligible as the areas comprising the NGS and proposed KMC currently are not open to public recreation activities and the closure of those facilities would not change recreational opportunities in the area. If the closure of the NGS plant and potential out-migration of some displaced workers does have a negative effect to the recreational business in the area it would be considered a minor impact due to the relatively small number of people affected.

Operation of the WTS and STS is not dependent on the NGS and proposed KMC continued operations and would continue as permitted for the duration of the ROW grant/permit period. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

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Section 3.15

Public Safety

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Acronyms and Abbreviations

1969 Lease	Navajo Project Indenture of Lease
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
CAP	Central Arizona Project
CCR	Coal combustion residual
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
dBA	decibels on the A-weighted scale
Development Fund	Lower Colorado River Basin Development Fund
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt
N-Aquifer	Navajo Aquifer
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
OSHA	Occupational Safety and Health Administration
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PFR	Partial Federal Replacement

PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
RCRA	Resource Recovery and Conservation Act
ROW	Right-of-way
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
U.S.	United States
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
WTS	Western Transmission System

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3.15 Public Safety

For purposes of this analysis, Section 3.15, Public Safety, addresses the risks of direct public exposure to operational activities (e.g., blasting with potential noise and vibration effects), hazards associated with transportation of hazardous materials, and railway and transportation safety. Refer to Section 3.16, Public Health, which primarily focuses on the potential consequences of indirect effects of individual exposures to power plant and/or mine operations (e.g., airborne pollutants, noise, etc.), and the associated human health risks.

3.15.1 Regulatory Framework

3.15.1.1 Public Safety

The Navajo Generating Station (NGS) and associated facilities are located on Navajo Nation tribal trust land, and the proposed Kayenta Mine Complex (KMC) is located on Navajo Nation and Hopi tribal trust lands. The proposed KMC is subject to tribal laws and regulations, as well as federal regulations; however, the operation of NGS is not subject to tribal laws and regulations per a 'Covenant Not to Regulate' in the 1969 lease. The U.S. Environmental Protection Agency (USEPA) provides continuing oversight for major federal environmental programs, including the transport and storage of hazardous materials and waste. Bulk products and chemicals, including petroleum products, are delivered to the NGS and the Kayenta Mine over the public highway system. The State of Arizona has no jurisdiction over public safety at the NGS and associated facilities (located on the Navajo Reservation) or the proposed KMC.

The Occupational Safety and Health Administration (OSHA) and Mine Safety Health Administration would oversee worker safety at NGS and the proposed KMC, respectively. Agencies that are involved in the regulation of hazardous materials and solid waste include U.S. Department of Transportation (USDOT), Arizona Department of Transportation, and Arizona Department of Environmental Quality. An evaluation of worker safety is outside the scope of this Environmental Impact Statement.

3.15.1.2 Industrial Noise

The U.S. Department of Labor's OSHA has jurisdiction over most occupational health and safety issues within the state. Industrial construction and routine workplace operations are governed by the OSHA standards of 1970, particularly 29 Code of Federal Regulations (CFR) Part 1910 (general industry standards). The Mine Safety Health Administration provides regulatory guidance on mining workplace safety thresholds, specifically the Mine Safety Health Administration standards of 1977. Evaluation of worker safety is not within the scope of this Environmental Impact Statement, but some USEPA standards are applicable to public safety, particularly residences located in proximity to active mining.

The USEPA Noise Control Act of 1972 indicates that a 24-hour equivalent level of less than 70 decibels on the A-weighted scale (dBA) prevents hearing loss and that a level below 55 dBA, in general, does not constitute a major impact. **Table 3.15-1** details the workplace protection measures provided per OSHA guidance against the effects of noise exposure.

Table 3.15-1 OSHA Workplace Permissible Noise Exposures

Duration per Day (hours)	Sound level (dBA)
8	90
6	92
4	95
3	97
2	100

Table 3.15-1 OSHA Workplace Permissible Noise Exposures

Duration per Day (hours)	Sound level (dBA)
1.5	102
1	105
0.5	110
Less than 0.25	115

dBA = decibels on the A-weighted scale.

Source: OSHA 1974.

Regulation 30 CFR Part 816.67, overseen by the Office of Surface Mining Reclamation and Enforcement (OSMRE), regulates the control of effects resulting from blasting activity in terms of noise and vibration resources.

3.15.1.3 Hazardous Materials

Hazardous substances are defined in various ways under a number of regulatory programs and can represent potential risks to both human health and the environment when not managed properly. The term “hazardous substances” includes the following materials that may be utilized or disposed of in conjunction with the proposed project:

- Substances covered under the OSHA Communication Standard aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (29 CFR Part 1910.1200) and Mine Safety Health Administration Communication Standards (30 CFR Part 47). The types of materials that may be used in project-related activities and that would be subject to these regulations would include almost all of the materials covered by the regulations identified below.
- Hazardous materials as defined under the USDOT regulations (29 CFR, Parts 170-177). The types of materials that may be used in project-related activities and that would be subject to these regulations would include fuels, paints and coatings, and other chemical products.
- Hazardous substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act and listed in 40 CFR Part 302.4. The types of materials that may contain hazardous substances that may be used in project-related activities and that would be subject to these requirements include certain solvents, solvent-containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- Hazardous waste as defined in the Resource Conservation and Recovery Act (RCRA) - procedures in 40 CFR Parts 260, 261, and 262 are used to determine whether a waste is hazardous. The types of materials used in project-related activities and that would be subject to these requirements could include flammable liquid with a flash point less than 140 degrees Fahrenheit, spent solvent, and corrosive liquids.
- Any “hazardous substances” and “extremely hazardous substances” as well as petroleum products (e.g., gasoline, diesel, or propane) are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of the Superfund Amendments and Reauthorization Act. The types of materials that may be used in project-related activities and that would be subject to these requirements include fuels, coolants, acids, solvent-containing products such as paints and coatings, and any hazardous materials and chemicals that fall under the OSHA and Mine Safety Health Administration hazard communication standards as well as 29 CFR Part 1910 and 1926 Subpart Z Table Z-1.

- Petroleum products defined as “oil” in the Oil Pollution Act of 1990. The types of materials used in project-related activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following lists provide information regarding management requirements during transportation, storage, and use of particular hazardous chemicals, substances, or materials:

- Superfund Amendment and Reauthorization Act Title III List of Lists or the Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act and Section 112(r) of the Clean Air Act.
- USDOT listing of hazardous materials in 49 CFR Part 172.101.
- Pursuant to regulations promulgated under the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendment and Reauthorization Act, release of a reportable quantity of a hazardous substance to the environment must be reported within 24 hours to the National Response Center (40 CFR Part 302).

3.15.1.4 Solid Waste

Solid waste includes a broad range of materials including garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (e.g., solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (U.S. Department of the Interior-OSMRE 2011). Solid waste is regulated under different subtitles of the RCRA and includes non-hazardous waste and hazardous waste. Non-hazardous waste is regulated under RCRA Subtitle D.

A solid waste generated by coal-fired power plants is coal ash, often referred to as coal combustion residuals (CCRs). In December 2014, the USEPA issued new regulations for the disposal and handling of CCRs. The USEPA’s regulatory determination was that CCRs would be regulated under Subtitle D of the Resource Recovery and Conservation Act (USEPA 2014).

Universal waste is a category of waste materials designated as ‘hazardous waste,’ but containing materials that are common. It includes batteries, pesticides, mercury containing equipment, and lamps containing mercury as defined in 40 CFR Part 273.

While potentially hazardous if made friable, the handling and disposal of asbestos is not regulated under the RCRA. Rather it is regulated under the National Emission Standards for Hazardous Air Pollutants program.

3.15.2 Study Areas

3.15.2.1 Proposed Action and Action Alternatives

The public safety study area for the NGS is the NGS with a 3-mile buffer. The study area for the Kayenta Mine is the proposed KMC permit area with a 3-mile buffer, inclusive of noise-sensitive receptors such as residences within the proposed KMC permit area. The NGS and proposed KMC are displayed on **Figure 3.14-1**. A 3-mile buffer was applied to the NGS and its associated facilities and KMC to account for noise-related impacts, and was selected based on attenuation of a 100-dBA noise source to approximately 50 dBA, a sound level that generally is considered to be quiet. The public safety study area for the Black Mesa & Lake Powell (BM&LP) Railroad is 200 feet either side of the BM&LP Railroad. The 230-kilovolt (kV) and 500-kV transmission lines also have a study area of 200 feet of either side of the transmission lines.

The study area for hazardous materials and solid waste includes the NGS site, proposed KMC permit area, and the major transportation routes used to deliver bulk products and chemicals to both facilities. The hazardous materials and solid waste study area also includes the BM&LP Railroad right-of-way (ROW) that extends from the proposed KMC to the NGS.

3.15.2.2 Cumulative

The cumulative impacts study areas for public safety and noise, hazardous materials, and solid waste are the same as for the Proposed Action and action alternatives.

3.15.3 Affected Environment

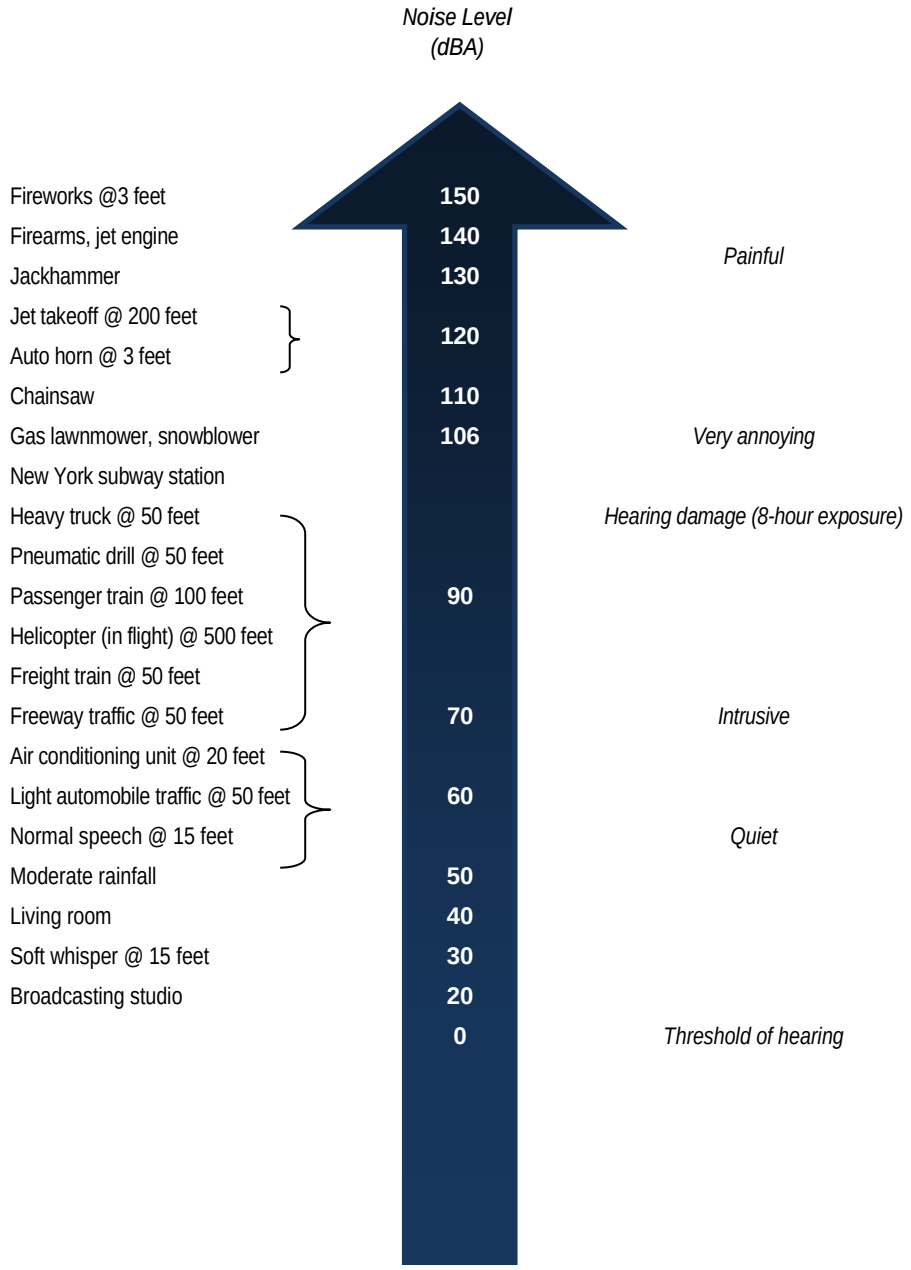
The affected environment for public safety and noise include human resources that could be affected by noise and vibrations. The historical noise and vibration environment near the Kayenta Mine and NGS has been dominated by noise associated with mining and power plant operations, including coal processing, blasting, and rail hauling and unloading. Low frequency vibrations include those from heavy equipment or trucks traveling through the study area and blasting. Sensitive receptors to noise and vibration include residences, with approximately 19 residences located inside or within close proximity to the proposed KMC permit boundary. No other human sensitive receptor sub-populations (e.g., school, hospital, long-term care facility) were identified in or around the proposed KMC area. There are six noise sensitive receptors (i.e., residences) within the NGS study area; four are located approximately 1 to 2 miles to the southeast of the NGS facility near Arizona Highway 89, and two, a residence and the Navajo Nation Park Entrance, are located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell.

Sound level measurements are often adjusted or weighted, and the resulting value is called an “A weighted” sound level. The dBA measurements are standardized at a reference value of zero decibels (0 dBA), which corresponds to the average threshold of human hearing (OSHA 2015a). The A-rated scale is logarithmic, that is, a sound that is 10 decibels louder is perceived by the human ear as twice as loud (Hanson et al. 2006). As a result, methods have been developed for weighting the sound frequency spectrum to approximate the response of the human ear. The dBA scale is widely used for environmental noise assessments because of its relative convenience and accuracy in correlating with people’s judgments of what constitutes noise. Typical A-weighted sound and noise levels associated with common activities or situations are shown on **Figure 3.15-1**.

Vibration occurs when energy is released from some type of activity such as blasting or heavy truck movement, and is converted into vibrations as either ground motion or air overpressure (air blast). Ground motion is a wave motion that spreads outwards from the blast, and is the principal vibration that could result from blasting. This ground motion is measured as peak particle velocity and is used as an indicator of possible blast damage (OSMRE 2011). Air blast may be more noticeable because of the accompanying noise effects. Like other noises, air blast is measured in decibels; however, the overpressure normally is at low frequencies, so an air blast may be felt more than heard. Blasting activity only occurs at Kayenta Mine.

The affected environment for hazardous materials and solid waste includes air, water, soil, and biological resources within the study area that could be affected by an accidental release of products, chemicals, hazardous materials, or solid wastes during transportation to or from the NGS and proposed KMC, transportation along the railway ROW, or during on-site storage, disposal, or use.

The volumes of hazardous materials used, and the generation of solid waste during maintenance of the transmission lines, substations, switchyards, and communication sites, are considerably less than used or generated at the NGS and Kayenta Mine. In addition, the use and disposal of these materials are episodic and depend on the required maintenance or repairs.



Source: Council on Environmental Quality 1970.

Figure 3.15-1 Typical A-weight Sound Levels

3.15.3.1 Navajo Generating Station

3.15.3.1.1 Public Safety and Noise

The main urban center closest to the NGS is the Town of Page (population 7,247 as of 2010), Arizona, which is located approximately 5 road miles to the west of the NGS power plant. There are six noise sensitive receptors (i.e., residences) within the NGS study area; four are located approximately 1 to 2 miles to the southeast of the NGS facility near Arizona Highway 98, and two are located 0.5 mile south of the NGS pump station at Lake Powell and 0.75 mile west of the NGS pump station at Lake Powell. The NGS Emergency Response Plan provides guidelines to augment the health and safety of NGS employees and the public in the event of an emergency, such as fire, explosion, hazardous materials release, terrorism, workplace violence, or other catastrophic event. The NGS Emergency Response Plan also pertains to the BM&LP Railroad. The Emergency Response Plan was developed in accordance with OSHA regulations and has been provided to local fire and hazardous materials teams. It also applies to enhancing the health and safety of the surrounding community in the event of an emergency. Formalized mutual aid agreements would further lessen the risk of impacts to the workers and the surrounding communities in the case of an emergency. Unwritten mutual aid agreements are in place with the City of Page, Peabody Western Coal Company (PWCC), National Park Service, Coconino County Sheriff's Department, and Navajo Nation Police. Potential impacts to worker safety also would be reduced by the emergency action plan which has been developed in accordance with OSHA. The plan facilitates and organizes employee actions during workplace emergencies (**Appendix 1B**). The emergency action plan includes, but is not limited to means of reporting fires, evacuation procedures, procedures to account for all employees after an evacuation, and employee rescue and medical duties. Additional resources for an incident such as firefighting include 1 million gallons of water in the NGS Makeup Reservoir reserved for fighting fires.

Current noise and vibration at the NGS and associated facilities result from an assortment of sounds at varying frequencies from typical plant operations, as well as noise associated with coal rail operations and maintenance actions on associated facilities. Noise levels at the NGS are assumed to be similar to those experienced near the Kayenta Mine (detailed below), with the exception of Kayenta Mine blasting noise levels, as there are no blasting activities at the NGS.

The BM&LP Railroad is used to deliver coal from the Kayenta Mine to NGS. Ongoing operation, repair, preventative maintenance, and improvements of the railroad track structure, catenary system, crossing locations, crossing gates, signals, signage, ROW roads, water drainage systems, culverts, fire walls, and cattle guards are performed to ensure the safety of train operations and the public, and to prevent livestock from accessing the ROW. As part of the service program, each train receives a periodic exterior inspection. When maintenance activities are performed, emphasis is placed on the braking system and the integrity of the cars.

Safety is further enhanced by training railway operations teams to use standardized visual and auditory signals for public safety communication. The locomotive horn, bells, and flashing ditch lights are used at crossings. Headlights are used to increase train visibility when a train is in motion and flares are used at night to warn motorists when a crossing is blocked by a stationary train.

Train operation is limited to a maximum of 50 miles per hour. Trains also are required during vision-impairing weather conditions to slow down to a speed that ensures safety and to stop when tracks are flooded. Bells and whistles must be sounded frequently under these conditions. Troubleshooting and repair personnel are dispatched to restore function as soon as possible when a concern is identified. To protect operators and the public when railroad crossing signals and gates are taken out of service for repair, a "stop and proceed" order is given to train operator crews, and the crossings are flagged by NGS personnel until the crossing can be returned to normal service. The railroad ROW corridor is fenced, except at the open grade crossings, to keep livestock away from the rail line. When notified that a ROW fence has been removed or damaged, a crew is dispatched to repair the fence to prevent livestock from entering the ROW. Should livestock be injured by train operations, livestock owners with a grazing permit

along the ROW may file claims for losses through Salt River Project Agricultural Improvement and Power District's (SRP's) Litigation and Claims Department.

Public safety warning devices at 36 low-use public crossings include railroad crossing (cross buck) warning signs and stop signs. The crossings at Mileposts 31, 42, 55, and 66 have automated electronic warning lights and bells as additional safety warnings to the public. Crossing arms are installed at Milepost 66 where Arizona Highway 98 crosses the rail line. Although there have been approximately 10 to 15 incidents involving the train and motor vehicles, including three incidents in the past 15 years, the BM&LP Railroad has never been deemed responsible for any railroad crossing incident involving a motor vehicle (**Appendix 1B**).

After coal is delivered via rail, it is processed by the NGS coal handling system. Dust emissions in the coal handling system are controlled by two dust-suppression systems – train unloading dust suppression and coal conveyor dust suppression. For train unloading, a dust suppression misting system is used when dumping coal from the rail cars into the track hopper. Conveyors, except the yard conveyor, are housed in enclosed conveyor galleries. Dust extractors and openings supply adequate ventilation in conveyor galleries for personnel ventilation, which also reduces the risk of coal dust explosions.

Noise connected with the BM&LP Railroad is related to coal loading from the silos at the rail loading site north of U.S. Highway 160 (**Figure 1-9**) and unloading activity at the NGS, the locomotive horn, and bells that are used at crossings. The nearest sensitive receptors to the BM&LP Railroad coal-loading silos are a cluster of homes located 800 feet from the railroad on the south side of U.S. Highway 160.

3.15.3.1.2 Hazardous Materials Transportation, Storage, and Usage

Storage tanks installed at the NGS, ranging from over 55 gallons to more than 5 million gallons, are used to store a variety of liquid hazardous materials used in plant operations. These materials include diesel, gasoline, turbine lube oil, transformer oil, antifreeze, and used oil. Chemicals also are stored in tanks and include sulfuric acid, sodium hydroxide, ammonium hydroxide, ferric sulfate sodium hypochlorite, scale inhibitor, and other corrosive chemicals. A list of storage tanks used to store hazardous materials is included in the Operations and Maintenance Plan (**Appendix 1B**). The hazardous material used in the largest quantity is diesel fuel. Depending on the overhaul status of the boiler, annual diesel fuel consumption can range from 1.1 to 1.8 million gallons. Current vehicle fuel usage at the NGS site is limited to unleaded gasoline and diesel fuel, and current gasoline and fuel use is approximately 255,000 gallons per year. A summary of vehicle fuel use is provided in the Operations and Maintenance Plan (**Appendix 1B**).

There are multiple oil-filled transformers, including three for each unit's generator. The oil provides electrical insulation and cooling.

Transportation of chemicals to the NGS is outlined below. All chemicals are transported on highways and NGS facility access roads. **Table 3.15-2** provides information on bulk chemical and product transportation.

Table 3.15-2 Major Bulk Chemical and Product Deliveries to NGS

Product	Truck Deliveries per Year	Load Size	Point of Origin
Limestone	3,664	25, 37.2, or 41 tons	Apex, Nevada
Calcium bromide for mercury control[1]	300-500	3,200 gallons	To be determined
Powder activated carbon for mercury control[1]	To be determined	To be determined	To be determined
Diesel[2]	175	7,200 gallons	Holbrook, Arizona; Phoenix, Arizona; Las Vegas, Nevada; Farmington, New Mexico American Forks, Utah
Ammonium hydroxide[2]	3	45,000 pounds	Salt Lake City, Utah
Caustic soda[2]	5	3,600 gallons	Buckeye, Arizona
Sulfuric acid[2]	151	3,300 gallons	Haden, Arizona
Lime[2]	122	40 tons	Cricket Mountain, Utah
Ferric sulfate[2]	30	135,000 pounds	Salt Lake City, Utah
Sodium hypochlorite[2]	30	45,000 pounds	Henderson, Nevada
Hydrogen[2]	11	111,000 cubic feet	Phoenix, Arizona
Carbon dioxide[2]	10	9.3 tons	Phoenix, Arizona
Nitrogen[2]	2	53,000 cubic feet	Tucson, Arizona
Soda ash[2]	263	24 tons	Argus, California

[1] Based on projected actuals.

[2] Based on 2014 actuals.

Source: Operations and Maintenance Plan (**Appendix 1B**).

3.15.3.1.3 Solid Waste Disposal

Solid wastes (non-hazardous and hazardous) are disposed of in on-site and off-site facilities. **Table 3.15-3** lists the wastes that are disposed off-site. Among the waste that is disposed off-site is RCRA hazardous waste. NGS currently operates as a Small Quantity Generator and implements a Hazardous Waste Minimization Plan using the best available and affordable waste management methods to minimize waste generation. Hazardous waste minimization includes training on strategies for eliminating and minimizing waste at the source, recycling, reclaiming, and reusing material. Annual hazardous waste generation at NGS was reduced to 1,274 pounds in 2014 compared to 39,000 pounds in 1991 (**Appendix 1B**).

Table 3.15-3 Annual Off-site Solid Waste Volume and Disposition

Waste Stream	Average Annual Amount over a 5-year Period (2010-2014)	Annual Amount Generated (2014)	Ultimate Disposition/Site	Transportation
Bulk solid waste (non-RCRA and does not include CCRs)	Not Available	3,848 cubic yards	Washington County Landfill, UT	Republic services
Used oil rags	23.1 tons	19.2 tons	Subtitle D Landfill/Waste Management – Butterfield Landfill, AZ	MP Environmental Services, Inc.
Arsenic-treated cooling tower wood (exempted wastes)	1.53 tons	0 tons	Subtitle D Landfill/Waste Management – Butterfield Landfill, AZ	MP Environmental Services, Inc.
Hazardous waste (e.g., lab wastes, mixed solvents, and oil-based paint)	3,165 pounds	1,274 pounds	Clean Harbors – Aragonite, UT (incineration) and Grassy Mountain, UT (Subtitle C landfill); Veolia, Port Arthur, TX (incineration); US Ecology, Beatty, NV (Subtitle C landfill)	MP Environmental Services, Inc.
Used Oil	11,677 gallons	17,120 gallons	Recycled with Thermofluids	Thermofluid
Universal Waste (e.g., lamps, batteries, and mercury-containing equipment)	820 pounds of lamps/153 pounds of batteries/957 pounds of mercury-containing equipment	1,385 pounds of lamps/114 pounds of batteries; 142 pounds of mercury-containing equipment	Recycled with Veolia, Phoenix, AZ	Veolia Phoenix
Polychlorinated Biphenyl Electrical Equipment	1,057 kilograms	920 kilograms	Clean Harbors – Aragonite, UT (incineration) and Grassy Mountain, UT (Subtitle C landfill); Veolia, Port Arthur, TX (incineration); US Ecology, Beatty, NV (Subtitle C landfill)	MP Environmental Services, Inc.

Source: Operation and Maintenance Plan (**Appendix 1B**).

3.15.3.1.4 On-site Material Management

The on-site asbestos landfill is used only to dispose of asbestos-containing material generated during abatement or demolition activities (**Appendix 1B**). The landfill does not accept waste generated outside of the plant site. The 3-acre landfill is southeast of the railroad loop and has a fenced perimeter with a gated entrance. Currently less than half of the site has been used for disposal of asbestos-containing materials. In 2014, the NGS disposed of about 24 cubic feet of asbestos containing materials (**Appendix 1B**). The average annual amount of asbestos-containing material disposed from 2008 to 2014 was 124 cubic feet.

Non-hazardous solid waste was formerly disposed at the NGS Solid Waste Landfill. As of 2016, the solid waste landfill is inactive, and all non-hazardous waste is transported to an off-site landfill. Historically, the on-site landfill received mostly industrial waste, construction materials, and miscellaneous demolition debris. In 2015, a new policy was implemented with the expectation that nearly all of the non-hazardous solid waste would be transported and disposed by off-site vendors (**Appendix 1B**).

CCRs are disposed of at the ash disposal site pursuant to the CCR regulations (see above and **Appendix 1B**). The CCRs generated at the plant include fly ash, economizer ash, bottom ash, and flue-gas desulfurization gypsum by-product (**Appendix 1B**). Fly ash is recycled in large amounts ranging from 350,000 to 500,000 tons (50 to 90 percent of the annual fly ash output). The fly ash is sold as a by-product and is used in a variety of applications where it can be bound into materials including wallboard, concrete, roofing materials, and bricks (USEPA 2015a). The largest use of fly ash is in concrete, concrete products, and grout. The materials that are not recycled are placed into the ash disposal site. **Table 3.15-4** lists the types and amounts of CCRs that were disposed of in 2014. At the ash disposal site, the CCR is placed in lifts directly on bedrock or compacted dunes. The lifts are 2 to 3 feet thick and are grouped into embankments that do not exceed 15 feet in thickness. The final lift is covered with 2 feet of native soil and the embankments are terraced to reduce or divert runoff.

Table 3.15-4 CCR Disposal in 2014

CCR Type	Tons
Disposal at On-site Ash Disposal Site	
Bottom and economizer ash	173,394
Fly ash	295,246
Scrubber by-products	458,048
Sold to Off-site Vendor	
Fly Ash	380,739

Source: Operation and Maintenance Plan (**Appendix 1B**).

3.15.3.2 Proposed Kayenta Mine Complex

3.15.3.2.1 Public Safety and Noise

The main hazards associated with mining and explosives use are the handling of explosives by workers and the proximity to the blast site. Blasting is used during mining operations to fragment material for excavation and transport. Blasting operations at the Kayenta Mine are conducted according to federal law, applicable regulations, and the approved permit application. Also, under OSMRE's permitting requirements, a resident or owner of a dwelling or structure within 0.5-mile of any part of the permit area may request that a pre-blasting survey be conducted on their dwelling or structure. Upon receipt of this request, PWCC conducts the survey by analyzing the conditions of the dwelling or structure prior to blasting activities and documenting any pre-blasting damage and other physical factors that could be

affected by the blasting (OSMRE 2011). A written report is prepared and a signed copy provided to the regulatory authority and the person requesting the survey (OSMRE 2011, 1983).

Blasting at the Kayenta Mine occurs about twice daily during weekdays between sunrise and sunset at a distance no closer than 0.5 mile from an occupied dwelling. There are three residences within or adjacent to current or future mining areas. One residence is adjacent to mining area N-10 and two residences are within area N-11E. Residents in or near the blasting area are evacuated prior to proceeding with any blasting operations. Warnings and all-clear signals audible for 0.5 mile are sounded before and after blasting. Except for emergencies, blasting occurs according to a schedule that is published annually in a newspaper with general circulation in the mining area. Blasting schedules also are delivered to all individuals living within the Kayenta Mine permit area and within 0.5 mile outside the permit area (OSMRE 2011).

Blasts are monitored for air blast and ground vibration twice per year in June and December. PWCC monitors airblast and ground vibration for all shots exceeding the scaled distance equation, as well as any required by the regulatory authority at their requested location(s). The OSMRE reviews the Kayenta Mine's blasting records monthly during field inspections (OSMRE 2011; PWCC 2012 et seq.). More information regarding blast warning signs, signals, surveys, and monitoring is detailed in **Appendix 1D**.

The Mine Safety and Health Administration regulates the storage of explosives used for blasting activities (30 CFR Parts 56 and 57). Mine Safety and Health Administration requires that explosives be secured in magazines or other appropriate explosive materials storage facilities. These facilities must be bullet-resistant, theft-resistant, fire-resistant, weather-resistant, and ventilated for the storage of explosives and detonators. Furthermore, areas surrounding storage facilities for explosive material should be clear of rubbish, brush, dry grass, and tress for 25 feet in all directions, with the exception that live trees 10 feet or taller are not required to be removed. Also, other combustibles are not to be stored or allowed to accumulate within 50 feet of explosive material.

Ambient noise conditions encountered in the study area consist of a variety of sounds at varying frequencies (Hanson et al. 2006). Existing mining-related noise within the proposed KMC is associated with operations, including blasting, coal hauling, and coal processing (OSMRE 2011).

The loudest single mining and excavation equipment noise source is the rock drill, which produces noise of 98 dBA at 50 feet (Hanson et al. 2006). Sensitive noise receptors in the proposed KMC are residences near the intersection of U.S. Highway 160 and Navajo Route 41 and along Moenkopi and Dinnebito washes. Noise levels expected at sensitive receptor locations within and adjacent to the proposed KMC were estimated from typical mining equipment noise levels and are listed in **Table 3.15-5**.

Table 3.15-5 Noise Levels at Various Distances from Typical Mining Equipment

Construction Equipment	Noise Level[1] at Distances (dBA)					
	50 feet	100 feet	200 feet	400 feet	800 feet	1,600 feet
Bulldozer	85	79	73	67	61	55
Concrete Mixer	85	79	73	67	61	55
Concrete Pump	82	76	70	64	58	52
Crane, Derrick	88	82	76	70	64	58
Crane, Mobile	83	77	71	65	59	53
Front-end Loader	85	79	73	67	61	55
Generator	81	75	69	63	57	51
Grader	85	79	73	67	61	55

Table 3.15-5 Noise Levels at Various Distances from Typical Mining Equipment

Construction Equipment	Noise Level[1] at Distances (dBA)					
	50 feet	100 feet	200 feet	400 feet	800 feet	1,600 feet
Rock Drill	98	92	86	80	74	68
Shovel	82	76	70	64	58	52
Truck	88	82	76	70	64	58

[1] The equivalent steady-state sound level that contains the same varying sound level during a 1-hour period.

Source: Hanson et al. 2006.

Based on the noise sources identified in **Table 3.15-5**, existing sound levels at 50 feet from equipment are likely to range from 80 to 95 dBA for typical daytime noise levels, depending on the level of intensity of mining activities and distance from the noise source. For comparison, 40 dBA is relatively quiet and can be equated to the noise level of a residence at night, while 60 dBA is comparable to a normal conversation and is considered a comfortable noise level (**Figure 3.15-1**). Noise from a point source, such as construction or mining equipment, decreases approximately 6 dBA per doubling of the distance to a sensitive noise receptor (OSMRE 2011; Traux 1999). For example, a source that emits 85 dBA at 50 feet decreases to 79 dBA at 100 feet (OSHA 1999). This concept is known as geometric spreading which results in the energy twice as far from the source being spread over four times the area, hence the sharp drop off in intensity. Sound intensity is subject to geometric spreading assuming there are no reflections or reverberations.

Low frequency vibrations normally are felt rather than heard. Existing sources of vibrations within the study area may include heavy equipment, trucks, or blasting. Monitored levels for ground movement and overpressure from the mining operation have not exceeded established OSMRE limits (OSMRE 2011; PWCC 2012 et seq.).

Flyrock is rock that is ejected into the air or along the ground from a blast. Flyrock is controlled by the blasting design. Additionally, access near the blast site is restricted. The federal regulation in 30 CFR Part 816.67 (c) prohibits flyrock from being cast more than one-half the distance to the nearest dwelling, beyond the area of control (required under 30 CFR Part 816.66 (c)), or beyond the permit boundary (OSMRE 2011).

Along Navajo Route 41, PWCC assists with maintenance of the road surface and slopes and coordinates maintenance with the Navajo Nation Department of Transportation for repaving and seal coating the road, or through their own roadway maintenance contract to maintain roadway shoulders and drainage. Some residents state that Navajo Route 41, from the former Black Mesa Mine facilities to the southern lease area boundary, and the Kayenta Mine road should both be paved for safety and dust control reasons. Residents also would like to see the paved portion of Navajo Route 41 realigned and improved to higher standards. To ensure public safety along the mine roads, public traffic is excluded from the active mine area by security gates. Security gates decrease the potential for heavy mining vehicles to interact with vehicles driven by the public. All roads are signed and maintained by grading and dust suppression, and school buses and deliveries are escorted by PWCC security vehicles (OSMRE 2011). PWCC also conducts snow removal and application of gravel and salt when needed.

3.15.3.2.2 Hazardous Materials, Chemicals, Products, and Solid Waste

Potential hazardous waste that is recycled includes batteries, computer equipment, fluorescent lamps (4-foot and 8-foot lengths), high-pressure sodium light bulbs, and mercury-vapor light bulbs (OSMRE 2011). Non-hazardous materials that are recycled consist of scrap metal and tires. Other waste that requires analysis before disposal or recycling includes used oil, parts washer fluid, spent solvent, grease, and antifreeze. The Kayenta Mine is classified as a small quantity generator of hazardous waste

(USEPA 2016). Small quantity generators generate more than 100 kilograms, but less than 1,000 kilograms, of hazardous waste per month. These materials are either recycled or disposed in accordance with the results of testing to determine appropriate off-site disposal.

The primary products and chemicals transported to, and stored and used at, the Kayenta Mine are listed in **Table 3.15-6**. All chemicals and products used are transported on major highways and Kayenta Mine facility access roads. Under the regulatory framework described above, diesel fuel is the largest by volume of the products used at the Kayenta Mine.

Table 3.15-6 Major Bulk Chemical and Product Deliveries to Kayenta Mine

Material	Estimated Annual Use	Unit
Diesel	5,400,000	Gallons
Gasoline	145,000	Gallons
Lubricating oil	100,000	Gallons
Gear Oil	11,300	Gallons
Hydraulic Oil	1,000	Gallons
Vehicle antifreeze	16,000	Gallons
Ammonium Nitrate	25,000,000	Pounds

Source: Lehn 2015.

The major waste streams at the Kayenta Mine include non-hazardous waste, materials that could be considered hazardous but are recycled, and hazardous waste (OSMRE 2011). Non-hazardous waste is collected and transported by a contractor and disposed off-site in a permitted landfill. Previously, such waste was disposed on-site at the “J-3 Landfill” which was closed after submittal of a reclamation plan in 1998 (PWCC 2012 et seq.). A bioremediation treatment unit for petroleum contaminated soil was operated until 2014 when closure was approved by the Navajo Environmental Protection Agency.

3.15.3.3 Transmission Systems and Communication Sites

3.15.3.3.1 Public Safety and Noise

There are three 500-kV transmission lines and one 230-kV transmission line associated with the NGS power transmission. Nineteen communication sites occur in the project area and most are co-located with other facilities. There are no sensitive receptors under or within 200 feet of either side of the 230-kV or 500-kV transmission lines.

