Chapter 6. Environmental Consequences

6.1 Introduction

This chapter analyzes the effects of the alternatives on physical, natural, cultural, and socioeconomic resources at the national wildlife refuges (refuges) covered in the Klamath Basin National Wildlife Refuge Complex (Refuge Complex). It analyzes the impacts of plans, projects, and strategies within each alternative and presents mitigation measures for adverse impacts. Some components included in the alternatives strategies have not been developed at a project-specific level of detail; for those components, this comprehensive conservation plan (CCP)/environmental impact statement (EIS) will serve as the first-tier National Environmental Policy Act (NEPA) document for future project-specific NEPA documents.

Analyzed for each refuge is a No Action Alternative (Alternative A) which would continue the current management program; this alternative serves as the baseline to compare the anticipated changes or impacts to the environment as a result of implementation of the other alternatives. Lower Klamath Refuge has three action alternatives; Clear Lake and Tule Lake Refuges each have two action alternatives; and Bear Valley and Upper Klamath Refuges each have one action alternative. Appendix L contains a list of best management practices (BMPs) that would be implemented to minimize and avoid adverse effects. Mitigation measures are identified if impacts have potential to be significant or substantial, based on the thresholds listed below, in order to reduce the intensity of the impact. Some of these measures are programmatic and may need to be refined at the project-level for specific actions.

This chapter is organized by refuge and then by resource topic, following the same order as Chapter 5, Affected Environment. Within each resource topic, impacts are discussed first for the No Action Alternative, then for the action alternatives. The analysis of the action alternatives focuses on the additional or new impacts that would result from new strategies that are being considered beyond the current management program. Summary tables comparing the impacts of each alternative are provided at the end of each refuge discussion.

The concept of significance, according to Council on Environmental Quality (CEQ) regulations (Title 40 Code of Federal Regulations [CFR] Part 1508.27), is based on both the context in which an action would occur and the intensity of that action on the aspect of the environment being analyzed. “Context” is the setting within which an impact is analyzed, such as a particular locality, the affected region, or society as a whole. “Intensity” is a measure of the severity of an impact. Determining the intensity of an impact requires consideration of the appropriate context of that impact as well as a number of other considerations, including the following.

- Impacts may be both beneficial and adverse. A significant effect may exist even if on the balance the effect would be beneficial.
- The degree to which an action affects public health or safety.
- Unique characteristics of the geographic area (e.g., historical of cultural significance, specially protected lands, ecologically critical areas).
- The degree to which the impacts of an action are likely to be highly controversial.
- The degree to which the possible impacts of an action are highly uncertain or involve unique or unknown risks.

- The degree to which an action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
- Whether an action is related to other actions with individually negligible but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment.
- The degree to which an action may adversely impact properties listed in or eligible for listing in the National Register of Historic Places (NRHP), or may cause loss or destruction of significant scientific, cultural, or historical resources.
- The degree to which an action may adversely impact an endangered or threatened species or critical habitat as listed under the Endangered Species Act of 1973 (ESA).
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

Impacts are assessed for scope, scale, and intensity of impacts to the human environment. Effects may be identified as beneficial or adverse as well as long-term or short-term. The following terms are used to provide an approximate assessment of the severity of an impact; they are not meant to be an absolute definition, but help the U.S. Fish and Wildlife Service (Service) and the public speak of impacts in the same way.

- **Neutral or Negligible**: Resources would not be affected (neutral effect), or the effects would be at or near the lowest level of detection (negligible effect). Resource conditions would not change or would be so slight there would not be any measurable or perceptible consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resources.
- **Minor**: Effects would be detectable, but small, and of little consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. Mitigation, if needed to offset adverse effects, would be easily implemented and is likely to be successful.
- **Intermediate**: Effects would be readily detectable and localized with consequences to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. Mitigation, if needed to offset adverse effects, would be easily implemented and is likely to be successful.
- **Major or Significant**: Effects would be obvious and would result in substantial consequences to a local area or regional population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. Of particular concern would be effects to resources that are fundamental to the refuge such as waterfowl at Upper Klamath, Clear Lake, Tule Lake, and Lower Klamath Refuges and the bald eagle at Bear Valley Refuge. Extensive mitigation measures may be needed to offset adverse effects and would be large-scale, very complicated to implement, and may not guarantee success. In some instances, major effects would include the irretrievable loss of the resource.

Time scales are defined as either short-term or long-term.

- **Short-term or temporary**: An effect that generally would last less than 1 year or one season.
- **Long-term**: A change in a resource or its condition that would last longer than 1 year or one season.

6.1.1 Physical Environment

Soils

An adverse impact is considered significant if an action would trigger or accelerate erosion, subsidence, or slope instability and affect other resources or if an action would result in substantial loss of topsoil.

Hydrology

Surface Water

An adverse impact is considered significant if an action would:

- alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation; or
- expose people or structures to a significant impact involving flooding.

Water Quality

An adverse impact is considered significant if an action would violate water quality standards or substantially alter water quality.

Air Quality

An adverse impact is considered significant if an action would:

- violate any air quality standard (e.g., *de minimis* standards for nonattainment areas) or contribute substantially to an existing or projected air quality violation; or
- expose sensitive receptors to substantial pollution concentrations.

Fire Hazards

An adverse impact is considered significant if an action would increase the risk of fire and result in a hazard to the public or environment.

6.1.2 Biological Resources

Vegetation and Habitat Resources

An adverse impact is considered significant if an action would:

- substantially reduce or degrade habitats, especially riparian or wetland habitats;
- result in an increase of nonnative species such that they become the dominant species in the habitat;
- fragment or isolate habitats, particularly specialized habitat for sensitive species;
- cause severe degradation of a habitat such that it is no longer suitable for native or endemic species; or
- result in direct mortality of federal- or state-listed plant species.

Fish and Wildlife

An adverse impact is considered significant if an action would:

- significantly affect habitats as described above;
- result in mortality or forced emigration of a substantial portion of a species' population on the refuge (non-sensitive);
- allow pest species access to areas previously restricted (e.g., aquatic habitats); or
- reduce, through direct or indirect means, the likelihood of both the survival and recovery of a sensitive species in the wild by reducing reproductive success, numbers, or distribution of that species.

6.1.3 Cultural Resources

An adverse impact is considered significant if an action would:

- cause physical destruction of or damage to all or part of a historic or prehistoric site;
- alter a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for the treatment of historic properties (36 CFR 68) and applicable guidelines;
- remove the property from its historic location;
- change the character of property use or any physical features within the property setting that contribute to its historic significance;
- introduce visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features; or
- neglect a property, which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to Native American tribe.

6.1.4 Visitor Services

An adverse impact is considered significant if an action would:

- increase the use of existing public use facilities such that substantial physical deterioration of the facility would occur or be accelerated;
- substantially displace public recreation opportunities; or
- substantially reduce the quality of recreation opportunities on the refuge.

6.1.5 Social and Economic Conditions

An adverse impact is considered significant if an action associated with the management of a refuge would result in substantial adverse impacts to refuge or regional economic conditions.

Lease Lands Farming Program

The effects on the physical environment of the ongoing pest management program for the leased farmlands on the refuges are assessed in the *Integrated Pest Management Plan and Environmental Assessment for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges, Oregon/California* (IPM Plan) (Service 1998a). Many of the same pesticide-related effects assessed in that document also apply to pesticide use elsewhere on refuge lands.

6.2 Lower Klamath National Wildlife Refuge

This section describes the potential impacts associated with the No Action Alternative and three action alternatives. A brief discussion of Alternative A (No Action: Current Management Program) is provided as baseline to compare the impacts of each action alternative. Impacts are judged for significance using the thresholds described in the introduction of this chapter. Mitigation measures for potentially adverse effects are described in the list of BMPs (see Appendix L). The following resources would not be affected by the action alternatives.

- Geology: Given the limited management actions currently implemented and proposed on the refuge, no effects to geologic resources would occur.
- Paleontological Resources: There is potential for as yet undiscovered paleontological resources to be affected during ground-disturbing activities. Should any paleontological resources be discovered by the Service, they would be conserved in place or deposited in an approved repository. On Service-owned land the public is not allowed to remove any paleontological resources from the refuge. As a result of protections under the Paleontological Resources Preservation Act (Public Law [PL] 111-011) (Omnibus Public Land Management Act of 2009), no effects to paleontological resources would occur.

6.2.1 Soils

Methodology for Analyzing Effects – Lower Klamath Refuge

Reports on the soil types within the refuge boundary that are available online through the Natural Resources Conservation Service (NRCS) were consulted to assess relative susceptibility of different soils to erosion. These finding were applied generally to help understand how land management actions and public use activities might affect the physical qualities of the soil.

Resource-specific contexts for assessing effects of the alternatives to soil resources include:

- construction-related impacts would be localized; and
- soils within the refuge boundary and outside of the refuge boundary have been historically disturbed or altered.

Alternative A – Lower Klamath Refuge

Ongoing habitat and water management activities, such as agricultural activities, fire suppression and treatments, pesticide application, and maintenance of public use facilities, as well as public use of the refuge result in varying levels of soil disturbance on the refuge. Agricultural activities, in particular, regularly disturb soils during planting and harvesting of crops. These activities periodically expose soil to wind and water erosion over a portion of the refuge, but they are subject to conditions in the special use permit (SUP) or lease contract that minimize erosion-related impacts (see Appendix G, Compatibility Determinations). In addition, vegetation tends to naturally re-establish in disturbed areas or is planted in agricultural areas, which protects soils from long-term erosion following the activities.

Impacts associated with the major components of habitat management and public use are described below.

Wetland Management

For the purposes of this CCP, managed wetlands are those managed for wetland functions and where water is intentionally and actively applied annually through a managed process (Service and Bureau of Reclamation [Reclamation] 2000). Most wetlands on the refuge are actively managed. Walking wetlands (flood fallowed lands) are addressed under the Farming sections.

The soils of Lower Klamath Refuge developed under the former Lower Klamath Lake and are the result of materials that settled out of a body of still water. Approximately 87% of refuge consists of deep, poorly drained, silt loam soils. These soil characteristics lend themselves to the development of both seasonal and permanent wetlands. Maintaining units on the refuge as wetlands is consistent with the underlying soil types. Water fluctuations in the wetlands can expose soils to erosion when some of the wetlands become dry in the fall. This impact is short-term and occurs periodically over the course of the year. It is minimized by the presence of wetland vegetation and re-establishment of the wetlands in winter. Wetland management activities that affect soils include disking, tilling, hand pulling weeds, mowing, and rotating seasonal wetland units through grain to set back vegetative succession and improve habitat conditions for waterfowl. These types of wetland management activities also serve as non-chemical pest management practices to control invasive species (see Section 4.2.2). Of the ongoing wetland management activities, tilling and disking have the greatest potential to affect soil because each time soil is tilled or disked, it is exposed to air which can reduce the organic matter level in the soil. Tilling and disking can also disrupt the abundance and diversity of flora and fauna in near-surface soils. In wetland areas tilling and disking is an infrequent occurrence because it is only used when marsh areas have become overly dense. Annually around 1,000 acres could be disked by refuge staff. Depending on how quickly vegetation matures, this process would not be repeated in the same location for around 10 years. The hand pulling of weeds turns over soils in very small areas; wheels on mowers and brush cutters can compact soils; however, mowing is generally confined to refuge roads and berms which are structures that have already been compacted. Mowing weeds would not lead to increased erosion.

Prescribed burns have also been used to set back vegetative succession. Prescribed burns could be used on up to 3,000 acres to set back vegetative succession. The number of acres burned is contingent on obtaining a burn permit, staffing, and funding. Prescribed burns in wetland areas affects tules and other native grasses. This type of vegetation is considered a light fuel which means that fire moves over this type of landscape so quickly that there are minimal effects on soil (Vogel 1979). Under normal circumstances, fires do not affect grassland soils adversely but generally improve them by returning charred organic matter to the soil. Prescribed burns to set back vegetation is used in a patchwork manner across the refuge as it will take a number of years for each area to mature. One of the benefits of prescribed burns is that they return nutrients that were locked up in plants back to the soil where they are once again available for uptake by plants. Because the lay of the land on the refuge is relatively flat, prescribed burns do not facilitate serious erosion, or harm the soil.

The potential for erosion from wetland management activities is relatively low. On a scale of 0 to 6, with 6 being high, the NRCS rates the soils in the wetland management area at scale of 2. The level landscape, moderate potential for soil erosion, and use of BMPs when working in wetland areas minimizes the extent of soil erosion on the refuge.

In addition to wetland management maintenance of equipment and buildings can require the use of repellents to deter rodents from damaging equipment and buildings. Most commonly used are bag-type repellents. Bag-type repellents include active ingredients that are often based on natural compounds, like cedar wood, eucalyptus oil, balsam fir needles, grapefruit oil, lemon oil, mineral concentrate, mint oil, peppers, predator scents, and soap. Bag-type repellents have no effect on soils.

The adverse effects to soils from wetland management is minor based on the extent and frequency of mowing, burning, and disking on soils.

Farming Programs

If the Service received full water deliveries needed to meet habitat objectives, the farmed acres on the refuge would total approximately 9,600 acres composed of 7,600 acres of grain and 2,000 acres of pasture. This constitutes about 18% of the refuge land area. However, the actual quantities of crops grown on the refuge will vary from year to year depending on the water year type and the water allocation system that is implemented. Projections of crop types and wetlands on the refuge under a range of scenarios are presented in Table 6.1 in Section 6.2.5. In addition to helping meet habitat objectives for dabbling ducks and geese, farming is also used to control invasive plant species such as perennial pepperweed. In dry years when water is not available for seasonal wetlands, the refuge may increase the acreage of cooperative farm fields by up to 4,000 acres as a method to control invasive plant species instead of using pesticides. In this situation, there may be more cooperative farming than is needed to meet habitat objectives. The additional cropland acreage on the refuge would be used to provide incentives for cooperative farmers to provide wetlands on private lands off of the refuge through the Walking Wetlands Program.

Typical farming practices include prescribed burning, flood irrigation, tilling, rotational flood-fallow, application of pesticides, and variation in the timing of these practices. Prescribed burning reduces surface vegetation prior to tilling and planting. The vegetative stubble that is burned is a low fuel which means that the fire moves across the landscape so quickly as to have minimal effects on soil. Prescribed fire can be completed on many fields in less than an hour. Croplands are burned annually. Farm fields are then tilled and disked to eliminate weeds. As described under wetland management, tilling and disking have the greatest potential to affect soils because each time soil is tilled it is exposed to the air which can reduce organic matter. Farm fields are then pre-irrigated from November through February with water removed from February through April. Fields are then planted with small grains by early June. The high water-holding capacity of the soils means that no summer irrigation is needed for small grains. The acreage farmed each year is dependent on the water availability. Fertilizers are not used on the refuge. Flood fallowing (or walking wetlands) is an agricultural practice that enhances soil fertility and crop yields, and suppresses soil pathogens and weeds. Flood fallowing is a process by which a farm field is flooded either seasonally (fall through spring) or year-round for a 1- to 4-year fallow cycle before being returned to agricultural production. Flood fallowing reduces the need for fertilizers and pesticides and some of the adverse effects on soils, water quality, vegetation, and wildlife that can be associated with their use. Flood fallowing is done on a small percentage (less than 1%) of refuge lands as well as by local farmers on their own land. The incentive for local farmers to participate in flood fallowing on their own land is that they are then granted preferential treatment with regard to the cooperative farming program. In addition to providing off- refuge wetland habitat for wildlife, flood fallowing also enhances soil fertility and crop yields, and suppresses soil pathogens

and weeds. In addition to environmental benefits, farmers are able to sell organic crops at a higher market price.

The potential for erosion from agricultural practices is relatively low. On a scale of 0 to 6, with 6 being high, the NRCS rates the soils in the farmed area at levels 2 and 3 (see Figure 5.4). The level landscape, the small percentage of the refuge that is farmed, moderate potential for soil erosion, and use of BMPs minimizes the extent of soil erosion on the refuge.

The adverse effects to soils from farming programs are minor.

Haying and Grazing Programs

Annually, up to 700 acres of cooperative farm fields and 1,800 acres of the lease lands in Area K are hayed on the Lower Klamath Refuge. This use accounts for approximately 5% of refuge lands. Haying is conducted similarly to farming except that hay fields undergo additional flood irrigation in the summer. Haying requires the use of a variety of farm machines on the refuge (potentially including tractors, swathers/windrowers, hay rakes, hay balers, and trucks and the personnel to operate these machines. Personnel are on site as needed throughout the season to monitor the fields and perform appropriate farming-related functions, including operating he machines. Some of all of these machines are on the refuge throughout the season. Soils can be compacted from the use of this equipment. Transporting the equipment on and off the refuge is done on refuge roads which are already compacted. Hay rakes, balers, and trucks are used prior to planting and during harvest which limits the amount of soil compaction that takes place. Flood irrigation, tilling, harvesting associated with haying are similar to those associated with farming and similar affects would be expected as discussed in the previous section.

Prescribed grazing occurs annually on both the lease lands in Area K and on cooperative grazing units. On the lease lands up to 1,280 acres (1,280 animal unit months [AUMs]) are grazed in areas that have been hayed earlier in the season. Post haying fall-pasture lots are grazed from September through November. In addition, there are two small lots (less than 30 acres each) with permanent pasture that are grazed from June through November. This acreage makes up less than 3% of the refuge. Prescribed grazing may be used on up to 22% of the refuge in the western, central, and southern areas of the refuge (see Figure 5.7). In recent years 11,225 acres (3,670 AUMs) have been grazed annually. Prescribed grazing also requires the use of a variety of equipment and infrastructure on the refuge such as trucks, trailers, off-road vehicle, fences and gates as well as ranching personnel to operate equipment and manage livestock. Some of this equipment is on the refuge throughout the grazing season and can compact soils in the areas it is used. Livestock can temporarily expose and disturb soils and increase erosion (Gifford and Hawkins 1978; Roberson 1996), and physical disturbance from equipment used for grazing expose soils and increase erosion. Collectively, these management activities may increase the potential for short-term, localized exposure of bare soils that may result in increased water and wind erosion. Stipulations incorporated into the grazing and haying agreements restrict the number of livestock allowed on the refuge, location, and livestock management on the refuge (see Haying and Grazing compatibility determinations in Appendix G).

The potential for erosion from haying and grazing is relatively low. On a scale of 0 to 6, with 6 being high, the NRCS rates the soils in the haying and grazing areas at levels 2 and 3. The level landscape, the small percentage of the refuge that is farmed, moderate potential for soil erosion,

and use of stipulations in the haying and grazing agreements and BMPs minimizes the extent of soil erosion on the refuge.

The adverse effects on soils from haying and grazing are minor.

Pesticide Application

As part of the ongoing integrated pest management (IPM) activities, pesticides are used to control weeds for the farming program as well as to control invasive plant species, and maintain refuge facilities. Pesticides can fall on the soil surface as a result of overspray and wind drift; pesticide spray missing its mark; excess pesticide dripping from plant stems, leaves, or other plant parts; or spillage from storage, mixing, loading, equipment cleaning, and disposal areas. Pesticides are only applied after the approval of a pesticide use proposal (PUP). When pesticides are used, the Service follows standard BMPs (Appendix L) to reduce adverse effects to soil, including adherence to all U.S. Environmental Protection Agency (USEPA) and Oregon or California EPA warning labels and application requirements. During the PUP process the Service considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the physical environment associated with the proposed site-, time-, and target-specific use of pesticides on the refuge are evaluated using the chemical profile prepared for the pesticide.

Prior to approval of the PUP, the mobility of the pesticide in soil and their potential toxicity is considered as follows: Once on the ground surface, pesticides can volatilize, be transported by wind or water across the land in their applied form or adsorbed to soil particles, be adsorbed and stay on top of or near the soil surface, or be degraded through exposure to weathering (Fishel 2003; O'Callaghan 2002; van Es and Trautmann 1990). Soil adsorption occurs to a greater degree in drier soils that are high in organic matter or clay and certain pesticides (e.g., glyphosate) are more tightly bound than others (Fishel 2003; van Es and Trautmann 1990). Pesticides on the soil surface or in the soil profile can also be changed into more- or less-toxic forms through microbial actions (metabolization by soil bacteria and fungi), chemical reactions (oxidation, reduction, and hydrolysis), and photochemical reactions (photolysis) (Fishel 2003; NRCS 1998; van Es and Trautmann 1990). These actions are influenced by the physical and chemical properties of the pesticide; exposure to and the intensity of sunlight; the degree the pesticide adsorbs onto soil particles; and soil conditions, such as moisture, temperature, aeration, pH, and amount of organic matter (Fishel 2003; van Es and Trautmann 1990). Depending on their chemical makeup and persistence, some pesticides may remain at or near the soil surface for extended periods of time. Again, depending on their chemical properties, concentrations, and other factors, the existence of some pesticides or their decomposition products in the soil profile could prove toxic to some soil-dwelling organisms and plants, including farm crops (Lindgren et al. 1954). This range of soil/pesticide interaction is considered during the PUP process.

The PUP (including appropriate BMPs) is approved when scientific evidence indicates that effects to refuge biological resources and its physical environment are likely to be minor, temporary, or localized in nature.

The types of pesticides that have been approved for use are listed in Tables 5.17 and 5.19. Annual pesticide application on the cooperative farming lands has ranged from 942 acres in 2011 to 688 acres in 2013. Annual pesticide application targeting invasive species management and facility maintenance has ranged from 3,639 acres in 2011 to 652 acres in 2013. Pesticide application on the

lease lands in Area K is reported in conjunction with the lease land program on Tule Lake Refuge (see Section 6.4.1).

The adverse effects on soils from pesticide application are negligible.

Public Use

The refuge is open to the public for wildlife observation and photography, interpretation, environmental education, and hunting. These types of activities have relatively limited impacts on soils because they are mostly conducted on developed trails and facilities such as the visitor center on Tule Lake Refuge and on the photo blinds, vehicle pull-offs, wildlife overlooks, and the 10-mile auto tour route on the Lower Klamath Refuge. Hunters, including their vehicles, boats and trailers, and dogs, can also compact soils, and generate dust and erosion. These effects would be localized primarily on access roads, trails, and at boat-launch sites. Informal observations by refuge staff have not identified adverse effects to soils from public use. Therefore, the Service anticipates that there would be negligible, short-term adverse effects to soils from public use activities.