Public health and safety concerns associated with transmission lines typically are focused on the effects of electromagnetic fields. The electric field created by high voltage transmission lines extends from the energized conductor to the other conducting objects. Resulting field effects include induced current and voltage in the ground, structures, vegetation, buildings, vehicles, and people near the transmission line. The electric field or voltage gradient is expressed in units of volts per meter or kVs per meter. There are no federal standards for transmission line electric fields. Typical average electric field readings for a 230-kV line and a 500-kV line at the edge of the study area (200 feet from ROW centerline) are depicted in **Table 3.15-7**.

Table 3.15-7 Noise and Average Electric and Magnetic Field Strengths at Study Area Edge

Transmission Line Capacity	Average Magnetic Field at Study Area Edge	Average Electric Field at Study Area Edge	Noise Levels at Study Area Edge
230-kV	9 milliGauss	0.1 kV per meter	20 dBA
500-kV	20 milliGauss	0.6 kV per meter	48 dBA

Source: Bureau of Land Management (BLM) 2011.

Magnetic field strength is expressed in terms of teslas or gauss. While electric fields can be easily shielded or reduced by walls and other objects, magnetic fields cannot, and they are more likely to penetrate into the body. The International Commission on Non-Ionizing Radiation Protection in a November 2010 release stated that the exposure limits for magnetic fields was 2,000 milliGauss for the public (International Commission on Non-Ionizing Radiation Protection 2010). Typical homes produce background magnetic levels (away from appliances and wiring) that range from 0.5 milliGauss to 4 milliGauss, with an average value of 0.9 milliGauss (USEPA 1992). Natural static magnetic fields from the earth are near 0.6 milliGauss. There are no federal standards for transmission line electric fields; however, the International Commission on Non-Ionizing Radiation Protection has set a voluntary protection level for electrical fields for the general public of 4.2-kV per meter (International Commission on Non-Ionizing Radiation Protection 1998). Typical average magnetic and electric field readings for a 230-kV line and a 500-kV line at the edge of the study area (200 feet from ROW centerline) are depicted in **Table 3.15-7** (BLM 2011).

Corona is the electrical breakdown of air into charged particles caused by the electrical field at the surface of conductors, insulators, and hardware of energized high-voltage transmission lines. Corona-generated audible noise generally is characterized as a crackling/hissing noise, most noticeable during wet-weather conditions. Noise level from a line source such as a power line will decrease by 3 dBA for every doubling of the distance away from the source (Truax 1999). This concept is known as cylindrical spreading. Noise levels at the edge of the 230-kV and 500-kV study area are depicted in **Table 3.15-7** (BLM 2011).

Fire along electric transmission lines, specifically in forested areas, is another source of public safety concern. During the 2010 to 2015 time frame, there were approximately 4,833 fires which occurred in Arizona on BLM and National Forest lands and burned on average 266 acres per fire (Geographic Area Coordination Center 2016). Appendix 3 (Industrial Fire Precaution Plan) of the Arizona Public Service Company Transmission Line Corridor Management Plan for 500-2, Prescott National Forest (**Appendix 1B**) details steps that contractors would take to reduce fire risk while conducting vegetation maintenance within the transmission line corridor. Vegetation maintenance within the transmission line corridor serves to provide protection against wildfires by reducing the potential for fire ignition from vegetation in and around the power lines. It also reduces fuel load under the lines, thereby reducing the potential for existing fires to damage structures or cause power fault in the lines. The Transmission Line Corridor Management Plan also details Best Management Practices to facilitate fire reduction. Additionally, where needed, Arizona Public Service Company maintains a 20-foot radius around steel footers free of shrubs, trees, or other such vegetation to provide a fire break to minimize arcing of electricity or burning of structures during a fire under or near the transmission line.

Maintenance activities around communication sites also are conducted to minimize fire risk. Typical maintenance activities to prevent fire at communication sites include clearing of vegetation within the site grounds and at the fence line.

3.15.3.3.2 Hazardous Materials and Solid Waste

Hazardous materials used in the operation and maintenance of the transmission line corridors and communication sites consist primarily of vehicle fuel, propane for emergency backup generators, and dielectric oil used in the electrical equipment at the substations. Solid waste generation consists of scrap metal, debris, and office and shop trash.

3.15.4 Environmental Consequences

3.15.4.1 Issues

3.15.4.1.1 Public Safety and Noise

The major issues concerning public safety and noise are listed below.

- Potential public safety impacts associated with the NGS and BM&LP Railroad operations.
- Potential injuries from blasting and construction and the storage of explosives at the proposed KMC.
- Potential exceedance of federal noise and blasting levels at sensitive receptors near the proposed KMC.
- Potential transmission line electromagnetic field exposure.
- Potential transmission line noise

3.15.4.1.2 Hazardous Materials, Chemicals, Products, and Solid Waste

The major concerns regarding hazardous materials and solid waste include issues listed below.

- Potential spills and releases of hazardous chemicals or substances that exceed regulatory thresholds.
- Improper handling and disposal of waste that would pose a threat to public health and the environment.

3.15.4.2 Assumptions and Impact Methodology

3.15.4.2.1 Public Safety and Noise

The methodology for evaluating impacts on public safety involves identifying and assessing design, construction, and operational standards and guidelines for the project components and determining potential effects on sensitive receptors within the study areas. Noise and vibration impacts are evaluated based on the extent the activity could exceed federal noise and vibration regulations at sensitive receptors.

3.15.4.2.2 Hazardous Materials and Solid Waste

The impact analysis involved the review of a variety of sources including information from the project proponents, government agencies, and published documents. The review of data sources documented potential impacts of hazardous materials and the generation and disposal of solid waste, including CCR, and hazardous waste. The assessment:

- Identifies potential impacts associated with CCR disposal;
- Analyzes the impact on soil and water resources from potential spills and releases; and
- Identifies applicable mitigation measures, if necessary.

Assumptions used in the assessment of risks involving hazardous materials and solid waste are listed below.

- The review of solid waste handling and disposal was not intended as a comprehensive audit of regulatory compliance, but rather to disclose potential impacts under the National Environmental Policy Act.
- The analysis was not concerned with nearby off-ROW or off-site contaminated sites not owned or operated by the proponents. The reason for this limitation is that the NGS, the BM&LP Railroad, the Western Transmission System (WTS), and Southern Transmission System (STS) are existing facilities and would not be expanded outside their previously established boundaries. The proposed KMC would operate through 2044, but it would not overlap with the activities of the former Black Mesa Mine except where existing Black Mesa Mine support facilities are currently being used by the Kayenta Mine, and would be used in the future.
- Use of hazardous materials and generation of solid waste at the facilities relied on information provided by the proponents.
- Accident and incident data were obtained from publically available data provided by federal and state governmental agencies.

3.15.4.3 Proposed Action

3.15.4.3.1 Navajo Generating Station

3.15.4.3.1.1 Public Safety and Noise

The impact analysis study area for the NGS is detailed in Section 3.15.2. To reduce public safety risks, health and safety procedures and the NGS Emergency Response Plan and Emergency Action Plan would be updated and modified, as needed. No noise impacts from NGS operation would occur outside the plant boundaries as there are no sensitive receptors within 200 feet of the BM&LP Railroad. The nearest sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

Under the Proposed Action, impacts to public safety from potential rail accidents due to future operation of the BM&LP Railroad would be lessened by ongoing and future maintenance and improvements. These improvements would include, but would not limited to, the replacement and improvement of the railroad ties along the entire line; replacement and improvement of power feeder lines, poles, transformers; and installation of new road crossings and related warning systems (**Appendix 1B**). In addition, the NGS Emergency Response Plan would apply to railway operations. Based on continued implementation of the maintenance and improvement activities and the plan, it is anticipated that impacts associated with ongoing operation of the BM&LP Railroad, such as vehicle or livestock collisions, would be minor.

Additionally, activity on the BM&LP Railroad would stay the same or be incrementally reduced as compared to historical BM&LP Railroad activity. The distance of sensitive receptors from the BM&LP railroad as well as the long-term historical presence of the BM&LP railroad would result in negligible impacts to sensitive receptors. Also, for the cluster of sensitive receptors approximately 800 feet from the railway on the south side of U.S. Highway 160, the highway would continue to contribute a substantial amount to the existing noise level in addition to the noise generated from BM&LP railroad operations.

Under the Proposed Action, the operating and support facilities at the plant site would be dismantled and demolished to ground level by the end of 2045. Noise and vibration impacts associated with decommissioning of the NGS and BM&LP Railroad would be limited to removal of the operating and support facilities, and the overhead power lines, rails, ballast, ties, and structures, respectively. Noise

from demolition also would include blasting from chimney removal and truck traffic for salvage material disposal. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

3.15.4.3.1.2 Hazardous Materials Transportation

Under the Proposed Action, it is possible that anhydrous ammonia may be used for the selective catalytic reduction process to reduce nitrogen oxide emissions (described in detail in **Appendix 1B**). If anhydrous ammonia is used, under the 3-Unit Operation the selective catalytic reduction process would require approximately 17, 500 tons of anhydrous ammonia per year (**Appendix 1B**). Under the 2-Unit Operation, the use of anhydrous ammonia would be approximately 10,700 tons per year. Although there would be a number of products and chemicals used on-site, the discussion below is concerned with the two materials that present elevated risk. One material that presents elevated risk is anhydrous ammonia (anhydrous meaning that it contains no water). It presents elevated risk because it is classified as an extremely hazardous substance. The other substance that presents elevated risk is diesel fuel because large quantities of diesel fuel would be routinely stored and used on an annual basis (1.26 million gallons). The discussion below provides a review of the hazardous properties of the materials and a transportation risk assessment.

<u>Anhydrous Ammonia</u>

Ammonia and ammonia-compounds largely are used for agricultural fertilizer (80 to 90 percent); however, they also are used in other manufacturing and industrial processes such as water purification, cleaning compounds, refrigerant, pulp and paper, metallurgy, rubber, food, textile, leather, pharmaceuticals, and explosives (Agency for Toxic Substances and Disease Registry 2004).

Anhydrous ammonia is a USDOT hazardous material Class 2.2 - non-flammable compressed gas (49 CFR Part 173.115). While ammonia is a gas, it is more efficiently transported and stored as a liquid in pressure vessels. It is considered an extremely hazardous substance under the Emergency Planning and Community Right-to-Know Act reporting rules under Superfund Amendments and Reauthorization Act Title III, and the threshold planning quantity is 500 pounds (USEPA 2015b). As an extremely hazardous substance, it has physical characteristics that have the potential to harm people and the environment.

A common route of ammonia exposure is inhalation. Ammonia is an irritant to the respiratory system, but it also can affect the eyes and skin (Agency for Toxic Substances and Disease Registry 2004). Ammonia combines with water, creating ammonium hydroxide, a base that causes chemical burns to affected areas. Also, contact with the ammonia in liquid form can cause cryogenic (cold) injuries. Exposure to anhydrous ammonia can cause symptoms that vary from minor throat, lung, and skin irritation to severe chemical burns and pulmonary edema (OSHA 2015b). The work place exposure limit set by OSHA is 50 parts per million on an 8-hour time weighted average. Acute exposures can be fatal with concentration threshold levels from 5,000 to 10,000 parts per million (Agency for Toxic Substances and Disease Registry 2004). Anhydrous ammonia is probably not a carcinogen, but it may have synergistic effects with other compounds coupled with chronic exposure.

An ammonia spill to soil would result in fairly rapid conversion to nitrogen and subsequent uptake by microbes and plants except in places that would be the most impacted (Agency for Toxic Substances and Disease Registry 2004). If released into an aquatic environment, ammonia is highly toxic to aquatic life because it is very soluble in water. Fish are very vulnerable since ammonia interferes with the functioning of gills. Aquatic plants and invertebrates have a higher tolerance but can still be affected (Oram 2014). Lethal concentrations for fish range from 0.2 to 2.0 milligrams per liter. However, ammonia is not persistent in the environment and is fairly rapidly broken down and diluted.

In a catastrophic release to the air, the severest hazards and effects are closest to the source. An example would be the rupture of an ammonia tank under transport. Since the ammonia is under pressure, a puncture or rupture of the tank would cause a rapid loss of pressure, and the liquid ammonia would evaporate rapidly, but not instantaneously (Nordin 2006). The evaporation would be somewhat constrained because as the liquid evaporates, cooling occurs. As the ammonia evaporates, a visible plume would form in the air and would stay fairly close to the ground because, although ammonia is lighter than air, it readily mixes with water vapor. Because the evaporation is not instantaneous, liquid that leaks from the tank would pool on the ground, cooling or freezing whatever it contacts. In the case of a large spill (greater than 55 gallons) from a tanker truck or trailer, the USDOT recommends that persons be excluded up to a distance of 400 feet and that protective action distances downwind vary from 0.3 to 1.6 miles depending on atmospheric conditions and diurnal cycle (day or night) (USDOT 2012). Although anhydrous ammonia is not considered very flammable, when dispersed in the air it may be readily ignited. If the contents of a ruptured tank are on fire, a larger exclusion area may be necessary, at least 1 mile (National Institute of Occupational Safety and Health 2015).

Data for hazardous material incidents in Arizona over the period of 2012 to 2013 indicate there were 44 incidents involving non-flammable compressed gas (USDOT Hazard Class 2.2) out of a total of 922 hazardous material incidents (Arizona Division of Emergency Management 2013). In Coconino County, there were 10 hazardous material incidents from 2010 to 2013, but the hazard classes were not identified. However, there were no incidents involving the transportation of anhydrous ammonia in Coconino County from 2009 to 2015 (Pipeline and Hazardous Material Safety Administration 2016).There were only four reported releases of anhydrous ammonia in Arizona in 2014 (Right-to-Know Network 2016).

Because of the number of truck trips it would take to supply the plant with anhydrous ammonia under the 3-Unit Operation and 2-Unit Operation, the most likely impacts would occur due to a transportation incident. Nationally during the period from 2009 to 2014, most of the transportation-related incidents for anhydrous ammonia occurred while the material was in transit compared to material transfer, and in-transit storage incidents (Pipeline and Hazardous Material Safety Administration 2015). The handling and storage of ammonia at the plant would be governed by a response plan that would be in effect for emergencies that may occur at the plant. However, a transportation incident would occur in a less controlled environment, and the transportation company would be responsible for response and cleanup of incidents that may occur during transportation.

For this analysis, the transportation routes were limited to highways from Flagstaff to the power plant, a distance of 130 miles. Although it is likely that anhydrous ammonia would be trucked from Phoenix to Flagstaff on Interstate-17 or from other locations along Interstate 40, the increase in traffic due to the NGS plant (1.5 to 2.4 trucks per day) would statistically be very small since Interstate-17 averaged approximately 79,000 vehicles per day in 2014 (Arizona Department of Transportation 2015). The most likely transportation route would be U.S. Highway-89, but transportation could occur over Navajo Route 20 (Copper Mine Road) which intersects U.S. Highway 89 at Gap Express, about 17.0 miles north of the intersection of U.S. Highway 89 and U.S. Highway 160.

Table 3.15-8 lists the potential of an anhydrous ammonia spill for two annual use projections, for the 3-Unit Operation and 2-Unit Operation. The calculated number of incidents indicates that the probability of an incident or spill is low, even with the increased number of loads. If selective catalytic reduction is installed on all three units by 2024, then the calculated number of incidents over a 20-year time span (2024 to 2044) would be 0.28. Because of the low incident rate, after 20 years of hauling the chemical there is a low probability of a release. Therefore, impacts due to a release would be negligible to minor.

Table 3.15-8 Potential Transportation Incidents During Transportation of Chemicals and Products

Material	Case	Annual Use	Shipment Quantity	Number of Shipments per Year	Distance (miles)[1]	Accident/ Incident Rate[2]	Calculated Number of Incidents
Anhydrous Ammonia[3]	20 Years 3-Unit Operation	17,500 (tons)	20 tons	875	2,275,000	1.4×10^{-7}	0.32
	20 Years 2-Unit Operation	10,700 (tons)	20 (tons)	535	1,391,000		0.19
Diesel Fuel	25 Years (2019 to 2044) 2-Unit Operation	831,600 (gallons)	7,200 (gallons)	116	377,000	7.0×10^{-7}	0.26
	25 Years (2019 to 2044) 3-Unit Operation	1,260,000 (gallons)	7,200 (gallons)	175	568,750		0.40

[1] 130 miles from Flagstaff to NGS.

[2] Table 25, Battelle Memorial Institute (2001), accident and incident rate per million miles. Incidents include non-accident releases during transit.

[3] Anhydrous ammonia is not currently used at the NGS.

Diesel Fuel and Other Petroleum Compounds

A product that is used in large quantities at the site is diesel fuel. Other petroleum products include gasoline and other grades of fuel oils (Agency for Toxic Substances and Disease Registry 1995). These materials are combustible but have varying effects and persistence in the environment. In the case of a spill due a transportation accident, diesel fuel could have impacts to air, water, and soil depending on the location of an incident. Volatile compounds may be released into the air and, if ignition occurs, the uncontrolled burning could lead to the formation of combustion compounds and hydrocarbon particulates. If a spill were to go into a stream, the material, being lighter than water and not very soluble, would have a tendency to float on the surface and be carried downstream or to banks and affect plants and animals within and near the aquatic environment. Over a period of time, the oil may adhere to fine-grained particles and end up entrained in the stream sediments. In contact with soils, fuels rapidly degrade through the action of biodegradation (Agency for Toxic Substances and Disease Registry 1995).

For the substances described above, a large release (greater than 55 gallons [USDOT 2012]) could have implications for public safety, but the location of a spill would be the primary factor in determining the effects of a release. The probability of a release anywhere along the anticipated transportation route to the NGS is expected to be low. Because of the low population density along the route, the probability of a release within a populated area would be small. The only major streams that are crossed by the transportation route are considered intermittent or perennial. The Little Colorado River is classified as intermittent, and Moenkopi Wash is classified as intermittent or perennial (Arizona Department of Water Resources 2009). Given the lack of surface water receptors, there also is a low probability of impacts to surface water. The risk of impacts to groundwater also would be small because generally groundwater is too deep to be affected. The groundwater along the route ranges from 1,962 feet to 80 feet except in the

vicinity of the Little Colorado River, where groundwater levels may be less than 50 feet below ground surface (Arizona Department of Water Resources 2009).

For either substance discussed above, the immediate effects of a transportation incident or accident could be severe, especially if cargo or fuel tanks are ruptured and a major spill occurs. However, the probability of an accident or in-transit release is low and the effects would be short-term. Based on the low probability of a transportation accident or release, and the procedures in place for use in the event of a release, the impacts would be minor depending on the location along the transportation route.

3.15.4.3.1.3 Hazardous Materials Storage and Use

Oils and fuels that are stored and used on-site are covered by a site-specific Spill Prevention, Control, and Countermeasure (SPCC) Plan. The SPCC Plan provides procedures to deal with spills or releases of oils, including petroleum and mineral oil. A SPCC program includes written prevention and spill response plans, notification in case of a spill, periodic inspections, tank leak detection systems, spill and overfill protection, external pipe protection, secondary containment, and formal training for personnel. The USEPA has documented that the implementation of SPCC plans has a definable reduction in impacts based on the number of spills, spill volume, cleanup cost, and off-site migration (USEPA 1996). According to the USEPA study, “reduction” indicates that there is 95 percent confidence that SPCC provisions listed above have a positive effect on reducing the particular spill risk (e.g., leak detection reduces the number of spills).The implementation of a SPCC plan would not prevent spills entirely, but the risks would be reduced; therefore, impacts due to spills of petroleum products would be minor.

Under the 2-Unit Operation, the risk of a spill or release may decrease as compared to the 3-Unit Operation because one-third less hazardous materials would be used on-site. In the case of spills or releases of non-petroleum chemicals and products, NGS has an Emergency Response Plan. This plan covers procedures for handling spills, as well as other emergencies. Therefore, with implementation of the Emergency Response Plan in the event of a spill or release, impacts would be minor under either the 3-Unit Operation or 2-Unit Operation.

3.15.4.3.1.4 Summary of Risk

<u>Hazardous Materials, Chemicals, and Products</u>

Based on the 2010 U.S. Census, the main urban center closest to the plant, Page, Arizona, has a population of 7,247 (U.S. Census Bureau 2010). The prevailing winds at Page for most of the year are from the west (Western Regional Climate Center 2016). Given the prevailing winds and the recommended exclusion zones for a release of anhydrous ammonia, Page is not likely to be affected by a release at the plant or along the transportation routes. Outside of Page, the population is isolated and dispersed with the second largest population center being LeChee, with a 2010 population of 1,443 (U.S. Census Bureau 2010). Because Lechee is along the Coppermine Mine Road, which is a potential transportation route, it may have a slightly elevated exposure risk in case of a transportation incident. However, as discussed above, there is a low overall probability of a transportation incident. Based on the prevailing winds at Page, Lechee is located such that an airborne plume of anhydrous ammonia from the plant is not likely to affect the community. The SPCC and Emergency Response Plans and appropriate storage controls also would minimize potential risk and impacts. The impacts due to spills and releases of hazardous materials, chemicals and products would be minor.

<u>Solid Waste</u>

If not handled and disposed of properly, solid waste can have effects on human health and the environment (including air, soil, and water resources). The solid waste that is generated is either recycled, appropriately disposed off-site, or placed into permitted waste landfills on-site.

CCR Disposal

One of the largest waste streams consists of CCRs, which are placed into an on-site landfill and managed pursuant to the CCR regulations. The disposal of CCRs at NGS poses a small risk of impacts to the environment. The CCRs have stabilized to the point that samples from test holes of the original layers have shown to have compressive strength similar to lean concrete (**Appendix 1B**). Lean concrete is concrete with less cement than the standard concrete cement to water ratio. Although it does not have the strength of conventional concrete, it does indicate that the waste material has strength that helps to stabilize the material. Several factors also increase the stability and include the fact that not only is the material dry, run-on controls and compacted native soil cap prevent entry of moisture into the lifts of material. The arid climate also contributes to keeping the material dry. Because the material is dry, there would not be a tendency for leaching of harmful constituents like metals into groundwater. Also, the depth to groundwater is approximately 900 feet below the ground surface at the ash disposal facility (Section 3.7).

Under the 3-Unit Operation, it is possible that the landfill would have to be expanded to accommodate the estimated nearly 23 million cubic yards of CCRs. This also is dependent on how much fly ash could be marketed over the 2020 to 2044 time period (**Appendix 1B**). Expansion would require an additional 239 acres (Table 3.0-1) within the current area leased for the landfill. Under the 2-Unit Operation, there would be enough capacity in the permitted on-site landfill to operate from 2020 to 2044.

The recent USEPA revision of the disposal regulations for CCRs was motivated out of concern regarding the effects that surface impoundments and landfills could have on people and the environment if mismanaged. CCRs may contain contaminants, including heavy metals (mercury, cadmium and arsenic). If improperly managed, these contaminants can pollute surface water, groundwater, and the air. Although CCRs are not regulated as a hazardous waste, there are new requirements regarding certification, operating criteria, groundwater monitoring and corrective action, and closure and post-closure care. NGS would comply with those requirements that apply to the landfill as described in the *Navajo Generating Station: Coal Combustion Residuals Ash Disposal Landfill Requirements*, which is Appendix B of the Operations and Maintenance Plan (**Appendix 1B**). The new regulations for CCRs management would not affect the ability to market recyclable fly ash. In addition to the facility's current management of CCRs, the compliance with the new regulatory requirements noted above would provide an added level of protection and decreased risk of impacts to the environment and health and safety. Based on these requirements, as well as the compressive strength of the landfilled CCRs, the arid climate, soil cap and run-on controls, and depth to groundwater under the landfill, the impact of CCR disposal would be minor.

Other Solid Waste Disposal

The potential impacts from disposal of other solid waste would be much reduced because most of the other materials would be disposed of off-site. In addition, new policy was instituted in 2015 to strictly control materials that had previously gone into the landfill and disposal of all materials off-site (see **Appendix 1B**). The asbestos landfill would be kept open in order to receive waste generated during routine operation and maintenance, as well as potential shut down and demolition of facilities under the 2-Unit Operation. If operated in compliance with governing regulations, the asbestos landfill would present little risk of impacts to the environment, and therefore, the impact would be minor.

Site Closure and Decommissioning

Under the Proposed Action, the operating and support facilities at the plant site would be dismantled and demolished to ground level by the end of 2045, unless the Navajo Nation continues NGS operations beyond 2044. The overall decommissioning process is described in **Appendix 1B** and includes a discussion of closure of impoundments and CCR disposal facility.

As part of the decommissioning process, the following activities would take place with regard to hazardous materials and solid waste:

- A comprehensive Phase I Environmental Site Assessment (ESA) would be conducted to determine if there are any sources or paths of contamination and to identify environmental receptors and develop remedial alternatives if applicable. The Phase I ESA would consist of a records review, site visit, regulatory review, and hydrogeologic review to determine if environmental contamination, which may result in future environmental liability is likely to be present at the property.
- Phase II ESA would consist of on-site sampling to determine if environmental issues exist. A sampling and analysis plan would be developed to identify sample locations, sampling methodologies, analytical parameters, and a quality assurance plan.
- Equipment systems would be surveyed to verify that no fuels remain.
- Coal would be removed from storage areas, conveyors, hoppers, and feed equipment.
- Fuel oils would be drained and purged from tanks, piping, and pumping equipment.
- Sludge and residues would be removed and equipment cleaned.
- Glass, paper, cardboard, plastics, and metals would be recovered for recycling.
- Remediate any contaminated soils found during demolition.
- Plant native vegetation.

Except for hazardous materials and parts and material salvaged, recycled, or sold for scrap, it is anticipated that demolished structural material would be placed within a landfill area on the NGS site, and covered with soil. In accordance with Lease Amendment 1, the coal ash landfill would be left in place and capped with soil material, and revegetated. Hazardous materials would be transported and disposed in compliance with the RCRA and other applicable requirements. Decommissioning of the BM&LP Railroad would involve removal of overhead power lines, rails, and ties.

As required in the 1969 Lease, the land would be restored as closely as possible to original condition where the surface of any leased land has been modified or improved. The areas that do not contain permanent facilities would have all nonindigenous material removed from the surface and the area would be filled and graded in order to provide proper drainage; however, there would be no attempt to return the leased lands or the ROW to the preconstruction elevations. All restored land would be covered with topsoil indigenous to the area and revegetated with native plants to meet the lease requirements (**Appendix 1B**).

The decommissioning and closure activities would remove potentially hazardous materials from the site. In addition, the Phase I and II ESA's would determine if there are impacts to soil and groundwater and provide the basis for remediation of contaminants. The cleanup of soil and groundwater would be conducted under applicable federal, state, tribal regulations, lease obligations. The impacts due to closure and decommissioning would be negligible because removal and cleanup of potential contaminants would contribute to overall restoration of the site.

3.15.4.3.2 Proposed Kayenta Mine Complex

3.15.4.3.2.1 Public Safety and Noise

The impact analysis study area for the proposed KMC is detailed in Section 3.15.2. Regulatory changes in safety requirements would be included in standard operating procedures, and compliance with mandated safety rules would continue to be required. Blasting operations would continue to occur, and pre-blast surveys would be conducted as requested. Residents would continue to be notified and warned of blasting operations, and notification of the blasting would continue to be posted and advertised.

Blasting would continue to be monitored for air blast and ground vibration twice per year in June and December. PWCC would monitor airblast and ground vibration for all shots exceeding the scaled distance equation, as well as any required by the regulatory authority at their requested location. KMC's blasting records would continue to be monitored by OSMRE on a monthly to quarterly basis during field inspections.

Sensitive noise receptors, including residents who live near mine roads and within range of warning signals for blasting during mining operations, would continue to experience noise from mining activities. The number of warning and all-clear signals produced at blasting sites by an audible-speaker warning device of 100 watts or greater (audible at 0.5 mile) also would remain at or slightly below existing levels as overall coal production per year is not anticipated to increase, but may decrease under the 2-Unit Operation. Any sensitive receptors at 0.5 mile of construction activities would potentially incur noise ranging in sound levels from moderate rainfall to light automobile traffic (**Figure 3.15-1**). Natural topographic screening between mining operations and sensitive noise receptors could reduce noise for sensitive receptors. In addition to the distance of the sensitive noise receptors from the active mine areas, mining activities occur below grade, which result in the walls of the pit and spoil piles absorbing and attenuating some of the noise from mining activities. The noise reduction measures related to mining activities would include maintenance of equipment exhaust systems and engine sound controls to manufactures' specifications and limiting blasting to daylight hours. In addition to these measures, activity at the proposed KMC would stay the same or be incrementally reduced.

Vibration impacts were determined using the Blasting Guidance Manual, which was developed by OSMRE to prevent injury and damage to public and private property outside the mine permit area. OSMRE requires that airblast levels be limited to a maximum of 134 decibel (peak). Ground vibrations cannot exceed peak particle velocity of 1.25 inches per second at a distance of 300 feet or 0.75 inch per second at 5,000 feet (Rosenthal and Morlock 1987). There are three residences within or adjacent to current or future mining areas, one residence adjacent to mining area N-10, and two residences within N-11E. Because mining area N-10 would not be mined under the 2-Unit Operation, the residence in that area may not be affected.

Residents would be notified well in advance of the blasting schedule, and notices posted in public locations. Additionally, no blasting would be conducted within 0.5 mile of an occupied dwelling; therefore, residents in or near the blasting area would be evacuated prior to proceeding with any blasting actions. Temporary effects from vibration and airblast levels within standards established in 30 CFR Part 816.67 are not considered capable of producing injury or property damage, but could cause annoyance depending on the distance to the receptor (Mohamed 2010). Blasting activities would be conducted in accordance with administrative regulations established to minimize impacts resulting from noise and vibration in 30 CFR Part 816.67. Noise and vibration impacts would not be expected to exceed federal regulations detailed in Section 3.15.1, resulting in minor noise and vibration impacts levels. Section 3.16, Public Health, contains additional analysis related to noise and vibration.

Coal fires could occur in the mined cut, with the capability to spread to surrounding areas. Burning coal in these areas would be extinguished under the supervision of a qualified and certified Mine Safety Health Administration "Green Card" Surface Certified Supervisor in accordance with 30 CFR Part 816.87. Within 48 hours of its discovery, PWCC would commence efforts to extinguish any coal-related fire. If the fire is not extinguished within 96 hours after its discovery, PWCC would notify the BLM. Within 48 hours of notice, PWCC would submit to BLM a written report describing the extent of the fire, its exact location, the amount of recoverable coal affected, and any other information. The first response team at the mine site would have the ability to potentially control fires within the mine site before they spread outside the mine boundary. These first responders also would continue to serve the local residents under the Proposed Action.

The proposed realignment of Navajo Route 41 would straighten the road and make the route a more consistent elevation, eliminating a steep drop and curve where several accidents have occurred.

Under the Proposed Action, mining activities would cease in 2044 and public safety risks related to mining operations and blasting would be eliminated after decommissioning and reclamation activities are finalized. During the reclamation period, expected to take 2 to 3 years after cessation of mining, PWCC would continue to comply with all applicable federal, tribal, and state rules and regulations regarding health and safety and the handling and disposal of explosives and hazardous materials and wastes. Safety procedures regarding truck traffic would continue to be observed during reclamation activities, although fewer vehicles would be required for these activities. After the reclamation period, PWCC would no longer assist with Navajo Route 41 roadway maintenance or provide dust control measures. The realignment of Navajo Route 41 would be delayed. Emergency health care and first responder services provided by the mine would continue during the reclamation period but would cease following the completion of reclamation activities.

Noise and vibration effects associated with decommissioning would be limited to activities associated with removal of surface structures, facilities, and mining equipment, as well as reclamation activities. Mine-related noise and vibration effects would cease following the completion of decommissioning and reclamation.

3.15.4.3.2.2 Hazardous Materials, Chemicals, Products, and Solid Waste

The most used product at the KMC would be diesel fuel. Under the 3-Unit Operation diesel consumption would be 5.4 million gallons per year, and consumption under the 2-Unit Operation would be 4.2 million gallons per year. Based on the data in **Table 3.15-8**, the risk of a transportation incident would be low. The mine is required to have an SPCC Plan and an Emergency Response Plan to cover the storage, handling, and spill prevention and management of petroleum and hazardous materials. If an accident resulting in a release should occur, the impact would be anticipated to be negligible to minor depending on the location of the release.

If the proposed project is authorized to proceed, neither the type nor quantity of any wastes generated and disposed of by the mine would change. Solid and hazardous wastes would be disposed of off-site at approved facilities. Therefore, potential impacts would be negligible.

3.15.4.3.3 Transmission Systems and Communication Sites

3.15.4.3.3.1 Public Safety and Noise

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

The impact analysis study area for transmission systems and communication sites is detailed in Section 3.15.2. Typical average electric field readings for a 230-kV line and a 500-kV line at the edge of the study area (200 feet from ROW centerline) are 0.1 kV per meter and 0.6 kV per meter, respectively (**Table 3.15-7**). There are no federal standards for transmission line electric fields; however, the International Commission on Non-Ionizing Radiation Protection has set a voluntary protection level for electrical fields for the general public of 4.2-kV per meter (International Commission on Non-Ionizing Radiation Protection 1998). The average 230-kV line and 500-kV line electric field readings of approximately 0.1 kV per meter and 0.6 kV per meter at the edge of the study area are well below International Commission on Non-Ionizing Radiation Protection levels, resulting in negligible impact to sensitive receptors.

Typical homes produce background magnetic levels (away from appliances and wiring) that range from 0.5 milliGauss to 4 milliGauss, with an average value of 0.9 milliGauss (USEPA 1992). Natural static magnetic fields from the earth are near 0.6 milliGauss. Typical average magnetic field readings for a 230-kV line and 500-kV line at the edge of the study area (200 feet from ROW centerline) during average use are approximately 9 milliGauss and 20 milliGauss, respectively (**Table 3.15-7**). The International

Commission on Non-Ionizing Radiation Protection in a November 2010 release stated that the exposure limits for magnetic fields was 2,000 milliGauss for the public (International Commission on Non-Ionizing Radiation Protection 2010). The average magnetic field readings of both the 230-kV and 500-kV lines at the edge of the study area are well below International Commission on Non-Ionizing Radiation Protection levels, resulting in no impact to sensitive receptors.

Estimated 230-kV and 500-kV transmission line noise at the edge of the study area (200 feet from ROW centerline) is 20 dBA and 48 dBA, respectively, approximately the sound level of a soft whisper at 15 feet (20 dBA) or a moderate rain on foliage (48 dBA) (**Table 3.15-7**). This would result in negligible impact to sensitive receptors. There would be no change to transmission line noise levels under the Proposed Action from existing noise levels, as transmission line use would stay the same.

3.15.4.3.3.2 Hazardous Materials, Chemicals, Products, and Solid Waste

Under the Proposed Action, no new transmission line construction would take place, but operation and maintenance activities would continue. The major products used would consist of petroleum fuels and other materials related to vehicle maintenance and application of herbicides to control undergrowth along the ROW. The use of herbicides would be carefully monitored and controlled and applied by hand (**Appendix 1B**). Applications would take place periodically but not continually (for example once every 5 years). Empty containers would be returned to the suppliers and no materials would be left on-site. Impacts due to spills of herbicides are expected to be small to negligible due to the application measures and spill [prevention and clean-up measures described (**Appendix 1B**).

Maintenance activities that would be conducted on-site on an as-needed basis would include repair of equipment, vegetation control, fence repair, and access road repair. These activities would only require very small quantities of products. Impacts from the use of these products in the conduct of these repair and maintenance activities would be negligible.

3.15.4.3.4 Project Impact Summary – All Project Components

The project impact from the Proposed Action is anticipated to be negligible to moderate as a result of limited and in some cases no sensitive receptors within the respective study areas of the NGS and BM&LP Railroad, proposed KMC, and transmission lines and communication sites. Potential impacts would be reduced during decommissioning and reclamation and would cease following closure.

3.15.4.3.5 Cumulative Impacts

Past and present actions within the public safety and hazardous materials and solid waste cumulative impacts study areas include the former Black Mesa Mine and the existing NGS plant site and associated facilities and BM&LP Railroad, Kayenta Mine, and transmission system and communication sites. Operations at these sites began in the late 1960s and 1970s. Potential reasonably foreseeable future actions include the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines that may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada, and segments of the Lake Powell water pipeline and transmission line that are proposed to overlap with the WTS utility corridor in Coconino County, Arizona, west of Lake Powell (**Figure 3.0-2**). Based on the Proposed Action analysis, the Proposed Action would not contribute to public safety or hazardous materials and solid waste cumulative impacts other than from a temporal standpoint, resulting from continued operations from 2019 to 2044.

3.15.4.4 Natural Gas Partial Federal Replacement Alternative

Under the Natural Gas Partial Federal Replacement (PFR) Alternative, a selected quantity of power between 100 megawatts (MW) and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation.