Beneficial Effects

Indirect beneficial effects to soils are expected from land management activities that conserve natural resources and public use activities are expected that increase public appreciation and stewardship of refuge lands. The beneficial effects of Alternative A on soils are negligible.

Mitigation

Appropriate BMPs (Appendix L) will be implemented during ongoing refuge management to minimize indirect effects of soil disturbance, including dust and erosion.

Alternative B – Lower Klamath Refuge

Land Management

Wetland Management

Impacts to soils would be similar to those identified for Alternative A activities. In wetland units the Service would continue to use disking, plowing, prescribed burns, and rotation through grain in seasonal wetland units to set back vegetative succession. As described under Alternative A, a maximum of 3,000 acres would be burned annually on the refuge depending on staffing and budget. No more than 1,000 acres of wetlands would be disked to set back vegetative succession.

Under Alternative B the Service would continue to use the *Klamath Basin National Wildlife Refuge Complex Fire Management Plan* (Fire Management Plan) (Service 2001) and update the refuge habitat management plan. These plans would not directly affect the physical environment. Site-specific restoration projects developed in the future would be subject to subsequent NEPA compliance, and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document.

Impacts of wetland management to soils would be minor as described under Alternative A.

Farming Programs

Under a full demand scenario, although the proportion of grain and pasture would change, the overall extent of farmed areas on the refuge would be the same as Alternative A. Under Alternative B, up to 5,591 acres of grain would be grown annually on the refuge and up to 4,018 acres of pasture would be grown on the refuge (see Figure 4.5). Because there would be more lands in pasture than under Alternative A, the potential for wind erosion may be slightly reduced. Pasture lands may be less susceptible to wind erosion than plowed fields, due to the increased length of time soils are exposed to wind when soils are plowed. The use of cooperative farmland for invasive species control in dry years would be the same as Alternative A. In summary, impacts to soils under Alternative B would be minor.

Haying and Grazing Programs

The haying and grazing program would be the same as described under Alternative A. Impacts to soils would continue to be minor.

Pesticide Application

Pesticide application would continue to be authorized only after the approval of a PUP. **An approved PUP is required for pesticide application on a refuge, not an IPM plan (see 569 FW 1.10 and 1.12). The Service will continue to use the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on cooperative farm units. However, the Service will also continue to limit the amount and type of pesticide used at Lower Klamath Refuge. On Lower Klamath Refuge, the restrictions in the SUP limit the types of pesticides that can be used on conventional crops to the following: one ground broadcast application of 2,4_D amine, MCPA, glyphosate, and/or dicamba. On cooperative farm units that are in organic production, only pesticides that meet the standards outlined by the National Organic Program criteria are allowed. Under Alternative B, the Service would formalize the ongoing IPM activities for cooperative farm units, habitat restoration and general maintenance under an IPM Program (see Appendix Q).** No additional pesticide or other pest management-related effects are anticipated from the farming, grazing, haying, and invasive species management programs beyond those described in Alternative A. Therefore, the effects to soils from implementation of Alternative B would be the same as described under Alternative A.

Public Use

Alternative B would also involve construction of a vehicle pull-off on State Line Highway, installation of a contact station at the refuge entrance, and modification or expansion of access routes on the refuge. These activities would result in soil disturbance in relatively small, localized areas, but could expose the soil to erosion or result in a loss of topsoil. These impacts will be analyzed further in project-specific NEPA documents once specific details on the new facilities are available.

Beyond this, effects on soils under Alternative B would be the same as under Alternative A. Therefore, the Service anticipates that there would be negligible, short-term adverse effects to soils from public use activities.

Beneficial Effects

The beneficial effects would be the same as described under Alternative A.

Mitigation

Appropriate BMPs (Appendix L) would be implemented during refuge management activities to minimize indirect effects of soil disturbance, including dust and erosion.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Wetland Management

In wetland units the Service would continue to use disking, plowing, prescribed burns, and rotation through grain in seasonal wetland units to set back vegetative succession.

Farming Program. The use of prescribed burning and disking would not be any greater than under Alternative A. Impacts to soil from wetland management would be considered minor.

Farming Program

Under a full demand scenario the acreage of grain and pasture on the refuge would be the same as under Alternative B. Modifications to the farming program would occur under Alternative C such as structuring the lease land contracts so that if habitat objectives for unharvested standing grain cannot be met on cooperatively farmed units, lease land contract holders would be required to leave 25% of their fields as unharvested standing grain. In addition, the refuge would work to expand areas of organically farmed units. The use of cooperative farmland for invasive species control in dry years would be the same and Alternative A. Impacts to soils under Alternative C would be very similar to Alternative B and are considered minor.

Grazing and Haying Programs

Under Alternative C, the refuge would expand the use of grazing in uplands and dry seasonal wetland units by 2 to 3,000 acres per year to improve habitat for waterfowl. This would increase the acreage of grazing on the refuge by a maximum of 5%. The effects of grazing on soils would remain minor.

Pesticide Applications

Alternative C would also include formalizing the ongoing IPM activities under an IPM Program (see Appendix Q). Pesticide application would continue to be authorized only after the approval of a PUP. Under Alternative C, the Service would work to expand the use of organic farming on lease land and cooperative farming unit which would reduce the application of chemical pesticides on the refuge. Under Alternative C, the effects to soils from the land management programs would be the same as described under Alternative A.

Public Use

In addition to the public use activities described under Alternative B, the Service would phase in a requirement to allow only 4-stroke or direct injection 2-stroke boat engines on the refuge. This requirement would have no effect on soils. As with Alternative B, adverse effects from public use activities would be negligible and short-term.

Beneficial Effects

Beneficial effects would be similar to those described under Alternative A. The expansion of organic farm fields on the refuge would reduce the application of chemical pesticides on the refuge.

Mitigation

Appropriate BMPs (Appendix L) would be implemented during refuge management activities to minimize indirect effects of soil disturbance, including dust and erosion.

Alternative D – Lower Klamath Refuge

Land Management

Wetland Management

Under Alternative D the Service would reconfigure and construct a new levee in the southern portion of the refuge to create a Big Pond area that encompasses approximately 9,000 acres. Wetland management actions that affect soils outside of the Big Pond would be similar to Alternative A with the use of disking, plowing, prescribed burning, grazing, and rotation through grain to set back vegetative succession and improve habitat conditions. However, within the Big Pond area wetland management would be limited to capturing water to fill the pond in the winter and spring and then allowing the levels to gradually recede during the summer and fall. Construction of the Big Pond would require the removal of 31 water control structures and 29 miles of interior levees/roads that are within its footprint, in addition to the construction of the exterior levee. Construction activities associated with the Big Pond would result in additional soil disturbance and the potential loss of topsoil. Following construction of the Big Pond, there would be some degree of wind-driven wave erosion. This large body of water would be affected by winds (primarily from the south) that could create waves as large as 2.3 feet. Levees or dikes likely would be needed to reduce wind-driven wave erosion, and vegetation, once established, could further reduce this wind-driven erosion, particularly on the northern shoreline. This area was once historic Klamath Lake, and the southern shoreline consists of a naturally stable bank from the historic lakeshore. Construction activities associated with the Big Pond would take more than 1 year; therefore, effects associated with that work would be considered long-term, but not permanent. Because of the construction related adverse effects to soils the overall impact of wetland management to soils under Alternative is considered intermediate. If this alternative is selected, a site-specific NEPA document would be prepared to analyze these impacts in more depth.

Farming Programs

Under a full water demand the proportion of grain and pasture grown on the refuge would be the same as under Alternative C. The use of cooperative farmland for invasive species control in dry years would be the same and Alternative A. The impacts to soil from farming would be minor.

Haying and Grazing Programs

Under Alternative D, the haying and grazing on the refuge would be the same as Alternative B. Impacts to soils would be minor.

Pesticide Application

Pesticide or other pest management-related effects are would be the same as described in Alternative B. The effects of pesticides on soils would be negligible as described under Alternative B.

Public Use

Under Alternative D, the hunt and sanctuary areas would need to be modified as the Big Pond unit is developed. This modification would not result in increased use of the refuge for hunting so it is likely that soil-related impacts from public use under Alternative D would be very similar to those described for Alternative B. As with Alternative B, adverse effects from public use activities would be negligible and short-term.

Beneficial Effects

Beneficial effects are the same as under Alternative B.

Mitigation

Appropriate BMPs (Appendix L) would be implemented during construction and demolition activities to minimize indirect effects of soil disturbance, including dust, erosion, and sedimentation.

6.2.2 Hydrology

Methodology for Analyzing Effects – Lower Klamath Refuge

To evaluate hydrology the Service obtained information about the annual pattern of water deliveries to the refuge and considered those water deliveries in relation to current management practices.

Resource-specific contexts for assessing effects of the alternatives to hydrology are:

- water is delivered to the refuge through the Klamath Reclamation Project;
- the regional hydrology has been greatly altered through development in the Klamath Basin; and
- within the refuge there is a system of canals, ditches, and water control structures that are used to flood various units.

Alternative A – Lower Klamath Refuge

Land Management

Wetland Management

Hydrology of the wetlands at the refuge is dependent on the Klamath Reclamation Project managed by Reclamation, which limits the ability of the Service to manage the wetlands for both spring and fall bird migrations. Water is not delivered during summer and fall to the wetlands, resulting in most wetlands drying up by fall. Area K is flooded during the fall for agricultural uses. Because of the restrictions of the Klamath Reclamation Project, the Service cannot manage the hydrology of the refuge to fully achieve its purpose (as a preserve and breeding ground for native birds).

One element of operations includes the Walking Wetlands Program, which includes flooding former croplands on a rotational basis to create additional wetland habitats, then returning to farming at some point in time. Flooding of these areas has enhanced both wetland habitats and resulting crop productivity following flooding, benefiting both wildlife and wetlands. Walking wetlands could alter the existing drainage pattern of the area slightly, but because the landscape is largely flat and the flooding relatively shallow, erosion or flooding impacts to people or structures would not be significant and would likely be no more than minor in intensity.

Other operations include irrigation and flooding for invasive species management and would have similar effects on hydrology as described below for the cooperative farming program. Tilling/disking, variation in timing of practices, hand-pulling of weeds, mowing and brush cutting, prescribed burning, use of bag-type repellents, and trapping and removal of animals have less than significant, negligible effects on hydrology.

Farming Programs

Properly applied irrigation has few effects on hydrology and discharges of flood waters from refuge fields/management units using the water. Irrigation, tilling, crop rotation, and prescribed burning will have less than significant, minor effects on hydrology.

Haying and Grazing Programs

It is expected that these programs would continue to operate as presently operated. Therefore, no associated change in currently negligible effects on hydrology are anticipated. Particularly with implementation of the BMPs, the prescribed grazing and haying programs would have a negligible effect on the hydrology of the area.

Pesticide Application

The Service expects that the use of herbicides to control dense vegetation within canals or ditches that are used to deliver water to and drain water from cooperative farmlands and refuge wetlands would result in a more efficient flow of water within those waterways (i.e., the volume and velocity of water flow would increase). The magnitude of this change would depend on the amount of vegetation removed through herbicide application. Although they have not been measured, because of the relatively flat lay of the land, it is believed that these hydrologic changes (especially in velocity) would be minor. These potential changes are not expected to alter the existing

drainage pattern of the area in a manner that causes substantial erosion or siltation; nor expose people or structures to a significant impact involving flooding.