3.15.4.4.1 Navajo Generating Station

Potential impacts to public safety associated with operation of NGS would be similar to those described for the 3-Unit Operation and 2-Unit Operation under the Proposed Action. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

The frequency of potential impacts from BM&LP railroad operations would decrease for both the 3-Unit Operation and 2-Unit Operation since this alternative would require fewer round trips than under the Proposed Action; however, noise levels during times of operation would not change. Therefore, potential impacts would be minor.

The selective catalytic reduction units for the Natural Gas PFR Alternative would require less volume of anhydrous ammonia for pollution control as the 3-Unit Operation or 2-Unit Operation. Consequently, risks associated with the transportation, storage, and use of anhydrous ammonia (as well as other chemicals and products) would be less than the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a low probability for a release under either operation. There also would be a low probability for a release of other chemicals and products. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

CCR generation would be reduced for both the 3-Unit Operation and 2-Unit Operation because of reduced coal consumption. The risks associated with landfill disposal would be the same as for the Proposed Action and would be further reduced by compliance with new regulations as outlined in **Appendix 1B**.

The operating and support facilities at NGS would be dismantled and demolished to ground level by the end of 2045. Noise and vibration impacts associated with decommissioning of the NGS and BM&LP Railroad would be limited to removal of the operating and support facilities, and the overhead power lines, rails, ballast, ties, and structures, respectively. Noise from demolition also would include blasting from chimney removal and truck traffic for salvage material disposal. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

3.15.4.4.2 Proposed Kayenta Mine Complex

Under the Natural Gas PFR Alternative, less coal would be mined at the proposed KMC than under the Proposed Action; however, blasting operations would continue as needed. Blasting-related noise and vibration impacts would not be expected to exceed federal regulations, resulting in minor noise and vibration impacts levels. These levels would be the same or less than under the Proposed Action.

Hazardous materials transportation, storage, and use and solid waste generation would be reduced commensurately with the reduction of mine operations. Impacts from hazardous materials and solid waste are expected to be negligible because of the low risks as described under the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a minor probability for a release under either operation. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

Mining activities would cease in 2044 and public safety risks related to mining operations and blasting would be eliminated after decommissioning and reclamation activities are finalized. During the reclamation period, expected to take 2 to 3 years after cessation of mining, PWCC would continue to

comply with all applicable federal, tribal, and state rules and regulations regarding health and safety and the handling and disposal of explosives and hazardous materials and wastes. Safety procedures regarding truck traffic would continue to be observed during reclamation activities, although fewer vehicles would be required for these activities. After the reclamation period, PWCC would no longer assist with Navajo Route 41 roadway maintenance or provide dust control measures. The realignment of Navajo Route 41 would be delayed. Emergency health care and first responder services provided by the mine would continue during the reclamation period but would cease following the completion of reclamation activities.

Noise and vibration effects associated with decommissioning would be limited to activities associated with removal of surface structures, facilities, and mining equipment, as well as reclamation activities. Mine-related noise and vibration effects would cease following the completion of decommissioning and reclamation.

3.15.4.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

The average magnetic field readings of both the 230-kV and 500-kV lines at the edge of the study area are well below International Commission on Non-Ionizing Radiation Protection levels, resulting in no impact to sensitive receptors. Noise levels associated with transmission line use would result in negligible impacts to sensitive receptors. Impacts due to the transportation, storage, and use of hazardous materials and the generation of solid waste would be the same as the Proposed Action.

3.15.4.4.4 Project Impact Summary – All Project Components

The impacts from the Natural Gas PFR Alternative are expected to be negligible to minor. Potential impacts would be reduced during decommissioning and reclamation and would cease following closure.

3.15.4.4.5 Cumulative Impacts

Past and present actions within the public safety and hazardous materials and solid waste cumulative impacts study areas include the former Black Mesa Mine and the existing NGS plant site and associated facilities, and BM&LP Railroad, Kayenta Mine, and transmission system and communication sites. Operations at these sites began in the late 1960s and 1970s. Potential reasonably foreseeable future actions include the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines that may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada, and segments of the Lake Powell water pipeline and transmission line that are proposed to overlap with the WTS utility corridor in Coconino County, Arizona, west of Lake Powell (**Figure 3.0-2**). Based on the analysis above, the NGS, proposed KMC, and their associated transmission systems and communication sites would not contribute to public safety or hazardous materials and solid waste cumulative impacts other than from a temporal standpoint, resulting from continued operations from 2019 to 2044.

3.15.4.5 Renewable Partial Federal Replacement Alternative

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation.

3.15.4.5.1 Navajo Generating Station

Potential impacts to public safety associated with operation of NGS would be similar to those described for the 3-Unit Operation and 2-Unit Operation under the Proposed Action. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

The frequency of potential impacts from BM&LP railroad operations would decrease for both the 3-Unit Operation and 2-Unit Operation since this alternative would require fewer round trips than under the Proposed Action; however, noise levels during times of operation would not change. Therefore, potential impacts would be minor.

The selective catalytic reduction units would require less anhydrous ammonia for pollution control for the 3-Unit Operation. Consequently, risks associated with the transportation, storage, and use of anhydrous ammonia (as well as other chemicals and products) would be the same as the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a low probability for a release under either operation. There also would be a low probability for a release of other chemicals and products. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

CCR generation would be reduced for both the 3-Unit Operation and 2-Unit Operation because of reduced coal consumption. The risks associated with landfill disposal would be the same as for the Proposed Action and would be further reduced by compliance with new regulations as outlined in **Appendix 1B**.

Decommissioning impacts would be similar to the Proposed Action and the Natural Gas PFR Alternative.

3.15.4.5.2 Proposed Kayenta Mine Complex

Under the Renewable PFR Alternative, less coal would be mined at the proposed KMC than under the Proposed Action; however, blasting operations would continue as needed. Blasting-related noise and vibration impacts would not be expected to exceed federal regulations, resulting in minor noise and vibration impacts levels.

Hazardous materials transportation, storage, and use and solid waste generation would be reduced commensurately with the reduction of mine operations. Impacts from hazardous materials and solid waste are expected to be negligible because of the low risks as described under the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a minor probability for a release under either operation. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

Decommissioning impacts would be similar to the Proposed Action and the Natural Gas PFR Alternative.

3.15.4.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

The average magnetic field readings of both the 230-kV and 500-kV lines at the edge of the study area are well below International Commission on Non-Ionizing Radiation Protection levels, resulting in no impact to sensitive receptors. Noise levels associated with transmission line use would result in

negligible impacts to sensitive receptors. Impacts due to the transportation, storage, and use of hazardous materials and the generation of solid waste would be the same as the Proposed Action.

3.15.4.5.4 No Action Impact Summary – All Project Components

The impacts from the Renewable PFR Alternative are expected to be negligible to minor. Potential impacts would be reduced during decommissioning and reclamation and would cease following closure.

3.15.4.5.5 Cumulative Impacts

Past and present actions within the public safety and hazardous materials and solid waste cumulative impacts study areas include the former Black Mesa Mine and the existing NGS plant site and BM&LP Railroad, Kayenta Mine, and transmission system and communication sites. Operations at these sites began in the late 1960s and 1970s. Potential reasonably foreseeable future actions include the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines that may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada, and segments of the Lake Powell water pipeline and transmission line that are proposed to overlap with the WTS utility corridor in Coconino County, Arizona, west of Lake Powell (**Figure 3.0-2**). Based on the analysis above, the NGS, proposed KMC, and their associated transmission systems and communication sites would not contribute to public safety or hazardous materials and solid waste cumulative impacts other than from a temporal standpoint, resulting from continued operations from 2019 to 2044.

3.15.4.6 Tribal Partial Federal Replacement Alternative

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate National Environmental Policy Act process once a facility location is identified.

3.15.4.6.1 Navajo Generating Station

Potential impacts to public safety associated with operation of NGS would be similar to those described for the 3-Unit Operation and 2-Unit Operation under the Proposed Action. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

The frequency of potential impacts from BM&LP railroad operations would decrease for both the 3-Unit Operation and 2-Unit Operation since this alternative would require fewer round trips than under the Proposed Action; however, noise levels during times of operation would not change. Therefore, potential impacts would be minor.

The selective catalytic reduction units would require the lessanhydrous ammonia for pollution control for the 3-Unit Operation. Consequently, risks associated with the transportation, storage, and use of anhydrous ammonia (as well as other chemicals and products) would be less than the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a low probability for a release under either operation. There also would be a low probability for a release of other chemicals and products. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

CCR generation would be reduced for both the 3-Unit Operation and 2-Unit Operation because of reduced coal consumption. The risks associated with landfill disposal would be the same as for the

Proposed Action and would be further reduced by compliance with new regulations as outlined in **Appendix 1B**.

Decommissioning impacts would be similar to the Proposed Action.

3.15.4.6.2 Proposed Kayenta Mine Complex

Under the Tribal PFR Alternative, less coal would be mined at the proposed KMC than under the Proposed Action; however, blasting operations would continue as needed. Blasting-related noise and vibration impacts would not be expected to exceed federal regulations, resulting in minor noise and vibration impacts levels that would be the same or less than historical levels associated with the Kayenta Mine.

Hazardous materials transportation, storage, and use and solid waste generation would be reduced commensurately with the reduction of mine operations. Impacts from hazardous materials and solid waste are expected to be negligible because of the low risks as described under the Proposed Action. Based on the low potential for a transportation incident rate (**Table 3.15-8**), there would be a minor probability for a release under either operation. The potential for public health impacts would depend on the type of material released and the location of the release in relation to sensitive receptors.

Decommissioning impacts would be similar to the Proposed Action.

3.15.4.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

The average magnetic field readings of both the 230-kV and 500-kV lines at the edge of the study area are well below International Commission on Non-Ionizing Radiation Protection levels, resulting in no impact to sensitive receptors. Noise levels associated with transmission line use would result in negligible impacts to sensitive receptors. Impacts due to the transportation, storage, and use of hazardous materials and the generation of solid waste would be the same as the Proposed Action.

3.15.4.6.4 Project Impact Summary – All Project Components

The impacts from the Tribal PFR Alternative are expected to be negligible to minor.

3.15.4.6.5 Cumulative Impacts

Past and present actions within the public safety and hazardous materials and solid waste cumulative impacts study areas include the former Black Mesa Mine, the existing NGS site and BM&LP Railroad, Kayenta Mine, and transmission system and communication sites. Operations at these sites began in the late 1960s and 1970s. Potential reasonably foreseeable future actions include the TransWest Express, Southern Nevada Intertie, and Eastern Nevada transmission lines that may be constructed in an existing West-Wide ROW adjacent to the WTS from the vicinity of Mesquite to the Eldorado Valley south of Las Vegas, Nevada, and segments of the Lake Powell water pipeline and transmission line that are proposed to overlap with the WTS utility corridor in Coconino County, Arizona, west of Lake Powell (**Figure 3.0-2**). Based on the analysis above, the NGS, proposed KMC, and associated transmission systems and communication sites would not contribute to public safety or hazardous materials and solid waste cumulative impacts other than from a temporal standpoint, resulting from continued operations from 2019 to 2044. Cumulative impacts associated with the new photovoltaic generation facility would be analyzed in a separate National Environmental Policy Act action document once a location for the facility is identified.

3.15.4.7 No Action

3.15.4.7.1 Navajo Generating Station

Under the No Action Alternative, decommissioning activities would begin in 2018 with effective shutdown of the plant occurring by the end of 2019. The decommissioning and closure activities would be same as the Proposed Action and impacts would be negligible. The operating and support facilities at the plant site would be dismantled and demolished to ground level; however, the water supply facilities, and certain buildings and equipment would remain. Noise and vibration impacts associated with decommissioning of the NGS and BM&LP Railroad would be limited to removal of the operating and support facilities, and the overhead power lines, rails, ballast, ties, and structures, respectively. Noise from demolition also would include blasting from chimney removal and truck traffic for salvage material disposal. The nearest noise sensitive receptors to the NGS are four scattered residences approximately 1 to 2 miles to the southeast near Arizona Highway 98, and a residence and the Navajo Nation Park Entrance located 0.5 mile south and 0.75 mile west, respectively, of the NGS pump station at Lake Powell. At these distances no noise impacts are anticipated at these sensitive receptors.

Under the No Action Alternative, transportation and use of hazardous materials and the generation of solid wastes would be greatly reduced. This reduction would result in a much lower probability for impacts to public safety and the environment during decommissioning and reclamation; potential impacts would be anticipated to be negligible. The potential for impacts would cease following the completion of these activities.

3.15.4.7.2 Proposed Kayenta Mine Complex

Under the No Action Alternative, mining activities would cease and public safety risks related to mining operations and blasting would be eliminated. During the reclamation period, expected to take 2 to 3 years after cessation of mining, PWCC would continue to comply with all applicable federal, tribal, and state rules and regulations regarding health and safety and the handling and disposal of explosives and hazardous materials and wastes. Safety procedures regarding truck traffic would continue to be observed during reclamation activities, although fewer vehicles would be required for these activities. After the reclamation period, PWCC would no longer assist with Navajo Route 41 roadway maintenance or provide dust control measures. The realignment of Navajo Route 41 would be delayed. Emergency health care and first responder services provided by the mine would continue during the reclamation period, but would cease following the completion of reclamation activities.

Noise and vibration effects under the No Action Alternative would be limited to activities associated with removal of surface structures, facilities, and mining equipment, as well as reclamation activities. Mine-related noise and vibration effects would be less than under the Proposed Action and would cease following the completion of decommissioning and reclamation.

Under the No Action Alternative, reclamation activities would consume diesel fuel and products used for equipment maintenance; however, the consumption would be at a much lower rate over a much shorter time period compared to the Proposed Action. This reduction in use would result in a much lower probability for impacts to public safety and the environment during decommissioning and reclamation; the potential for impacts would be considered to be negligible. The potential for impacts would cease following the completion of these activities.

3.15.4.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.15.4.7.4 Project Impact Summary – All Project Components

Under the No Action, it is anticipated that impacts would be negligible during decommissioning and reclamation and would cease following these activities, with one exception. Impacts associated with ongoing operation of the transmission systems and communication sites would be anticipated to be negligible.

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Section 3.16

Public Health and Human Health Risk Assessment

Please note: Language referring to time frames in this section is consistent with the Human Health Risk Assessment. The term “Future Operations” refers to the time frame associated with the Proposed Action (i.e., 2020 through 2044).

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Acronyms and Abbreviations

µg/dl	micrograms per deciliter
µg/m^3	micrograms per cubic meter
1969 Lease	Navajo Project Indenture of Lease
ADHS	Arizona Department of Health Services
AGFD	Arizona Game and Fish Department
ALA	American Lung Association
BART	Best Available Retrofit Technology
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BM&LP Railroad	Black Mesa & Lake Powell Railroad
BO	Biological Opinion
BRFSS	Behavioral Risk Factor Surveillance System
CAP	Central Arizona Project
CDC	Center for Disease Control
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPC	chemical of potential concern
Co-tenants	Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
dBA	A-weighted decibels
Development Fund	Lower Colorado River Basin Development Fund
DPM	diesel particulate matter
EIS	Environmental Impact Statement
EMS	Emergency Medical Service
EPRI	Electric Power Research Institute
ERA	Ecological Risk Assessment
ESA	Endangered Species Act of 1973
HHRA	Human Health Risk Assessment
HHRAP	Human Health Risk Assessment Protocol
HI	Hazard index
HQ	Hazard quotient
ICMM	International Council on Mining and Metals
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
IUR	Inhalation Unit Risk
km	kilometer
KMC	Kayenta Mine Complex
kV	kilovolt
kW	kilowatt
MW	megawatt

N-Aquifer	Navajo Aquifer
NAAQS	National Ambient Air Quality Standards
NEC-NDOH	Navajo Epidemiology Center-Navajo Department of Health
NEPA	National Environmental Policy Act of 1969, as amended
NGS	Navajo Generating Station
NGS Participants	U.S. (Reclamation), Salt River Project, Arizona Public Service Company, NV Energy, and Tucson Electric Power Company
NHPA	National Historic Preservation Act
NNEPA	Navajo Nation Environmental Protection Agency
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
NRC	National Research Council of the National Academies
OSMRE	Office of Surface Mining Reclamation and Enforcement
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PFR	Partial Federal Replacement
PWCC	Peabody Western Coal Company
Reclamation	U.S. Bureau of Reclamation
ROW	Right-of-way
SCR	Selective Catalytic Reduction
SO_2	sulfur dioxide
SRP	Salt River Project Agricultural Improvement and Power District
STS	Southern Transmission System
tpy	Tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency
WHO	World Health Organization
WTS	Western Transmission System

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3.16 Public Health and Human Health Risk Assessment

The Public Health and Human Health Risk Assessment (HHRA) section describes the potential direct, indirect, and cumulative effects on public health (both positive and negative) and potential human health risks associated with the Proposed Action, other action alternatives, and the No Action Alternative.

The public health evaluation assesses the potential health impacts on the local populations within a 50-kilometer (km) radius of the Navajo Generating Station (NGS), including the area downwind of the NGS and proposed Kayenta Mine Complex (KMC). It provides an assessment of the current health conditions of the potentially affected communities, including the existing environmental conditions and public health resources within the communities that could be affected.

3.16.1 Regulatory Framework

The National Environmental Policy Act (NEPA) requires an integrated analysis of health effects be addressed when an environmental impacts analysis is conducted. The public health and HHRA evaluations fulfill this requirement and evaluates the potential impacts to public health associated with the proposed project alternatives. All worker health issues are covered under the Occupational Safety and Health Act and Federal Mine Safety and Health Act.

The public health analysis follows National Research Council (National Research Council of the National Academies [NRC] 2011) and the North American Health Impact Assessment Practice Standards Working Group (2010) guidelines for assessing public health impacts of potential projects.

The HHRAs summarized in this section were conducted in accordance with standard U.S. Environmental Protection Agency (USEPA) risk assessment methodology, including Risk Assessment Guidance for Superfund, Volume I (Parts A, B, E, and F) (USEPA 2009a, 2004a, 1991, 1989) and the HHRA Protocol (HHRAP) for Hazardous Waste Combustion Facilities (USEPA 2005). Additional guidance documentation includes the following:

- User's Guide for the AMS/USEPA Regulatory Model - AERMOD. USEPA-36 454/B-03-001. U.S. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. September (USEPA 2004b)
- USEPA NONROAD Model. Office of Transportation and Air Quality. USEPA-420-F-09-020. April (USEPA 2009a)
- Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK), Windows version (win v1.1 build11) February (USEPA 2010)
- Exposure Factors Handbook (USEPA 2011)
- USEPA online regional screening levels (USEPA 2015)

3.16.2 Overview

3.16.2.1 Public Health

Public health is the science of protecting and improving the health of families and communities through promotion of healthy lifestyles, research for disease and injury prevention, and detection and control of infectious diseases. Public health is concerned with protecting the health of entire populations; these populations can range from local neighborhoods to entire regions of the world. Public health also works to limit health disparities by promoting healthcare equity, quality, and accessibility.

Public health is related to incidences and death rates for infectious and chronic diseases or other health conditions, including mental health. It can be affected by environmental conditions as well as

demographics (such as poverty and minority status), the availability of health care services, and the prevalence of behavioral and social problems (see Section 3.18, Socioeconomics, and Section 3.19, Environmental Justice).

This section describes the approach used to evaluate potential effects on public health associated with the proposed project. The National Research Council guidance (NRC 2011) lists five general areas that should be addressed as part of a public health evaluation to systematically select the issues that need to be addressed for a particular project. These five areas are environment, economy, infrastructure, services, and demographics. Five categories of health impacts are assessed for each area (NRC 2011):

- Chronic Disease: For the purposes of this evaluation, chronic diseases are considered to be health conditions that persist for long periods of time (e.g., 3 months or longer) and are non-communicable, such as heart disease, cancer, or asthma.
- Infectious Disease: Infectious diseases are considered to be associated with viral, bacterial or microbial infections and are commonly communicated from person to person through direct contact, such as influenza or malaria.
- Injury: Unintentional or accidental event resulting in injury or trauma, such as a car accident or fall.
- Nutrition: Impacts to health (positive or negative) associated with diet.
- Well-being/Psychosocial Effects: Well-being and psychosocial effects consider the social, cultural, and well-being of the populations.

The potential for health impacts associated with the Proposed Action and Partial Federal Replacement (PFR) action alternatives are considered irrespective of the baseline environmental/community health conditions and geographic scope. The rationale for the selection of areas with health issues that may be relevant to the Proposed Action, and the rationale for the exclusion of areas with no or negligible impacts to health, is provided in the following subsections. Section 3.16.4 evaluates the affected environment as it relates to the categories selected for further consideration. Section 3.16.5 evaluates the magnitude of the potential health issues selected for further evaluation (both positive and negative) on the local community and the cumulative impacts over baseline conditions.

Additional information relevant for evaluating public health in the project vicinity was compiled (Gradient 2016) and used as supporting documentation of health-related information throughout the public health evaluation. This additional information includes data from air monitoring stations within and in the vicinity of the project area, information regarding the health status and availability of health services.

3.16.2.1.1 Environment and Health

Impacts to the environment typically are evaluated by environmental media (air, soil, groundwater, and surface water). Specifically, this section asks the question “will chemicals be emitted from the Proposed Action and enter environmental media at levels that could be a health concern?”

Health concern is evaluated by considering the amount of human exposure to potentially impacted environmental media. Human exposure to environmental media can occur through several pathways of exposure (e.g., inhalation of vapors or particulates in air, incidental ingestion or dermal contact with impacted soils, ingestion or dermal contact with impacted groundwater or surface water, etc.). The HHRAs directly address the health effects associated with exposure to chemicals released to the environment from the Proposed Action and PFR action alternatives. The public health evaluation considers the potential impacts to air quality from the Proposed Action and PFR action alternatives.

The release of particulate matter (PM), particularly $PM_{2.5}$, to the air and its possible effects on the local population is discussed in detail in Section 3.16.4. Two specific types of PM associated with NGS-KMC

operation, diesel exhaust emissions and coal dust emissions, are discussed in further detail. In addition, the burning of coal in homes, as commonly practiced by Navajo peoples, as a source of PM via indoor air to the Navajo people also is discussed.

3.16.2.1.2 Economy and Health

Economic impacts may have indirect impacts on health, due to more or less financial resources available to the local population or local government health-related services. Section 3.18 discusses the socioeconomic conditions of the project area and the impacts that Proposed Action operations would have on the existing socioeconomic conditions.

3.16.2.1.3 Public Services/Infrastructure and Health

Changes in public services and infrastructure can have direct or indirect health benefits or consequences. For example, health benefits can occur if new water or sanitation systems reduce disease incidence rates for the local community. Or, there may be negative impacts if new roads or transit corridors increase accidents or negatively impact access to health-related services or activities.

3.16.2.1.4 Demographics and Health

The characteristics of the existing population are directly relevant to assessing potential impacts. For this project, local demographics and land use patterns were evaluated as well as the health status of the local community. Potential human health impacts selected for analysis that are relevant to land use are:

- Potential impacts to lands used for livestock grazing;
- Potential relocation of residents living within the mining zone;
- Disturbance of cultural resources that might affect traditional tribal lifestyles; and
- Noise and vibration disturbances during mine blasting.

In addition to a local community's land use, the local population's health status is relevant, as some populations are especially sensitive to the effects of particulate inhalation due to a pre-existing health condition, such as asthma or diabetes (American Academy of Pediatrics 2004; Jaspers et al. 2009; O'Neill et al. 2007, 2005). Populations with pre-existing conditions that could be worsened by air pollution also may be at increased risk of infectious complaints if their underlying health condition is worsened (Kelly and Fussell 2011). Some recent information has found that air pollution, specifically including diesel exhaust, may be associated with causing asthma in children (Patel and Miller 2009), in addition to exacerbating the condition if already present. However, this is an on-going area of research and the role of various components of air pollution (e.g., ozone and nitrogen oxide versus particulates) and a causal relationship with asthma is not clear (Kelly and Fussell 2011). In addition, populations without health insurance and those in poor health due to socioeconomic conditions may be particularly adversely affected either because their baseline health is poorer (sensitive sub-population) or their ability to receive medical care when they need it is compromised (Gresenz and Escarce 2011; Hadley 2003; Hadley and Cunningham 2005; Newton et al. 2008) (see Section 3.18, Socioeconomics, and Section 3.19 Environmental Justice, for additional discussion).

3.16.2.1.5 Summary of Public Health Approach

For this Environmental Impact Statement, potential public health impacts with regard to environment, economy, demographics and community health were considered for NGS and/or the proposed KMC. No new public infrastructure or changes to existing public services are anticipated under the Proposed Action and PFR action alternatives. **Table 3.16-1** summarizes the approach to the public health evaluation.

Table 3.16-1 Summary of Public Health Approach: Health Categories Selected for Public Health Evaluation

Potentially Affected Categories	Project Area	Project Specifics	Possible Health Impacts				
			Chronic Disease	Infectious Disease	Injury	Nutrition	Well-being or Psychosocial
Environment							
Air	NGS	Stack emissions from NGS operations; secondary emissions and fugitive dust from plant and ash disposal area; diesel emissions from vehicle traffic.	**(PN)** Inhalation of criteria and hazardous air pollutants	**(PN)** Inhalation of criteria and hazardous air pollutants	None	None	**(PN)** Inhalation of criteria and hazardous air pollutants
		Deposition impacts from air emission.	**(PN)** Direct contact with hazardous pollutants	**(PN)** Direct contact with hazardous pollutants	None	**(PN)** Uptake of hazardous pollutants through consumption of livestock, fish, and/or garden/home grown foods.	**(PN)** Direct contact with hazardous pollutants
	Proposed KMC	Fugitive dust and particulate emissions from bulk coal during mining operations; diesel emissions from vehicle traffic and machinery	**(PN)** Inhalation of particulate emissions	**(PN)** Inhalation of particulate emissions	None	None	**(PN)** Inhalation of particulate emissions
		Deposition impacts from air emission.	**(PN)** Direct contact with hazardous pollutants	**(PN)** Direct contact with hazardous pollutants	None	**(PN)** Uptake of hazardous pollutants through consumption of livestock, fish, and/or garden and home grown foods.	**(PN)** Direct contact with hazardous pollutants

Table 3.16-1 Summary of Public Health Approach: Health Categories Selected for Public Health Evaluation

Potentially Affected Categories	Project Area	Project Specifics	Possible Health Impacts				
			Chronic Disease	Infectious Disease	Injury	Nutrition	Well-being or Psychosocial
Economy							
Personal (income, employment)	NGS and proposed KMC	Increase in local employment	**(PP)** Increased access to health care	**(PP)** Increased access to health care	None	**(PP)** Increased access to healthy foods	**(PP)** Positive impacts due to job opportunities
Revenue or expense to local, state, or tribal government (support for or drain on services, infrastructure)	NGS and proposed KMC	Increased funds to Navajo and Hopi through extension of lease and coal royalties	**(PP)** Positive impacts due to increased revenue stream	**(PP)** Positive impacts due to increased revenue stream	None	**(PP)** Positive impacts due to increased revenue stream	**(PP)** Positive impacts due to increased revenue stream
Public Services and Infrastructure							
Need for new infrastructure	NGS and proposed KMC	None	None	None	None	None	None
Demand on existing infrastructure	NGS and proposed KMC	None	None	None	None	None	None
New and continuing public services as direct result of proposal	NGS and proposed KMC	Continued access to emergency medical service (EMS) from Peabody Western Coal Company (PWCC) clinic	**(PP)** Continued access to health care	**(PP)** Continued access to health care	None	None	**(PP)** Continued access to health care
Drain on existing services resulting from Proposed Action	NGS and proposed KMC	No impacts on local services are expected.	None	None	None	None	None

Table 3.16-1 Summary of Public Health Approach: Health Categories Selected for Public Health Evaluation

Potentially Affected Categories	Project Area	Project Specifics	Possible Health Impacts				
			Chronic Disease	Infectious Disease	Injury	Nutrition	Well-being or Psychosocial
Demographics							
Land use patterns (residential, recreational, or tribal use patterns)	NGS	No changes to land use patterns are anticipated	None	None	None	None	None
	Proposed KMC	Potential impacts to lands used for livestock grazing Potential relocation of residents living within the mining zone. Disturbance of cultural resources that might affect traditional tribal lifestyles Noise and vibration disturbances during mine blasting	None	None	None	**(PN)** Effects on livestock, fish, and/or garden/home grown foods	**(PN)** Psychological effects due to relocation **(PN)** Disturbance of cultural resources **(PN)** Psychological effects due to noise and vibration
Community Health	NGS and proposed KMC	Potential effects to sensitive sub-populations (e.g., exacerbation of asthma, impacts on lung/heart disease rates)	**(PN)** Inhalation of particulate emissions	**(PN)** Inhalation of particulate emissions	None	None	**(PN)** Inhalation of particulate emissions

(**PN**) Indicates selected for evaluation, possible negative effect.

(**PP**) Indicates selected for evaluation, possible positive effect.

3.16.2.2 Human Health Risk Assessment

To assist in the qualitative assessment of impacts to public health, HHRAs can be conducted for defined study areas. A HHRA is a quantitative technical method used to estimate potential exposures, hypothetical cancer risks, and potential noncancer adverse health effects from measured or estimated levels of chemicals. HHRAs can be performed to evaluate past, current, and even future exposures to chemicals found in air, soil, water, food, consumer products or other materials. See Section 3.0 for additional descriptions of the methodologies used in the HHRAs.

HHRAs rely on a scientific understanding of pollutant behavior, human exposure, dose, and toxicity and produce estimates of hypothetical health risks for a receptor population. A HHRA cannot determine whether a current health problem or symptom was caused by a specific exposure to a specific chemical. Other types of information are needed to evaluate potential causal links between exposures and human health effects, e.g., results from human epidemiology studies. To evaluate potential links, scientists or doctors may conduct epidemiological studies of specific communities or populations. Toxicity studies can be used to explore exposure levels, types of health endpoints, and mechanisms of action associated with specific chemical exposures, while epidemiological studies can survey the occurrence of health endpoints in a specific group and can compare observations in that group with those in relevant groups (e.g., individuals in other cities, communities, or the population as a whole).

Additional information relevant for evaluating public health in the project vicinity was compiled (Gradient 2016) and used as supporting documentation of health-related information throughout this section. This additional information includes data from air monitoring stations within and in the vicinity of the project area, information regarding the health status and availability of health services, and information obtained from scientific literature relating to health effects associated with substances assessed in the HHRAs.

Although both HHRAs and epidemiological studies focus on potential health impacts in human populations, they have different objectives. Epidemiological studies can evaluate whether past chemical exposures may be associated with documented health effects in a specific group of people. In contrast, HHRAs are used to estimate the type and degree of potential health risks posed by past, current, or future chemical exposures in a specific population and exposure setting, such as a local community.

Epidemiology studies of the study area population were not conducted as part of this Environmental Impact Statement because they take many years to complete. Instead, information relevant for evaluating public health in the project vicinity was compiled (Gradient 2016) and used as supporting documentation of health-related information throughout this section. This additional information includes data from air monitoring stations within and in the vicinity of the project area, information regarding the health status and availability of health services and information obtained from scientific literature relating to health effects associated with substances assessed in the HHRAs.

HHRAs for the two study areas (NGS and proposed KMC) were performed as separate evaluations considering study area-specific receptors and sampling data. HHRAs for the two study areas evaluated baseline conditions (i.e., existing site conditions measured in 2014 and considered representative of historical operations through 2019) and several sets of future scenarios relating to the Proposed Action, combined impacts from the NGS and proposed KMC projects on each other, and other cumulative sources scenario. The baseline HHRAs assessed the human health impacts due to exposure to existing on-the-ground environmental conditions on December 22, 2019; i.e., the potential human health risk during the time period of operation of the project but due to the effect of the baseline conditions. The results of the baseline risk assessments for NGS and proposed KMC are presented in Section 3.16.4.1 and 3.16.4.2, respectively.

Sampling data for the NGS and proposed KMC baseline HHRAs were collected in 2014 and are considered representative of study area conditions as of December 22, 2019, primarily because soil data concentrations near NGS and proposed KMC are less than regional or national background levels after

40 years of operation and other potential non-project related impacts. This suggests that soil concentrations are at an equilibrium and the 5-year lag period is unlikely to significantly change concentrations (Flatirons Toxicology, Inc. 2015; Ramboll Environ 2016a).

The future operation HHRAs evaluated scenarios related to the proposed action with data obtained from air modeling. Two scenarios were modeled to represent the future operations at NGS (i.e., conditions predicted in the vicinity of the facilities as a result of future facility operations and emissions). Future Operations scenarios were selected to represent the highest and lowest potential environmental impacts (i.e., air emissions). The two operations (3-Unit, 2,250-megawatt [MW] output and 2-Unit, 1,500-MW output) are based on USEPA's July 2014 Best Available Retrofit Technology (BART) Rule to achieve reductions in emissions of nitrogen oxides at NGS. Additional detail on each Future Operations scenario is presented in the NGS Baseline HHRA (Ramboll Environ 2016a). Results of the risk assessments for the 3-Unit Operation (representing highest nitrogen oxide emissions) and 2-Unit Operation (representing lowest nitrogen oxide emissions) scenarios are presented in Section 3.16.5.

The proposed KMC HHRA modeled two Future Operations risk cases using maximum and minimum predicted rates of coal production. These Future Operations risk cases are based on mining rates of 8.1 million tons per year (tpy) and 5.5 million tpy, to represent maximum and minimum rates, respectively. Results of the risk assessments and impacts on human health for the 8.1 million tpy and 5.5 million tpy operations are presented in Section 3.16.5.3.

Incremental upper-bound lifetime cancer risks and noncancer hazard indexes (HIs) for individuals who may reside, work, or recreate in the vicinity of NGS - and individuals who reside within and in the vicinity of the proposed KMC - mine permit area were estimated for the Baseline, Proposed Action, and Other Cumulative Sources risk cases.

The HHRAs calculated incremental lifetime cancer risks and noncancer HQs for each chemical of potential concern (COPC) for each potentially exposed population. For carcinogens, the risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of the specified exposure occurring over the defined exposure interval. The cumulative cancer risk estimates (the summation of the calculated result for each chemical) were compared to USEPA acceptable incremental risk range of 1×10^{-4} (one hundred in a million) to 1×10^{-6} (one in one million).[1] If estimated hypothetical cancer risks are within this range, then no further evaluation was required.

An HHRA cancer risk estimate of 1×10^{-6}, or one in one million, means that in a population of one million people, not more than one additional person would be predicted to develop cancer as the result of the evaluated exposure. Regulators generally define a one-in-one million to 100 in one million lifetime cancer risk range due to exposure to a chemical or group of chemicals for a specified duration integrated over a lifetime to be within an "acceptable risk" risk range. This acceptable regulatory risk range is extremely low compared to the overall cancer rate one out of every two (male) or three (female) in the United States or an approximately 40 percent (or 4×10^{-1}) average lifetime risk of being diagnosed with cancer (American Cancer Society 2015).

[1] It is standard practice to express cancer risks in scientific notation. Scientific notation can be used to convert 0.0001 into 1×10^{-4} by moving the decimal place until you have a whole number between 1 and 10. If you keep moving the decimal place to the right four places in 0.0001 you will get 1. The number of places you moved the decimal point determines the negative exponent (E). In this case, the decimal point was moved four places to get to the whole number of 1 and can be expressed as 1×10^{-4}. A larger negative exponent indicates a smaller number, which is important when comparing cancer risks to the USEPA acceptable risk range. A cancer risk of 3×10^{-7} represents a number that is less than the risk range of 1×10^{-4} to 1×10^{-6}, and is considered acceptable risk. A cancer risk of 4×10^{-3} represents a number that is greater than the risk range, and is considered unacceptable risk.

The potential for noncancer adverse health effects was determined by comparing an estimated level of exposure to a chemical to the level of exposure that is not expected to cause any adverse effects (e.g., asthma, birth defects, nervous system disorders), even in susceptible or sensitive individuals (USEPA 1989). The ratio between the estimated exposure level and these comparison values (called reference doses or reference concentrations) and the estimated exposure level or concentration yields for each chemical a simple ratio referred to as a Hazard Quotient (HQ), a quantitative estimate of noncancer health effects. The HQ for all COPCs were then summed to derive a HI. If the sum of all the HQs (i.e., HI) was less than 1, then the exposures were considered to be acceptable for noncancer risk and no further risk calculations or evaluations were warranted.

Lead does not have standard toxicity values so health hazards from exposure to lead cannot be estimated using the same risk assessment methodology as other chemicals. USEPA recommends lead hazards be evaluated based on blood lead concentrations in children, which are estimated using the IEUBK model (USEPA 2010). Predicted blood lead concentrations were compared to the Center for Disease Control (CDC) recommended reference blood level of 5 micrograms per deciliter (µg/dl) and the USEPA recommended reference blood level of 10 µg/dl. If they were less than these reference levels, exposure to lead was considered acceptable and no further risk calculations or evaluations were necessary.