Public Use

Wildlife-dependent recreational uses of the refuge have no effects (neutral) on hydrology because activities are limited to walking or driving on the refuge.

Beneficial Effects

Beneficial effects to hydrology include the addition of walking wetlands and flooding of Area K for agriculture increasing the total area of seasonal wetlands, and the increased efficiency of water delivery related to vegetation removal in canals.

Mitigation

Overall, Alternative A is not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation; nor expose people or structures to a significant impact involving flooding. Continued application of BMPs (Appendix L) would mitigate less than significant effects of land management activities to hydrology in the area that exist under current operations.

Alternative B – Lower Klamath Refuge

Land Management

Land management of the refuge would not change under Alternative B. Impacts from land management would be the same as described under Alternative A.

Public Use

Public use of the refuge would not change under Alternative B. Impacts from public use would be the same as described under Alternative A.

Beneficial Effects

Beneficial effects to hydrology would be the same as described under Alternative A.

Mitigation

Overall, Alternative B is not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation; nor expose people or structures to a significant impact involving flooding. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management activities to hydrology in the area that exist under current operations.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Land management of the refuge would not change under Alternative C. Impacts to hydrology from land management would be the same as described under Alternative A.

Public Use

Public use of the refuge would not change under Alternative C. Impacts from public use would be the same as described under Alternative A.

Beneficial Effects

Beneficial effects to hydrology would be the same as described under Alternative A.

Mitigation

Alternative C is not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation; nor expose people or structures to a significant impact involving flooding. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management activities to hydrology in the area that exist under current operations.

Alternative D – Lower Klamath Refuge

Land Management

Wetland Management

Hydrologic management of the refuge under Alternative D would differ from Alternative A in that water distribution would be modified to flood the southern one-fifth of the refuge (9,000 acres). The Service examined varying rates of water delivery (e.g., 20%, 50%, and 80%) because water is restricted and relatively scarce. Full flooding of the area is expected in 8 out of 10 years under the Klamath Basin Restoration Agreement (KBRA) scenario and fewer than 2 out 10 years under the 2013 biological opinion (BiOp). In other years only partial flooding would occur so long as water depths reach greater than 4 feet. In addition, some water delivery facilities would be removed to improve and modify water distribution, and approximately 6 miles of levee would be constructed. The removal of water delivery facilities would affect water management of the wetlands, and would have an intermediate effect on the existing hydrology.

Flooding the southern one-fifth of the refuge could alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation. With a large open body of water, wind waves may impact adjacent levees, potentially causing significant erosion. This erosion can be mitigated through proper design of levees protection (e.g., vegetation erosion protection), wetland vegetation management, operations that would alter water levels seasonally to minimize erosion, modifying local depths adjacent to the levees to reduce wind wave energy, or other measures.

Deeper water (7 feet) would probably limit certain aquatic vegetation communities (bulrush, cattail) and favor others (pondweed). While in lotic (rapidly moving water) systems a reduction in

vegetation may result in decreased siltation rates, in lentic (still water) wetland systems the overall sedimentation would not haven an intermediate effect.

As noted above, the Walking Wetlands Program refer to an experimental rotation of wetlands, which includes flooding former croplands to create additional wetland habitats, then returning farming at some point in time. Flooding of these areas enhances both wetland habitats and resulting crop productivity following flooding, benefiting both wildlife and wetlands. Impacts to hydrology from this practice would be minor.

Overall, the effects of Alternative D on hydrology would be considered intermediate.

Farming Programs

Some of the management practices used in the farming program would have a less than significant impact on hydrology. On-refuge irrigation is carefully managed to avoid or minimize any runoff and sediments. When a rainstorm event follows a prescribed burn, runoff waters can carry higher-than-normal loads of sediments. The relatively flat terrain on the refuge and the slow movement of water in canals and ditches reduces the likelihood of erosion or flooding to a minor impact. Crop rotation does not significantly affect hydrology.

Haying and Grazing Programs

The effects of haying and grazing programs would be the same as under Alternative A.

Pesticide Applications

The effects of pesticide applications would be the same as under Alternative A.

Public Use

Impacts of public use would be the same as described under Alternative A.

Beneficial Effects

No beneficial effects to hydrology have been noted at this time.

Mitigation

To avoid shoreline erosion from the proposed large open water area, levee design, water operations, and adjacent wetland elevations, vegetation distribution can be maintained to minimize or eliminate potential levee erosion to a less than significant impact.

BMPs (Appendix L) would be implemented to mitigate any potential minor adverse effects of land management activities to hydrology in the area.

6.2.3 Water Quality

Methodology for Assessing Effects – Lower Klamath Refuge

Reports on water quality for the overall Klamath Basin are available online. Information from online resources and the Klamath Reclamation Project water quality program were used to assess the impacts of each alternative on water quality.

Resource-specific contexts for assessing effects of the alternatives to water quality are as follows.

- The quality of water reaching the refuge varies seasonally from good in the winter and early spring to poor during the remainder of the year (Department of the Interior [DOI] and California Department of Fish and Game 2012; Reclamation and Service 1998).
- Water on the refuge originates from two sources: Tule Lake (source: Lost River) and Ady Canal (source: Klamath River). Both of these sources are listed as impaired under the Klamath Lost River total maximum daily loads (TMDLs).
- Pesticide applications are restricted around water sources.

Alternative A – Lower Klamath Refuge

Land Management

Wetland Management

Water quality on the refuge reflects the quality of sources of water to the refuge. The quality of both sources (Upper Klamath Lake; and the Lost River Basin [Clear Lake Reservoir, Gerber Reservoir, and Lost River]) supplying waters to the refuge is generally above state standards during winter and early spring. Water quality declines in the spring, summer, and fall due to seasonal impairment and agricultural runoff upstream of the refuge and within refuge sources. Waterbodies throughout the entire area are listed as impaired for nutrients, low dissolved oxygen, and high pH (see Chapter 5 for more information). Sources include regional activities such as agriculture, nonpoint sources, water diversion and removal of riparian vegetation, as well as natural conditions. Contributions from Lower Klamath Refuge include agricultural runoff and ongoing management activities, such as prescribed fire and invasive plant treatments in and adjacent to the managed wetlands. The Service continues to use monitoring data from Reclamation to assess the quality of water delivered to the refuge and implements BMPs in conjunction with other agencies and partners to improve water quality within and upstream of refuge lands. Wetland plants also typically help filter water and improve water quality. In addition, controls on the timing, extent, duration and intensity of prescribed burns help mitigate impacts from refuge management practices.

As noted in the Affected Environment section on refuge water quality, current water quality does not meet state standards, a significant impact that would continue if Alternative A were implemented. However, the impact of continuing current management over the lifetime of the CCP (15 years) compared to existing conditions would be negligible.

Although water quality is not likely to become significantly more degraded than is currently the case, it may improve as long-term regulatory processes related to the TMDLs described in the Affected Environment section are currently being reconsidered and may result in overall reductions in pollutant loads. Such discussions include multiple stakeholders, are complex and

geared to reducing cumulative impacts, and may take substantial time to resolve. As such, specific timelines and specific water quality improvements have not been formally defined at this stage, including the prescriptions for the Service to undertake on the refuge, but are part of a longer-term strategy to improve water quality. If changes result from these discussions, they would have beneficial impacts and be common to all alternatives. If needed, additional NEPA compliance would be conducted in the future to examine alternatives and their impacts in meeting new TDML requirements.

Farming Programs

Some management practices used in the farming program can potentially affect water quality. On-refuge irrigation is carefully managed to avoid or minimize any runoff and associated potential adverse water quality effects associated with sediments (from tilling/disking). When waters are discharged, they can carry elevated concentrations of nutrients and potentially salts (as measured by electrical conductivity). Rainstorm events can likewise result in higher-than-normal loads of sediments and dissolved nutrients. The relatively flat terrain on the refuge lands, wetland and other vegetation, and the slow movement of water in canals and ditches reduces the likelihood that sediment loads are carried beyond the refuge. Nonetheless, these practices contribute adverse impacts to water quality at the refuge.

Haying and Grazing Programs

It is expected that these program would continue to operate as presently operated. Therefore, no associated change in the currently minor effects on water quality are anticipated, particularly with implementation of the BMPs.

Pesticide Application

Pesticides are used for the farming program, to manage invasive plant species, and to maintain refuge structures. Pesticides can enter surface waters as a result of overspray and wind drift; pesticide spray missing its mark; excess pesticide falling from plant stems, leaves, or other plant parts; spillage from storage, mixing, loading, equipment cleaning, and disposal areas; transport by wind or water across the land surface adsorbed onto soil particles or in a dissolved form; and precipitation carrying pesticides through the air (van Es and Trautmann 1990). Pesticides that are soluble, are not adsorbed onto soil particles, and/or are persistent can also travel through the soil and enter groundwater in the applied chemical form, in a dissolved form, or in a degraded form (van Es and Trautmann 1990). Soil characteristics such as texture, amount of organic matter, permeability, and distance to the water table affect leaching of pesticides into groundwater (Fishel 2003). In some situations, applied waters may eventually empty into surface waters. Depending on their chemical makeup and persistence, some pesticides may remain in surface or shallow subsurface waters for extended periods of time. Others (e.g., glyphosate) degrade quickly and exhibit reduced toxicity (Folmar et al. 1979). Again, depending on their chemical properties, concentrations, and other factors, the existence of some pesticides or their decomposition products in water could prove toxic to some aquatic plants and/or animals. In decades past, toxic concentrations of pesticides have been found in refuge waters (Snyder-Conn et al. 1999). However, more recently, no pesticides have been documented in refuge waters at concentrations that are toxic to fish and wildlife (Cameron 2008; Snyder-Conn et al. 1999; unpublished data 2011). Cameron (2008) completed a study on pesticide byproducts in Tule Lake and found only detectable pesticide concentrations two compounds out of 160 chemicals compounds—2,4-D and

carbaryl—both far below the no observed effect concentration (NOEC) and lowest observed effect concentration (LOEC). When applied consistent with PUP-directed BMPs, the concentrations of pesticides in refuge waters would not be expected to be high enough to adversely affect waterbirds or other species of special management attention. Additionally, Eagles-Smith and Johnson (2012) completed a review of available information on pesticides in the Klamath Basin that encompasses the project area. Although the review identified a wide range of data gaps, principal findings included evidence that past organochlorine pesticide use was a major source of avian impacts in the basin, but that the moratorium on organochlorine pesticide resulted in a sharp decrease in exposure, reducing the likelihood that these compounds still pose a threat. Eagles-Smith and Johnson (2012) identified that those degradation products resistant to decay may continue to pose a threat to fauna in the region, but a lack of data limits assessment of this potential legacy effect. Current contaminant threats and impacts were uncertain due lack of monitoring data, and specific assessments do not exist. When applied consistent with PUP-directed BMPs, the concentrations of pesticides in refuge waters would not be expected to be high enough to adversely affect waterbirds or other species of special management attention. Impacts to water quality would be minor.

Public Use

The refuge is open to a variety of public uses from wildlife observation and photography to hunting. Visitors are not generally a cause of water quality degradation. However, hunters could cause soils to be eroded into waterways, sediments to be stirred up, and turbidity to be created and increased when they launch boats into and remove them from the water; when they propel their watercraft with paddles, poles, flippers, and/or propellers; and when boat-generated waves reach shallow waters or shorelines. Water quality effects would be greater when boats traveled at higher speeds. Waterways could also be contaminated by fuels and oils if they were spilled or were otherwise discharged by motorboats (this is a greater concern with traditional 2-stroke boat motors) (Mosisch and Arthington 1998). Although motorboats have been used for hunting on the refuge for the number of years, no data are available to assess impacts and the potential for minor adverse effects to water quality remains. Public use is expected to have a minor impact on water quality.

Beneficial Effects

Continuing to maintain up to 25,000 acres of permanent and seasonal wetlands can improve overall water quality that is discharged from the refuge.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative B – Lower Klamath Refuge</u>

Land Management

Land management of the refuge would not change under Alternative B. Impacts from land management would be the same as described under Alternative A.

Public Use

Public use of the refuge would not change under Alternative B. Impacts from public use would be the same as described under Alternative A.

Beneficial Effects

Beneficial effects to water quality would be the same as described under Alternative A.

Mitigation

Alternative B is not expected to alter the water quality from current conditions. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management and public use activities to hydrology in the area that exist under current operations.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Land management of the refuge would not change under Alternative B. Impacts from land management would be the same as described under Alternative A.

Public Use

Alternative C includes phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge. Switching to 4-stroke engines would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines.

Beneficial Effects

Phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines. Potential adverse effects from public use to water quality would continue to be minor.

Mitigation

Alternative C is not expected to alter the water quality from current conditions. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management and public use activities to water quality in the area that exist under current operations.

Alternative D – Lower Klamath Refuge

Land Management

In addition to the effects described under Alternative A, under Alternative D water delivery facilities (dikes and water control structures) would be removed in the lower portion of the refuge to allow flooding of up to 9,000 acres, providing permanent open water and other habitat. Modification of the this refuge area would remove it from farming, grazing, and haying programs, reducing seasonal dust and potential soil erosion generated from these activities. As compared to Alternative A, Alternative D would have potentially significant adverse water quality effects

during construction. BMPs (storm water management and erosion control plans) would be required to mitigate any adverse water quality impacts.

After construction is completed, the conversion to permanent wetlands may affect water quality processes through this portion of the refuge. Mayer (2005) identified that an existing permanent wetland in the Tule Lake Refuge (near Lower Klamath Refuge) had the highest reduction of dissolved inorganic nitrogen of the sites studied. However, Mayer (2005) notes that scaling up the results of a relatively small permanent wetland to a larger wetland may not be representative. Instead of using this small permanent wetland as a proxy, the overall refuge reductions presented by Mayer (2005), which encompass all activities in the refuge, may be more appropriate and would suggest reductions currently experienced through the refuge will be similar in the future. Large open water areas in the Klamath Basin may be subject to nuisance algae blooms that could impact water quality. Blue-green algae (cyanobacteria) form surface scums, producing taste and odor compounds, and sometimes releasing toxic or irritating substances into the water.

Public Use

Alternative D includes phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge. Switching to 4-stroke engines would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines. Potential effects to water quality from public use would continue to be minor.

Beneficial Effects

Phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines.

Mitigation

BMPs (Appendix L) would be implemented to reduce water quality impacts during construction and activities that disturb the soil.

6.2.4 Air Quality

Methodology for Assessing Effects – Lower Klamath Refuge

Air quality was assessed at a basin-wide level using online reports from the States of California and Oregon that identify the general air quality characteristics. **Emissions for prescribed fire were calculated using California Air Resources Board's 2000 memo entitled *Agricultural Burning Emissions Factors*. Emissions from agricultural land preparation and harvesting were calculated using the Western Regional Air Partnership's Fugitive Dust Handbook, Section 2.2. The emissions from construction of the 6-mile dike under Alternative C were calculated using the USEPA NONROAD Model.**

Listed here are resource-specific contexts for assessing effects of the alternatives on air quality.

- Land management activities occur within a basin dominated by agriculture, with over 500,000 acres of irrigated lands in the Upper Klamath Basin and 220,000 acres of farmland in the Klamath Reclamation Project.

- The Northeast Plateau, which includes Lower Klamath Refuge, is designated as in attainment for all seven federal criteria pollutants: ozone, PM2.5, PM10, carbon monoxide, lead, nitrogen dioxide, and sulfur dioxide. The acreage of refuge lands flooded (versus dry lands that may be subject to dust-generating land management practices) is highly dependent on water deliveries controlled by the Klamath Reclamation Project (outside of Service control).

Alternative A – Lower Klamath Refuge

Land Management

Wetland Management

A variety of potential pollutant emissions are associated with wetland management including dust (particulate matter), tailpipe emissions, and smoke. Short-term increases in particulate emissions (PM2.5 and PM10) would result from wetland management activities that disturb the soil including plowing, disking, and mowing in wetland units. The size of area where these activities occur and the amount of resulting emissions is expected to vary from year to year depending on vegetation management needs. On average, approximately 1,000 acres of wetland units receive some form of mechanical vegetation management each year and this pattern is expected to continue. In addition, windblown dust from vehicle and heavy equipment use of unpaved roads is another source of particulate emissions. Both sources of particulate emissions are expected to be seasonal (when soils are dry), relatively short term (during soil disturbing activity), and minor in the context of other particulate emissions in the region.

Tailpipe emissions (particulates, ROG, and NO_X) would result from the use of combustion engines in heavy equipment used to manage wetland vegetation. As with particulate emissions, tailpipe emissions are expected to vary annually depending on vegetation management needs and are more likely to occur in the dry season. Tailpipe emissions are also expected from the use of refuge passenger vehicles to and from job and meeting sites, as well as employee vehicles during trips to and from work. These emissions are expected to occur year-round and are considered minor in the context of other particulate emissions in the region.

Prescribed fire is used to open habitat and help in controlling invasive species on wetlands. The Fire Management Plan (Service 2001) includes annual acreage objectives of prescribed fire on uplands, permanent and seasonal marshes and ditch berms, and roadway edges over the entire Refuge Complex. Prescribed burns could be used on up to 3,000 acres to set back vegetative succession. The number of acres burned each year is contingent on obtaining a burn permit, staffing, and funding. Prescribed burning activities would result in temporary emissions of particulate, carbon monoxide, volatile organics, and nitrogen oxides. **Actual emissions would depend on the size of the burn, the type of fuel (e.g., grass, emergent vegetation), fuel loading, and fuel moisture content. Estimated pollutant missions could range as follows.**

- **PM_{10}: 48–143 pounds/acre**
- **$PM_{2.5}$: 46–137 pounds/acre**
- **NO_x: 14–41 pounds/acre**
- **SO_2: 2–5 pounds/acre**
- **CO: 342–1,026 pounds/acre**
- **VOC: 32–96 pounds/acre**

The effects of these emissions would be minor because 1) the Service would develop a prescribed burning plan and obtain and adhere to the requirements of a burning permit issued by the Air Pollution Control District; 2) effects would be avoided and minimized by coordinating activities with the district, implementing burn prescriptions and cessation requirements based on predetermined levels established by the district, and use of fire breaks around burning units to prevent wildfires; and 3) effects would be mitigated through wind direction considerations, and distance to receptors. Based on the federal and state requirements that control adverse effects of prescribed burning, the Service anticipates that adverse effects to regional air quality from prescribed burning would be minor and short-term.

Farming Programs

Some of the management practices described in Section 4.2.2 and used in the farming programs can affect air quality. Sources of pollutant emissions associated with farming programs include fugitive windblown dust from fields and unpaved roads; smoke from burning of agricultural fields; tailpipe emissions from vehicles and farm equipment; emissions associated with the use of fertilizers and pesticides; and emissions associated with the cultivation of organic soils.

The majority of areas where the lease land and cooperative farming occur have silt loam soils (see Figure 5.3). The potential for wind erosion from agricultural practices is relatively low. On a scale of 0 to 6, with 6 being high, the NRCS rates the soils in the farmed area at levels 2 and 3 (see Figure 5.4). In small grain areas (up to 7,500 acres), wind erosion is primarily confined to the spring cultivation season during periods of high winds. **Fugitive dust emissions from different land preparation operations (e.g., root cutting, discing, tilling, chiseling, ripping, land planning, and weeding) can range from 0.3 to 12.5 pounds per acre per pass.** If the weather is dry and windy when refuge fields are worked, dust is generated and can be carried across the refuge and potentially to adjacent properties. Once crops have emerged, the potential for soil erosion declines sharply. To minimize soil erosion in small grains, the Service would continue to restrict fall work in farmed areas until just prior to cultivation.

Tailpipe emissions (particulates, ROG, and NO_X) would result from the use of combustion engines in farming equipment. As with particulate emissions, tailpipe emissions are expected to vary annually depending on the area farmed which in turns is dependent on the volume of water deliveries. Tailpipe emissions are also expected from the use of passenger vehicles by cooperative and lease land farmers when traveling to and from fields. These emissions are expected to occur year-round, but are considered minor in the context of agricultural and other sources of tailpipe emissions in the region.

Nitrous oxide is produced naturally in soils through the microbial processes of denitrification and nitrification. The natural emissions of nitrous oxide can be increased by a variety of agricultural practices, including the use of synthetic and organic fertilizers, growing of nitrogen-fixing crops (e.g., alfalfa), cultivation of soils with organic matter, and the application of livestock manure to croplands (Aneja et al. 2009). These emissions are expected to occur year-round, but are considered minor in the context of agricultural emissions in the region.

Prescribed burning used to reduce biomass on wheat fields after harvest generates smoke that can rise to great heights and potentially drift considerable distances. Smoke contains ash particulates, partially consumed fuels, liquid droplets, and very small quantities of gases such as carbon monoxide, carbon dioxide, and hydrocarbons. **Actual emissions would depend on the size**

of the burn, fuel loading, and fuel moisture content. Estimated pollutant emissions for burning wheat stubble are listed here.

- **PM_{10}: 20 pounds/acre**
- **$PM_{2.5}$: 19 pounds/acre**
- **NO_x: 8 pounds/acre**
- **SO_2: 2 pounds/acre**
- **CO: 235 pounds/acre**
- **VOC: 14 pounds/acre**

As noted above under the discussion of wetland management, prescribed fires are conducted consistent with a burn plan that takes into consideration weather, regional air quality, and smoke management to minimize the likelihood that smoke would drift into populated areas or create safety problems for roadways or airports. Also, dilution in the atmosphere greatly reduces potential adverse air quality effects. The effects associated with these management actions are temporary in nature and, in light of the vast acreage of agricultural lands in the area, relatively common in the Klamath Basin. Nonetheless, prescribed burns would be detectable, with temporary minor adverse impacts to air quality.

Lands that are flooded are not subject to dust-generating land management practices; therefore, irrigation/flooding are not expected to adversely affect air quality.