The details of the HHRA methodology are described in the NGS Baseline HHRA (Ramboll Environ 2016a) and the proposed KMC Baseline HHRA (Flatirons Toxicology, Inc. 2015). The analysis followed the Risk Assessment Guidance for Superfund (USEPA 1989) and HHRAP; (USEPA 2005), procedures established by the USEPA which are comprised of the following steps:

- Hazard Identification (identification of chemicals of potential concern);
- Dose-Response Assessment (toxicity criteria for cancer and noncancer health effects are identified);
- Exposure Assessment (identification of potentially exposed populations, development of exposure scenarios and exposure pathways, estimation of exposure point concentrations, and calculation of intakes by various exposure routes);
- Risk Characterization (provide estimates of potential cancer risk and noncancer hazard to human health from exposure to COPCs); and
- Uncertainty Analysis (discuss the uncertainty associated with methods and assumptions used in the risk assessment and how these uncertainties may either increase or decrease the magnitude of potential risks).

3.16.3 Study Areas

3.16.3.1 Proposed Action and Action Alternatives

3.16.3.1.1 Human Health Risk Assessment

The study areas for the HHRAs include the area up to 50 km from the NGS (**Figure 3.16-1**) and up to a distance of approximately 50 km from the center of the proposed KMC lease permit boundary, as reflected in the dispersion modeling that was used to evaluate impacts.

3.16.3.1.2 Public Health

The study area for the public health evaluation consists of the local community, including members of the Navajo Nation and the Hopi Reservation within northern Coconino and Navajo counties, Arizona, particularly the Navajo Mountain Chapter (of the Western Agency) and portions of the Hopi Reservation surrounding NGS and the Kayenta Chapter (of the Western Agency) surrounding the proposed KMC, as

well as the nearby off-reservation communities in the two counties, including Page, Arizona (**Figure 3.16-3**).

3.16.3.2 Cumulative

3.16.3.2.1 Human Health Risk Assessment

The cumulative study area for the HHRA is the same as the HHRA study area for the Proposed Action and alternatives.

3.16.3.2.2 Public Health

The cumulative study area for the public health evaluation is the same as the public health evaluation study area for the Proposed Action and alternatives.

3.16.4 Affected Environment

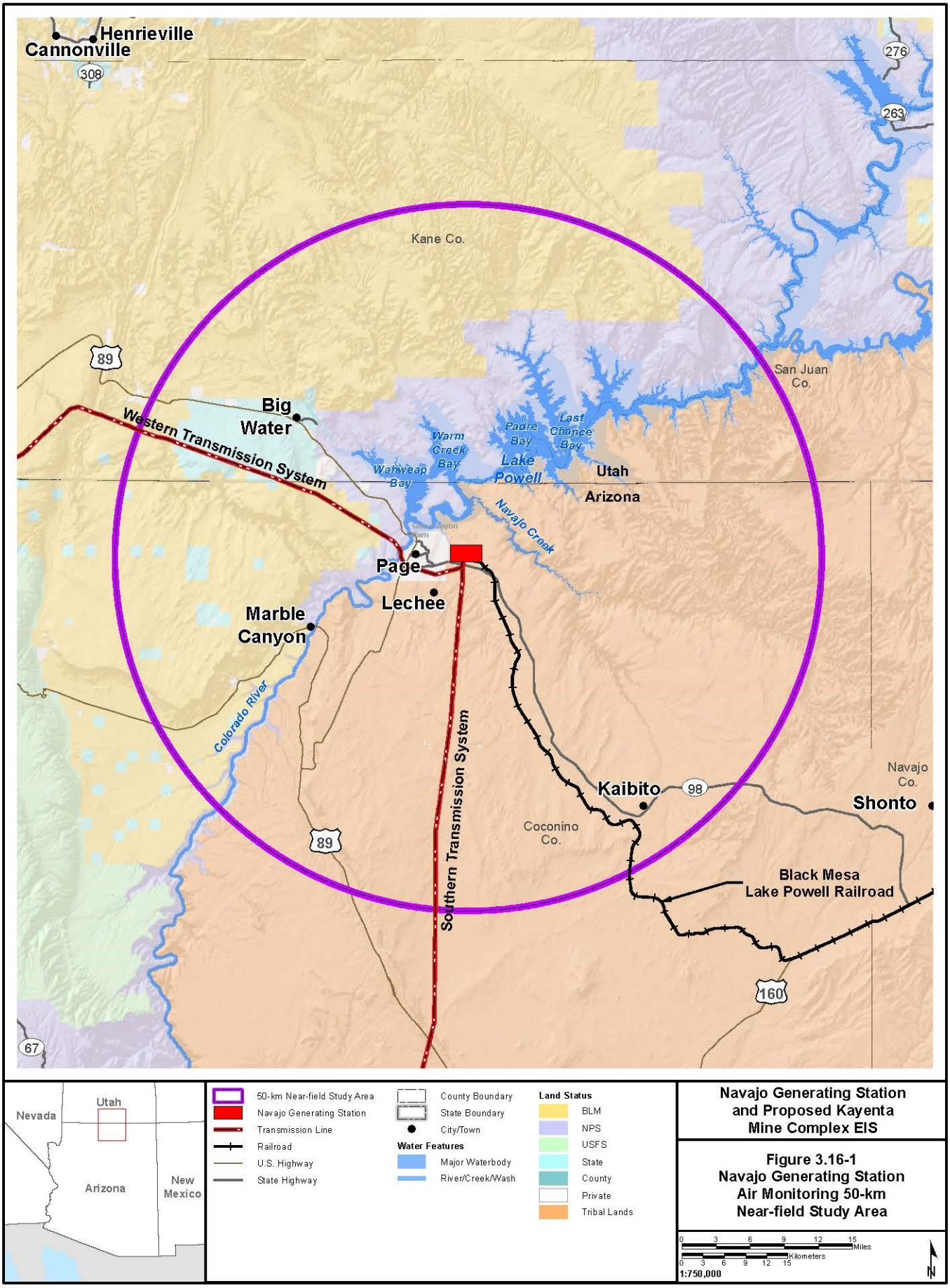
The baseline HHRAs provide data and methods to evaluate the affected environment in terms of potential human health risk from baseline conditions. For specific substances of interest for facility emissions (e.g., air emissions of metals from various aspects of NGS and proposed KMC operations), these analyses generated chemical-specific quantitative estimates of potential human health risk associated with various exposure pathways. In accordance with standard risk assessment guidance and practice, these analyses focused on broad categories of potential health effects such as cancer and noncancer effects (Flatirons Toxicology, Inc. 2015; Gradient 2016; Ramboll Environ 2016a). The human health risk estimates for baseline conditions for the NGS are summarized in Section 3.16.4.1 and for the proposed KMC in Section 3.16.4.2. The transmission systems and communications sites potential exposures relative to human health are discussed in Section 3.16.4.3.

The public health evaluation includes an assessment of the current public health conditions of the potentially affected community, including the existing environmental conditions and public health and safety resources within the community that could be affected by the proposed project (Section 3.16.4.4).

3.16.4.1 Navajo Generating Station HHRA

NGS is a coal-fired electric power generating station located in northern Arizona on the Navajo Reservation, about 3 miles east of the City of Page on approximately 1,020 acres of land leased from the Navajo Nation. **Figure 3.16-1** shows the NGS and associated 50-km Near-field study area. Based on the preliminary assessment of the surrounding community, along with information received from Navajo Nation, and USEPA's HHRAP's recommendation, the following receptors and exposure pathways were considered in the baseline HHRA at the NGS:

- Off-site Resident – This scenario evaluated potential residential (adult and child) exposure resulting from incidental ingestion of soil, dermal contact with soil, inhalation of volatiles and resuspended particulate from soil, and ingestion of breast milk (infant only).
- Off-site Resident Gardener – This scenario evaluates potential residential (adult and child) exposure resulting from incidental ingestion of soil, dermal contact with soil, inhalation of volatiles and resuspended particulate from soil, ingestion of breast milk (infant only) and ingestion of homegrown produce.
- Off-site Resident – Farm Family – This scenario evaluated potential exposures for residential farming residents (adult and child) who live outside Page, Arizona. The same exposure pathways evaluated for the off-site resident gardeners were evaluated for the farm families with the additional pathway of livestock (lamb) ingestion. The farm family scenario increased exposure to soil associated with farming activities and used higher ingestion rates for homegrown produce.



Navajo Generating Station and Proposed Kayenta Mine Complex EIS

Figure 3.16-1
Navajo Generating Station Air Monitoring 50-km Near-field Study Area

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7/19/2016

- Off-site Commercial Worker – This scenario evaluated potential commercial/industrial exposures resulting from incidental ingestion of soil, dermal contact with soil, and inhalation of volatiles and resuspended particulate from soil.
- Off-site Recreational User (adult and child) – This scenario evaluated incidental ingestion of and dermal contact with surface water and sediment while swimming or wading. This scenario also evaluated incidental ingestion of and dermal contact with surface water and sediment while fishing, and ingestion of fish taken from waterbodies (i.e., Lake Powell and Colorado River).

Exposure due to traditional activities and lifestyles for local Navajo Nation tribe members could occur through medicinal or ceremonial uses of native herbs or, as well as other uses of native plants such as yucca for making shampoo. Exposures through these activities were not evaluated quantitatively at the NGS for three reasons. First, the consumption rate of native herbs likely would be significantly lower compared to local consumption of other homegrown produce in terms of quantity and exposure frequency and therefore would be accounted for in the exposure evaluation for homegrown produce. Second, gathering of native herbs for medicinal or ceremonial purposes is not a common practice within the study area. Lastly, the herbs used for medicinal or ceremonial uses are not from locations within the NGS study area (Ramboll Environ 2016a).

Baseline conditions represent the existing on-the-ground environmental conditions on December 22, 2019, which includes natural conditions and any pollutants produced by past NGS operations and other local, regional, and global emission sources that have accumulated. The baseline risk assessment evaluated the potential human health risk due to the effect of these baseline conditions.

3.16.4.1.1 Chemicals of Potential Concern

COPCs identified for quantitative evaluation in the NGS HHRA included pollutants typically emitted from coal-fired electric generating units based on two previous studies conducted by the Electric Power Research Institute (EPRI 2011, 2009) and diesel particulate matter (DPM) emitted from other on-site sources (e.g., trucks). A few additional metals (aluminum, boron, cobalt, copper, iron, and vanadium) were added based on the coal composition data collected during the Kayenta Mine Sampling Investigation in 2014 (Ramboll Environ 2016c). The COPCs quantitatively evaluated in the NGS baseline HHRA included metals, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, polycyclic aromatic hydrocarbons, volatile organic compounds, and some other inorganics.

COPCs that are not persistent in the environment, normally only exist in vapor phase, or only have human health impact through the inhalation pathway were not evaluated for baseline (which includes historic operations) in the HHRA. These chemicals include elemental mercury, acrolein, benzene, sulfuric acid, hydrogen chloride, hydrogen fluoride, nitrogen dioxide, sulfur dioxide, carbon monoxide, and DPM. These chemicals are not likely to accumulate in the environment and their ambient air concentrations would soon be consistent with surrounding regions once NGS ceases operation (Ramboll Environ 2016a). Although not included in the baseline HHRA evaluation, they were evaluated in the HHRA for future operation scenarios.

Exposure point concentrations represent the concentration of each chemical that an individual may be exposed to at a given receptor location. Exposure point concentrations were used together with pathway-specific intake equations to calculate the exposure (dose) attributable to each chemical of potential concern. For the Baseline scenario for NGS HHRA, 95 percent upper confidence limits on the mean of the soil, surface water, and sediment data were used as the exposure point concentrations. COPC concentrations in homegrown produce, lamb, fish and breast milk were estimated based on soil, surface water, and sediment exposure point concentrations following recommended approaches from the USEPA's HHRAP.

3.16.4.1.2 Risk Characterization

As presented in **Table 3.16-2**, the results of the NGS Baseline HHRA show that potential cancer risks due to existing on-the-ground conditions for the off-site resident, off-site resident gardener, off-site resident farmer, recreational user, and commercial worker are within the USEPA acceptable risk range of 1×10^{-4} (1 in 10,000) to 1×10^{-6} (1 in 1,000,000). For noncancer effects, the NGS Baseline HHRA reported that the HIs for all receptors were equal to or less than the USEPA benchmark of 1. The estimated HI for a recreational user child is the highest of all receptors at 1.2, due to exposure of methyl mercury via fish consumption in Lake Powell. Note that the Arizona Game and Fish Department issued a fish consumption advisory in 2012 recommending that people, including pregnant women and children, limit their consumption of striped bass caught in the southern portion of Lake Powell (Arizona Game and Fish Department [AGFD] 2012). The estimated average daily doses for infants exposed to dioxins/furans through ingestion of breast milk were well below the national exposure level of 60 picograms Toxic Equivalency Quotient/kilogram/day.

Table 3.16-2 NGS Baseline HHRA Result

Receptor	Cancer Risk	Hazard Index	Breast Milk Average Daily Dose (pg/kg-bw/day)
Resident	2E-06	0.1	0.27
Resident-Gardener	5E-06	0.7	0.45
Resident-Farm Family	4E-05	0.8	1.9
Recreational User	4E-06	1.2[1]	NA
Commercial Worker	5E-07	0.02	NA
Benchmark[2]	1E-04 to 1E-06	1	60

[1] The HI of 1.2 for the child recreational user is due to exposure to methyl mercury via the consumption of fish.

[2] Cancer risk estimates within or less than the benchmark cancer risk range are considered acceptable and require no further evaluation. HIs less than the target HI of 1 are considered acceptable and require no further evaluation. For dioxins and furans in breast milk, an average daily dose less than 60 pg/kg-bw/day is considered acceptable and requires no further evaluation.

pg/kg-bw/day = picograms per kilogram-body weight per day.

As presented in **Table 3.16-3**, the estimated blood lead concentrations were well below both the USEPA target blood lead level of 10 micrograms per deciliter (µg/dL) and the CDC reference blood lead concentration of 5 µg/dL. When risk estimates and/or dioxin/furan and lead concentrations are less than their respective benchmarks, no further evaluation is necessary. The Baseline HHRA concluded that negligible impact on human health was identified based on the baseline conditions in the vicinity of NGS. The Baseline HHRA also concluded that given the degree of conservatism purposefully built into the risk assessment methods and benchmarks, this conclusion is highly protective of public health.

Table 3.16-3 NGS Baseline HHRA Blood Lead Model Results

Receptor	Geometric Mean of Blood Lead Level (µg/dL)	Percent >10 µg/dL
Resident	0.84	<0.001
Resident-Gardener	0.82	<0.001
Resident-Farm Family	0.95	<0.001
Benchmark[1]	5 (CDC reference blood lead level) 10 (USEPA benchmark blood lead level)	

[1] If receptor modeled lead levels are less than the CDC (5 µg/dL) and USEPA (10 µg/dL) blood lead level benchmarks, then modeled blood lead levels are considered acceptable and require no further evaluation.

CDC = Centers for Disease Control.

µg/dL = micrograms per deciliter.

3.16.4.1.3 Uncertainty Analysis

Key uncertainties associated with the estimated exposures and risks for potentially exposed populations in the vicinity of NGS include chemical of potential concern selection, toxicity values, exposure point concentrations, exposure parameters (e.g., food consumption rates), exposure pathways, and the 5-year lag period. The uncertainty associated with chemical of potential concern selection, toxicity values, exposure point concentrations, exposure parameters and the 5-year lag period is low, and it is likely that the HHRA outcome results in overestimates of exposure because of the generally conservative nature of inputs. Additional discussion regarding this uncertainty is provided in the NGS Baseline HHRA (Ramboll Environ 2016a).

The uncertainty associated with exposure pathways, specifically the exposure to the farm family through consumption of lamb, is considered high. The default livestock species evaluated in the HHRAP are beef, pork and chicken (USEPA 2005). However, the primary livestock consumed within the NGS study area is lamb (Ramboll Environ 2016a). Because no specific consumption rates for lamb were provided in the NGS HHRAP, consumption rates for beef were utilized. To account for the difference in the livestock species evaluated vs. consumed available bio-transfer factors were estimated for lamb and used in the NGS HHRA. Bio-transfer factors were not available for some chemicals of potential concern (mostly metals), such as arsenic. Consequently, potential risks for these chemicals of potential concern were not quantitatively evaluated, and risks for the livestock ingestion pathway likely are underestimated. Bio-transfer factors were not available for some chemicals of potential concern (mostly metals), such as aluminum, antimony, arsenic, barium, beryllium, chromium, cobalt, iron, lead, manganese, molybdenum, nickel, vanadium, and zinc. Consequently, potential risks for these chemicals of potential concern were not quantitatively evaluated, and risks for the livestock ingestion pathway likely are underestimated. Driving pathways for the overall risk (i.e., primary contributors to potential risk) for cancer and noncancer risk estimates for the resident farmer are ingestion of homegrown produce, ingestion of lamb and incidental ingestion of soil. Metals not evaluated for the lamb ingestion pathway, including arsenic, are evaluated for the residents for the homegrown produce and soil ingestion pathways.

3.16.4.2 Proposed Kayenta Mine Complex HHRA

The proposed KMC is an active coal-mining site located in northeast Arizona that has been in continuous operation for over 40 years. The proposed KMC permit area is approximately 62,930 acres and is located about 110 miles northeast of Flagstaff, Arizona, and 15 miles southwest of Kayenta, Arizona. The receptor population for the proposed KMC HHRA was defined as nearby residents located at various areas in and around the mine permit area. No other sensitive receptor sub-populations were identified in or around the mine permit area. The following receptors were considered in the HHRA at the proposed KMC:

- Resident – This scenario evaluated potential residential (adult and child) exposure resulting from incidental ingestion of soil, dermal contact with soil, and inhalation of resuspended soil particulates.
- Resident Gardener – This scenario evaluates potential residential (adult and child) exposure resulting from incidental ingestion of soil, dermal contact with soil, inhalation of resuspended soil particulates, and ingestion of homegrown produce.
- Resident – Farm Family – This scenario evaluates potential residential (adult and child) exposure resulting from incidental ingestion of soil, dermal contact with soil, inhalation of resuspended soil particulates, and ingestion of homegrown produce and livestock (beef).

The proposed KMC HHRA calculated hypothetical cancer risks and potential for noncancer health effects for four types of risk cases. These risk cases included Baseline, Proposed Action, Combined Impacts (NGS-KMC), and other cumulative sources.

Baseline conditions represent the existing on-the-ground environmental conditions on December 22, 2019. Baseline conditions include naturally occurring soil constituents, as well as any anthropogenic (human-caused) contributions from local, regional, and global emission sources, including past mining operations.

3.16.4.2.1 Chemicals of Potential Concern

COPCs in proposed KMC fugitive dust include metals (overburden/coal) and polycyclic aromatic hydrocarbons (coal). Criteria pollutants (particulate matter, carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, and lead) are generated in the course of some mining operations and are addressed in terms of compliance with National Ambient Air Quality Standards in the air monitoring report (McVehil-Monnett Associates, Inc. 2016). Lead also was identified as a chemical of potential concern and was evaluated quantitatively in the HHRA. Diesel particulate matter is a component of diesel emissions from heavy diesel equipment used in mine operations, and was considered a chemical of potential concern in the proposed KMC HHRA.

For the proposed KMC Baseline risk case (Flatirons Toxicology, Inc. 2015), soil sampling data collected in summer 2014 (Ramboll Environ 2016c) as part of the proposed KMC HHRA Field Sampling Plan Addendum (Flatirons Toxicology, Inc. 2014) were used to evaluate Baseline exposure conditions in 2019. Significant changes in soil concentrations between 2014 and 2019 are unlikely because soil concentrations were generally within background range for Arizona. Rapid changes in COPC concentrations are extremely unlikely over a 5-year period. Consequently, 2014 sample data are considered to be representative of 2019 conditions (Flatirons Technology, Inc. 2015). For residential areas, 19 composite samples from the surface soil (0 to 3 inches) were collected within and outside the proposed KMC (**Figure 3.16-2**). These locations represent a variety of potential factors that may determine exposure from past KMC, NGS, and other local, regional, and global sources, and future proposed KMC activities, as well as potential impacts from NGS operations. These factors included source area types, wind directions, and proximity to source areas (Flatirons Toxicology, Inc. 2014). An additional 8 surface soil samples collected from 7 reclaimed land parcels used for livestock grazing also were collected to evaluate potential exposure from this pathway. Overburden and coal samples at proposed KMC were collected to characterize metal and polycyclic aromatic hydrocarbon concentrations and used as inputs into the air dispersion and deposition modeling of fugitive dust emissions from mining operations to evaluate the Proposed Action scenarios in the HHRA. A total of 10 coal samples and 8 overburden samples were collected in accordance with the proposed KMC Field Sampling Investigation Report (Ramboll Environ 2016c).

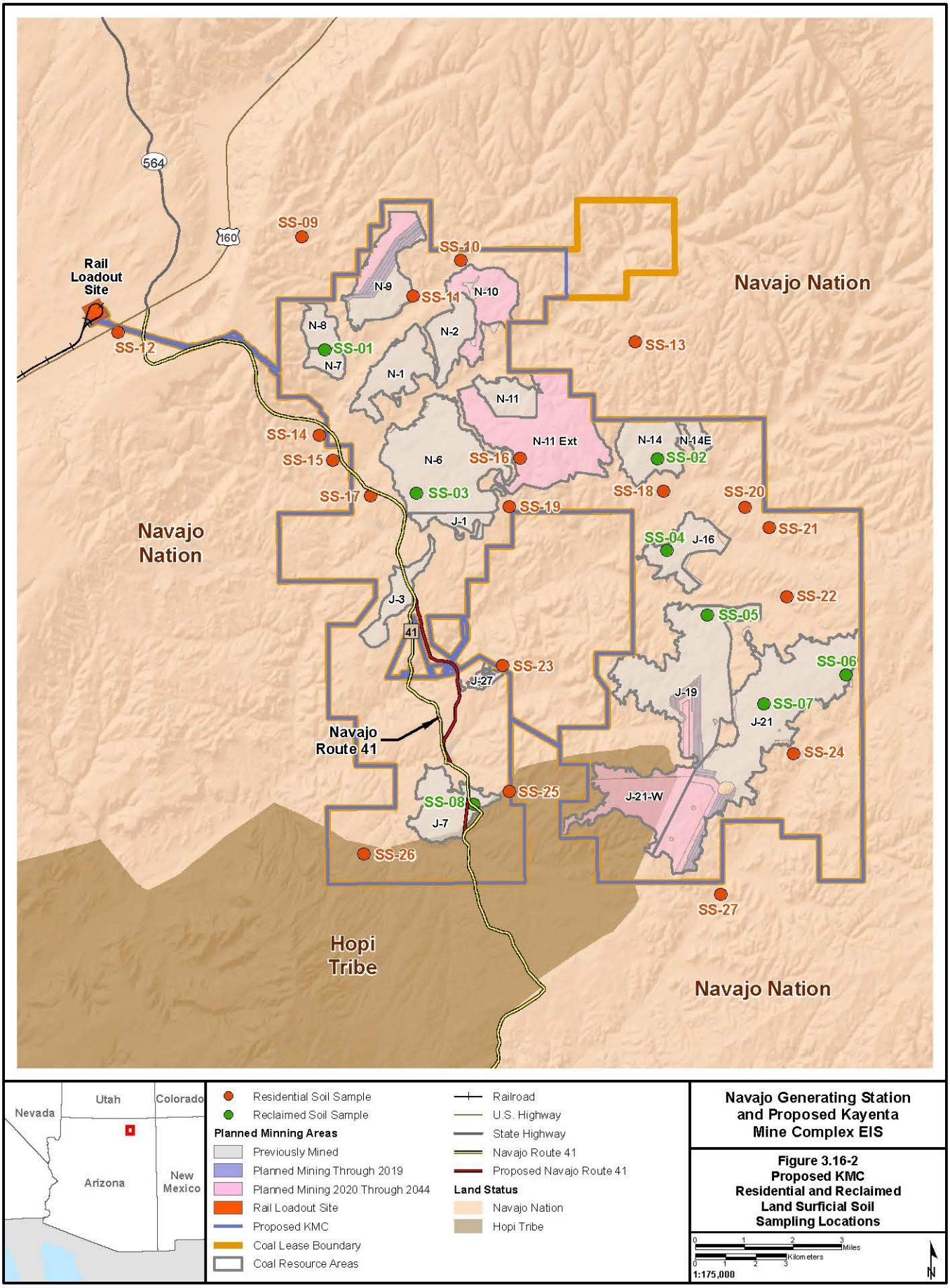

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Figure 3.16-2 Proposed KMC Residential and Reclaimed Land Surficial Soil Sampling Locations

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3.16.4.2.2 Risk Characterization

As presented in **Table 3.16-4**, the results of the proposed KMC Baseline HHRA show that potential cancer risks due to existing on-the-ground conditions for the resident, resident gardener, and resident farmer are within the USEPA acceptable risk range of 1×10^{-4} (one in ten thousand) to 1×10^{-6} (one in one million). The HI for the resident-gardener and resident-farmer exceeded 1. When a HI exceeds 1, a target organ analysis is performed. A target organ analysis evaluates chemicals that have similar modes of toxicological action or similar impacts on an organ or system of the body (e.g., the liver, kidney, or nervous system). Such chemicals are grouped together to calculate a target organ-specific HI. Calculating risk based on a target organ analysis reduces the possibility of overestimating risk by summing HQs for a mixture of chemicals that are not expected to induce the same types of effects on a specific target organ. For noncancer effects, the HHRA reported that all receptor HIs or target organ-specific HIs were less than the USEPA benchmark of 1 (see **Table 3.16-4** footnotes).

Table 3.16-4 Proposed KMC Baseline Risk Case Result

Receptor	Cancer Risk	Hazard Index
Resident	6E-06	0.9
Resident-Gardener	9E-06	1.1[1]
Resident-Farmer	2E-05	1.9[2]
Benchmark[3]	1E-04 to 1E-06	1

[1] A HI of 1.1 for the resident gardener child exceeded the target HI of 1 and required further evaluation consisting of a target organ analysis. The conclusions of the target organ analysis performed for the resident farmer child also apply to the resident gardener child.

[2] A HI of 1.9 exceeded the target HI of 1 and required further evaluation consisting of a target organ evaluation. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HI were acceptable, a similar evaluation was not performed for any other scenario or receptors.

[3] Cancer risk estimates within or less than the benchmark cancer risk range are considered acceptable and require no further evaluation. HIs less than the target HI of 1 are considered acceptable and require no further evaluation.

For the proposed KMC baseline risk case, a total of five carcinogenic chemicals of potential concern were identified: arsenic, beryllium, cobalt, cadmium, and nickel. The primary risk driver for cancer risks for all exposure scenarios, receptors, and exposure pathways was arsenic. Arsenic accounted for virtually 100 percent of the potential cancer risk estimates.

The results of the noncancer risk show that the HI for the resident-gardener and resident-farmer exceeded 1The majority of the noncancer risk was due to five metals; aluminum, arsenic, cobalt, iron, and manganese. These metals accounted for approximately 87 to 92 percent of the reported noncancer risk HIs, depending on exposure scenario. While these five metals drive the noncancer risk estimates in the proposed KMC baseline HHRA, they are not included in the NGS baseline HHRA livestock ingestion pathway (due to lack of a bio-transfer factor for lamb) for the resident farmer. The inclusion of these metals accounts for higher baseline HI for the resident farmer at proposed KMC. The resident gardener child HI was slightly greater than the target HI of 1. Evaluation of target organ HQs is discussed below for the resident farmer child exposure scenario. The same conclusions for the resident farmer child target organ evaluation apply to the resident gardener child HI.

It is not uncommon for a HI to exceed 1, especially with a large number of chemicals of potential concern, because even if the individual HQs are well below 1, summing a large number of small HQs can lead to a HI greater than 1. For example, if each of the 20 chemicals of potential concern evaluated for the proposed KMC HHRA had a HQ of 0.1, the HI would be 2.0 and greater than the target HI.

However, exceedance of an initial HQ or HI by itself does not necessarily mean that the exposure is unacceptable. It simply indicates that further evaluation is necessary (USEPA 1989).

Because the HI for the resident farmer child and the resident gardener child exceeded 1, it was necessary to perform a target organ analysis to determine if any target organ HI exceeded 1. A summary of the target organs and HQs/HIs for the proposed KMC chemicals of potential concern for the resident farmer child is presented in the proposed KMC HHRA (Flatirons Toxicology, Inc. 2015). Because the target organ evaluation for the resident farmer child exposure scenario demonstrated that all target organ HQs and HIs were acceptable, a similar evaluation was not performed for any other scenarios or receptors (because the resident farmer exposure scenario had greater estimated exposures than the other resident scenarios). A detailed discussion of the target organ analysis process and the analysis performed for the resident farmer child at proposed KMC is presented in the proposed KMC HHRA (Flatirons Toxicology, Inc. 2015).

Lead was evaluated separately for noncancer health risk using the USEPA's Integrated Exposure Uptake Biokinetic Model (USEPA 2010), which allows evaluation of lead exposure in children. As presented in **Table 3.16-5**, predicted blood lead levels for children aged 0 to 7 years ranged from 0.2 to 0.4 µg/dL. The current CDC recommendation for reference blood levels in 1- to 5-year old children is 5.0 µg/dL (CDC 2012). This reference level reflects lead exposure levels that are considered elevated relative to typical levels in U.S. children in the same age range. The proposed KMC predicted blood levels were well below the CDC and USEPA reference blood levels. The probability of exceeding the CDC reference level was less than 0.0001 percent (Flatirons Toxicology, Inc. 2015).

Table 3.16-5 Proposed KMC Baseline Risk Case Blood Lead Model Results For the Resident Farmer Child

Receptor	Geometric Mean of Blood Lead Level (µg/dL)	Percent >10 µg/dL
Resident-Farmer Child	0.2-0.4	<0.0001
Benchmark[1]	5 (CDC Reference Blood Lead Level) 10 (USEPA Benchmark Blood Lead Level)	

[1] If receptor modeled lead levels are less than the CDC (5 µg/dL) and USEPA (10 µg/dL) blood lead level benchmarks, then modeled blood lead levels are considered acceptable and require no further evaluation.

CDC = Center for Disease Control.

HI = hazard index.

µg/dL = micrograms per deciliter.

Based on the cancer risk estimates, noncancer and target organ analysis HIs, and the separate evaluation for blood lead in children, there were no unacceptable human health risks identified for the baseline risk case. Because all baseline human health risks were considered acceptable, negligible impact on human health was identified in the vicinity of the proposed KMC.

3.16.4.2.3 Uncertainty Analysis

In general, conservative assumptions are made throughout the risk assessment to ensure that the health of local residents is protected. For the chemicals assessed, when all of the assumptions are combined, it is more likely that actual risks are overestimated rather than underestimated.

The assumptions that introduce the greatest amount of uncertainty in the proposed KMC Baseline Risk are discussed in this section. They are discussed in general terms and assigned a qualitative designation of low, medium or high uncertainty as to whether the assumptions overestimate or underestimate potential risk. Additional discussion of all uncertainties associated with the proposed KMC

HHRA is presented in the proposed KMC Baseline HHRA (Flatirons Toxicology, Inc. 2015). The most significant uncertainties associated with the proposed KMC HHRA Baseline Risk case are related use of 95 percent upper confidence limits as exposure point concentrations instead of individual residential area soil concentrations and the use of beef as surrogate for mutton consumption. Use of the 95 percent upper confidence limit for the proposed KMC residential areas provides reasonably conservative estimates for exposure point concentrations in all but a handful of residential areas that either have a chemicals of potential concern risk driver (a chemical responsible for most or all reported risk) at the highest concentration or a combination of risk driver chemicals of potential concern at elevated concentrations relative to their 95 percent upper confidence limit concentrations. Preliminary risk calculations revealed that variation in types of chemicals of potential concern and chemicals of potential concern concentrations across the residential sites were limited and that a single exposure point concentration for each chemical of potential concern could be used to estimate potential health risks for the site. The potential underestimate of risks from use of the 95 percent upper confidence limit is low (15 to 30 percent) and limited to only a handful of residential areas. Furthermore, the 95 percent upper confidence limit approach is more consistent with USEPA guidance and does not change overall results or conclusions for the proposed KMC Baseline HHRA in any significant way.

Conversely, the inclusion of essential nutrient metals and metals commonly used as therapeutic agents likely resulted in overestimates of potential noncancer health effects. For example, iron accounted for the highest portion of the Baseline HIs, but iron is an essential nutrient that is expected to be nontoxic at the intake levels estimated for proposed KMC residents. This factor had a high probability of overestimating the potential Baseline noncancer HIs by 30 to 50 percent.

Another potential source of uncertainty for the Baseline Risk case was the use of homegrown beef was used as a surrogate for the resident farmer livestock ingestion instead of lamb, even though lamb or mutton may be a preferred meat source for some area residents. This decision was based on the availability of beef biotransfer factors for the risk-driving metals at proposed KMC; lamb biotransfer factors for metals are not available. The use of beef as a surrogate for lamb was intended to capture exposures to a larger array of metals from the livestock ingestion pathway and presents a low to medium level of uncertainty in the HHRA. It is difficult to determine if the use of beef as a surrogate for home-raised meat overestimates or underestimates the potential risk for the livestock ingestion pathway; however, it can be concluded that risks for the resident farmer exposure scenario would be lower by up to a third or more, if the livestock ingestion pathway was not evaluated in the proposed KMC HHRA (Flatirons Toxicology, Inc. 2015).

3.16.4.3 Transmission Systems and Communications Sites

The existing transmission lines and communication sites operate at remote locations from NGS and proposed KMC. The communication sites include propane-fired backup generators that provide backup emergency power. Many of the sites are operated and maintained by other users. Given the relatively infrequent testing that is applied to these facilities, the remote locations, and the relatively low emission rates associated with propane-fired units, the air quality emissions and historical operation's impacts on existing air quality conditions and soil deposition are assumed to be minimal. Maintenance activities for the communication sites, transmission lines, and access roads can include vehicle traffic (vehicle exhaust and fugitive dust from unpaved roads), but the maintenance activities are often infrequent, short duration, and/or localized. For example, transmission line structure maintenance and repair occur on an as-needed basis, routine actions such Southern Transmission System (STS) vegetation clearing occurs once every five years or more infrequently depending on need, repair of STS access roads and Western Transmission System (WTS) and STS transmission tower infrastructure occurs along localized sections of the lines or roads, and annual maintenance of WTS access roads occurs once or twice a year but equipment moves through the areas quickly. Therefore, emissions of historical operations are considered minimal, and because these impacts are infrequent, short duration, and localized, and thus cause very little effect, the environmental impacts are considered negligible. A HHRA was not performed

for receptors located at these sites because the exposure and potential risk would be less than the exposure and potential risk for residential receptors located in the vicinity of NGS and proposed KMC.

3.16.4.4 Public Health

This section evaluates the current health conditions of the potentially affected community, the affected environment with respect to particulates, and demographics with respect to economy, land use, and baseline community health issues relevant to particulate inhalation.

3.16.4.4.1 Demographics – Land Use

This section provides information on current land use patterns and demographics particularly relevant to health. The local community includes members of the Navajo Nation and the Hopi Reservation within northern Coconino and Navajo counties, Arizona, particularly the Navajo Mountain Chapter (of the Western Agency) and portions of the Hopi Reservation surrounding NGS and the Kayenta Chapter (of the Western Agency) surrounding the proposed KMC, as well as the nearby off-reservation communities in the two counties, including Page, Arizona (**Figure 3.16-3**).

Detailed information on land use in the vicinity of the NGS and the proposed KMC is provided in Section 3.14, Land Use. As described in Section 3.14, the primary land use in the study area is livestock grazing by the Navajo (PWCC 2012 et seq.). The majority of the area is sparsely populated with dispersed residential dwellings or small communities. Commercial uses include small stores and gas stations located along major transportation routes and in or adjacent to local communities.

The NGS site is located in Coconino County approximately 3 miles east of Page, Arizona, within the LeChee Chapter of the Navajo Nation. Overall the area surrounding the NGS is sparsely populated with the exception of the City of Page which had a population of 7,247 in 2013 (City-data 2015). The developable area of LeChee is about 10 miles south of Page. Livestock grazing is an important land use for the LeChee Community. In addition, the residents of the LeChee Community enjoy dispersed recreation in the canyon areas where they hike and hunt. Other recreation in the vicinity of the NGS involves the large number of visitors to Lake Powell, Glen Canyon, the Antelope Canyon Tribal Park, and the Grand Canyon. The tourism industry is a large contributor to the economy of the City of Page.

The proposed KMC is located approximately 15 miles south of Kayenta, Arizona, in Navajo County on the Hopi Reservation and the Navajo Nation Chapters of Chilchinbito, Forest Lake, Kayenta, and Shonto. As detailed in Section 3.14, approximately 150 Navajo residents live in dispersed houses within the Kayenta permit boundary (Office of Surface Mining Reclamation and Enforcement [OSMRE] 2011, 2008). Frequently, multiple families will reside in a single dwelling. Many graze livestock (mainly cattle, sheep, and goats) on reclaimed lands for a food source and for economic and cultural reasons. Livestock grazing is the primary pre-mine use of the land and occurs year-round.