Haying and Grazing Programs

Under Alternative A, approximately 200 acres in the western portion of the refuge (i.e., Miller Lake and Unit 2) and 2,150 acres in the northern (Oregon) portion of the refuge (i.e., Area K) would be hayed annually. Air quality emissions from haying would be similar but smaller than farming since the area hayed is less than 30% of the area farmed. In addition, haying generally involves much less soil disturbance than farming so particulate emissions are expected to be less. However, in drought years when water deliveries are insufficient to provide summer irrigation of pasture grasses or alfalfa, the fields become prone to broad-leaf competition and permanent desiccation requiring expensive replanting. As a result, the air pollutant emissions in those years could be greater due to soil disturbance during replanting. The Service anticipates that adverse effects to regional air quality from haying programs would be temporary and no more than minor.

Under Alternative A, grazing would continue to be used as a vegetation management tool on up to 11,000 acres per year. The grazing program, including operations and maintenance activities, and use of vehicles by ranching personnel, would result in fugitive dust and vehicle emissions. Prescribed grazing activities would result in temporary increases in exposed soil, which would increase fugitive dust emissions, particularly during strong winds. Also, heavy equipment (e.g., tractors, haying machinery) used during haying practices may make soils vulnerable to erosion from clearing and mowing. These activities would result in localized and temporary increases in particulate matter, reactive organic gases, nitrogen oxides, and carbon emissions. The Service anticipates that adverse effects to regional air quality from grazing programs would be temporary and no more than minor.

Pesticide Application

Pesticides are used to control pests on farmed areas, for habitat restoration, and around refuge structures. When sprayed, pesticides travel through the air to their intended target. Although

generally formulated and propelled to reach and (with the assistance of a surfactant) attach to their target pest, a percentage of some pesticides may volatilize into the air or small pesticide droplets may remain suspended in the air. These effects would be more pronounced with aerial spraying, and less so with ground-level spot spraying and direct injection into the soil. Once airborne, pesticides can move off of the pest control site and drift with the wind or return to surface soils, waters, or plants through precipitation (van Es and Trautmann 1990). High temperatures, low relative humidity, air movement, and small pesticide droplet size all increase volatilization; and pesticides that tightly adsorb onto soil particles are less likely to volatilize (Fishel 2003). **The estimated pesticide VOC emissions on Lower Klamath Refuge farmland are 0.55 pound per acre.** In light of the vast acreage of lands in agricultural use throughout the Klamath Basin and PUP-directed BMPs on the refuge, it is expected that adverse effects to regional air quality from pesticide use on the farming programs would be negligible.

In conclusion, land management activities would not change in any substantial way within the 15-year life of the CCP. Based on the above analysis of farming, grazing, and haying programs, continuation of current land management activities is expected to result in no more than minor and temporary effects to local air quality. No long-term adverse effects on air quality are anticipated as a result of continuing the land management practices under Alternative A.

Public Use

Vehicle use by visitors and Service staff (both during visitor programs and maintenance activities associated with visitor facilities) may create fugitive dust and vehicle emissions. During visitors' use of auto tour routes, traveling to destinations for wildlife observation and photography, and hunting, PM10 is produced by vehicles and by fugitive sources, such as roadway dust from paved and unpaved roads.

Vehicle access is allowed within the refuge, and an auto tour route provides a 10-mile loop for visitors to view wildlife. Limited parking is available on the refuge, and most hunting is by boat or walk-in access. With the moderate visitor numbers, vehicle emissions from public access contribute minimal emissions at the refuge. Exhaust from hunters' cars, trucks, and motorboats (this is a greater concern with traditional 2-stroke boat motors), and dust from vehicle and pedestrian travel would all contribute to gaseous and particulate air pollution at the refuge. Due to the moderate visitation, wind dispersal in the basin, and the large acreage of the refuge (nearly 51,000 acres), adverse effects to local and regional (Klamath Basin) air quality from public use are expected to quickly disperse from their source and be negligible. Because public use activities and levels are expected to remain similar to those experienced now under Alternative A, this level of impact would continue for the 15-year life of the CCP.

Beneficial Effects

Wetlands support the sequestration and long-term storage of carbon dioxide from the atmosphere. However, wetlands are also a natural source of greenhouse gas emissions, especially methane. Although not a criteria pollutant, methane is a potent greenhouse gas with 25 times the global warming potential of carbon dioxide (Intergovernmental Panel on Climate Change [IPCC] 2007). Nevertheless, most wetlands are carbon sinks when balancing carbon sequestration and methane emissions over the long term (centuries) (Mitsch et al. 2013). However, given the fact that many of the wetlands are drained periodically to manage vegetation or due to lack of water, any beneficial effect is likely negligible.

Mitigation

BMPs (Appendix L) would be implemented to reduce particulate emissions during construction and activities that disturb the soil.

Alternative B – Lower Klamath Refuge

Land Management

Land management activities and associated minor air quality impacts under Alternative B would be similar to those under Alternative A with a few exceptions. Under Alternative B, the Service would increase the acreage of unharvested cooperatively farmed grain by 500 acres and reduce the acreage of harvested grain accordingly. This would result in minor decreases in dust and tailpipe emissions since the operation of harvesting equipment would be reduced by approximately 30% on those acres. In addition, 2,000 acres of harvested grain would be converted to pasture/green browse. This would result in a reduction in both fugitive dust and tailpipe emissions compared to Alternative A since grass and alfalfa are perennial plants that do not have to be replanted each year like wheat.

To the extent that monitoring results for invasive plant species are used to direct rapid assessment and control actions, new outbreaks of priority invasive species would more likely be controlled when they are smaller in size. Refuge-wide, over time, this would likely require fewer pest management actions, including less use of pesticides. Potential air quality impacts from these actions and pesticides would be reduced accordingly.

Based on the above analysis of changes in land management activities, and in the context of other emissions sources in the basin and the fact that the Northeast Plateau Air Basin is in attainment of all criteria pollutant standards, implementation of Alternative B is expected to result in no more than minor and temporary effects to air quality.

Public Use

Improvements to the auto tour route could increase vehicle traffic to the refuge, although most visitation to the refuge would continue to be by walk-ins from parking areas on and off the refuge and by boats. Increased traffic would result in increased vehicle emissions including particulate, ROG, NOx, and carbon emissions in the vicinity of the refuge, but the impacts on air quality would be temporary, readily dispersed and negligible to minor based on the estimated visitation to the refuge. Under Alternative B, the use of vehicles and minor soil surface grading to providing more opportunities on the refuge for mobility-impaired hunters could generate some dust and minor and temporary increases in particulate, ROG, NOx, and carbon emissions. In light of the very small scale of this project, construction or rehabilitation of an existing site would occur quickly, and these effects would be localized and short-term and would not result in long-term degradation of air quality.

Similar to Alternative A, public use under Alternative B is expected to result in negligible adverse effects to air quality. No long-term adverse effects on air quality are anticipated as a result of continuing public use under Alternative B.

Beneficial Effects

Beneficial effects under Alternative B would be similar to those listed under Alternative A. In addition, the Service would seek to leverage more wetland habitat on private lands in the basin by expanding the use of preferential permits for cooperatively farmed grain and hay units on the refuge for farmers that participate in the walking wetlands program on their private lands. As a result, both farming-related fugitive dust and tailpipe emissions in the basin would decrease since no farming activity would occur during the period the fields are in walking wetlands.

Mitigation

BMPs (Appendix L) would be implemented to reduce particulate emissions during construction and activities that disturb the soil.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Under Alternative C, land management activities and associated minor air quality impacts would be similar to those under Alternatives A and B with a few exceptions. Under Alternative C, the Service would expand the use of grazing by 2,000 to 3,000 acres to improve habitat conditions, limit wildfire danger, and control invasive plants. Air quality impacts of this expansion would be similar but increased in magnitude over those described under Alternative A (12,500 acres). These effects could be offset somewhat by the reduced risk of wildfire and its associated air quality impacts. In addition, the expansion or organic farming under Alternative C could reduce emissions associated with pesticide use compared with Alternatives A and B.

Public Use

Under Alternative C, public use activities and associated negligible air quality impacts would be similar to those under Alternatives A and B with a one exception. Under Alternative C, the Service would phase in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines on the refuge. Since 4-stroke and direct injection 2-stroke engines produce burn cleaner than traditional 2-stroke engines, combustion emissions associated with boat use would expected to be reduced under this alternative.

Beneficial Effects

Same as Alternative B

Mitigation

BMPs (Appendix L) would be implemented to reduce particulate emissions during construction and activities that disturb the soil. Under Alternative C, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) boat motors to be used on the refuge.

Alternative D – Lower Klamath Refuge

Land Management

In addition to the effects associated with land management activities described under Alternatives B and C, the Service would develop a new "Big Pond" Unit. Approximately 9,000 acres of existing units actively managed as permanent wetland, seasonal wetland, and grain (see Figure 4.3) would be replaced by this single large wetland unit. A new, taller dike up to 6 miles long would likely need to be constructed along an existing canal embankment on the north side of the unit to contain the ponded water. Up to 31 water control structures would likely require irrevocable removal. In addition, the Service would abandon or remove up to 29 miles of interior levees/roads and abandon up to 100 miles of interior drain fields. As compared to Alternative A, Alternative D is expected to have significant, long-term (more than 1 year, but not permanent) adverse effects on air quality during construction. The demolition and construction work could generate dust and temporary increases in tailpipe emissions (particulates, ROG, NOx) from equipment. **Following are the estimated emissions from construction and demolition equipment.**

- **PM: 0.08 ton**
- **NO_x: 1.74 tons**
- **CO: 1.29 tons**

In addition, fugitive dust emissions from unpaved roads are estimated to include 0.70 ton of PM_{10} and 0.07 ton of $PM_{2.5}$.

After construction, flooding of this area would remove portions of this unit from farming, grazing, and haying programs, thereby reducing tailpipe emissions from equipment and seasonal dust generated from these activities.

Public Use

Same as Alternative C.

Beneficial Effects

Same as Alternative C.

Mitigation

BMPs (Appendix L) would be implemented to reduce particulate emissions during construction and activities that disturb the soil. Under Alternative D, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) boat motors to be used on the refuge.

6.2.5 Vegetation and Habitat Resources

Methodology for Assessing Effects – Lower Klamath Refuge

In collaboration with Reclamation, the Service developed estimates of the volume and timing of water deliveries to the refuge under both the current water allocation system governed by the 2013 BiOp and the KBRA or similar settlement. The range of water deliveries were then used to determine the types of habitats that could be made available to meet the refuge purposes.

Scientific literature was then consulted to predict the types of impacts that could occur due to land management and public use activities.

The quantity and distribution of water for each habitat type was based on work done by Service hydrologists for water rights claims in the Oregon adjudication. The application rates are 3.6 acre-feet/acre for permanently flooded wetlands (which includes 0.6 acre-feet/acre or 20% of the annual evapotranspiration for a salinity flushing flow, to be met during November through March, and 3.0 acre-feet/acre for evapotranspiration), 3.0 acre-feet/acre for fall seasonal wetlands, and 2.5 acre-feet/acre for farm units and spring seasonal wetlands. Water for flooding and maintaining refuge habitats originates from both the Klamath River via the Ady Canal and return flows from Tule Lake via the D Plant.