Other uses of the land by residents living within the permit boundary include the gathering of plants for food, medicine, cultural purposes, firewood gathering, and farming small agricultural plots (approximately 4 to 5 acres in size) typically used for growing corn (PWCC 2012 et seq.). As the mine areas are developed, residents occasionally need to be relocated to different areas.

Recreation activities in the vicinity of the proposed KMC consist primarily of dispersed recreation on Black Mesa, which is a prominent geographic feature of the Colorado Plateau. Typical activities include hiking, small game hunting, bird watching, and photography. No developed recreation is present in this area.

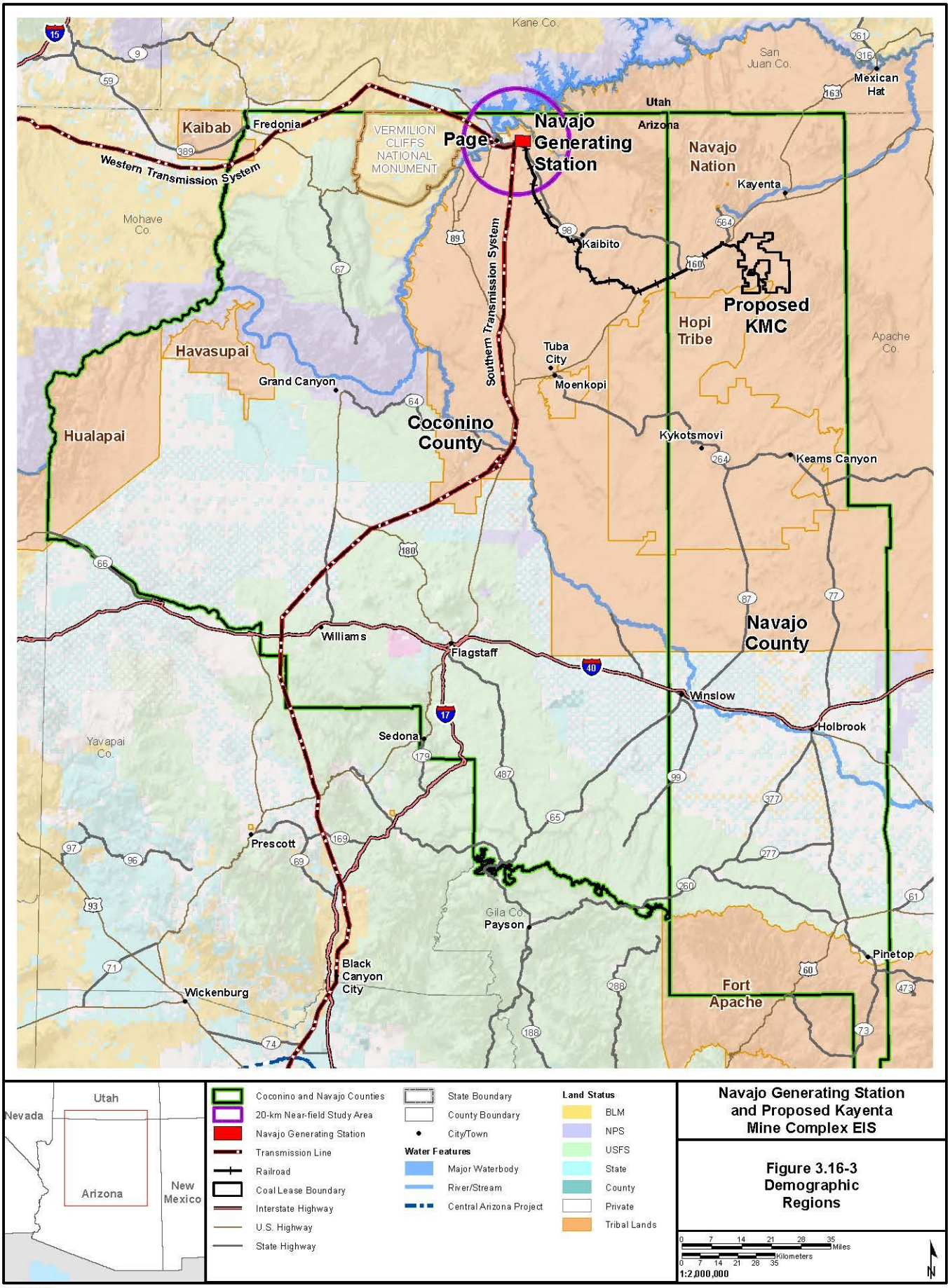

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Figure 3.16-3 Demographic Regions

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3.16.4.4.2 Demographics – Population

Detailed population and demographic information is presented in Section 3.18. American Indians, primarily Navajo, were the single largest racial group in northeastern Arizona in 2010. Navajo accounted for over 90 percent of the population of the primary analysis area. Whites and individuals of other races accounted for less than four percent of the residents of the Hopi Reservation and portion of the Navajo Nation in Arizona. The majority of residents of Page were non-American Indian, although American Indians accounted for nearly 38 percent of the city's residents. Across the state and nation, American Indians comprised 5.5 percent and 1.7 percent of the population, respectively. The concentration of residents of other races and who are Hispanic or Latino are substantially higher across the state and nation than in the northeastern Arizona and the primary analysis area.

3.16.4.4.3 Economy

Detailed information on labor market conditions and other economic characteristics in the primary analysis area is provided in Section 3.18. In Navajo County, average incomes are lower among residents and poverty rates are higher than the state average (Navajo Public Health Services District 2012; U.S. Census Bureau 2015). In addition, unemployment rates of Navajo County also exceeded the State of Arizona unemployment rates. As discussed in Section 3.18, the general economic climate of the Navajo Nation and Hopi Reservation is poor and labor force participation on the Navajo Nation and Hopi Reservation is low in comparison to the statewide and off-reservation areas. Unemployment is persistently high among those in the labor force. The 2009 – 2013 American Community Survey estimated unemployment on the Navajo Nation at 21.6 percent, 4.7 percent points higher than on the Hopi Reservation, and 11.2 percentage points higher than the statewide average. Local estimates of unemployment are much higher (e.g., above 50 percent) on the Navajo Nation (Navajo Housing Authority 2011).

High unemployment, low labor force participation, and factors such as reliance on seasonal and part-time employment are manifested in household incomes that are below the statewide and national norms in terms of income distribution, higher than average dependency on public assistance, and poverty rates more than double the statewide rate. In 2010, an estimated 35 percent of Hopi and 38 percent of Navajo residents on the reservations had incomes below the poverty level (**Table 3.18-10**).

In the City of Kayenta, the median household income is substantially below the state median household income ($26,199 less), and the percent of people in poverty exceeds the state level by more than 33 percent (U.S. Bureau Census 2015). Kayenta also has a high unemployment rate of 9.4 percent, compared to the unemployment rate of the State of Arizona at 6.2 percent (Home Facts 2016). In contrast, Coconino County average incomes and unemployment rates are equal to the state average although, prior to 2013, Coconino County unemployment rates were consistently below the state level and median incomes were slightly higher than the state median (Coconino County Public Health Services District 2013). The median household income City of Page is above the state median, and poverty levels are slightly below the state level (U.S. Census Bureau 2015).

3.16.4.4.4 Community Health – Particulate Inhalation

This section describes the health status of the local community with a focus on health issues relevant to particulate inhalation, the most significant exposure pathway. Most general community health data in the vicinity of the study area is available at the county level. Limited additional information is available for Navajo peoples (Navajo alone or Navajo in combination[2]) living within the Navajo Nation or in Navajo Nation border towns, including Page, Arizona (Navajo Epidemiology Center-Navajo Department of

[2] As defined in NEC-NDOH (2013), the *Navajo alone* consist of individuals who claim to be only Navajo as their race during the 2010 U.S. Census. The *Navajo in combination* include individuals who claim to be Navajo only or individuals who claim to be *Navajo in combination* with another race or tribe.

Health [NEC-NDOH] 2013). As discussed in Gradient (2016), the NEC-NDOH has recently undertaken a multi-year disease surveillance project funded by the Centers for Disease Control and Prevention (CDC) to address the gaps in Navajo Nation specific health data. They are administering a Navajo Behavioral Risk Factor Surveillance Survey (BRFSS) to representative study populations across the Navajo Nation (NEC-NDOH 2014). The results of the Navajo BRFSS will provide baseline and ongoing disease surveillance within the Navajo Nation and will allow evaluations of disease rates within and across the Navajo Nation in ways that previously have not been possible using traditional epidemiological methods. The data collection timeline for the Navajo BRFSS includes three phases, and the survey will be administered to study populations within each of the five agencies, in turn (NEC-NDOH 2014). Data collection for the first phase was conducted in the Chinle Agency and completed in 2013; the final results for the Chinle Agency are available (NEC-NDOH 2015), and relevant findings are incorporated below in the discussion of specific Navajo health conditions.

At the county level, of the 15 counties in Arizona, Navajo County ranks among the unhealthiest in the state as summarized in the **Table 3.16-6** (larger numbers indicate worse health performance). Life expectancy rates are lower, mortality rates are higher, and many behavioral risk factor rates exceed the state averages. The socioeconomic patterns in Navajo County could be responsible for a large part of the discrepancy between the health patterns of Navajo County relative to the rest of Arizona. Navajo County has higher poverty rates, higher unemployment rates, and lower education averages. Behavioral risk factors that contribute to poor community health, such as smoking, obesity, poor diet, and lack of adequate physical activity are more common among communities with lower socioeconomic status, and this association is demonstrated in Navajo County (University of Wisconsin Population Health Institute 2015). The obesity and inactivity rates are higher in Navajo County compared to Arizona as a whole. These behavioral risk factors lead to increases in the prevalence of chronic diseases, such as cardiovascular diseases, stroke, and diabetes, which are among the leading causes of mortality in Navajo County.

Table 3.16-6 Coconino and Navajo Counties Health Ranking within Arizona

County	Coconino					Navajo				
Measure	2010 Report Rank (out of 15)	2012 Report Rank (out of 15)	2013 Report Rank (out of 15)	2014 Report Rank (out of 15)	2015 Report Rank (out of 15)	2010 Report Rank (out of 15)	2012 Report Rank (out of 15)	2013 Report Rank (out of 15)	2014 Report Rank (out of 15)	2015 Report Rank (out of 15)
Health Outcomes (mortality and morbidity)	5	4	5	5	6	14	12	12	12	12
Health Factors (overall)	3	3	4	4	4	11	13	13	12	13
Clinical Care (Uninsured adults, primary care providers rate, preventable hospital stays, diabetic screenings)	4	6	7	6	5	7	10	9	11	10

Table 3.16-6 Coconino and Navajo Counties Health Ranking within Arizona

County	Coconino					Navajo				
Measure	2010 Report Rank (out of 15)	2012 Report Rank (out of 15)	2013 Report Rank (out of 15)	2014 Report Rank (out of 15)	2015 Report Rank (out of 15)	2010 Report Rank (out of 15)	2012 Report Rank (out of 15)	2013 Report Rank (out of 15)	2014 Report Rank (out of 15)	2015 Report Rank (out of 15)
Health Behaviors (tobacco, diet and exercise, alcohol use, high risk sexual behavior)	2	1	1	1	1	9	10	10	10	9
Social and Economic Factors (education, employment, income, family and social support, community safety)	2	4	3	7	5	13	13	14	14	14
Physical Environment (air quality, built environment)	9	5	2	7	9	3	9	9	8	3

Source: County Health Rankings for Arizona (University of Wisconsin Population Health Institute 2015, 2014, 2013, 2012, 2011, 2010).

In contrast to Navajo County, Coconino County ranks among the healthiest in the state as summarized in **Table 3.16-6**. Many of the behavioral risk factors for Coconino County are ranked better than the State of Arizona (University of Wisconsin Population Health Institute 2015).

Rankings from the last 5 years have been fairly consistent for both counties, with the exception of rankings for physical environment, including air quality. The ranking for Navajo County in regard to physical environment have decreased (improved) and those for Coconino County have increased (declined). However, the air quality (specifically particulate matter with an aerodynamic diameter of 2.5 microns or less [$PM_{2.5}$]) was not the factor in the change. The change in the rankings was due mainly to drinking water standard violations and to driving alone, especially during long commutes.

The leading causes of death in Navajo and Coconino counties are summarized in **Table 3.16-7**. Most of the leading causes of death are related to chronic diseases that potentially could be mitigated by healthier lifestyles. Increased physical activity, improved diet, and the cessation of smoking could improve the county rates of obesity and high blood pressure, conditions which lead to some of the chronic diseases listed in **Table 3.16-7**. Some chronic diseases such as cardiovascular disease, chronic lower respiratory disease, and stroke are all potentially associated with particulate inhalation, particularly particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) (see subsection *Health Effects of $PM_{2.5}$* for further discussion).

Table 3.16-7 Leading Causes of Death in Coconino and Navajo Counties

Cause of Death	Coconino County (rate per 100,000)	Navajo County (rate per 100,000)	Arizona State (rate per 100,000)
Major Cardiovascular Diseases (excluding stroke)	105.4	197.8	208.9
Cancer	101	169.3	170.1
Chronic Lower Respiratory Diseases	23.6	35.9	50.1
Accidents	68.5	100.3	47.7
Alzheimer's	13.3	17.5	36.2
Stroke	11.1	39.6	31.1
Diabetes	16.7	45.1	26.5
Suicide	19.2	22.1	17.0
Liver Disease and Cirrhosis	16.2	40.5	15.8
Influenza and Pneumonia	8.8	19.3	11.0

Source: Arizona Department of Health Services (ADHS) 2013.

As listed in **Table 3.16-7**, accidents or unintentional injuries are a large cause of mortality in Navajo County, with accident-related death rates for Navajo County (rate of 100.3 per 100.000) almost double those for Arizona (rate of 47.7 per 100,000). Accidental deaths are those that could be caused by motor vehicle crashes, poisoning, falls, and drowning (ADHS 2013). ADHS (2013) also presents the top 5 leading causes of death among American Indians of Arizona. The leading causes of death among Arizona American Indians (age-adjusted males and females, combined) are as follows: cardiovascular diseases (123 per 100,000); cancer (118 per 100,000); unintentional injury (104 per 100,000); diabetes (65.7 per 100,000) and liver disease and cirrhosis (62 per 100,000). Accidental injuries are the second leading cause of death among male Arizona American Indians, and the leading cause of death for American Indians ages 1 to 44 years (ADHS 2013).

As discussed in Gradient (2016), two reports published by ADHS provide perspective on the health of all Native Americans residing in the state, including Navajo and Hopi residents as well as those of other tribes (ADHS 2015a,b). These reports include observations that mortality rates of Native Americans in Arizona are elevated, relative to other state residents, for alcohol-induced causes, car accidents, diabetes, and unintentional injuries/accidents. Conversely, mortality rates of Native Americans in Arizona are lower on average than those for other state residents for lung cancer, chronic lower respiratory diseases, and heart disease.

According to the Navajo Population Profile (NEC-NDOH 2013), Navajo people are burdened with many health issues such as alcoholism, diabetes, and cancer. From an epidemiological standpoint, most of the current health issues affecting the Navajo people are related to socioeconomic status and social behavior. The Navajo Population Profile (NEC-NDOH 2013) also found that there are more women than men in the Navajo population overall. As the years progress, the higher percentage of women relative to men in the population profile increases. The Profile (NEC-NDOH 2013) indicates that a possible explanation is that males in this age range have a higher mortality rate due to alcoholism, injury, or other preventable diseases.

The Navajo Nation Mortality Report 2006-2009 (Navajo Epidemiology Center no date) reported unintentional injuries as the leading cause of death for Navajo Nation males and females from 2006-2009, accounting for 18.9 percent of all deaths (no age range is provided in the Navajo Nation Mortality Report 2006-2009). Among males, the mortality rate for unintentional injuries is 24.2 percent, nearly twice that of the next leading cause of death (heart disease, 12.5 percent) and accounts for nearly 1 in

4 male deaths. In contrast, unintentional injuries are the fifth leading cause of death in the U.S., and account for only 4.8 percent of all deaths. The age-adjusted mortality rate for unintentional injuries is 126.5 per 100,000 for the Navajo Nation and 37.3 per 100,000 for the U.S. in 2009. Death due to chronic liver disease and cirrhosis is the fifth leading cause of death for the Navajo Nation, accounting for 5.6 percent of all deaths, whereas chronic liver disease and cirrhosis is the twelfth leading cause of death for the U.S. accounting for 1.3 percent of all deaths. The age-adjusted mortality rates for chronic liver disease and cirrhosis are 43.1 per 100,000 and 9.2 per 100,000 for the Navajo Nation and U.S., respectively. **Table 3.16-8** summarizes the leading causes of death among the Navajo Population. Unintentional injuries account for nearly 1 in every 5 Navajo deaths. As reported in Navajo Nation Mortality Report 2006-2009, there are nearly 33 percent and 35 percent more unintentional injury deaths than cancer deaths and heart disease deaths, respectively.

Table 3.16-8 Leading Causes of Death Among Navajo

Rank	Cause of Death[1]	Rate per 100,000	Percent of All Deaths
1	Unintentional Injuries	107.73	18.9
2	Cancer	72.49	12.7
3	Heart Disease	69.48	12.2
4	Diabetes	32.66	5.7
5	Chronic Liver Disease and Cirrhosis	32.09	5.6
6	Influenza and Pneumonia	25.93	4.6
7	Suicide	17.05	3.0
8	Stroke	15.33	2.7
9	Septicemia	12.89	2.3
10	Dementia	12.03	2.1
11	Assault	11.89	2.1
12	Alcohol Dependence Syndrome	11.6	2.0
13	Renal Failure	11.03	1.9
14	Hypertensive Disease	8.45	1.5
15	Chronic Obstructive Pulmonary Disease	7.02	1.2

[1] Data includes both males and females.

Source: Navajo Nation Mortality Report 2006-2009.

Among the Navajo living in the Chinle Agency, a smaller percentage of the population considers that they are in excellent or very good health and a larger percentage considers that they are in fair health compared to the State of Arizona or the U.S. (NEC-NDOH 2013), as summarized in **Table 3.16-9** below. Forty-seven percent of Chinle Agency respondents were classified as obese (by body mass index) compared to 28.9 and 26.8 percent of U.S. and Arizona respondents, respectively. Twenty-seven percent of Chinle Agency respondents indicated that there was a time in the last 12 months when they felt they should see a doctor, but did not. By far the most common reason (34.7 percent) given for not seeing a doctor was an inability to get a ride to the medical facility.

Table 3.16-9 General Health Status Among Chinle Agency, U.S., and Arizona Populations

"Would you say that in general your health is…?"	Response (Age Adjusted Percent)		
	Chinle	U.S.	Arizona
Excellent	13.3	18.6	19.8
Very Good	14.6	33.5	33.0
Good	38.5	30.9	30.5
Fair	29.3	12.5	12.3
Poor	4.3	4.4	4.4

Source: 2013 Navajo Nation Health Survey, Chinle Agency Results (NEC-NDOH 2013).

The Navajo Area Indian Health Service is responsible for the delivery of health services to American Indians in portions of Arizona, New Mexico, and Utah (within a region known as the Four Corners area). The Navajo Area Indian Health Service is primarily responsible for healthcare to members of the Navajo Nation, but care also is provided to other Native Americans including the Hopi Tribe. As discussed in Gradient (2016), the Indian Health Service interactive national map of health facilities identifies healthcare facilities serving the Navajo Nation and Hopi Tribe (U.S. Department of Health and Human Services 2015) and indicates that 1 hospital is present on the Hopi Indian reservation, and 18 health centers, 7 health stations, and 7 hospitals are present within the boundaries of the Navajo Nation. None of these are located within 50 km of the NGS site. There is one hospital located in Page, Arizona, a few miles from the NGS site. Three hospitals and one health center in the Navajo Nation are located within 50 km of the proposed KMC site. One hospital is located in the vicinity of the Black Mesa/Lake Powell Railroad line.

In addition to the western healthcare services offered by the Indian Health Service, Navajo people often seek care from native healers or "medicine people." According to the Chinle Agency results from the 2013 Navajo BRFSS described above, 68.3 percent of Navajo residents in the Chinle Agency visited a native healer or used traditional medicine in the 12-month period prior to the survey (NEC-NDOH 2013).

3.16.4.4.5 Community Health – Diseases

The following sections specifically address current health status in the community for heart disease and stroke, diabetes, asthma, and lung cancer. This discussion compares the incidence of cardiovascular problems, respiratory problems, and lung cancer currently present in the local community as compared to other places in Arizona and the U.S. as a whole. Therefore, this discussion is not a measure of absolute health, but is a measure of whether, for the diseases reviewed, there is a different health pattern in the local community than in the rest of Arizona or the U.S.

3.16.4.4.5.1 Heart Disease and Stroke

The prevalence of heart disease and stroke in Navajo County is higher compared to Coconino County. Approximately 7.2 percent of adults in Navajo County were reported to have suffered a heart attack, which is almost double the 3.6 percent reported for Coconino County; compared to 4.8 percent in Arizona state and 4.4 percent in the Nation (ADHS 2012). Heart disease is the second leading cause of death in Arizona and the leading cause of death in Navajo and Coconino County. Mortality rates in Navajo County for cardiovascular disease (197.8 per 100,000) were almost double the mortality rates for Coconino County (105.4 per 100,000), however they also were slightly lower than Arizona (208.9 per 100,000) (ADHS 2013). Mortality rates among Navajo peoples for cardiovascular disease are significantly lower (69.48 per 100,000) (Navajo Nation Mortality Report, 2006-2009). Heart disease is the

second leading cause of death in Arizona, the leading cause of death in Navajo and Coconino County, and the third leading cause of death among Navajo peoples.

Stroke is the sixth leading cause of death in Arizona and the fifth in the nation. In Navajo County, 4.5 percent of adults have had a stroke, compared to 1.1 percent in Coconino County and 2.9 percent for both Arizona and the Nation (ADHS 2012).[3] Stroke mortality rates among the Navajo peoples (15.3 per 100,000) and in Navajo County (39.6 per 100,000) were considerably higher than stroke mortality rates for Coconino County (11.1 per 100,000) and slightly higher than Arizona (31.1 per 100,000) (ADHS 2013; Navajo Nation Mortality Report 2006-2009).

3.16.4.4.5.2 Diabetes

The 2013 nationwide mortality data and the 2013 Arizona mortality data shows diabetes as the seventh leading cause of death for both the nation and the state (ADHS 2013; CDC 2014). The Navajo Nation Mortality Report, 2006-2009, shows diabetes as the fourth leading cause of death among the Navajo Nation. According to the Arizona Diabetes Burden Report, the age adjusted percentage of adults with diabetes in Arizona has steadily increased from 4.0 percent in 1995 to 8.1 percent in 2010 (ADHS 2011). American Indians in Arizona also were the population of race that had the highest reported percentage of diabetes at 15.8 percent. Diabetes also was found to be more prevalent in populations with lower incomes. Navajo County was reported as having a higher percentage of people diagnosed with diabetes at 15.4 percent when compared to Coconino at 11.7 percent. Both counties were higher than the state and national percentages of 10.6 and 10.2 (ADHS 2012).

3.16.4.4.5.3 Asthma

Limited relevant information was found for assessing asthma prevalence and severity among Navajo Nation or Hopi Tribe members. Arizona State's asthma rates are similar to the national rates. The 2012 Behavior Risk Factor Surveillance Survey showed that 13.5 percent of Arizona adults had asthma compared to 13.2 percent nationally (ADHS 2012). Navajo County has among the highest asthma rates in the state, with an adult rate of 17.2 percent. Coconino County asthma rates are slightly lower than the state and national rates at 12.1 percent. Since 2003, asthma rates in Arizona and the nation have steadily but slowly increased until 2010, at which point asthma rates began to slightly decrease (ADHS 2012).

In Arizona, the prevalence of asthma is higher among lower income populations. Adults with an annual household income less than $25,000 were reported to have higher percentages of asthma than adults with higher income brackets. "Other" (races not named), whites, and Hispanics have the highest percentages of asthma diagnosed. Nationally, black populations have higher asthma rates than whites. The Coordinated Federal Action Plan to Reduce Racial and Ethnic Disparities showed that minority children and children from impoverished families are disproportionately affected by asthma (U.S. President's Task Force 2012). According to the Arizona Comprehensive Asthma Control Plan, there was no statewide survey to accurately determine the number of children in Arizona with asthma. However, using the nationwide survey which utilized U.S. Census data, it was estimated in 2003 that the prevalence rates for pediatric asthma was 2.87 percent of the population for Navajo County and 2.38 for Coconino County (ADHS 2005).

3.16.4.4.5.4 Lung Cancer

Lung cancer is the leading cause of cancer deaths in both Arizona and the nation. In Arizona, lung cancer mortality rates increased from 1980 until 1999, when the trend reversed, and lung cancer mortality rates have declined through 2013. However, lung cancer was the number one cause of cancer

[3] Self-reported lifetime prevalence – Survey respondent answered "yes" to "have you ever been told by a health care professional that you have coronary heart disease (or heart attack, angina, stroke, etc.)."

deaths from 2007 to 2011 in Arizona. In contrast to diabetes, American Indians have the lowest rate of lung cancer in Arizona (ADHS 2013). In 2014, the age-adjusted mortality rate of lung cancer was 42 per 100,000 people in Arizona (ADHS 2013). In Navajo County, the mortality rate (38.6 per 100,000) was slightly lower than the State rate, but in Coconino County the mortality rate (22.1 per 100,000) was considerably lower than the state rate. Air pollution also has been implicated in the development of some lung cancers, but this association is still under study. The USEPA concluded in the 2009 particulate matter evaluation that particle pollution may cause lung cancer (USEPA 2009b).

NEC-NDOH (2010) summarizes the incidence and mortality rates for various types of cancer among the Navajo Nation. Overall, the report indicated a lower or comparable incidence of most cancer types in the Navajo population relative to that in Arizona/New Mexico and the U.S. as a whole. Information from the ADHS (2013) online database also indicated that, based on data from 2005-2009, the incidence of all cancer types in the Navajo Nation was significantly lower than statewide. The reported incidence in the Hopi Tribe was more than twice that for the Navajo Nation, but was only approximately 15 percent greater than incidence in Arizona overall and not statistically significant: 478 per 100,000 (95 percent CI: 395-560). As summarized in Table 3.1, information from the Arizona Health Matters website (Healthy Communities Institute 2015) indicates that the 2012 incidence of all cancers combined in Coconino and Navajo counties was approximately 75 percent of the national incidence rate, while the county incidence rates for lung and bronchus cancer were approximately one-half of the national rates.

3.16.4.4.6 Environment – Air Quality

Section 3.1 provides a detailed assessment of the current air quality conditions in the study area. As described in Section 3.1, criteria air pollutants are monitored at a regional level and at several locations on and near the area of the Proposed Action. Section 3.1 provides a summary of 2011 to 2014 criteria air pollutant results compared to ambient standards for sites in northern Arizona, Southern Utah, extreme northwestern New Mexico (San Juan County), and southwestern Colorado for carbon dioxide monitoring. The data demonstrate that the regional air quality conditions are much better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The overall air quality conditions and air quality related values in the region are generally improving or being maintained.

Section 3.1 also provides a summary of 2011 to 2014 monitored air quality conditions at the proposed KMC compared to ambient standards. The data demonstrate that the local air quality conditions near the area of the Proposed Action are better than the NAAQS for all criteria pollutants.

Gradient (2016) compares 2012-2014 averages of pollutant data for criteria pollutants for the Glen Canyon and proposed KMC ambient air monitors, with corresponding data for a number of cities in the U.S. Southwest and West – Denver, Las Vegas, Los Angeles, Phoenix, Salt Lake City, and San Diego. Gradient (2016) indicates that air quality in the vicinity of the NGS facility and within the proposed KMC facility is either similar to or better than that of many of the major population centers in the U.S. Southwest and West.

Gradient (2016) further compared the current air quality conditions in the study area to other U.S. locales, and reported that the World Health Organization (WHO) also indicate that Coconino and Navajo counties have good air quality relative to other U.S. and worldwide locales. With regard to $PM_{2.5}$ air quality, the American Lung Association (ALA) publication, “State of the Air 2015” (ALA 2015), ranked Coconino County as being among the cleanest in the country. For example, among the more than 600 counties in the U.S. with $PM_{2.5}$ monitors, Coconino County was ranked in the top 25 cleanest U.S. counties for “Year-round Particle Pollution (Annual $PM_{2.5}$).” In addition, having no days when $PM_{2.5}$ levels reached the unhealthful range based on USEPA's Air Quality Index, Coconino County was among the counties listed by ALA as the “Cleanest Counties [in the U.S.] for Short-term Particle Pollution (24-hour $PM_{2.5}$).”

As reported in Gradient (2016), the Flagstaff, Arizona, metropolitan statistical area in Coconino County was listed among the "Top 25 Cleanest U.S. Cities for Year-round Particle Pollution (Annual $PM_{2.5}$)," ranked Number 5, with a design value5 of 5.3 micrograms per cubic meter (µg/m^3). With an overall ranking of #1 based on 24-hour $PM_{2.5}$ concentrations, the Flagstaff, Arizona, metropolitan statistical area is listed among the "Cleanest U.S. Cities for Short-term Particle Pollution (24-hour $PM_{2.5}$)." Finally, Flagstaff is among just 17 U.S. cities ranked as being the top cleanest cities for both year-round and short-term particle pollution. Thus, the ALA assessment does not suggest that NGS emissions have detrimental effects on $PM_{2.5}$ air quality and instead supports Coconino County as being one of the cleanest U.S. counties in terms of particle pollution.

Overall, the analysis of recent air quality data for the criteria air pollutants indicate that NGS and proposed KMC emissions do not result in exceedance of the health-protective NAAQS levels at air quality monitors in or near the Navajo Nation. Concentrations of these criteria air pollutants are general in compliance with NAAQS at the air quality monitors closest to the NGS and proposed KMC facilities. In addition, historical monitoring data indicate that air quality in and near the Navajo Nation has generally been better than today's NAAQS levels.

The existing environment for air quality and deposition, as presented above, already is capturing the effect of the Proposed Action on a regional scale, except for proposed additional controls related to Selective Catalytic Reduction (SCR) installation at NGS or the potential shutdown or curtailment of a unit at NGS. Such changes would act to reduce the impact from current operations, and may lead to further reductions in impacts on air quality and air quality related values in the region.

The release of $PM_{2.5}$ to the air and its possible effects on the local population was selected for evaluation for the reasons described below. PM is a complex mixture of very small particles and liquid droplets. PM can be generated by numerous sources and can be made up of a number of components, including acids, organic chemicals, metals, and soil or dust particles (USEPA 2009b). PM may be emitted directly from a source (i.e., primary particles) or may form in reactions in the atmosphere (i.e., secondary particles). Sources of primary particles include construction sites, unpaved roads, power plants, motor vehicles, mining operations, and biomass combustion (e.g., forest fires and residential wood combustion). Components of secondary particles can originate from sources such as power plants, industries, and vehicle emissions (Stanek et al. 2011; USEPA 2009b).

Following inhalation, deposition and retention of particles in the respiratory tract is strongly dependent upon the size of the particles (Hinds 1999; USEPA 2009b), although other factors, such as particle shape and chemical composition, also play a role. In general, the larger the particle, the higher in the respiratory tract it will be deposited. Particle size is generally described using the aerodynamic diameter of individual particles. Larger particles (i.e., with aerodynamic diameters ≥20 µm) are subject to deposition in the nose and pharynx and removal by nose blowing. Very small particles, with aerodynamic diameters <10 µm and especially <2.5 µm, have greater potential to penetrate to the terminal bronchioles and the alveoli. Because of their ability to reach the deep lung, particles with aerodynamic diameters <10 µm are considered the most likely to cause health effects. USEPA regulates PM in two size fractions, PM_{10} and $PM_{2.5}$, and is considering establishing regulatory criteria for ultrafine particles ($PM_{0.1}$) as well.

USEPA's Integrated Science Assessment for Particulate Matter reviewed a large body of evidence for health effects associated with exposure to PM and established a weight-of-evidence framework for determining causality for certain health effects associated with relevant pollutant exposures (USEPA 2009b). USEPA identified five categories for characterizing available information regarding causality: 1) causal relationship; 2) likely to be a causal relationship; 3) suggestive of a causal relationship; 4) inadequate to infer a causal relationship; and 5) not likely to be a causal relationship. USEPA concluded the following for exposure to $PM_{2.5}$:

- A causal relationship between short-term and long-term exposure to $PM_{2.5}$ and cardiovascular effects has been demonstrated.
- There is likely to be a causal relationship between short-term and long-term exposure to $PM_{2.5}$ and respiratory effects.
- A causal relationship between short-term and long-term exposure to $PM_{2.5}$ and cardiovascular and respiratory mortality has been demonstrated.

In addition, PM exposures have been linked with worsening adverse effects in asthmatics. PM has been potentially linked ("suggestive" rating) with worsening existing cardiopulmonary problems for those with diabetes (USEPA 2009b). Until recently, particulate exposures have not been found to increase the incidence of asthma, only to worsening the condition under certain circumstances; however, some recent studies indicate there may be a causal link between particulate inhalation and an increased incidence of asthma (American Academy of Pediatrics 2004; Guarnieri and Balmes 2014; Patel and Miller 2009; USEPA 2009b). This is an ongoing area of research. In addition, there is evidence that asthmatics and other populations with compromised respiratory systems also may be more susceptible to viral and bacterial respiratory infections during and after increases in air pollution events (Kelly and Fussell 2011; USEPA 2009b).

It is important to note that there are multiple causes of the diseases associated with particulate exposures. Although it is possible that some cases of cardiovascular problems, respiratory problems, lung cancer, and diabetes may be related to or result from $PM_{2.5}$ or be worsened by $PM_{2.5}$ (primarily at air pollution levels that are substantially higher than those expected from the Proposed Action's minimal increase in particulate emissions), most cases of these health problems are associated with other causes, including those found at higher rates in Navajo and Coconino County (e.g., lifestyle factors such as diet, inactivity, and alcohol consumption).

Because the physical and chemical composition of PM is complex and can vary greatly, questions remain as to whether some PM types or specific components pose a greater human health hazard than others (Adams et al. 2015; Wyzga and Rohr 2015). Two specific types of PM associated with NGS-KMC operation, diesel exhaust emissions and coal dust emissions, are discussed in further detail. In addition, the burning of coal in homes, as commonly practiced by Navajo peoples, as a source of particulate matter via indoor air to the Navajo people also is discussed.

3.16.4.4.6.1 Diesel Exhaust Emissions

As described in Gradient (2016), diesel engine exhaust is a complex mixture of thousands of chemical constituents in vapor, gaseous, and particulate phases (International Agency for Research on Cancer 2014; USEPA 2002). Diesel engine exhaust is dominated by products of complete combustion, namely carbon dioxide and water vapor; however, owing to impurities in diesel fuel and conditions that prevent complete combustion, diesel engine exhaust also typically contains smaller amounts of PM (known as DPM or diesel exhaust particulate) and various gaseous substances. Increasingly more stringent emission standards and major advances in diesel engine technologies in the last couple of decades have resulted in dramatic reductions in DPM levels and changes in DPM composition.

Gradient (2016) reviewed the available body of literature relevant to health effects associated with exposure to DPM. Gradient (2016) indicates that a variety of health effects have been linked to elevated DPM exposures, including acute irritant effects (e.g., eye, throat, or bronchial irritation), respiratory symptoms (e.g., cough, phlegm, and wheezing), immunologic effects (e.g., exacerbation of asthma and allergenic responses), lung inflammatory effects, cardiovascular health responses (e.g., clotting or other blood flow restrictions), and cancer (e.g., lung cancer) (Gradient 2016). However, most of the health effects information for DPM exposures is associated with DPM produced through traditional diesel exhaust that is characteristic of older diesel engines. Gradient (2016) reports that although relatively few health effects studies have assessed new technology diesel exhaust (i.e., exhaust from post-2006, low

emission, advanced-technology diesel engines), recent studies indicate that health risks posed by new technology diesel exhaust are less than those observed for traditional diesel exhaust, and recent findings indicate that new technology diesel exhaust is not carcinogenic.