Resource-specific contexts for assessing the effects of the alternatives on vegetation and habitat resources are:

- vegetation and habitat resources are managed to achieve the refuge purposes as identified and defined in Appendix M; and
- some vegetation and habitat resources (e.g., wetlands and agricultural crops) are dependent on the quantity of water delivered through the Klamath Reclamation Project. In addition, the type of water right is an important factor in determining what the water can be used for. Regardless of which alternative is selected for implementation, these habitats may be limited in some years if water deliveries are insufficient.

Alternative A – Lower Klamath Refuge

Land Management

The Service would continue to use a variety of techniques to increase habitat value (food, water, and vegetative cover) for migratory birds and other wildlife, such as water management, mowing, disking, prescribed burning, herbicide, haying and grazing to manage vegetation. Similar management practices would be used by lease land farming contractors and cooperative farming permittees that grow crops for sale (e.g., small grains and hay). The Service currently manages wetland, upland, and agricultural habitats at the refuge based on and in accordance with its water deliveries, which are in turn based on irrigation and federal reserved water rights and (see Section 4.2.1 for more information). Invasive plant treatments on lease land crops would be implemented as needed in accordance with the 1998 IPM Plan (Service 1998a), and fire management activities are implemented in accordance with the Fire Management Plan (Service 2001). These activities cause temporary disturbances to the habitats at the refuge, but they primarily result in long-term beneficial effects that improve habitat conditions.

Table 6.1 presents the estimated acreages for each refuge habitat type and under the six different water delivery scenarios shown in Section 4.2.1, Figure 4.2. This table also includes estimates of the acreage of wetland units that the Service would be unable to flood due to insufficient water deliveries (labeled “Dry Wetland Units”).

Table 6.1. Alternative A Estimated Habitat Areas (acres) for Lower Klamath Refuge under Six Different Water Delivery Scenarios

	Permanent Wetland	*Seasonal Wetland*	*Dry Wetland Units*[1]	*Standing Grain (coop/ lease land)*	*Harvested Grain (coop/ lease land)*	*Pasture (coop/ lease land)*	*Nesting Islands*	*Wet Meadow*	*Upland*
Projected Deliveries under the Current Water Allocation System									
0.2	600	3,000	21,800	1,000/0	500/0	700/700	0	0	12,200
0.5	700	8,100	16,600	1,000/0	3,000/800	700/700	2	5,700	6,500
0.8	1,100	16,000	8,300	1,000/0	3,000/3,500	700/1,100	2	5,700	6,500
Projected Deliveries under the Klamath Basin Restoration Agreement									
0.2	7,500	13,000	5,000	1,000/0	3,000/0	700/700	2	0	12,200
0.5	8,400	13,800	3,200	1,000/0	3,000/900	700/900	2	5,700	6,500
0.8	9,000	14,500	1,900	1,000/0	3,000/3,000	700/1,800	2	5,700	6,500
FULL[2]	9,294	16,114	n/a	1,000	6,534	2,018	2	5,700	6,500

[1] Dry wetland units are seasonal or permanent wetland units that are not flooded due to insufficient water deliveries.
[2] Full acreage objective for each habitat from Appendix F.

Wetland Management

Under Alternative A, the Service would continue to manage for both seasonal and permanent wetlands on Lower Klamath Refuge. The timing and quantity of water available to the refuge varies greatly depending on the demands of more senior water rights holders and precipitation. As noted above, the landscape-scale changes in vegetative communities at the refuge depends directly on water delivery. Because water deliveries to the refuge vary both in quantity and seasonality, precise impacts to vegetation and habitat are impossible to predict. Therefore, these broader impacts are discussed by type, that is, qualitatively or are presented as ranges.

Under the current water allocation system, the acreage of permanent wetlands at Lower Klamath Refuge would range from approximately 600 acres in a dry year to greater than 9,000 acres in a wet year (see Table 6.1). If the KBRA or a similar agreement were implemented, the acreage of permanent wetlands would be greater and vary much less, from approximately 7,500 acres in a dry year to greater than 16,000 acres in a wet year (see Table 6.1). Permanently wetlands would be managed for a diverse emergent and submergent plant community with hardstem bulrush and sago pondweed the preferred plant species. The target emergent/open water interspersion ratio is between 30% and 70% of either type. This habitat type would be maintained by flooding year-round. Permanent wetlands at the refuge would be intensively managed to provide for an interspersion of successional stages. Managers would use a variety of tools such as water management, farming for grain, selective disking, prescribed fire, and pesticide applications to manage vegetation in permanent wetland units. The effects of these management tools are addressed below. With the exception of Unit 2 (4,500 acres), the remaining units that can be managed as permanent wetland would be periodically rotated through seasonal wetland or cooperatively farmed grain (see Figure 4.3).

Under the current water allocation system, the acreage of seasonal wetlands at Lower Klamath Refuge would range from approximately 3,000 acres in dry years to greater than 16,000 acres in wet years (see Table 6.1). If the KBRA or a similar agreement were implemented, the acreage of permanent wetlands would be greater and vary much less, from approximately 13,500 acres in a dry year to greater than 15,000 acres in a wet year (see Table 6.1). Seasonally flooded wetlands are managed for moist soil and a diversity of emergent wetland plants, with an emphasis toward

red goosefoot, smartweed, and hardstem bulrush. The protracted draw down of water during the growing season yields a complex mosaic of vegetative communities. Plant diversity is enhanced by uneven bottom contours which are exposed by a declining plane of water. As these "patches" of the bottom are dewatered, they warm allowing germination of various plant species. Since these "patches" dry at different times, a specific plant association develops on each and results in a "patchwork" of differing plant associations in the unit. Over time (3–4 years), red goosefoot and smartweed is replaced by alkali bulrush. Although this plant may be associated with other plants, it often forms large monotypic patches. In order to maintain seasonal wetlands at a diversity of successional stages, a variety of management tools would be utilized to periodically set back vegetative succession. These tools include water management; farming for grain; selective disking, tilling, and mowing; prescribed grazing; prescribed fire; and pesticide applications. The effects of these management tools are addressed below. The remaining units that can be managed as seasonal wetland would be periodically rotated through permanent wetland or cooperatively farmed grain (see Figure 4.3).

When water deliveries are insufficient to meet permanent and seasonal wetland demands, large areas of wetlands are left dry and susceptible to invasion by highly invasive plants such as perennial pepperweed. Under the current water allocation system, the acreage of dry wetlands at Lower Klamath Refuge would range from 22,000 or more acres in a dry year to 8,000 acres in a wet year (see Table 6.1). If the KBRA or a similar agreement were implemented, the acreage of dry wetlands would be significantly less, ranging from approximately 5,000 acres in a dry year to 2,000 acres in a wet year (see Table 6.1). Lack of water for wetland management is expected to continue to result in significant adverse effects on vegetation and habitat resources at Lower Klamath. The time scale for these effects can range from short- to long-term, depending on when adequate water deliveries for permanent and seasonal wetlands are restored.

The mix, acreage, locations, and timing of vegetation management techniques deployed during any particular year for seasonal and permanent wetland management would be based on an assessment of current and likely future habitat conditions and wildlife needs, including the potential availability of water; the availability of adequate funding, staff, and equipment; the availability of local farmers, ranchers, and livestock; forage quality; and site conditions (e.g., access, roughness of the terrain, fencing, and other infrastructure).

Prescribed fires would be used to burn grasses, brush, small trees, and invasive species; open areas that are choked with vegetation; set back plant succession; and return nutrients that were locked up in plants back to the soil where they are once again available for uptake by plants. Soil and plant moisture, surface water, winds, and other factors cause fires to burn hotter in some areas and not in others, and otherwise burn in a non-uniform manner. This creates a more natural habitat mosaic of different plant species and open areas across the landscape. Among others, the effects of prescribed fires on post-burn plant growth depend on the species burned and the intensity of the burn. Plants that are resistant to fire or actually require fire for reproduction can thrive after a burn and out-compete other species. However, if a fire burns too hot, it can harm feeder roots, sterilize the soil, and kill more plants and plant species than desired. In accordance with the Fire Management Plan (Service 2001), prescribed fire planning helps ensure that these burns travel quickly and lightly across the landscape, and result in significant beneficial effects on wetland vegetation and habitat quality for waterfowl and other priority wildlife species. These effects could range from short-term to long-term, depending on the intensity of the burn and implementation of post fire management such as flooding. The refuge would use prescribed burning on up to 3,000 acres annually.

Mechanical tools such as tilling and disking would be used to disrupt plants' annual cycles and/or reduce the vigor of or kill undesirable plants (although some species can re-sprout from cuttings of plant stems and/or roots). These activities open up dense stands of vegetation, create habitat diversity, and set back succession in a plant community. Conversely, some species can re-sprout from cuttings of plant stems and/or roots. Hand pulling, another technique used to manage weeds, can be very effective, but it is time-consuming and requires substantial human resources. Effects are limited to small areas (e.g., relatively small, early infestations of purple loosestrife). Mowing with a brush/deck mower and cutting with a sickle-bar mower can reduce plant heights and, when properly timed, preclude distribution of plant seeds (e.g., perennial pepperweed). Depending on the size of the area treated, mechanical vegetation management tools are expected to result in minor to intermediate beneficial effects on wetland vegetation and increases in habitat diversity and productivity for waterfowl and other wildlife. These effects could range from short-term to long-term, depending on implementation of additional tools such as flooding, prescribed fire, and herbicide treatment. The refuge would till and disk up to 1,000 acres on the refuge annually. The overall level of disturbance to vegetation and habitat from wetland management is relatively low and is used strategically to make overall improvements in habitats. Impacts to vegetation and habitat are considered minor.

In a 1995 biological opinion (Service 1995) for Reclamation on the use of pesticides and fertilizers on federal lease lands, the Service described the endangered Applegate's milk-vetch (*Astragalus applegatei*) occurrence in a narrow region restricted to seasonally moist meadows/bunchgrass flats near Klamath Falls, Klamath County, Oregon. The specific habitat found supporting these plants is a seasonally moist, lightly vegetated, alkaline grassland community and characterized by poorly drained, alkaline soils (Henley/Malin clay loams). Applegate's milk-vetch potentially occurs on Lower Klamath Refuge given the occurrences within the vicinity, but there are no known modern occurrences. Intra-Service consultation would be conducted pursuant to Section 7 of the federal ESA, for federally listed species, including Applegate's milk-vetch. There is no designated critical habitat for federally listed species within Lower Klamath Refuge. Any conservation measures, as well as terms and conditions resulting from consultation under the federal ESA would be implemented to protect listed species and their habitat that occur on the refuge, as applicable.

Farming Programs

As with wetland units, the area farmed (grain or irrigated pasture) would vary depending on the quantity and timing of water deliveries. Given the fact that the Lower Klamath irrigation water right is more senior than its Federal Reserve water right (1905 versus 1925), irrigation water deliveries for Lease Land and cooperatively farmed units vary less from wet to dry years. As a result, the area farmed tends to vary less from wet to dry years than the area managed for permanent and seasonal wetlands that rely on Federal Reserve water.

Under the current water allocation system, the acreage of grain at Lower Klamath Refuge would range from approximately 1,500 acres in a dry year to greater than 7,500 acres in a wet year. Similarly, the acreage of irrigated pasture would range from 1,400 acres in a dry year to 1,800 acres in a wet year (see Table 6.1).