3.16.4.4.6.2 Coal Dust Emissions

Coal dust consists of small fragments of coal that can be generated when coal is handled, stored, and transported. As with other particulate matter sources, coal dust is a complex mixture, with its toxicity depending on chemical composition and the size of the dust particles. Coal's chemical composition varies across the geographic regions from which it is mined; consequently, coal dust composition also varies. Chemical components potentially toxic to humans include silica, polycyclic aromatic hydrocarbon compounds, and trace metals, such as arsenic, lead, copper, iron, mercury, and selenium. Metals concentrations in coal dust are typically low. For example, the Montana Bureau of Mines and Geology recently analyzed coal samples from the Otter Creek coal bed in Montana and reported concentrations of various metal elements mostly in the range of a thousandth of a percentage or less by mass (U.S. Department of Transportation 2015). Metals and polycyclic aromatic hydrocarbon compounds are found in a similar concentration range in coal samples collected at the proposed KMC site (Ramboll Environ 2016b). As described above, the health risks of airborne PM depend strongly upon particle size, which determines how well particles penetrate and are retained in the respiratory tract, where they are deposited and/or transported, and where and to what extent they are absorbed. Thus, in addition to any chemical-specific toxicity, the size of individual dust particles also plays an important role in the toxic potential of coal dust. The particle sizes of coal dust emissions will vary depending on the source materials, the processes leading to the emissions, and the distance from the emission source. Based on information regarding the average sizes of uncontrolled particle emissions resulting from handling and processing of ores, like coal, it has been estimated that most coal dust emissions are likely to be generated during bulk coal handling and storage, and that typically approximately half of the particles would be in the PM_{10} size range, and only approximately 15 percent would be in the $PM_{2.5}$ size range (Ramboll Environ 2016b; USEPA 1995).

Furthermore, particle size and shape determines the potential for and extent of particle transport. As particle size increases, particles are less likely to be lifted into the air and, once airborne, are less likely to stay suspended. In general, the potential for coal dust exposure decreases with increasing distance from the emission source.

Relatively little toxicology and epidemiology research has been conducted to evaluate coal dust toxicity. Most research regarding the potential health effects of coal dust exposure has focused on occupational settings, specifically those of coal miners exposed to dust in above-surface or underground coal mines. Underground miners typically are exposed to very high concentrations of airborne coal dust for many hours per day over years of employment. As reported in Gradient (2016), these concentrations are orders of magnitude greater than the highest airborne dust concentrations that would be expected in non-occupational settings (National institute for Occupational Safety and Health 2011; Pless-Mulloli et al. 2001). Gradient (2016) explored, in depth, the available literature relating to toxicity associated with exposure to coal dust. Taken together, Gradient (2016) reported that the studies suggest that chronic exposure to coal dust at exposure levels as high as the federal permissible limit results in low overall toxicity.

3.16.4.4.6.3 Indoor Burning of Coal and Wood

An additional source of local Navajo PM exposure and health information (in relation to nearby coal mines) is a research study titled “Navajo Coal Combustion and Respiratory Health Near Shiprock (Bunnell et al. 2010). The U.S. Geological Survey-supported study addressed the issue of coal burning in homes as a source of particulate matter via indoor air to the Navajo people. Two power plants, Arizona Public Service Company Four Corners Power Plant and Public Service of New Mexico San Juan Generating Station, located near Shiprock, New Mexico together consume the second largest amount of coal in the nation. The coal mines, Navajo Mine Complex and San Juan Generating station that supply

Four Corners Power Plant and San Juan Generating Station, respectively, are located adjacent to the plants. The Navajo Mine Complex is leased from the Navajo Nation. Shiprock is considered unique on the reservation because atmospheric thermal inversions trap air pollution low to the ground, which tend to create a thick layer of smog most often during winter.

Significant amounts of coal are still used for home heating and cooking by the Navajo people. Though, a survey conducted during the mid-1990s reported that coal is used primarily for heating rather than for cooking in the Shiprock area (Los Alamos National Laboratory and Navajo Community College 1997). Compared to the general U.S. population, American Indians suffer disproportionately from respiratory morbidity. Based on the unique properties of Shiprock and published health studies (Morris et al. 1990; Robin et al.1996), the Shiprock study was performed to support the hypothesis that indoor air quality is a factor associated with respiratory illness among the Navajo.

Key factors that influence exposure potential associated with indoor wood and coal combustion include the type and condition of the stove and associated venting, whether the fuel is used for heating and/or cooking, and the type of coal:

- Emissions are higher for stoves that are not functioning properly and/or are not properly vented. In studies of the Shiprock area, stoves used for burning wood and coal were found to have a number of characteristics that would tend to increase emissions. Specifically, some stoves were homemade, at least 10 years old, not properly vented or not vented to a chimney, and/or vented to a chimney with visible cracks (Charley 2013; USEPA 2014).
- Both the duration and intensity of exposure differ depending on whether the fuel is used for cooking or heating. Although use of a specific fuel type for heating may be associated with a longer exposure duration, its use in cooking is associated with higher peak exposures, especially for women and children involved in cooking activities (who may be in closer proximity to the stove during such activities). A survey conducted during the mid-1990s reported that coal is used primarily for heating rather than for cooking in the Shiprock area (Los Alamos National Laboratory and Navajo Community College 1997).
- Different types of coal (e.g., bituminous vs. anthracite) may differ in composition. Whereas bituminous coal has a higher sulfur content, anthracite coal has a higher carbon content (Gordon et al. 2014). The coal available regionally in the vicinity of the Environmental Impact Statement study area is low-sulfur bituminous coal (Ramboll Environ 2016b).

The Shiprock study found that respiratory disease/conditions increased in the winter as compared to summer even though power plant emissions were greater in the summer months. The study also noted that the smoke from residential chimneys used for heating was a likely significant factor to the observed thick brown smog that indicates heavy air pollution. The Shiprock study quantified $PM_{2.5}$ levels and chemically characterized particulate matter inside homes of Navajo Nation residences. Many residents were exposed to $PM_{2.5}$ levels greater than the USEPA 24-hour standard for ambient air; most likely due to the combustion of wood and coal for home heating purposes. The research also found that one-quarter of the stoves used for coal combustion were not designed to operate at the higher temperatures required for burning coal. A comparison of both organic and trace elements indoors versus outdoors also suggested indoor coal use increased human exposure and may be a factor to Navajo respiratory health problems. The results of the Shiprock study suggests that respiratory disease/conditions risks could be reduced by changing methods of home heating such as upgrading or exchanging old stoves or opening controllable dampers in chimneys. Another factor that affected $PM_{2.5}$ levels in the study was the number of windows in a residence; better ventilated homes resulted in lower measurements of fine particulate concentrations.

Gradient (2016) includes a comprehensive compilation of the available data on the potential health impacts associated with indoor coal burning practices. The Shiprock study has provided data that wood and coal burning within a house may contribute to poor indoor air quality and therefore may be

promoting respiratory health risks. However, additional studies directly linking indoor $PM_{2.5}$ concentrations and respiratory health outcomes in coal burning versus non-coal burning households are needed to resolve this issue conclusively.

Many American Indian residents living near the proposed KMC, including members of the Navajo Nation, use coal for heating homes. Coal used for home heating and cooking comes from many sources throughout the Navajo Nation. PWCC provides coal at no cost to Navajo tribal members living near the mine. Navajo tribal members living further away from the mine must pay for coal obtained from the mine. A pamphlet developed by PWCC describing safety tips for proper in-home use is available for residents who obtain coal from PWCC.

3.16.5 Environmental Consequences

3.16.5.1 Issues

The estimation of potential risks to human health receptors located in the study areas based on air emissions due to the Proposed Action and the impact of the Proposed Action on public health issues are evaluated in this section.

3.16.5.2 Assumptions and Impact Methodology

3.16.5.2.1 Human Health Risk Assessment

The analysis method for the HHRAs consist of the following:

- Identify the key chemicals of potential concern for the NGS and proposed KMC sites;
- Analyze the impact on exposure media by deriving exposure point concentrations for each medium;
- Evaluate the potential adverse health effects from chemicals of potential concern;
- Assess the potential cumulative impacts from the Proposed Action combined with past, present, and reasonably foreseeable projects; and
- Determine impact to human health receptors based on magnitude of cancer risk estimates and noncancer HIs, i.e., acceptable risk estimates are associated with negligible impact on human receptors.

3.16.5.2.2 Public Health

In assessing the potential for health impacts due to the Proposed Action, the health categories selected and described in the affected environment discussion in Section 3.16.4 are evaluated in this section. The magnitude of the health impact is assessed. In assessing the magnitude of the impact (high, medium, low, or none), several factors are evaluated: the level of consequence, the duration of the exposure, and the number of people potentially affected. In addition to categorizing the strength of the impacts, effects are categorized as positive or negative. Each impact category is defined on **Table 3.16-10**.

Table 3.16-10 Definitions of Health Impact Categories

Impact	Positive Effect	Negative Effect	Mitigation
None	No discernible or measurable impacts		None
Low	Low level quality-of-life impacts, low/short exposures, limited area/people affected	Low level quality of life impacts, low/short exposures, limited area/people affected	Mitigation measures possible
Medium	Significant quality-of-life enhancement, or reduce	Exacerbations of existing illness, reduction in quality of	Mitigation measures possible, but minor residual negative

Table 3.16-10 Definitions of Health Impact Categories

Impact	Positive Effect	Negative Effect	Mitigation
	exacerbation of existing illness, or reduce disease incidence; Moderate, intermittent, exposures, relatively localized	life (e.g., increase in "nuisance" factors such as noise/odors); Moderate, intermittent, exposures, relatively localized	effects may remain
High	Prevent deaths/prolong life	Increase deaths, increase chronic or acute diseases, increase mental ill health; High/long duration exposures, over a wide area	Mitigation measures possible, but residual negative effects may remain

Source: International Council on Mining and Metals (ICMM) 2010.

As described in ICMM (2010), when analyzing the overall public health impact, the magnitude of the consequence is combined with the likelihood that the consequence will occur. There is no universally agreed upon formula for assessing overall public health impact (ICMM 2010). Characterization of public health effects relies on qualitative and quantitative evidence (NRC 2011) and the assessments of the magnitude of the impact or likelihood of occurrence are often based on a subjective judgement (ICMM 2010). As recommended in NRC (2011) and ICMM (2010), a matrix can be a useful way to organize the results of the public health analysis and to convey results of the overall public health impacts in a manner that is easy to understand. The matrix is supplemented in the following sections with clear explanation of the evidence used to develop the ratings in each public health category. Overall impact rating on public health is assigned using the following matrix, which was adapted from ICMM (2010) and (NRC 2011). The characterization of the magnitude or consequence of action is determined by using the descriptions of public health impact categories provided in **Table 3.16-10**. The number of persons affected and the spatial impact is considered when determining the magnitude of action.

3.16.5.3 Proposed Action

3.16.5.3.1 Human Health Risk Assessment

3.16.5.3.1.1 Navajo Generating Station HHRA

Due to the various uncertainties described in Chapter 2.0, the future operation of NGS may range across a number of generation scenarios. A set of reasonably foreseeable future operation scenarios were modelled to capture the highest and lowest potential environmental impacts from air emissions.

The scenarios with the highest (3-Unit Operation) and lowest (2-Unit Operation) nitrogen oxides emissions were selected.

<u>Exposure to NGS 3-Unit Operation Emissions</u>

A HHRA evaluating potential human health impacts due to exposures to chemicals of potential concern emitted from the NGS at levels representing a total output of 2,250 MW between 2020 and 2044 (i.e., 3-Unit Operation HHRA) in the study area (within 50 kilometers [km] of NGS) is described in this section.

The chemicals of potential concern quantitatively evaluated in the 3-Unit Operation HHRA include metals, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, polycyclic aromatic hydrocarbons, volatile organic compounds, DPM, diphenylmethyl, and some other inorganics. Cyanide was removed from the original NGS chemicals of potential concern list because it was not found in the emission inventory from the facility. Additional discussion on the removal of cyanide from the NGS chemicals of potential concern list is provided in the NGS HHRA (Ramboll Environ 2016a). Exposure

point concentrations for chemicals of potential concern in air were based on model-predicted air concentrations provided by the near-field air modeling (Ramboll Environ 2016a). Exposure point concentrations for chemicals of potential concern in soil, surface water, sediment, homegrown produce, livestock, fish, and breast milk were estimated following methodology recommended in the HHRAP (USEPA 2005) based on air concentrations and deposition rates predicted by the near-field air modeling.

Emission modeling was conducted for years 2020 and 2030 representing pre-SCR and post-SCR conditions, respectively. The emissions for affected sources and chemicals of potential concern are different between pre-SCR and post-SCR conditions (Ramboll Environ 2016a). The HHRA conservatively uses the higher emissions in exposure point concentration estimation and risk characterization.

The near-field air dispersion and deposition modeling was used to assess the ambient air concentrations and deposition rates, which were then used to estimate media concentrations for chemicals of potential concern in the HHRA. In accordance with recommendations in the HHRAP guidance, AERMOD was used in this analysis. The modeled emission sources included the three 750-MW electric generating units and associate ancillary sources, fugitive dust sources (e.g., from ash disposal area), and on-road/off-road mobile sources at NGS. Buildings and other large structures also were incorporated in the model in case the plumes emitted from stacks were influenced by the aerodynamic wakes caused by nearby structures. The parameters used to characterize each emission source (e.g., stack height, air flow rates) and details of the modeling scenarios are described in the Near-field Dispersion and Deposition Modeling Protocol (Ramboll Environ 2016d).

Air concentrations for each chemical of potential concern were predicted by the near-field air modeling at each modeled receptor location. Chemicals of potential concern concentrations in soil, produce, livestock, and breast milk were estimated for each receptor location using HHRAP methodology based on near-field air modeling predicted air concentrations and deposition rates. Chemicals of potential concern concentrations in surface water, sediment, and fish tissue were not modeled for each receptor location within the waterbody because surface water is a dynamic system. Instead, the chemicals of potential concern concentrations were estimated to represent the whole waterbody based on the overall load calculated using average dispersion factors and deposition rates over the waterbody or the associated watershed following the recommended approach from HHRAP. The model-predicted exposure point concentrations for soil, surface water, and sediment used in the 3-Unit Operation HHRA generally are a few orders of magnitude lower than the field sampling data collected in the summer of 2014 for the baseline HHRA to evaluate the affected environment. It was concluded that the chemicals of potential concern concentrations detected near the vicinity of NGS likely are naturally occurring and the contribution from NGS is minimal.

NGS 3-Unit Operation HHRA Results

The 3-Unit Operation HHRA evaluated the human health impact from chemicals of potential concern solely emitted from NGS under the 3-Unit Operation (excluding baseline) in two zones within the NGS study area, the 0- to 20-km zone and the 20- to 50-km zone. There is a significant decreasing trend in near-field air modeling predicted air concentrations and deposition rates along the distance from NGS. Environmental medium concentrations predicted in the 0- to 20-km zone are much higher than those predicted in the 20- to 50-km zone; consequently, the human health impact within the 0- to 20-km zone was quantitatively evaluated. The human health impact within the 20- to 50-km zone was expected to be much lower than the 0- to 20-km zone and was therefore not quantitatively evaluated (Ramboll Environ 2016a).

As presented in **Table 3.16-11**, the results of the 3-Unit Operation HHRA predicted that the excess lifetime cancer risks due to emissions from NGS at a total output of 2,250 MW levels for each receptor evaluated in the HHRA were within the acceptable USEPA cancer risk range of 1×10^{-4} to 1×10^{-6}. For noncancer effects, the 3-Unit Operation HHRA reported all HIs less than the benchmark of 1. The

estimated average daily doses for infants exposed to dioxins/furans through ingestion of breast milk were well below the national average background exposure level of 60 kilogram/day toxic equivalency quotient. As presented in **Table 3.16-12**, the estimated blood lead concentrations were well below both the USEPA target blood lead level of 10 µg/dL and the CDC reference blood lead level of 5 µg/dL. Given the degree of conservatism purposefully built into the risk assessment methods and benchmarks, the results of the 3-Unit Operation HHRA concluded that negligible impact on human health was identified in the vicinity of NGS based on this future scenario because potential risks to human health were considered acceptable, and required no further evaluation.

Exposure to NGS 2-Unit Operation Emissions

A HHRA evaluating potential human health impacts due to exposures to chemicals of potential concern emitted from the NGS at levels representing a total output of 1,500 MW between 2020 and 2044 (i.e., 2-Unit Operation) in the Near-field study area (within 50 km) of NGS is described in this section.

NGS 2-Unit Operation HHRA Results

Similarly to the 3-Unit Operation HHRA, the 2-Unit Operation HHRA quantitatively evaluated the potential human health impact from chemicals of potential concern solely emitted from NGS under the 2-Unit Operation within the 0- to 20-km zone. The human health impact from chemicals of potential concern within the 20- to 50-km zone was expected to be much lower than the 0- to 20-km zone and was therefore not quantitatively evaluated (Ramboll Environ 2016a).

As presented in **Table 3.16-11**, the results of the NGS 2-Unit Operation HHRA (1,500 MW) predicted that the excess lifetime cancer risks due to emissions from NGS at a total output of 1,500 MW levels at the location representing the maximally exposed individual were within the acceptable USEPA cancer risk range of 1×10^{-4} to 1×10^{-6}. For noncancer effects, the 2-Unit Operation HHRA) reported all HIs less than the benchmark of 1. The estimated average daily doses for infants exposed to dioxins/furans through ingestion of breast milk were well below the national average background exposure level of 60 kilogram/day toxic equivalency quotient. As presented in **Table 3.16-12**, the estimated blood lead concentrations were well below both the USEPA target blood lead level of 10 µg/dL and the CDC reference blood lead level of 5 µg/dL. Given the degree of conservatism purposefully built into the risk assessment methods and benchmarks, the results of the 2-Unit Operation HHRA concluded that negligible impact on human health was identified in the vicinity of NGS based on this future scenario because potential risks to human health were considered acceptable and required no further evaluation. The NGS baseline HHRA results are presented in **Table 3.16-11** and **Table 3.16-12** for comparison purposes. In general, the 3-Unit Operation and 2-Unit Operation HHRA results (cancer risk estimates, HIs, breast milk average daily doses, and estimated blood lead concentrations) were less than those for the baseline HHRA.

Additional risk scenarios included for evaluation as part of the Proposed Action include the potential human health impacts from proposed KMC emissions under the 8.1 million tpy scenario (the more conservative scenario between the two proposed KMC future operation scenarios) on the sensitive receptors located within the study area of NGS. This scenario was evaluated based on the proposed KMC air modeling results for the 8.1 million tpy scenario at the overlap area of NGS and proposed KMC air modeling domains and combined with the impacts of the NGS 3-Unit Operation HHRA results.

Table 3.16-11 Comparison of NGS Baseline and Proposed Action HHRA Results

Receptor	Cancer Risk			Hazard Index			Breast Milk Average Daily Dose (pg/kg-bw/day)		
	Baseline	3-Unit	2-Unit	Baseline	3-Unit	2-Unit	Baseline	3-Unit	2-Unit
Resident	2E-06	3E-06	2E-06	0.1	0.06	0.04	0.27	0.00024	0.00016
Resident-Gardener	5E-06	3E-06	2E-06	0.7	0.06	0.04	0.45	0.00046	0.0003
Resident-Farm Family	4E-05	4E-05	4E-05	0.8	0.2	0.2	1.9	0.0057	0.0038
Recreational User	4E-06	3E-08	3E-08	1.2[1]	0.01	0.01	NA	NA	NA
Commercial Worker	5E-07	9E-06	9E-06	0.02	0.05	0.04	NA	NA	NA
Benchmark[2]	1E-04 to 1E-06			1			60		

[1] The HI of 1.2 for the child recreational user is due to exposure to methyl mercury via the consumption of fish.

[2] Cancer risk estimates within or less than the benchmark cancer risk range are considered acceptable and require no further evaluation. HIs less than the target HI of 1 are considered acceptable and require no further evaluation. For dioxins and furans in breast milk, an average daily dose less than 60 pg/kg-bw/day is considered acceptable and requires no further evaluation.

pg/kg-bw/day = picograms per kilogram body weight per day.

Table 3.16-12 Comparison of NGS Baseline and Proposed Action Blood Lead Model Results

Receptor	Geometric Mean of Blood Lead Level (µg/dL)			Percent >10 µg/dL		
	Baseline	3-Unit	2-Unit	Baseline	3-Unit	2-Unit
Resident	0.84	0.75	0.75	<0.001	<0.001	<0.001
Resident-Gardener	0.82	0.71	0.7	<0.001	<0.001	<0.001
Resident-Farm Family	0.95	0.69	0.69	<0.001	<0.001	<0.001
Benchmark[1]	5 (CDC Reference Blood Lead Level) 10 (USEPA Benchmark Blood Lead Level)					

[1] If receptor modeled lead levels are less than the CDC (5 µg/dL) and USEPA (10 µg/dL) blood lead level benchmarks, then modeled blood lead levels are considered acceptable and require no further evaluation.

CDC = Centers for Disease Control.

µg/dL = micrograms per deciliter.

As presented in **Table 3.16-13**, the potential risk from NGS Baseline and Future NGS 3-Unit Operation + proposed KMC 8.1 million tpy at NGS HHRA results predicted that the excess lifetime cancer risks were within the USEPA acceptable cancer risk range (1×10^{-4} to 1×10^{-6}). The noncancer HIs were less than or equal to the USEPA target HI of 1 for all NGS receptors. The estimated chronic HIs ranged from 0.05 to 0.2 at the maximum exposed individual for child residents, child resident gardeners, child resident farmers, and commercial workers due to combined NGS and proposed KMC impacts. NGS contributes approximately 99 percent of the NGS and proposed KMC combined impact (Ramboll Environ 2016a). The results of the Baseline and Future Operation HHRA concluded that negligible impact on human health was identified in the vicinity of NGS.

The proposed KMC impact to the recreational users within the NGS study area was not evaluated because the recreational users are mostly located near the Lake Powell and Colorado River areas, to the north and west of NGS. The overlapping area of proposed KMC and NGS modeling domain is about 50 km southeast of NGS and is outside the ranges of the waterbodies and watersheds analyzed in the HHRA. The impact from proposed KMC is extremely low for the recreational users at extended distance from proposed KMC and therefore was considered negligible. Future operation contributes to approximately 52 percent of the total estimated cancer risk. The chronic HI for the child recreational user is equal to 1. The risk from the baseline scenario contributes to more than 99 percent of the total noncancer HI for recreational users under this scenario.

Table 3.16-13 NGS HHRA Results: Baseline and Future Operations

Receptor	NGS Baseline		NGS 3-Unit Operation		Proposed KMC 8.1 million tpy		NGS-KMC 8.1 million tpy at NGS		Baseline + Future Operation	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Resident	2E-06	0.1	3E-06	0.06	4E-08	0.0002	3E-06	0.06	5E-06	0.2
Resident-Gardener	5E-06	0.7	3E-06	0.06	4E-08	0.0002	3E-06	0.06	8E-06	0.8
Resident-Farm Family	4E-05	0.8	4E-05	0.2	4E-08	0.0002	4E-05	0.2	8E-05	1
Recreational User	4E-06	1.2[1]	3E-08	0.01	NA	NA	3E-08	0.01	4E-06	1.2[1]
Commercial Worker	5E-07	0.02	9E-06	0.05	9E-09	0.00005	9E-06	0.05	1E-05	0.07

[1] The HI of 1.2 for the child recreational user is due to exposure to methyl mercury via the consumption of fish.

For the risk scenario of the NGS baseline combined with the NGS 2-Unit Operation HHRA, all cancer risk estimates were within the USEPA acceptable cancer risk range. All HI estimates were equal to or less than the target USEPA benchmark of 1. Because the potential cancer and noncancer risks to all human receptors were considered acceptable, the impact to human health is negligible.

Key uncertainties associated with the calculations and assumptions used in the NGS Future Operation HHRAs are similar to those associated with the NGS baseline HHRA: COPC selection, toxicity values (particularly the unit risk factor for DPM), estimation of EPCs, exposure parameters, exposure pathways. Because of the inherent health-protective nature of the assumptions used in the Future Operation HHRAs, the analyses are likely to result in overestimates of exposure and ensure protectiveness of human health in the overall assessment.

3.16.5.3.1.2 Proposed Kayenta Mine Complex – Proposed Action Risk Case

Potential health risks associated with fugitive dust and emissions related to mining activity are the focus of the proposed KMC HHRA under the Proposed Actions scenarios: 8.1 million tpy (to support NGS 3-Unit Operation) and 5.5 million tpy (to support NGS 2-Unit Operation). Potential risks from airborne chemicals of potential concern were evaluated quantitatively on a site-wide basis, while potential risks for the soil and food exposure pathways were evaluated qualitatively because soil concentrations attributable to mining 8.1 million tpy and 5.5 million tpy were very small.

For the proposed KMC 8.1 million tpy scenario, soil concentrations derived from mining activities were based on deposition of fugitive dust modeled for each phase of mining activity at the proposed KMC. Deposition for each phase was based on a representative year for each of the three phases of mining operations identified for 8.1 million tpy; 2027, 2034, and 2042. Total suspended particulate and PM_{10} chemicals of potential concern concentrations were based on source concentration data for overburden and coal obtained from the 2014 sampling program. Steady state soil concentrations for 8.1 million tpy for each phase were calculated based on HHRAP equations. For quantitative analysis of proposed KMC air impacts, 95 percent upper confidence limits were used. DPM air concentrations were modeled by McVehil-Monnett Associates, Inc. (2016).

For the proposed KMC 5.5 million tpy scenario, soil concentrations derived from mining activities were based on deposition of fugitive dust modeled for each phase of mining activity at proposed KMC. Deposition for each phase was based on a representative year for each of the four phases of mining operations identified for 5.5 million tpy; 2022, 2027, 2036, and 2043.Total suspended particulate and PM_{10} chemicals of potential concern concentrations were based on source concentration data for overburden and coal obtained from the 2014 sampling program. Steady state soil concentrations for 5.5 million tpy for each phase were calculated based on HHRAP equations. For quantitative analysis of proposed KMC air impacts, 95 percent upper confidence limits were used.

<u>Proposed KMC HHRA Results</u>

The proposed KMC 5.5 million tpy scenario represents the lower end of the range of potential emissions from the Proposed Action in terms of coal extraction rate. There was virtually no difference in cancer risk estimates and HIs for the 8.1 million tpy compared to the 5.5 million tpy. As presented in **Table 3.16-14**, the cancer risk estimates for the receptors from the 5.5 million tpy and 8.1 million tpy were 2.0×10^{-6} and at the lower end of the USEPA acceptable cancer risk range. The HIs under the 5.5 million tpy and 8.1 million tpy scenario were 0.02 and less than the USEPA target HI of 1. Because the cancer and noncancer risk estimates were below the benchmark values, they required no further evaluation.

Table 3.16-14 Comparison of Proposed KMC Baseline to Proposed Action Risk Cases for Resident, Gardener, and Farmer Exposure Scenarios

Risk Case	Baseline		8.1 million tpy		5.5 million tpy		NGS at Proposed KMC (3-Unit Operation)		NGS at Proposed KMC + 8.1 million tpy		Baseline + NGS at Proposed KMC + 8.1 million tpy	
	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]
Resident	6E-06	0.9	2E-06	0.02	2E-06	0.02	3E-08	0.005	2E-06	0.02	8E-06	0.9
Resident -Gardener	9E-06	1.1[3]	2E-06	0.02	2E-06	0.02	3E-08	0.005	2E-06	0.02	1E-05	1.1[3]
Resident-Farm Family	2E-05	1.9[4]	2E-06	0.02	2E-06	0.02	3E-08	0.005	2E-06	0.02	2E-05	1.9[4]

[1] Cancer risk estimates within or less than the benchmark cancer risk range are considered acceptable and require no further evaluation.

[2] HIs less than or equal to the target HI of 1 are considered acceptable and require no further evaluation.

[3] A HI of 1.1 for the resident gardener child exceeded the target HI of 1 and required further evaluation consisting of a target organ analysis. The conclusions of the target organ analysis performed for the resident farmer child also apply to the resident gardener child.

[4] A HI of 1.9 exceeded the target HI of 1 and required further evaluation consisting of a target organ evaluation. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HIs were acceptable, a similar evaluation was not performed for any other scenario or receptors.

Potential impacts from NGS emissions on the proposed KMC permit area were evaluated at a grid cell located 80 km from NGS and approximately 50 km from the center of the proposed KMC (**Figure 3.16-4**). The impacts at that location were conservatively assumed to occur across the entire proposed KMC at those concentrations.

As presented in **Table 3.16-14**, the estimated cancer risks for chemicals of potential concern from NGS emissions modeled to the proposed KMC permit boundary from particulate matter with an aerodynamic diameter of 10 microns or less for the 3-Unit Operation NGS scenario were 3×10^{-8}, which is less than the USEPA cancer risk range of 1×10^{-4} to 1×10^{-6}.

The chronic HI for a proposed KMC resident from airborne NGS emissions during future operation is 0.005 for the 3-Unit Operation NGS scenario. These cancer and noncancer risks are below benchmark values and have negligible impact on human health.

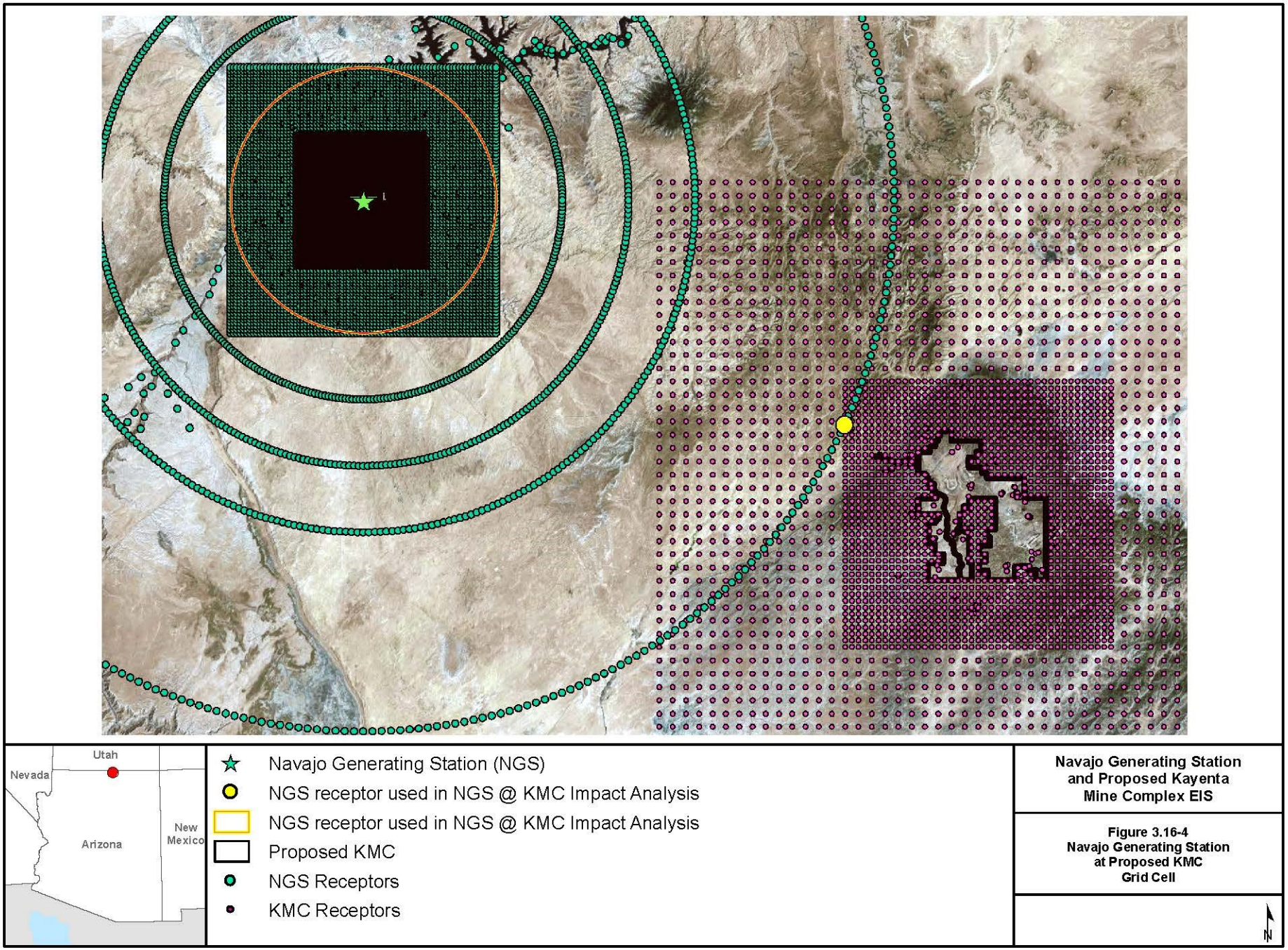
As presented in **Table 3.16-14**, the estimated cancer risks for chemicals of potential concern from NGS emissions modeled to the proposed KMC permit boundary in combination with the proposed KMC 8.1 million tpy scenario were 2×10^{-6}, which is within the USEPA cancer risk range of 1×10^{-4} to 1×10^{-6}. The addition of baseline to the NGS emissions modeled to the proposed KMC permit boundary in combination with the proposed KMC 8.1 million tpy scenario increases the risk estimates slightly but they are still within the USEPA cancer risk range of 1×10^{-4} to 1×10^{-6}. These cancer risk estimates are below benchmark values and have negligible impact on human health.

The chronic HIs for a proposed KMC resident from airborne NGS emissions during future operation plus the addition of the proposed KMC 8.1 million tpy scenario are 0.02 for the 3-Unit Operation NGS scenario. As presented in **Table 3.16-14**, the addition of baseline to the NGS emissions modeled to the proposed KMC permit boundary in combination with the proposed KMC 8.1 million tpy scenario increases the HIs to slightly above the target HI of 1 for the resident gardener and the resident farmer. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated that all target organ HIs were acceptable, a similar evaluation was not performed for any other scenario or receptors. These noncancer risk estimates are below benchmark values and have negligible impact on human health.

Lead is evaluated separately for the 5.5 million tpy and 8.1 million tpy options for noncancer health risk using the USEPA's IEUBK model (USEPA 2010). Predicted average air lead concentrations across the site over all phases of mine operations are 0.000006 $\mu g/m^3$ and 0.0000083 $\mu g/m^3$ for the 5.5 million tpy and 8.1 million tpy options, respectively. The National Ambient Air Quality Standards lead standard is 0.15 $\mu g/m^3$. Based on these data, the IEUBK model predicted no quantitative impact on child blood lead levels (<10µg/dL) even for the resident farmer child exposure scenario, which is the highest exposure scenario. The probability of a child's blood lead exceeding the CDC reference level (5 µg/dL) for the proposed KMC is less than 0.0001 percent.

<u>Uncertainty Analysis – Proposed Action Risk Case</u>

The primary source of uncertainty for the Proposed Action risk case was the Inhalation Unit Risk (IUR) factor for DPM that was used to calculate cancer risks. USEPA has not established an IUR for DPM. The IUR developed by California Environmental Protection Agency was selected for use in the proposed KMC HHRA as the IUR with the best estimate currently available. There is considerable uncertainty surrounding this IUR and alternative DPM IURs proposed by a variety of sources could potentially increase or decrease the Proposed Action risks by a factor of up to 10 fold. However, even if the DPM IUR were to change by a factor of 10, the Proposed Action cancer risk estimates would still be within the acceptable regulatory risk range.



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Another potential source of uncertainty for the Proposed Action risk case was the air modeling used to estimate potential COPC air concentrations from proposed KMC mining activities. Air models used to support the proposed KMC HHRA are complex and rely on key assumptions such as estimated emission rates, meteorological conditions, and transport mechanisms to estimate airborne concentrations of COPCs. The models used for the proposed KMC HHRA are recommended by USEPA and are generally based on conservative assumptions. In most cases, site-specific assumptions regarding emission rates were either worst-case or above-average and inhalation EPCs were therefore more likely to over-estimate than underestimate exposures. The uncertainty associated with the air models for the proposed KMC HHRA is probably best described as low to moderate.

The potential cancer risk estimates and noncancer HIs are likely over-estimated due to the conservative approach used in the proposed KMC HHRA to evaluate impacts on proposed KMC residential areas from NGS emissions. COPC estimated concentrations were modeled to a point that was 15 km from the proposed KMC lease boundary and used to calculate cancer risks and noncancer HIs for residents based on these air concentrations. The impact of this source of uncertainty is a slight overestimate of risks, since NGS emissions were already quite low at the modeling grid cell and concentrations would be expected to decrease slightly as the distance from NGS increased.

3.16.5.3.1.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

The communication sites include propane-fired backup generators that provide backup power. Many of the sites are operated and maintained by other users. Given the relatively infrequent testing that is applied to these facilities, the remote locations, and the relatively low emission rates associated with propane-fired units, the air quality emissions and impacts on existing air quality conditions are assumed to be minimal and therefore, the impact on human health would be negligible. Maintenance activities for the communication sites, transmission lines, and access roads would include vehicle traffic (vehicle exhaust and fugitive dust from unpaved roads), but the maintenance activities would be infrequent, short duration, and/or localized. For example, transmission line structure maintenance and repair would occur on an as-needed basis, routine actions such STS vegetation clearing would occur once every 5 years or more infrequently depending on need, repair of STS access roads and WTS and STS transmission tower infrastructure would occur along localized sections of the lines or roads, and annual maintenance of WTS access roads would occur once or twice a year but equipment would move through the areas quickly. Therefore, emissions of future operations are considered minimal, and because these impacts are infrequent, short duration, and localized, and thus cause very little effect, the human health impacts are considered negligible.

3.16.5.3.2 Public Health

This section addresses the public health impacts associated with the proposed power plant and mine operations. **Table 3.16-1** summarizes the approach to evaluating public health impacts and identifies the health categories selected for further evaluation. The potential public health impacts with regard to environmental air quality, economy, public services/infrastructure, and demographics are further considered in this section for the Proposed Actions at NGS and proposed KMC. Section 3.16.3 evaluated the affected environment as it relates to the categories selected for further consideration. This section evaluates the magnitude of the potential health issues selected for further evaluation (both positive and negative) on the local community and the cumulative impacts. **Table 3.16-11** summarizes the assigned impacts described in the following sections, and presents the overall public health impact rating of each impact.

3.16.5.3.2.1 Environmental Air Quality and Public Health

As indicated on **Table 3.16-15**, possible health impacts associated with air emissions from the NGS and proposed KMC were noted. As discussed in Section 3.16.4.4, the public health impacts associated with air quality focus on exposures to particulate matter, specifically $PM_{2.5}$. Thus, this discussion focuses on the potential impacts to public health associated with particulate emissions from the proposed NGS and proposed KMC operations.

Navajo Generating Station

The NGS may operate as either a 3-Unit Operation or 2-Unit Operation. The 3-Unit Operation and 2-Unit Operation represent an upper and lower operational bound for the Proposed Action. The Proposed Action would result in a continuation of existing emissions and impacts, except for proposed additional controls related to SCR installation at NGS or the potential shutdown or curtailment of a unit at NGS. SCR installation at NGS would reduce the impact from historical operations through 2019, and may lead to a reduced impact on air quality and air quality related values in the region. Section 3.1 details the potential impacts to air quality associated with the proposed operations of the NGS.

Tables 3.1-12 and **3.1-13** present the results of the predicted emissions resulting from the NGS 3-Unit Operation and 2-Unit Operation, respectively. Maximum impacts of NGS on ambient concentrations of $PM_{2.5}$ are to receptors that are very near the NGS boundary. The predicted $PM_{2.5}$ emissions from the 3-Unit Operation and 2-Unit Operation are virtually the same. The existing background 24-hour $PM_{2.5}$ concentration is 20.8 µg/m^3, based on current air quality levels measured from the Glen Canyon ambient air monitoring station, approximately 2.7 miles west of downtown Page, Arizona, and approximately 6 miles west-northwest of the NGS. The predicted 3-Unit Operation emissions would result in predicted 24-hour $PM_{2.5}$ concentrations of 11.9 µg/m^3, and would increase the total 24-hour $PM_{2.5}$ concentrations to 32.7 µg/m^3. Though the maximum impacts associated with proposed NGS operations could potentially increase the current 24-hour $PM_{2.5}$ concentrations by 57 percent, the maximum cumulative impact on 24-hour $PM_{2.5}$ concentrations of 32.7 µg/m^3 would still meet the NAAQS criteria for 24-hour $PM_{2.5}$ of 35 µg/m^3 for both the 3-Unit Operation and 2-Unit Operation. Likewise, the predicted impacts of NGS Operations on the annual average $PM_{2.5}$ concentrations also would meet the NAAQS criteria for annual $PM_{2.5}$ of 12 µg/m^3. Specifically, the existing background annual average $PM_{2.5}$ concentration is 5.9 µg/m^3, based on current air quality levels measured from the Glen Canyon ambient air monitoring station. The predicted 3-Unit Operation emissions would result in predicted annual average $PM_{2.5}$ concentrations of 1.8 µg/m^3, and would increase the total annual average $PM_{2.5}$ concentrations to 7.6 µg/m^3, which is only 64 percent of the NAAQS criteria of 12 µg/m^3. The maximum $PM_{2.5}$ impact occurs at the NGS boundary, and the impacts rapidly decline with distance from NGS. Within 1 km from the NGS boundary, the maximum impact on 24-hour $PM_{2.5}$ concentrations is reduced from 32.7 µg/m^3 to about 24 µg/m^3 and impacts in all other directions are well below the ambient standard. Likewise, the maximum predicted impact on annual $PM_{2.5}$ concentrations of 7.6 µg/m^3 is on the NGS boundary and the impacts decline with distance from NGS. Because $PM_{2.5}$ concentrations meet NAAQS criteria, proposed NGS Operations will have little to no effects on the health of the general population.

Table 3.16-15 Proposed Project Public Health Impacts

Main Health Outcome	Specific Impact[1]	Project Area	Positive or Negative Health Impact?	Pathway of Health Impact	Magnitude/ Consequence of Impact	Likelihood/ Probability of Impact	Overall Impact on Public Health (Magnitude x Likelihood)[2]
Chronic Disease	Exacerbation of existing conditions for sensitive subpopulations (asthmatics, diabetics, others with compromised respiratory/circulatory systems)	NGS and proposed KMC	Negative	Particulate Inhalation	Low	Low	Minor
	Continued or increased access to health care	**NGS and proposed KMC**	**Positive**	**Indirect**	**Medium**	**High**	**Major**
Infectious disease	Increase in respiratory infections for sensitive subpopulations with respiratory health complications	NGS and proposed KMC	Negative	Particulate Inhalation	Medium	Low	Minor
	Continued or increased access to health care	**NGS and proposed KMC**	**Positive**	**Indirect**	**Medium**	**High**	**Major**
Nutrition	Temporary loss of livestock grazing areas	Proposed KMC	Negative	Indirect	Low	Medium	Minor
	Impacts to cultural resources	Proposed KMC	Negative	Indirect	Low	Low	Minor
	Continued or increased resources available to purchase healthy foods for the family	**NGS and proposed KMC**	**Positive**	**Indirect**	**Medium**	**High**	**Major**
Well Being or Psychosocial	Increase in stress or annoyance levels for populations living nearest to the mining areas due to noise and vibration	Proposed KMC	Negative	Noise and vibration	Low	High	Moderate
	Impacts to cultural resources	Proposed KMC	Negative	Direct and Indirect	Low	Low	Minor
	Increased stress due relocation of residents within the mining zones	Proposed KMC	Negative	Indirect	Low	High	Moderate
	Decreased stress due to more solid economic situation for the family	**NGS and proposed KMC**	**Positive**	**Indirect**	**Medium**	**High**	**Major**

Table 3.16-15 Footnotes:

[1] Impacts are for both 3-Unit Operation and 2-Unit Operation scenarios unless specifically noted; positive health effects indicated in **Bold**

[2]

Magnitude/Consequence of Impact	Likelihood of Occurrence of Health Impact		
	Low (unlikely to occur)	**Medium** (likely to occur sometimes)	**High** (likely to occur often)
None	negligible	negligible	negligible
Low	minor	minor	moderate
Medium	minor	moderate	major
High	moderate	major	major

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2

Proposed Kayenta Mine Complex

The Kayenta Mine directly supports NGS and includes operations that also lead to air emissions. The Proposed Action at Kayenta Mine includes a range of mining level activity that is consistent with the 3-Unit Operation and 2-Unit Operation at NGS. For this facility the target production is set at 5.5 million tpy and 8.1 million tpy of coal production to meet the NGS scenario coal demand. Emissions of criteria pollutants are generated by mining operations (coal and overburden removal and transport), coal preparation plant activities (coal transfers, crushing, screening, stockpiling) and wind erosion of stockpiles and disturbed areas. The majority of these emissions consist of fugitive and process particulate matter (total suspended particulates, PM_{10}, and $PM_{2.5}$). Section 3.1 details the potential impacts to air quality associated with the proposed operations of the Kayenta Mine.

Receptors for modeling impacts were placed at the proposed KMC boundary and at specific residence receptors within the mine lease area. Most of the maximum impacts occur near the proposed KMC lease boundary. **Tables 3.1-21** and **3.1-22** present the results of the maximum modeled design concentrations at the boundary and at the residence receptors, respectively, resulting from both the 5.5 million tpy and 8.1 million tpy of coal production scenarios. Background air quality concentrations were based on data collected at the proposed KMC or at regional stations that either are representative of remote locations or are conservative estimates of the regional background. Because there virtually are no other significant emission sources near the proposed KMC the overall approach to background concentrations is very conservative. All model results indicate that the impacts, including the calculated background concentrations, are below the ambient air quality standards. The predicted $PM_{2.5}$ emissions from the 5.5 million tpy and 8.1 million tpy of coal production scenarios are virtually the same.

The background 24-hour $PM_{2.5}$ concentration is 13 μg/m^3. The predicted impacts at the proposed KMC boundary would result in predicted 24 hour $PM_{2.5}$ concentrations of 6.8 and 5.7 μg/m^3 under the 5.5 million tpy and 8.1 million tpy of coal production scenarios, respectively, resulting in total 24 hour $PM_{2.5}$ concentrations of 19.8 and 18.7 μg/m^3, respectively. The predicted impacts at the proposed KMC resident receptors would result in predicted 24 hour $PM_{2.5}$ concentrations of 3.4 and 4.0 μg/m^3 under the 5.5 million tpy and 8.1 million tpy of coal production scenarios, respectively, resulting in total 24 hour $PM_{2.5}$ concentrations of 16.4 and 17 μg/m^3, respectively. The maximum cumulative impact on maximum 24-hour $PM_{2.5}$ concentrations associated with each coal production scenario would meet the NAAQS criteria for 24-hour $PM_{2.5}$ of 35 μg/m^3. Likewise, the predicted impacts on the annual average $PM_{2.5}$ concentrations also would meet the NAAQS criteria for annual $PM_{2.5}$ of 12 μg/m^3. Specifically, the background annual average $PM_{2.5}$ concentration is 4.7 μg/m^3. Impacts at the proposed KMC boundary would result in predicted annual average $PM_{2.5}$ concentrations of 1.3 and 1.2 μg/m^3 under the 5.5 million tpy and 8.1 million tpy of coal production scenarios, respectively, resulting in total annual average $PM_{2.5}$ concentrations of 6.0 and 5.9 μg/m^3, respectively. The predicted impacts at the proposed KMC residential receptors would result in predicted annual average $PM_{2.5}$ concentrations of 0.8 and 1.0 μg/m^3 under the 5.5 million tpy and 8.1 million tpy of coal production scenarios, respectively, resulting in total annual average $PM_{2.5}$ concentrations of 5.5 and 5.7 μg/m^3, respectively, which is only approximately 50 percent of the annual $PM_{2.5}$ NAAQS criteria of 12 μg/m^3. Because $PM_{2.5}$ concentrations meet NAAQS criteria, proposed KMC Operations will have little to no effects on the health of the general population.

Sensitive Subpopulations

There is some information that the NAAQS criteria may be insufficiently protective for sensitive subpopulations.

A broad range of health effects have been associated with ambient particulate matter, as described in Section 3.16.3. The NAAQS are set at a level expected to protect public health with an adequate margin of safety, taking into consideration effects on susceptible populations (USEPA 2012). However, it is still not clear whether there is a threshold concentration below which adverse health effects are not seen, even for sensitive populations. The detection of a threshold level for the effects of particulate matter on

mortality has proven to be very difficult. The current evidence shows limited support for use of a "no-threshold" model (USEPA 2012, 2009b). Since individual thresholds vary from person to person due to individual differences in susceptibility and pre-existing disease conditions (i.e., asthma or reactive airway disease), it is extremely difficult to mathematically demonstrate that a clear threshold exists in population studies. This is especially true if the most sensitive members of a population (generally children and the elderly) have pre-existing conditions (e.g., asthma) that make them unusually sensitive even down to very low concentrations. Because of these issues with determining a threshold, there may be some health effects associated with $PM_{2.5}$ for susceptible individuals even if ambient $PM_{2.5}$ levels meet the air quality criteria. Levy et al. (2002) estimated that a 1 $\mu g/m^3$ increase in daily $PM_{2.5}$ concentration could result in a 1 percent increase in asthma-related emergency room visits.

The predictive air dispersion modeling presented in Section 3.1 indicates that maximum impacts associated with NGS operations occur at the site boundary and decrease rapidly with increasing distance from the site. As discussed in Section 3.14, the overall area surrounding the NGS is sparsely populated with the exception of the City of Page and the developable area of LeChee, is 10 miles south of Page. Impacts associated with NGS Operations at these receptor points are negligible with respect to background. Even if sensitive individuals are present in the City of Page or LeChee, they are unlikely to be affected.

However, as detailed in Section 3.14, approximately 150 Navajo residents live in dispersed houses within the Kayenta permit boundary (OSMRE 2011, 2008). Socioeconomic status is a strong determinant of individual health (WHO 2008). As discussed in Section 3.14, the area surrounding the mine is a relatively low income area. Therefore, some residents may be in poorer health due to their socioeconomic conditions and/or more limited access to health care. Thus, the Navajo people residing within or near the proposed KMC permit boundary is the population of greatest concern for exposure to $PM_{2.5}$. The analysis of local health information (Section 3.16.3) found that of the 15 counties in Arizona, Navajo County ranks among the unhealthiest in the state. Life expectancy rates are lower, mortality rates are higher, and many behavioral risk factor rates exceed the state averages. In Arizona, the prevalence of asthma is higher among lower income populations. Navajo County has among the highest asthma rates in the state, with an adult rate of 17.2 percent. Limited relevant information was found for assessing asthma prevalence and severity among Navajo Nation or Hopi Tribe members. Therefore, in addition to being a sensitive subpopulation based on socioeconomic conditions (WHO 2008), there could potentially be a higher proportion of people with asthma in the proposed KMC permit boundary than the state.

Due to the proximity of Navajo residents to the proposed KMC operations and relatively poor existing socioeconomic and health conditions of the Navajo community, potential increases in $PM_{2.5}$ emissions associated with mine operations could lead to some minor negative health effects for sensitive subpopulations. However, as discussed in Gradient (2016), uncertainty remains regarding associations between long-term exposure and adverse health effects, and between short-term exposures and adverse health effects. In addition, as presented in Section 3.1, maximum $PM_{2.5}$ impacts at the proposed KMC boundary and residential receptor grids are largely influenced by ambient background $PM_{2.5}$ concentrations and total impacts are well below the ambient air quality criteria. While small increases in ambient $PM_{2.5}$ concentrations over existing background concentrations could potentially exacerbate existing health conditions of sensitive subpopulations, most cases of health problems among the affected population are associated with causes unrelated to $PM_{2.5}$ exposure, including those found at higher rates in Navajo and Coconino County (e.g., lifestyle factors such as diet, inactivity, and alcohol consumption). Furthermore, use of wood or coal as an indoor fuel with inadequate domestic facilities could potentially result in $PM_{2.5}$ exposures far greater than those associated with proposed KMC operations (Gradient 2016). Therefore, the magnitude or consequence of the health impact of air quality is rated as "low" on **Table 3.16-11** (because some minor impacts could potentially occur for sensitive subpopulations), and the likelihood of the impacts also is rated as "low" on **Table 3.16-11** (because concentrations are predicted to be well below the ambient air criteria). This results in an overall public health rating of "minor". There are no differences in impact findings between the 3-Unit Operation and 2-Unit Operation.

3.16.5.3.2.2 Economy and Public Health

As indicated on **Table 3.16-1**, potential positive health impacts associated with NGS-KMC proposed actions on local economic conditions were noted. Section 3.18 presents a detailed analysis of the impacts (both positive and negative) that the Proposed Action has on the socioeconomic conditions of the affected communities. In general, the sustained employment associated with continued operations of the NGS and proposed KMC and increased funds to Navajo and Hopi Tribes through extension of lease and coal royalties is expected to result in positive health impacts. The economic benefits associated with continued employment, and potentially increased employment opportunities, could lead to continued or improved access to health services, better nutrition, and better overall well-being. Furthermore, as described in Section 3.18, extending the operating life of NGS-KMC to 2044 would generate current and retirement income for many households beyond the operating life of the plant. Those benefits take on added importance given the persistent high unemployment and poverty among the Navajo.

The 3-Unit Operation of the NGS and associated proposed KMC activities to support the 3-Unit Operation provides the greatest economic benefit. As described in Section 3.18, implementation of the Proposed Action at NGS under the 2-Unit Operation results in many of the socioeconomic effects associated with the Proposed Action under the 3-Unit Operation, but at scaled back or reduced levels. For example, Proposed Action 3-Unit Operation sustains the current population in Page and nearby Navajo Chapters, while Proposed Action 2-Unit Operation could create lower employment levels resulting in population emigration from the region. Thus, the 2-Unit Operation has fewer economic benefits to the local community than the 3-Unit Operation at NGS. However, even under the 2-Unit Operation scenario, economic conditions would be vastly improved over a no action scenario where NGS and proposed KMC operations cease. Therefore, overall the Proposed Action at NGS and proposed KMC is expected to result in economic benefits to the affected community which will lead to positive public health impacts. The magnitude of impact shown on **Table 3.16-11** is “medium” and positive and the likelihood is rated as “high,” with an overall public health rating of “major” positive significance.” While the benefits for the 3-Unit Operation are expected to be higher than the 2-Unit Operation, there are no overall differences in public health impact findings between the 3-Unit Operation and 2-Unit Operation scenarios.

3.16.5.3.2.3 Public Services/Infrastructure and Public Health

No new public infrastructure would be required at the NGS and proposed KMC sites under the Proposed Action operations. Existing rail lines would continue to be utilized to transport coal from the proposed KMC to the NGS. As part of the Proposed Action, Navajo Route 41 would revert to its original alignment, which could lead to positive effects on public health due to the safety improvements associated with realignment. No negative health impacts associated with existing infrastructure are expected. In addition, no changes to existing services are anticipated under the Proposed Action, As discussed in Section 3.18, in general, existing infrastructure and service conditions are anticipated to remain relatively unchanged in the project impact area and the Navajo community would benefit from continued access to EMS from the PWCC clinic for life-threatening conditions. Therefore, overall the Proposed Action at NGS and proposed KMC is expected to result in no impacts to the affected community with regard to public services and infrastructure.

3.16.5.3.2.4 Demographics and Public Health

As indicated on **Table 3.16-1**, potential public health impacts associated with community demographics were noted. This section discusses the potential health impacts related to site land use and community health.

<u>Land Use</u>

Section 3.16.3 summarized the current land use patterns and demographics particularly relevant to health. The local community includes members of the Navajo Nation and the Hopi Reservation within

northern Coconino and Navajo counties, Arizona. No notable changes in land use patterns are anticipated in the vicinity of NGS based on the Proposed Action, as discussed in Section 3.14. Thus this discussion focuses on the public health impacts relevant to land use that are associated with proposed KMC operations. The following impacts and changes to land use in the vicinity of Kayenta Mine that could potentially impact public health were identified, and are discussed in greater detail below:

- Potential relocation of residents living within the mining zone;
- Potential impacts to lands used for livestock grazing;
- Noise and vibration disturbances during mine blasting; and
- Disturbance of cultural resources that might affect traditional tribal lifestyles.

Relocation of Residents

As the mine areas are developed, residents occasionally need to be relocated to different areas. PWCC incurs the expense to move or construct housing to a location agreed upon by the residents. As detailed in Section 3.14, under the Proposed Action 3-Unit Operation, mining would occur in the N-10, N-11 Ext, and J-21-W areas, as well as portions of the N-9, J-19 and J-21 areas of the proposed KMC. This could lead to relocation of up to 8 residences currently residing in the mining zones. Under the 2-Unit Operation no mining would occur in the N-10 area, which would result in an estimated two fewer residential relocations. PWCC consults with the affected residents and attempts to relieve some of the stress associated with relocation by helping them obtain homesite leases, performing the cultural surveys, and attempting to accommodate the family's preferences on location and replacement structures.

While no direct health impacts are anticipated from relocation, it is assumed that there could be some emotional stress associated with relocation that could potentially affect the overall well-being of those few residents who are relocated. This assumption is based on the comments and concerns expressed by community members through public meetings and hearings summarized in Chapter 1.0. The magnitude or consequence of the health impact of residential relocation is rated as “low” on **Table 3.16-11** (because some impacts to overall well-being and health, as well as quality of life, might occur for those few residents who are relocated), and the likelihood of the impact is rated as “high” on **Table 3.16-11** for those residences located within the future mining zones. This results in an overall public health rating of “moderate”. While fewer residences are expected to be relocated under the 2-Unit Operation compared to the 3-Unit Operation, the overall impact rating is the same for both scenarios.

Livestock Grazing

Many residents graze livestock (mainly cattle, sheep, and goats) on reclaimed and undisturbed lands within the proposed KMC for a food source and for economic and cultural reasons. Livestock grazing is the primary pre-mine and post-mine use of the land and occurs year-round. Other uses of the land by residents living within the permit boundary include the gathering of plants for food, medicine, cultural purposes, firewood gathering, and farming small agricultural plots (approximately 4 to 5 acres in size) typically used for growing corn (PWCC 2012 et seq.). The HHRA determined that no unacceptable health risk exist for residents consuming livestock that graze in the permit boundary or consuming plants harvested from within or near the mine site. Thus, no public health impacts are anticipated from consumption of livestock or plants under either the 3-Unit Operation or 2-Unit Operation scenario. However, as discussed in Section 3.14, as the mine areas are developed, up to six assigned grazing areas could be affected under the 3-Unit Operation until final reclamation is complete. This would number be reduced under the 2-Unit Operation. The loss of these grazing areas may be partially or completely offset due to the reclamation that has occurred on previously mined areas. Most of the reclaimed areas now provide a greater amount of forage vegetation than was available under pre-mine conditions. Regardless, the loss of these grazing areas could potentially impact the nearby residents. If

livestock have to be relocated due to the loss of the grazing area, diets could be affected or loss of income could be experienced if livestock grazing provides an income source. However, the loss of grazing areas is temporary and compensation for affected grazing areas could offset the potential loss of income. As discussed in Section 3.14, after mining areas are fully reclaimed, the land will be restored to pre-mining conditions. The purpose of reclamation is to restore the affected lands to the approximate landforms that existed prior to mining and to establish a diverse, effective, and permanent vegetative cover similar in seasonal variety, diversity, and plant composition to the native vegetation on undisturbed lands surrounding the mining operation. Therefore, the magnitude or consequence of the health impact associated with the loss of grazing areas is rated as "low" on **Table 3.16-11** (because some impacts to overall well-being and health, as well as quality of life, might occur yet those impacts would be temporary until areas are fully reclaimed), and the likelihood of the impact is rated as "medium" on **Table 3.16-11** because loss of these four or five grazing areas may be partially or completely offset due to the reclamation that has occurred on previously mined areas. This results in an overall public health rating of "minor." While fewer grazing areas are expected to be lost under the 2-Unit Operation compared to the 3-Unit Operation, the overall impact rating is the same for both scenarios.

Noise and Vibration

Noise is defined as "unwanted sound." Sound levels for this project do not approach levels that have been associated with hearing impairment. There are some non-auditory impacts on human health due to noise at sound levels below those associated with ear impairment (WHO 1999), and this is an on-going area of research. Non-auditory effects due to noise in a community can contribute to stressors that may influence health such as:

- Reductions in quality of life (potentially work, home, and school life), as noise can disrupt speech and sleep, potentially leading to increases in stress and reduction in productivity (UCLA 2011);
- Effects on cardiovascular health via increases in blood pressure (Babisch 2011); and
- Changes in hormone levels related to a stress response (Evans et al. 2001).

In addition, noise can represent a nuisance with associated annoyance levels for those affected. There is not a clear delineation as to when an "annoyance" results in a stress significant enough to produce measureable health effects; thus, some community noise analyses are based on annoyance perception levels rather than health effects (U.S. Department of Transportation 2005). Providing further complication, the impacts of increased sound depend not just on the numerical increase in sound levels, but also on the intensity of the sound, the duration of the sound, and the sound setting (WHO 1999). Unexpected, short duration, high intensity sounds can have a worse effect than relatively steady sounds. Humans do appear to have an adaptive response to typical sound levels in their environment and once adaptation has occurred, sleep patterns are not affected (Stansfeld and Matheson 2003).

As discussed in Section 3.15, current noise and vibration at the NGS and associated facilities consists of an assortment of sounds at varying frequencies from typical plant operations, as well as noise associated with coal rail operations and maintenance actions on associated facilities. No noise impacts from NGS operation would occur outside the plant boundaries as there are no sensitive receptors within 3 miles of NGS or 200 feet of the Black Mesa & Lake Powell Railroad. However, sensitive noise receptors, including residents who live near or within the proposed KMC permit boundaries and within range of warning signals for blasting during mining operations would continue to experience noise from mining activities under the Proposed Action. Surface blasting occurs less than twice daily during weekdays from sunrise to sunset. However, residents would be notified well in advance of the blasting schedule, and notices posted in public locations. The number of warning and all-clear signals produced at blasting sites by an audible-speaker warning device would remain at or slightly below existing levels as overall coal production per year is not anticipated to increase, but may decrease under the 2-Unit Operation. Additionally, no blasting would be conducted within 0.5 mile of an occupied dwelling; therefore, residents in or near the blasting area would be evacuated prior to proceeding with any blasting

actions. The noise reduction measures related to activities at mining sites would include maintenance of equipment exhaust systems and engine sound controls to manufactures' specifications and limiting blasting to daylight hours. Furthermore, natural topographic screening between mining operations and sensitive noise receptors could reduce noise for sensitive receptors. In addition to the distance of the sensitive noise receptors from the active mine areas, mining activities occur below grade, which result in the walls of the pit and spoil piles absorbing and attenuating some of the noise from mining activities.

Based on the noise sources associated with mining operations described in Section 3.15, existing sound levels for typical daytime noise levels, depending on the level of intensity of mining activities, and less depending upon distance from the noise source, are likely to range from 80 a-weighted decibels (dBA) to 95 dBA at 50 feet from equipment and reduce to 50 dBA to 70 dBA at 1,600 feet from equipment. For comparison, 40 dBA is relatively quiet and can be equated to the noise level of a residence at night, while 60 dBA is comparable to a normal conversation and is considered a comfortable noise level. Noise from a point source decreases rapidly with increasing distance. No blasting or mine operations will occur within 0.5 mile of a receptor. Thus, noise levels for residential receptors would be even lower. Blasting activities would continue to be conducted in accordance with administrative regulations established to minimize adverse impacts resulting from noise and vibration in 30 Code of Federal Regulations 816.67. Resulting noise and vibration impacts would not be expected to exceed federal regulations. Temporary effects from vibration and airblast levels within standards established in 30 Code of Federal Regulations 816.67 are not considered capable of producing injury or property damage, but could cause annoyance depending on the distance to the receptor (Mohamed 2010). Therefore, the magnitude or consequence of the health impact associated with noise and vibrations resulting from mining operations is rated as "low" on **Table 3.16-11** (because some impacts to overall well-being and health, as well as quality of life, might occur for those few residents located in close proximity), and the likelihood of the impact is rated as "high" on **Table 3.16-11** because of the daily mining operations and the regular and frequent blasting schedule. This results in an overall public health rating of "moderate." The overall impact rating is the same for both the 3-Unit Operation and 2-Unit Operation scenarios.

Cultural Resources

Section 3.17 discusses the impacts to cultural resources in the NGS-KMC Study Area. Tangible properties of traditional cultural importance can include, physical locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and water possessing healing powers or used for other subsistence purposes may be taken. Some of these locations may be considered sacred to particular Native American individuals or tribal communities and loss of these resources could impact the lifestyle of those individuals. As detailed in Section 3.17, potential impacts to cultural resources through implementation of the Proposed Action are limited to the proposed KMC study area. Section 3.17 indicates that affected resources include archaeological sites, architectural resources, traditional cultural properties, and currently known or suspected human burials within or adjacent to areas to be mined. Though no direct impacts to public health are expected due to potential loss of cultural resources, traditional lifestyles could be impacted which could impact the general well-being of the local community. Measurement of the public health impact associated with loss of cultural resources is difficult because some individuals may be affected more than others. As discussed in Section 3.17, any impacts on historic properties that may result from the project alternatives would be resolved through implementation of the stipulations in the proposed KMC Programmatic Agreement in consultation with the Tribes and agencies. Thus, significant efforts will be used to avoid or mitigate potential impacts to cultural resources, thereby reducing the potential for public health impacts related to cultural resources. Therefore, the magnitude or consequence of the health impact associated with impacts to cultural resources is rated as "low" on **Table 3.16-11** (because some impacts to overall well-being, as well as quality of life, might occur), and the likelihood of the impact is rated as "low" on **Table 3.16-11** because efforts will be implemented to avoid or mitigate loss of

cultural resources. This results in an overall public health rating of "minor." The overall impact rating is the same for both the 3-Unit Operation and 2-Unit Operation scenarios.

Community Health

Section 3.16.3 details the existing community health conditions for the affected community. As discussed, the general health of the local community ranks poorly compared to the rest of the State of Arizona. As discussed in Gradient (2016), two reports published by ADHS provide perspective on the health of all Native Americans residing in the state, including Navajo and Hopi residents as well as those of other tribes (ADHS 2015a,b). These reports include observations that mortality rates of Native Americans in Arizona are elevated, relative to other state residents, for alcohol-induced causes, car accidents, diabetes, and unintentional injuries/accidents. Conversely, mortality rates of Native Americans in Arizona are lower on average than those for other state residents for lung cancer, chronic lower respiratory diseases, and heart disease. These observations indicate that lifestyle risk factors are a major driver in the overall well-being of the local community. While this public health evaluation does identify some level of health impacts associated with the Proposed Action, particularly associated with relocation of residents and noise and vibration nuisances that could impact the psychosocial state and overall well-being of the community, these potential impacts are likely negligible relative to the lifestyle risk factors that are contributing to the general health of the community.

In addition, through public meetings and hearings summarized in Chapter 1.0, a number of local community members have expressed concerns about family members suffering from chronic respiratory conditions that they believe is associated with plant and mine operations. As discussed above, the existing air quality conditions meet the air quality standards derived to protect the general population against adverse health effects. In addition, the modeled air emissions associated with the Proposed Action also are expected to meet air quality standards within the 50-km study area. Furthermore, the risk assessment sections evaluated human health risks associated with contaminant exposures through a number of exposure pathways (both direct and indirect exposures to emissions). The HHRA concluded that no unacceptable health risk is associated with the Proposed Action. Therefore, the available data and conservative modeling results indicate that no negative health effects are expected to be associated with Proposed Operations. A possible exception would be the potential health impacts to the sensitive subpopulations with existing conditions that could be exacerbated by increases (albeit, slight) in $PM_{2.5}$ emissions associated with the Proposed Action. It is important to note that, as discussed in Section 3.16.3, use of coal as an indoor fuel source is a common practice among the local community. Poorly ventilated stoves and boilers produce far higher exposures to particulates in indoor air than the Proposed Action would produce in outdoor air. The improper use of coal as an indoor fuel source could explain some of the symptoms of health described by the local community. Regardless, the opposition among some of the community members of the Proposed Action and the continued operation of the NGS and associated mining activities is recognized. Whether the community concerns are related to direct health effects associated with mine operations (regardless of what the data indicate) or indirect effects such as visual disturbances, loss of traditional and cultural lifestyles, public safety related to nearby mining operations, etc. (see further details in Sections 1.9 and 1.10), the opposition against the Proposed Action in itself could potentially cause emotional stress, leading to an impact on overall well-being and/or psychosocial health. The magnitude of public health impact directly associated with opposition to the mine by a limited number of individual members of the community is difficult to quantify. However, the community concerns were considered when assigning impact ratings for other public health categories in this assessment. Thus, the overall impacts to public health summarized on **Table 3.16-11** are assumed to account for the potential impacts associated with opposition of the mine by some community members.

3.16.5.3.3 Project Impact Summary – All Project Components

The impacts to human health from all project components are negligible because the potential cancer and noncancer risks are considered acceptable.

The public health evaluation concluded that potential impacts to the environment from all project components will result in minor or negligible health impacts to the general population of the affected community. Overall, the public health evaluation and the HHRAs concluded that major benefits to public health due to positive impacts on the socioeconomic conditions of the community could be achieved through implementation of the Proposed Action. However, potentially major negative impacts to the well-being or psychosocial health of the residents living within or near the proposed KMC mining zones was identified for the proposed KMC operations due to the emotional stress caused by relocation of residents and the health effects associated with the annoyance and nuisance of the noise generated through blasting and mining operations. The HHRA and public health evaluation collectively concluded that potential impacts to the environment will result in minor or negligible health impacts to the general population of the affected community.

3.16.5.3.4 Cumulative Impacts

The HHRA and the public health evaluation conclusions consider the cumulative effects associated with existing conditions and the additional potential future impacts associated with the Proposed Action of both the NGS and proposed KMC. The HHRA evaluated the potential health risks from exposure to chemical pollutants emitted from the NGS or proposed KMC during proposed operations, and other non-project related regional and global sources, while the public health evaluation considered health effects associated with impacts to environmental air quality by particulate emissions during NGS and proposed KMC proposed operations. The public health evaluation noted that a possible exception would be the potential minor health impacts to the sensitive subpopulations with existing conditions that could be exacerbated by increases (albeit, slight) in $PM_{2.5}$ emissions associated with the Proposed Action.

Details of the cumulative impacts on HHRA and public health evaluations are presented in the following subsections.

3.16.5.3.4.1 Human Health Risk Assessment

The total human health impact from Baseline, Future Operation (NGS 3-Unit Operation + Proposed KMC 8.1 million tpy at NGS) and other cumulative sources were included in the HHRA to evaluate total cumulative impacts. The total cumulative action evaluates current environmental conditions, the 3-Unit future operations associated with the project, the impacts from proposed KMC emissions under the 8.1 million tpy scenario on NGS, and (non-project related) regional and global emission sources (i.e., other cumulative sources, impacts of mercury from sources other than NGS and proposed KMC, including non-U.S. sources were characterized using mercury deposition data from the EPRI San Juan River Basin study [EPRI 2016]).

As presented in **Table 3.16-16**, the estimated excess lifetime cancer risks for all receptors at NGS are within the USEPA acceptable cancer risk range of 1×10^{-4} to 1×10^{-6} and require no further action. The chronic HI estimates for the resident, resident gardener, resident farmer and commercial worker are less than or equal to the USEPA benchmark of 1 and require no further action. The HI for the child recreational user is greater than the USEPA benchmark of 1. The driving pathway for the child recreational user is exposure to methyl mercury via consumption of fish. Note that the Arizona Game and Fish Department issued a fish consumption advisory in 2012 recommending that people, including pregnant women and children, limit their consumption of striped bass caught in the southern portion of Lake Powell (AGFD 2012), which is the major surface waterbody to which a recreational user may be exposed. Based on an unacceptable noncancer hazard of 2 for the ingestion of fish by the recreational user under the NGS Total Cumulative Impact scenario, a low impact on human health was identified. The impact is considered minor because of the fish advisory (AGFD 2012) that likely limits the consumption of fish.

Table 3.16-16 NGS HHRA 3-Unit Operation Results for Total Cumulative Impacts

Receptor	Baseline		NGS 3-Unit Operation + Proposed KMC 8.1 million tpy at NGS		Other Cumulative Sources		Total Cumulative Impact	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Resident	2E-06	0.1	3E-06	0.06	3E-11	0.0006	5E-06	0.2
Resident-Gardener	5E-06	0.7	3E-06	0.06	3E-11	0.002	8E-06	0.8
Resident-Farm Family	4E-05	0.8	4E-05	0.2	3E-11	0.003	8E-05	1
Recreational User	4E-06	1.2[1]	3E-08	0.01	3E-13	1.1	4E-06	>1
Commercial Worker	5E-07	0.02	9E-06	0.05	8E-12	0.00006	1E-05	0.07

[1] The HI of 1.2 for the child recreational user is due to exposure to methyl mercury via the consumption of fish.

The total human health impact from Baseline, Future Operation (NGS 2-Unit Operation + Proposed KMC 8.1 million tpy at NGS) and other cumulative sources were included in the HHRA to evaluate total cumulative impacts. The total cumulative action evaluates current environmental conditions, the 2-Unit future operations associated with the project, the impacts from proposed KMC emissions under the 8.1 million tpy scenario on NGS, and (non-project related) regional and global emission sources (i.e., other cumulative sources, impacts of mercury from sources other than NGS and proposed KMC, including non-U.S. sources were characterized using mercury deposition data from the EPRI San Juan River Basin study [EPRI 2016]).

As presented in **Table 3.16-17**, the estimated excess lifetime cancer risks for all receptors at NGS are within the USEPA acceptable cancer risk range of 1×10^{-4} to 1×10^{-6} and require no further action. The chronic HI estimates for the resident, resident gardener, resident farmer, and commercial worker are less than or equal to the USEPA benchmark of 1 and require no further action. The HI for the child recreational user is greater than the USEPA benchmark of 1. The driving pathway for the child recreational user is exposure to methyl mercury via consumption of fish. Note that the Arizona Game and Fish Department issued a fish consumption advisory in 2012 recommending that people, including pregnant women and children, limit their consumption of striped bass caught in the southern portion of Lake Powell (AGFD 2012), which is the major surface waterbody to which a recreational user may be exposed. Based on an unacceptable noncancer hazard for the ingestion of fish by the recreational user under the NGS Total Cumulative Impact scenario, a low impact on human health was identified. The impact is considered minor because of the fish advisory (AGFD 2012) that likely limits the consumption of fish.

Table 3.16-17 NGS HHRA 2-Unit Operation Results for Total Cumulative Impacts

Receptor	Baseline		NGS 2-Unit Operation + Proposed KMC 8.1 million tpy at NGS		Other Cumulative Sources		Total Cumulative Impact	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Resident	2E-06	0.1	2E-06	0.04	3E-11	0.0006	4E-06	0.2
Resident-Gardener	5E-06	0.7	2E-06	0.04	3E-11	0.002	8E-06	0.8
Resident-Farm Family	4E-05	0.8	4E-05	0.2	3E-11	0.003	8E-05	1

Table 3.16-17 NGS HHRA 2-Unit Operation Results for Total Cumulative Impacts

Receptor	Baseline		NGS 2-Unit Operation + Proposed KMC 8.1 million tpy at NGS		Other Cumulative Sources		Total Cumulative Impact	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Recreational User	4E-06	1.2[1]	3E-08	0.01	3E-13	1.1	4E-06	>1
Commercial Worker	5E-07	0.02	9E-06	0.04	8E-12	0.00006	1E-05	0.06

[1] The HI of 1.2 for the child recreational user is due to exposure to methyl mercury via the consumption of fish.

The total human health impact from Baseline, Future Operation 8.1 million tpy scenario, NGS 3-Unit Operation at proposed KMC and other cumulative sources was included in the HHRA to evaluate total cumulative impacts. The total cumulative action evaluates current environmental conditions, the future operations associated with the project, air quality impacts from NGS operations throughout the proposed KMC, and (non-project related) regional and global emission sources from arsenic, selenium and mercury.

As presented in **Table 3.16-18**, the estimated excess lifetime cancer risks for all proposed KMC resident receptors are within the USEPA acceptable cancer risk range of 1×10^{-4} to 1×10^{-6} and require no further action. The chronic HIs range from 0.9 for the child resident to 1.9 for the child resident farmer, and due largely to the noncancer baseline risk. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HQs and HIs were acceptable, no further action is required. Because all cancer and noncancer risks were considered acceptable, the impact to human health based on the total cumulative impact at the proposed KMC is considered negligible.

Table 3.16-18 Proposed KMC HHRA Results for Total Cumulative Impacts

Risk Case	Baseline		8.1 million tpy		NGS at Proposed KMC (3-Unit)		Other Cumulative Sources		Total Cumulative Action	
	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]
Resident	6E-06	0.9	2E-06	0.02	3E-08	0.005	6E-11	0.0001	8E-06	0.9
Resident - Gardener	9E-06	1.1[3]	2E-06	0.02	3E-08	0.005	6E-11	0.0001	1E-05	1.1[3]
Resident- Farm Family	2E-05	1.9[4]	2E-06	0.02	3E-08	0.005	6E-11	0.0001	2E-05	1.9[4]

[1] Cancer risk estimates within or less than the USEPA cancer risk range (1×10^{-4} to 1×10^{-6}) are considered acceptable and require no further evaluation.

[2] HIs less than the target HI of 1 are considered acceptable and require no further evaluation.

[3] A HI of 1.1 for the resident gardener child exceeded the target HI of 1 and required further evaluation consisting of a target organ analysis. The target organ analysis revealed HIs less than 1 for all target organs, indicating acceptable noncancer risk and requiring no further evaluation.

[4] A HI of 1.9 exceeded the target HI of 1 and required further evaluation consisting of a target organ evaluation. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HQs and HIs were acceptable, a similar evaluation was not performed for any other scenarios or receptors.

3.16.5.3.4.2 Public Health

No cumulative impacts resulting in negative effects on public health associated the Proposed Action at the NGS are anticipated under either the 3-Unit Operation or 2-Unit Operation. However, over the 40 years of mining at proposed KMC, a number of factors have already impacted the public health of the local community (i.e., those living near or within the mine area boundaries). The public health evaluation concluded that a number of factors associated with mining operations lead to effects on the overall well-being and health, as well as quality of life of the affected population. Continued operation of the mine leads to cumulative impacts on the overall well-being and quality of life. Specifically:

- Within the history of the mine, an estimated 40 households have been relocated or compensated for their residences. Some relocated and compensated residents stayed within the lease area, others have moved to other locations. Continued operation of the mine under the Proposed Action leads to additional residents that will be relocated.
- A number of grazing areas have already been withdrawn over the 40-year operation of the mine. While reclamation has returned a number of those grazing areas to pre-mining conditions (or even improved conditions compared to pre-mining conditions), a number of community members have expressed concern that their withdrawn customary use areas may not be returned to them after reclamation is completed and the land is returned to the Navajo Nation. Note that the Navajo Nation in coordination with OSMRE, not PWCC, determines how reclaimed land is used (PWCC 2012 et seq.). Thus there is concern among some community members that loss of grazing areas will be permanent. Continued operation of the mine under the Proposed Action would lead to additional grazing lands being withdrawn and additional compensation to the affected residents.
- A number of community members have expressed concern over the loss of cultural resources associated with previous mining operations or past relocations (i.e., loss of burial grounds or disturbance of traditional landscape). While plans are in place to control and mitigate potential future losses to cultural resources, the historical losses are still affecting some of the community members, leading to a cumulative impact on the overall well-being, as well as quality of life of the affected population.

The public health evaluation of the Proposed Action noted the opposition to continued mining among some proposed KMC area residents. Whether the community concerns are related to direct health effects associated with mine operations (regardless of what the data indicate) or indirect effects such as visual disturbances, loss of traditional and cultural lifestyles, public safety related to nearby mining operations (see further details in Sections 1.9 and 1.10), the opposition to the Proposed Action could potentially cause emotional stress, leading to an impact on overall well-being and/or psychosocial health. A number of the people interviewed talked about being depressed because they had coexisted with mining effects and health issues for decades and now they are faced with the possibility of coexisting with mining for another 25 years. Thus, the continued opposition to the mine, could lead to cumulative impacts on the overall well-being and quality of life of the affected population.

In contrast, many community members support the continued operation of the mine. As discussed in Section 3.18, the mine has brought economic, employment and fiscal benefits to the local community, which leads to an improved quality of life. Those benefits take on added importance given the persistent high unemployment and poverty among the Navajo. Therefore, overall the continued operation of the NGS and proposed KMC also could result in positive cumulative impacts on overall well-being and quality of life due to the economic benefits associated with the proposed action.

3.16.5.4 Natural Gas Partial Federal Replacement Alternative

This discussion is divided into two parts. The first part describes the alternative site and operational characteristics, and primary human health and public health impacts that have occurred, or would occur.

The second part addresses the impacts to human health and public health from reducing the power generated at NGS, with consequent reductions in coal production at the Kayenta Mine.

Under the Natural Gas PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from currently unidentified, existing natural gas generation sources, displacing an equivalent amount of power from the federal share of NGS generation. Because the facility is assumed to currently exist, prior disturbance impacts to human health and public health resources are not evaluated. A key assumption about human health and public health resources related to such an existing site is listed below.

- Natural gas combustion to generate power would not result in deposition to soil of the trace metal associated with coal combustion under the Proposed Action. The difference in emissions is addressed in Section 3.1.

Impact issues for this PFR alternative are discussed across the range of NGS unit operations (3-Unit and 2-Unit) and associated alternative power reductions (100 MW and 250 MW) from the least NGS power reduction to the greatest. Reductions in NGS power generation would proportionally reduce the quantity of coal delivered from the Kayenta Mine.

The focus of this discussion is to distinguish differences in impacts within the replacement alternative operational range to provide a basis for comparison with the Proposed Action.

3.16.5.4.1 Navajo Generating Station

The following discusses the impacts to human health and public health if 100 MW to 250 MW of power generation were replaced at NGS by alternative power purchased from an unknown, but existing source of power from natural gas. As the alternative site is assumed to be an existing facility, prior disturbance impacts to human health and public health are not evaluated. At the NGS, the following relevant human health and public health impact topics are potentially affected by Natural Gas PFR alternative compared to the Proposed Action.

- Human exposures to airborne pollutants contained in stack emissions, and to pollutants deposited to the soil surface.
- Local employment opportunities to support NGS operations.

The NGS HHRA evaluated the human health impacts of the Natural Gas PFR. Potential cancer and noncancer risks to all receptors at NGS (Off-site Resident, Off-site Resident Gardener, Off-site Resident-Farm Family, Recreational Use, Off-site Commercial Worker) were less than USEPA benchmarks and considered acceptable under the Proposed Action NGS 3-Unit Operation and 2-Unit Operation risk scenarios. NGS emissions under this PFR would be approximately 5 percent (100-MW reduction) and 13 percent (250-MW reduction) less for than those estimated for the NGS 3-Unit Operation typical output. NGS emissions under this PFR would be approximately 8 percent (100-MW reduction) and 19 percent (250-MW reduction) less than those estimated for the NGS 2-Unit Operation typical output. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at NGS under the Natural Gas PFR also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Natural Gas PFR Alternative would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and NGS Operations under the Natural Gas PFR will have little to no effects on the health of the general population. Although NGS emissions would be reduced under the Natural Gas PFR, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts

such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Natural Gas PFR than for the Proposed Action scenarios.

As discussed in Section 3.18, under the Natural Gas PFR Alternative, net reductions in jobs, labor income, tax revenues and other economic effects as compared to Proposed Action would occur. One of the major health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at NGS. Implementation of the Natural Gas PFR Alternative would reduce the impact of those positive impacts.

3.16.5.4.2 Proposed Kayenta Mine Complex

The following discusses the impacts to human health and public health resources if 100 MW to 250 MW of power generation were replaced at NGS by alternative sources and the proposed KMC would mine less coal 8.1 million tpy production (NGS 3-Unit Operation) and 5.5 million tpy production (NGS 2-Unit Operation). Under the Natural Gas PFR, alternative power would be purchased by Reclamation from an unknown, but existing source. As the alternative site is assumed to be an existing facility, prior disturbance impacts to human health and public health are not evaluated. At the proposed KMC, the following relevant human health and public health impact topics are potentially affected by the Natural Gas PFR Alternative compared to the Proposed Action.

- Human exposure to airborne pollutants contained in fugitive dust, and to pollutants deposited to the soil surface.
- Local employment opportunities at proposed KMC to support NGS coal demands.
- Relocation of residents residing within the mining zones.
- Noise disturbances associated with mining.
- Loss of livestock grazing areas and cultural resources.

Potential cancer and noncancer risks to all receptors at proposed KMC (Off-site Resident, Off-site Resident Gardener, Off-site Resident-Farm Family) were less than USEPA benchmarks and considered acceptable under the Proposed Action proposed KMC 8.1 million tpy and 5.5 million tpy risk scenarios. Proposed KMC coal production under the Natural Gas PFR would be approximately 5 percent (100-MW reduction) and 12 percent (250-MW reduction) less for than those estimated for the proposed KMC 8.1 million tpy Proposed Action scenario. Proposed KMC coal production under the Natural Gas PFR would be approximately 7 percent (100-MW reduction) and 18 percent (250-MW reduction) less than those estimated for the proposed KMC 5.5 million tpy Proposed Action scenario. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at the proposed KMC under the Natural Gas PFR Alternative also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Natural Gas PFR would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and proposed KMC Operations under the Natural Gas PFR will have little to no effects on the health of the general population. Although proposed KMC emissions would be reduced under the Natural Gas PFR, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Natural Gas PFR than for the Proposed Action scenarios.

As discussed in Section 3.18, under the Natural Gas PFR, net reductions in jobs, labor income, tax revenues and other economic effects as compared to Proposed Action would occur. One of the major

health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at NGS. Implementation of the Natural Gas PFR would reduce the demand of coal from the proposed KMC, particularly under the 2-Unit Operation scenario (44 percent of the coal needs would be required compared to the existing coal demands). One of the major health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at proposed KMC. Implementation of the Natural Gas PFR would reduce the impact of those positive impacts. Thus, staffing reductions at proposed KMC and the associated reduction in beneficial health impacts associated with improved socioeconomics would be a likely outcome of the Natural Gas PFR. However, the reduced demand on coal to support the NGS operations under the Natural Gas PFR would lead to direct reductions in the number of residences affected (through emotional stress related to relocation, noise and vibration nuisances, and/or loss of grazing areas or cultural resources) by mining and blasting operations, particularly under the 2-Unit Operation scenario.

3.16.5.4.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.16.5.4.4 Project Impact Summary – All Project Components

The impacts to human health from NGS, proposed KMC, and transmissions lines and communication sites under the Natural Gas PFR would be negligible because potential cancer and noncancer risks to NGS and proposed KMC receptors would be less than USEPA benchmarks and considered acceptable. The potential public health benefits could be reduced based on the direct effects to the socioeconomic conditions of the affected community.

3.16.5.4.5 Cumulative Impacts

The public health evaluation and the HHRA conclusions consider the cumulative effects associated with existing conditions and the additional potential future impacts associated with the Natural Gas PFR. The same cumulative impacts on public health noted under the Proposed Action are anticipated under the Natural Gas PFR. Cumulative impacts to human health from baseline, the Natural Gas PFR and other cumulative sources would be low because all potential cancer and noncancer risks to NGS and proposed KMC receptors under these scenarios are less than USEPA benchmarks and considered acceptable, except for the unacceptable noncancer risk for the recreational user due to exposure to methyl mercury in fish. The number of potentially affected residents living within the mine zone requiring relocation would be reduced, particularly under 2-Unit Operation scenario; however, health impacts would still be moderate for the few residents that would be affected. Socioeconomic benefits associated with the Natural Gas PFR would be reduced compared to the Proposed Action, but would still result in better socioeconomic conditions than the No Action Alternative (see Section 3.18).

3.16.5.5 Renewable Partial Federal Replacement Alternative

3.16.5.5.1 Navajo Generating Station

Under the Renewable PFR Alternative, a selected quantity of power between 100 MW and 250 MW would be contracted for under a long-term power purchase agreement from a currently unidentified, existing renewable energy power source, displacing an equivalent amount of power from the federal share of NGS generation. As the site is assumed to be an existing facility, prior disturbance impacts to human health and public health are not evaluated. At the NGS, the following relevant human health and public health impact topics are potentially affected by the Renewable PFR Alternative compared to the Proposed Action.

- Human exposures to airborne pollutants contained in stack emissions, and to pollutants deposited to the soil surface.
- Local employment opportunities to support NGS operations.

Potential cancer and noncancer risks to all receptors at NGS (Off-site Resident, Off-site Resident Gardener, Off-site Resident-Farm Family, Recreational Use, Off-site Commercial Worker) were less than USEPA benchmarks and considered acceptable under the Proposed Action NGS 3-Unit Operation and 2-Unit Operation risk scenarios. NGS emissions under the Renewable PFR would be approximately 3 percent (100-MW reduction) and 7 percent (250-MW reduction) less for than those estimated for the NGS 3-Unit Operation typical output. NGS emissions under the Renewable PFR would be approximately 4 percent (100-MW reduction) and 11 percent (250-MW reduction) less than those estimated for the NGS 2-Unit Operation typical output. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at NGS under the Renewable PFR Alternative also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Renewable PFR would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and NGS Operations under the Renewable PFR Alternative will have little to no effects on the health of the general population. Although NGS emissions would be reduced under the Renewable PFR Alternative, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Renewable PFR Alternative than for the Proposed Action.

As discussed in Section 3.18, under the Renewable PFR Alternative, net reductions in jobs, labor income, tax revenues and other economic effects as compared to Proposed Action would occur. One of the major health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at NGS. Implementation of the Renewable PFR Alternative would reduce the impact of those positive impacts.

3.16.5.5.2 Proposed Kayenta Mine Complex

Under the Renewable PFR, alternative power would be purchased by Reclamation from an unknown, but existing source. Therefore, coal demand from proposed KMC would be reduced. As the alternative site is assumed to be an existing facility, prior disturbance impacts to human health and public health are not evaluated. At the proposed KMC, the following relevant human health and public health impact topics are potentially affected by the Renewable PFR Alternative compared to the Proposed Action.

- Human exposure to airborne pollutants contained in fugitive dust, and to pollutants deposited to the soil surface
- Local employment opportunities at proposed KMC to support NGS coal demands
- Relocation of residents residing within the mining zones
- Noise disturbances associated with mining
- Loss of livestock grazing areas and cultural resources

Potential cancer and noncancer risks to all receptors at proposed KMC (Resident, Resident Gardener, Resident-Farmer) were less than USEPA benchmarks and considered acceptable under the Proposed Action KMC 8.1 million tpy and 5.5 million tpy risk scenarios. Proposed KMC coal production under the Renewable PFR would be approximately 3 percent (100-MW reduction) and 7 percent (250-MW

reduction) less for than those estimated for the proposed KMC 8.1 million tpy Proposed Action scenario. Proposed KMC coal production under the Renewable PFR would be approximately 4 percent (100-MW reduction) and 11 percent (250-MW reduction) less than those estimated for the proposed KMC 5.5 million tpy Proposed Action scenario. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at proposed KMC under the Renewable PFR also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Renewable PFR would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and proposed KMC Operations under the Renewable PFR will have little to no effects on the health of the general population. Although proposed KMC emissions would be reduced under the Renewable PFR, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Renewable PFR than for the Proposed Action scenarios.

As discussed in Section 3.18, under the Renewable PFR, net reductions in jobs, labor income, tax revenues and other economic effects as compared to Proposed Action would occur. One of the major health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at the proposed KMC. Implementation of the Renewable PFR would reduce the demand of coal from the proposed KMC, particularly under the 2-Unit Operation scenario (44 percent of the coal needs would be required compared to the existing coal demands). Thus, staffing reductions at the proposed KMC and the associated reduction in beneficial health impacts associated with improved socioeconomics would be a likely outcome of the Renewable PFR. However, the reduced demand on coal to support the NGS operations under the Renewable PFR would lead to direct reductions in the number of residences affected (through emotional stress related to relocation, noise and vibration nuisances, and/or loss of grazing areas or cultural resources) by mining and blasting operations, particularly under the 2-Unit Operation scenario.

3.16.5.5.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

3.16.5.5.4 Project Impact Summary – All Project Components

The impacts to human health from NGS, proposed KMC, and transmissions lines and communication sites under the Renewable PFR would be negligible because potential cancer and noncancer risks to NGS and proposed KMC receptors would be less than USEPA benchmarks and considered acceptable. The potential public health benefits could be reduced based on the direct effects to the socioeconomic conditions of the affected community.

3.16.5.5.5 Cumulative Impacts

The public health evaluation and the HHRA conclusions consider the cumulative effects associated with existing conditions and the additional potential future impacts associated with the Renewable PFR. The same cumulative impacts on public health noted under the Proposed Action are anticipated under the Renewable PFR. Cumulative impacts to human health from baseline, the Renewable PFR and other cumulative sources would be low because potential cancer and noncancer risks to NGS and proposed KMC receptors under these scenarios are less than USEPA benchmarks and considered acceptable, except for the unacceptable noncancer risk for the recreational user due to exposure to methyl mercury

in fish. The number of potentially affected residents living within or in close proximity to an active mine zone requiring relocation would be reduced, particularly under 2-Unit Operation scenario; however, public health impacts would still be moderate for the few residents that would be affected. Socioeconomic benefits associated with the Renewable PFR would be reduced compared to the Proposed Action, but would still result in better socioeconomic conditions than the No Action Alternative.

3.16.5.6 Tribal Partial Federal Replacement Alternative

3.16.5.6.1 Navajo Generating Station

Under the Tribal PFR Alternative, between 100 MW and 250 MW of power generation from the NGS would be replaced by power supplied by a new photovoltaic generation facility on tribal land, displacing an equivalent amount of power from the federal share of NGS generation. The construction of a new photovoltaic generation site on tribal land would result in between 1,200 and 3,000 acres of new surface disturbance. The Tribal PFR facility would be analyzed in a separate NEPA process once a facility location is identified. Relevant human health and public health impacts topics are potentially affected by the Tribal PFR Alternative compared to the Proposed Action as listed below.

- Human exposures to airborne pollutants contained in stack emissions, and to pollutants deposited to the soil surface.
- Human exposures to emissions from natural gas electrical generation to provide firming (addressed in Section 3.1).
- Local employment opportunities to support NGS operations.

Potential cancer and noncancer risks to all receptors at NGS (Off-site Resident, Off-site Resident Gardener, Off-site Resident-Farm Family, Recreational Use, Off-site Commercial Worker) were less than USEPA benchmarks and considered acceptable under the Proposed Action NGS 3-Unit Operation and 2-Unit Operation risk scenarios. NGS emissions under the Tribal PFR would be approximately 2 percent (100-MW reduction) and 5 percent (250-MW reduction) less for than those estimated for the NGS 3-Unit Operation typical output. NGS emissions under the Tribal PFR would be approximately 3 percent (100-MW reduction) and 8 percent (250-MW reduction) less than those estimated for the NGS 2-Unit Operation typical output. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at NGS under the Tribal PFR also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Tribal PFR would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and proposed KMC Operations under the Tribal PFR will have little to no effects on the health of the general population. Although proposed KMC emissions would be reduced under the Tribal PFR, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Tribal PFR Alternative than for the Proposed Action.

One of the major health impacts associated with the Proposed Action was positive impacts due to the socioeconomic benefits associated with increased revenue and continued and future employment opportunities at NGS.As discussed in Section 3.18, the Tribal PFR Alternative would result in a combination of temporary construction and long-term operating jobs in conjunction with the photovoltaic solar project. Overall, the net differences in employment and revenue would be slightly less favorable for the Tribal PFR compared to the Proposed Action, but would still result in better socioeconomic conditions than the No Action Alternative.

3.16.5.6.2 Proposed Kayenta Mine Complex

The following discusses the impacts to human health and public health if 100 MW to 250 MW of power generation were replaced at NGS by alternative sources purchased by Reclamation from a new photovoltaic generation site on tribal land. The construction of a new photovoltaic generation site on tribal land would require the commitment of land, and would result in new surface disturbance at a location that would be evaluated in a subsequent NEPA action. Coal demand from proposed KMC would be reduced. At the proposed KMC, the following relevant human health and public health impact topics are potentially affected by Tribal PFR Alternative compared to the Proposed Action.

- Human exposure to airborne pollutants contained in fugitive dust, and to pollutants deposited to the soil surface.
- Local employment opportunities at proposed KMC to support NGS coal demands.
- Relocation of residents residing within the mining zones.
- Noise disturbances associated with mining.
- Loss of livestock grazing areas and cultural resources.

Potential cancer and noncancer risks to all receptors at proposed KMC (Resident, Resident Gardener, Resident-Farmer) were less than USEPA benchmarks and considered acceptable under the Proposed Action proposed KMC 8.1 million tpy and 5.5 million tpy risk scenarios. Proposed KMC coal production under the Tribal PFR would be approximately 2 percent (100-MW reduction) and 5 percent (250-MW reduction) less for than those estimated for the proposed KMC 8.1 million tpy Proposed Action scenario. Proposed KMC coal production under the Tribal PFR would be approximately 3 percent (100-MW reduction) and 7 percent (250-MW reduction) less than those estimated for the proposed KMC 5.5 Proposed Action scenario. As a consequence, human air and soil pollutant exposure would be proportionately reduced and potential cancer and noncancer risk estimates for all receptors at proposed KMC under the Tribal PFR also would be considered acceptable and have a negligible impact on human health.

Particulate emissions under the Tribal PFR would be proportionally lower than those reported under the Proposed Action scenarios. Thus, $PM_{2.5}$ concentrations would meet NAAQS criteria, and proposed KMC Operations under the Tribal PFR will have little to no effects on the health of the general population. Although proposed KMC emissions would be reduced under the Tribal PFR, because it is not clear whether there is a threshold $PM_{2.5}$ concentration below which adverse health effects are not seen and due to the uncertainty regarding associations between long-term and short-term exposure and adverse health effects, sensitive subpopulations could still potentially experience some minor impacts such as exacerbation of existing health conditions, but the likelihood of the impact is even lower for the Tribal PFR than for the Proposed Action scenarios.

As discussed in Section 3.18, under the Tribal PFR, net reductions in jobs, labor income, tax revenues and other economic effects as compared to Proposed Action could be potentially off-set by the increase in revenue associated with the new land lease to support the new solar project. In addition, the reduced demand on coal to support the NGS operations under the Tribal PFR would lead to direct reductions in the number of residences effected (through emotional stress related to relocation, noise and vibration nuisances, and/or loss of grazing areas or cultural resources) by mining and blasting operations, particularly under the 2-Unit Operation scenario.

3.16.5.6.3 Transmission Systems and Communication Sites

Operation of the WTS and STS would continue for the life of the project. The timing of decommissioning and final reclamation requirements for the WTS and STS ROWs ultimately would be determined by the authorities with responsibility for ROW issuance.

Additional disturbance could occur to an unknown number of acres related to connecting a new photovoltaic generation site on tribal land to the existing transmission system and would be evaluated in a subsequent NEPA action.

3.16.5.6.4 Project Impact Summary – All Project Components

The impacts to human health from NGS, proposed KMC, and transmissions lines and communication sites under the Tribal PFR would be negligible because potential cancer and noncancer risks to NGS and proposed KMC receptors would be less than USEPA benchmarks and considered acceptable. Compared to the Proposed Action, potential public health benefits under the Tribal PFR could be associated with reduced air pollutant emissions from NGS (yet continued operation of the plant through 2044), reduced impact to residents living on or near the mining zones (due to less coal demand), as well as the increased revenue associated with the new lease. While the NGS and proposed KMC would experience some reduction in labor requirements, leading to fewer job opportunities, the potential benefits could potentially offset this impact.

3.16.5.6.5 Cumulative Impacts

The public health evaluation and the HHRA conclusions consider the cumulative effects associated with existing conditions and the additional potential future impacts associated with the Tribal PFR. The same cumulative impacts on public health noted under the Proposed Action are anticipated under the Tribal PFR. Cumulative impacts to human health from baseline, the Tribal PFR and other cumulative sources would be low because potential cancer and noncancer risks to NGS and proposed KMC receptors under these scenarios are less than USEPA benchmarks and considered acceptable, except for the unacceptable noncancer risk for the recreational user due to exposure to methyl mercury in fish. The number of potentially affected residents living within the mine zone requiring relocation would be reduced, particularly under 2-Unit Operation scenario; however, health impacts would still be moderate for the few residents that would be affected. Socioeconomic benefits associated with the Tribal PFR would be reduced compared to the Proposed Action, but would still result in better socioeconomic conditions than the No Action alternative.

3.16.5.7 No Action

Under the No Action Alternative, required federal approvals to extend the operations of the plant beyond December 23, 2019, would not be obtained. Decommissioning activities would begin in 2018 with effective shutdown of the plant occurring by the end of 2019. Structures within the plant site would be demolished to ground level with the exception of those which are to remain in accordance with the lease agreement terms. Demolished structures largely would be buried in place or in on-site landfills.

NGS is the only consumer for the coal mined at the proposed KMC; therefore, if the NGS is not permitted beyond 2019, mining at the proposed KMC would cease once decommissioning is initiated at the NGS. Final reclamation would commence under an approved reclamation plan in accordance with Surface Mining Control and Reclamation Actand structures not approved as permanent facilities would be removed. Reclamation would likely resemble past reclamation and provide vegetation communities that offer forage for livestock grazing, in accordance with designated post-mining land use.

3.16.5.7.1 Navajo Generating Station

Under the No Action Alternative, the facilities would cease production in 2019 and demolition would occur starting in 2020. Immediately following cessation of operations, there may be site closure and remediation activities that would generate emissions (i.e., fugitive dust) and lead to nearby impacts. It is expected that such emissions and impacts would be in short duration and would be less than current emissions encountered at the site boundary due to standard construction best management practices implanted by Salt River Project Agricultural Improvement and Power District to minimize dust.

To determine the impacts from the No Action Alternative, the human health risks caused by emissions from other regional and global sources, i.e., other cumulative sources, impacts of mercury emissions from sources other than NGS and proposed KMC, including non-U.S. sources were characterized using mercury deposition data from the EPRI San Juan River Basin study (EPRI 2016). Impacts of arsenic and selenium emissions from the Four Corners Power Plant and San Juan Generating Station were characterized using data from the EPRI study. As presented in **Table 3.16-19**, HHRA results generated for the No Action Alternative (HHRA environmental baseline + other cumulative sources) predicted that the estimated excess lifetime cancer risks were within the USEPA acceptable cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}. All noncancer HIs for the No Action Alternative were less than the benchmark of 1 with the exception of chronic HI for the recreational users which was 2 due to exposures to methyl mercury via fish consumption.

The NGS HHRA concluded that negligible impact on human health was identified based on the No Action scenario for all receptor pathways which were considered acceptable except the ingestion of fish by the recreational user. Based on an unacceptable noncancer hazard of 2 for the ingestion of fish by the recreational user, a low impact on human health was identified. The impact is considered minor because of the fish advisory (AGFD 2012) that likely limits the consumption of fish.

Table 3.16-19 NGS HHRA Results: Baseline and Other Cumulative Sources

Receptor	Baseline		Other Cumulative Sources		No Action (Baseline + Other Cumulative Sources)	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Resident	2E-06	0.1	3E-11	0.0006	2E-06	0.1
Resident-Gardener	5E-06	0.7	3E-11	0.002	5E-06	0.7
Resident-Farm Family	4E-05	0.8	3E-11	0.003	4E-05	0.8
Recreational User	4E-06	1	3E-13	1	4E-06	2
Commercial Worker	5E-07	0.02	8E-12	0.00006	5E-07	0.02

3.16.5.7.2 Proposed Kayenta Mine Complex

Under the No Action Alternative, the mine would cease operation and mined areas would be reclaimed. Temporary emissions would be associated primarily with reclamation activities over 3 to 5 years after mining ceases. It is expected that such emissions would be in short duration and would be considerable less than current emissions encountered at the site boundary due to best practices to minimize dust implanted by PWCC.

The No Action risk scenario evaluated potential risks at the proposed KMC from non-NGS and non-KMC regional and global sources, and are the same for both Proposed Action (8.1 million tpy and 5.5 million tpy) options. As presented in **Table 3.16-20**, the cancer risk estimates for the No Action Alternative are within the USEPA acceptable risk range. The chronic HIs for the No Action Alternative are attributed to the baseline and range from 0.9 for the child resident to 1.9 for the child resident farmer. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HQs and HIs were acceptable, no further action was required. Estimated other cumulative sources impacts on the potential for adverse cancer and noncancer health effects at the proposed KMC were negligible.

Table 3.16-20 Summary of Proposed KMC HHRA Results – Baseline and Other Cumulative Sources (No Action)

Risk Case	Baseline		Other Cumulative Sources		Baseline + Other Cumulative Sources	
	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]	Cancer Risk[1]	Hazard Index[2]
Resident	6E-06	0.9	6E-11	0.0001	6E-06	0.9
Resident - Gardener	9E-06	1.1[3]	6E-11	0.0001	9E-06	1.1[3]
Resident- Farm Family	2E-05	1.9[4]	6E-11	0.0001	2E-05	1.9[4]

[1] Cancer risk estimates within or less than the USEPA cancer risk range (1×10^{-4} to 1×10^{-6}) are considered acceptable and require no further evaluation.

[2] HIs less than the target HI of 1 are considered acceptable and require no further evaluation.

[3] An HI of 1.1 for the resident gardener child exceeded the target HI of 1 and required further evaluation consisting of a target organ analysis. The target organ analysis revealed His less than 1 for all target organs, indicating acceptable noncancer risk and no further evaluation was required.

[4] A HI of 1.9 exceeded the target HI of 1 and required further evaluation consisting of a target organ evaluation. Because the target organ evaluation for the resident farmer child exposure scenario demonstrated all target organ HQs and HIs were acceptable, a similar evaluation was not performed for any other scenarios or receptors.

3.16.5.7.3 Transmission Systems and Communication Sites

The NGS transmission system is an established part of the western U.S. transmission grid and supports reliability and delivery of power throughout the region, well beyond the power generated by the NGS. Therefore, under the No Action Alternative it is likely that that one, several, or all of the land owners/managers of the transmission line rights-of-way and communication site leases would renew some portion of the facilities to keep the power grid performing as expected.

In the event it is determined that some or all of the transmission systems and communication site ROWs are not renewed, a lengthy study and permitting process would need to occur before any decommissioning is initiated due to the essential and integral nature of these facilities with the western electric grid. As noted in Section 2.3.3, up to 4,826 acres within and alongside the transmission system corridors could be temporarily disturbed if the entirety of the transmission systems and communication sites were decommissioned and removed.

3.16.5.7.4 Public Health

Under the No Action Alternative, all of the negative health impacts associated with the Proposed Action Alternative and identified on **Table 3.16-11** would be eliminated. Specifically, for the NGS, because it would no longer be operating, potential impacts to air quality would improve, reducing the potential for negative health impacts to sensitive subpopulations with existing health conditions that are exacerbated by exposure to increased levels of particulates. For proposed KMC, because mining operations would cease after 2019 under the No Action Alternative, the following negative health impacts would be eliminated:

- No additional relocation of residences would occur; eliminating the negative impact to overall well-being and psychosocial health resulting from the emotional stress associated with relocation;
- No blasting would occur, eliminating the negative impact to overall well-being and psychosocial health resulting from the stress induced by the nuisance and annoyance of blasting noise and vibration; and

- No loss of livestock grazing areas or cultural resources would occur; eliminating the negative impact to nutrition associated with loss of nutrition sources that livestock and culturally significant plants provide, the negative impact to well-being associated with the potential loss of income associated with change in livestock grazing areas, and the negative impact to well-being associated with the potential loss of cultural resources impacting traditional lifestyles and tribal cultures.

However, while all of the negative impacts associated with the Proposed Action would be eliminated under the No Action Alternative, the positive benefits on health associated with the improved socioeconomic conditions that the NGS and associated mining activities provides to the local community also would be eliminated. Because the NGS and the Kayenta Mine are economically interrelated in terms of impacts to employees, and revenues to the Navajo Nation and Hopi Tribe, the consequences of the No Action Alternative implementation are addressed for both components together. Specifically, as detailed in Section 3.18, socioeconomic effects that would result from the No Action Alternative would be major, widespread, long-lasting, and predominately adverse. These effects would directly and indirectly affect the Navajo and Hopi tribal governments, many households, businesses and local government agencies and services. Because the NGS and Kayenta Mine are among the largest private sector employers in northeastern Arizona, the effects would extend to Coconino, Navajo and Apache counties and throughout the state. The loss of jobs and income and the reductions in revenues paid to the tribes would be substantial adverse effects of the No Action Alternative, given persistently high unemployment and poverty among on-reservation Navajo and Hopi, and the importance of the revenues paid to the tribal governments in supporting tribal employment and the provision of services on a reservation wide basis.

The importance of the jobs, income and revenues is underscored by the lack of any currently identified or reasonably foreseeable new industrial or commercial development that offers prospects to offset the losses. These socioeconomic effects could have potentially dramatic indirect effects on health because general health and well-being are closely correlated to the socioeconomic conditions of the community (WHO 2008). In general, communities with low income potential and high unemployment have much poorer health statistics and reduced access to health care. In addition, with closure of the mine, the PWCC EMS clinic also would be closed, eliminating one of the already limited health care facilities in the area. The existing poor health rankings due in large part to lifestyle risk factors would remain and could potentially be exacerbated by the sudden economic impacts to the local community.

In addition, many community members support the continued operation of the NGS and supporting mining activities at proposed KMC. As discussed in Section 3.18, the mine has brought economic, employment and fiscal benefits to the local community, which leads to an improved quality of life. Implementation of the No Action Alternative could lead to emotional stress resulting from the uncertainties associated with potential loss of income, employment and health benefits. The emotional stress resulting from closure of NGS and proposed KMC mine also could potentially result in negative impacts to overall well-being, psychosocial health, and quality of life of the affected community.

3.16.5.7.5 No Action Impact Summary – All Project Components

The impacts to human health from NGS, proposed KMC, and transmissions lines and communication sites under the No Action Alternative would be low to moderate. Based on an unacceptable noncancer hazard of 2 for the ingestion of fish by the recreational user under the NGS No Action Alternative, a minor impact on human health was identified. The impact is considered minor because of the fish advisory (AGFD 2012) that likely limits the consumption of fish.

As discussed above, the socioeconomic and psychosocial effects (i.e., loss of jobs and income, reduction in revenue paid to the tribes, closure of PWCC EMS clinic) that would result from the No Action Alternative would be have a major impact on public health in the project study area.

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