If the KBRA or a similar agreement were implemented, the acreage of grain would vary from approximately 4,000 acres in a dry year to greater than 7,000 acres in a wet year. The acreage of

irrigated pasture would range from 1,400 acres in a dry year to 2,700 acres in a wet year (see Table 6.1).

If the Service received full water deliveries needed to meet habitat objectives, the farmed acres on the refuge would total approximately 9,600 acres composed of 7,600 acres of grain and 2,000 acres of pasture. This constitutes about 18% of the refuge land area. However the actual quantities of crops grown on the refuge will vary from year to year depending on the water year type and the water allocation system that is implemented. Refer to Table 6.1 for the projections of crop types and wetlands on the refuge under a range of scenarios. In addition to helping meet habitat objectives for dabbling ducks and geese, farming is also used to control invasive plant species such as perennial pepperweed. In dry years when water is not available for seasonal wetlands, the refuge may choose to increase the acreage of cooperative farm fields by up to 4,000 acres as a method to control invasive plant species instead of using pesticides. In this situation, there may be more cooperative farming than is needed to meet habitat objectives. The additional cropland acreage on the refuge would be used to provide incentives for cooperative farmers to provide wetlands on private lands off of the refuge through the walking wetlands program.

By their nature, most of the farming practices described in Section 4.2.1 as part of the lease lands and cooperative farming programs would affect vegetation and habitat resources on the refuge. Tilling, or the chopping and burying of remaining plant material after harvest, crop rotation, prescribed fires and flooding are examples of tools used at the refuge to manage vegetation. Flood fallowing of crop units would also be used to discourage weeds, diseases, and pest insects from effectively reproducing and establishing a robust presence in specific fields; and can lead to increased crop yields. These practices are largely confined to farmed fields and are considered minor. Although they have altered natural vegetation across much of the refuge historically, they also currently have minimal effects on units set aside as native or naturalized plant communities on the refuge. Use of grazing, haying, and the use of pesticides related to farming are covered separately below.

Haying and Grazing Programs

Under Alternative A, grazing would be used on up to 12,500 acres annually and haying would be used on up to 2,000 acres annually to manage vegetation and improve habitat conditions for waterfowl and other wildlife. Prescribed domestic livestock grazing (e.g., cattle) and haying would be used as one of many techniques to potentially reduce targeted vegetation height and cover, as necessary, to achieve habitat objectives. Grazing and haying would create short-grass pastures for migratory waterfowl; limit encroachment on meadows and grasslands by trees and shrubs; and, if managed carefully, could reduce the spread of some invasive plant species**. For example, cattle, sheep, and goats will graze perennial pepperweed, but the long-term effectiveness of grazing to control pepperweed is not known. Cattle and sheep will use perennial pepperweed where it grows with other plants, but they will not graze in dense, pure stands. In one study, grazing reduced perennial pepperweed in a pasture by 78% for 1 year (NRCS 2007).**

In the absence of natural or human-created environmental disturbance (e.g., flooding, fire, grazing, or mowing/haying), grass and marsh vegetation can become tall, dense, and decadent, with substantial thatch, resulting in reduced wildlife values (for diversity, foraging, nesting, etc.) (Kirby et al. 1993). Haying and moderate grazing and associated trampling by livestock would be used to create openings in such areas, help create a more diverse mosaic of habitats across the landscape, reestablish more structural habitat diversity, set back plant succession, revitalize

vegetation, enhance light penetration, facilitate earlier green up, and allow forbs and other low-growing plants a better chance to flourish (Bossenmaier 1964; Kirby et al. 1993). Each of these would help in supporting additional or more diverse waterfowl and other wildlife at the refuge.

Although prescribed grazing may provide long-term benefits as an important tool for managing a variety of habitat types, this strategy can generate both beneficial and adverse effects to native plants and plant communities. Scientific studies on the effects of grazing have shown that results are very site-specific and can depend on the interaction between site conditions (e.g., soil type), weather, and grazing practices (Bartolome et al. 2009; Briske 2011; Huntsinger et al. 2007; Kimball and Schiffman 2003; Stahlheber and D'Antonio 2013). As such, the Service has adopted an adaptive management strategy, with monitoring, to evaluate the effects of prescribed grazing on vegetation, which allows for adjusting grazing permits to mitigate adverse effects (e.g., stipulations related to timing, stocking density, type, access, maintenance, reporting, supplemental feeding, support equipment usage, livestock quarantine and origin restrictions [to reduce invasive species risk from livestock and vehicles used to transport livestock], and monitoring) (Bush 2006; Herrick et al. 2012). Such adverse effects would be mitigated by limiting grazing to targeted resource prescriptions, grazing permit restrictions, and other adaptive management techniques based on monitoring both residual dry matter and refuge resource targets. These methods have been used successfully to manage grazing intensity and distribution, as well as for determining carrying capacity (Bartolome et al. 2006; McDougald et al. 1991).

Potential adverse effects of grazing include introduction of non-native and invasive species; trampling sensitive species; trampling of vegetation; trench creation; wallowing during resting; habitat fragmentation; creating gaps for invasive species; overgrazing; preferential grazing of perennials over annuals; adverse effects from feces that can smother plants; and riparian damage (Van Dyne and Heady 1965). Areas surrounding watering facilities, mineral blocks, corrals, and loading ramps are especially vulnerable to being denuded by trampling and experiencing soil compaction. Livestock (their hair and manure), and ranching vehicles and equipment can also transfer invasive species. These adverse effects may be partially mitigated through implementing monitoring and adaptive management measures and restrictions measures, including erecting temporary exclusionary fences to prevent riparian, wetlands, and shrub habitat damage; adherence to restrictions and permit conditions outlined in SUPs (e.g., livestock quarantines and location restrictions to reduce the risk of introducing invasive species from livestock and vehicles used to transport livestock [Bush 2006]); monitoring to determine whether overgrazing is likely and rotation or other mitigation to reduce its potential; and controlled access. The grazing program utilizes adaptive management and monitoring to ensure that all management regimes achieve intended goals and objectives for refuge habitats. This effort would be enhanced and guided using the adaptive management process, to include consideration of additional research, inventorying, and monitoring. The use of monitoring data to determine whether thresholds of adverse impact from grazing have been reached and the application of BMPs such as those listed in Appendix L would keep adverse impacts minor.

Pesticide Application

Although the term "pesticide" applies to both animals and plants, only herbicides or those chemicals that target plant pests are used at Lower Klamath Refuge. Pesticide inputs and risk of impacts to terrestrial vegetation are primarily limited to the effects of herbicide use and exposure. By their nature, pesticides are toxic, at least to the target plant pest. Broad spectrum (or nonselective) herbicides kill all plants that receive an adequate dose and selective herbicides kill

certain types of plants while allowing others, including those that receive spray, to survive (e.g., the herbicide might kill broadleaf plants but not grasses, or vice versa). Some herbicides affect plants during different times in their growth cycle (e.g., pre-emergent versus post-emergent herbicides) and others target plant metabolism. Systemic herbicides are taken up into the plant's vascular system and others kill plant tissues on contact. In addition to killing plants, herbicides may cause stunted growth, cause plant leaves or stems to distort or discolor, or preclude seeds from emerging. Some herbicides are applied to or incorporated into the soil (e.g., root mitotic inhibitors that hinder root development, pigment inhibitors that destroy chlorophyll, shoot inhibitors that retard cell growth and division, and photosynthetic inhibitors that interfere with photosynthesis); some herbicides are applied to a plant's foliage (e.g., meristematic [lipid] inhibitors that stunt growth, membrane disrupters that block energy production, and photosynthetic inhibitors that interfere with photosynthesis); and other herbicides can be applied to the soil or foliage (e.g., hormone [auxin] herbicides that interfere with plant growth, and ALS enzyme inhibitors that block metabolism and cell division). Some herbicides are more persistent (i.e., are effective for a longer period of time) than others. In general, younger and herbaceous (non-woody) plants are the most sensitive to herbicides (Baumann et al. 1999; O'Callaghan 2002; Pike and Hager 1995).

The use of herbicides in native habitats to control of invasive vegetation would result in minor to intermediate beneficial effects to vegetation and habitat resources. The herbicides that have been approved for use on the refuge through the PUPS are reviewed to determine the potential effect of each herbicide on native vegetation in the event that unintentional pesticide drift should occur. The product and application method with the least potential for impact to native vegetation, while also providing effective control of the pest species, is selected. Following these procedures, as well as the application requirements provided on the product label, would minimize the potential for impacts. In general, no adverse effects to habitat and native vegetation are anticipated as a result of herbicide use. Certain nontarget vegetation might be killed or subjected to sublethal effects, such as reduced growth. However, these effects would be minimized through the selection of the most appropriate herbicide and application method. The effects of current herbicide use practices on terrestrial habitats would continue over the short term. The magnitude of these effects would vary from year to year depending on weed abundance and corresponding herbicide inputs.

The Service uses the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on cooperative farm units. However, the Service also limits and would continue to limit the amount and type of pesticide used at Lower Klamath Refuge. On Lower Klamath Refuge, the restrictions in the SUP limit the types of pesticides that can be used on conventional crops to the following: one ground broadcast application of 2,4_D amine, MCPA, glyphosate, and/or dicamba. On cooperative units that are farmed organically, only pesticides that meet the standards outlined by the National Organic Program criteria may be used. However, if crop pests reach levels that either cause significant economic injury within or adjacent to cooperative farm units, or if environmental or economic forces affect the attractiveness of refuge cooperative farm land to organic growers, then the spectrum of PUPs approved by the PUP Committee for lease land crops may be used on cooperative farm units. In croplands, pesticide use would continue to result in economic reductions of agricultural weeds. Herbicide use would continue to allow high yielding, weed-free grain fields providing abundant waste grain for both spring and fall migrating waterfowl. In buffer zones, established to protect waterways, aerial and ground spraying would not be allowed, but spot spraying, wicking and wiping of certain herbicides would continue to

eliminate noxious and other weeds. Similar to herbicide use in native habitats, use in croplands can effect nontarget vegetation which might be killed or subjected to sublethal effects, such as reduced growth. However, these effects would be minimized through the selection of the most appropriate herbicide and application method. The effects of current herbicide use practices on terrestrial habitats on leased lands and cooperatively farmed units would continue over the short term. The magnitude of these effects would vary from year to year depending on weed abundance and corresponding herbicide inputs.

Pesticide impacts to aquatic vegetation would be limited primarily to herbicide use in croplands and on berms. Indirect effects would potentially include the introduction of increased biomass of decaying vegetation into aquatic habitats, reducing available dissolved oxygen for aquatic life. These impacts would be negligible, but would continue over the short term. Buffer zones and drift retardants established to reduce the risk of pesticide entry into waterways, and restrictions on applications of pesticides, would continue to mitigate pesticide-associated risk to aquatic habitats. Special restrictions in applications of herbicides on the berms, such as more intensive drift monitoring and regulation of water flow adjacent to the canal or drain being treated, would be implemented to limit this risk. Because these restrictions would mitigate impacts to aquatic habitats, effects associated with pesticides would be negligible in the short and long terms.

Analysis of the effects of implementation of an IPM program for lease lands at Lower Klamath and Tule Lake Refuges is provided in the *Integrated Pest Management Plan and Environmental Impact Statement for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges, Oregon/California* (Service 1998a) and is incorporated by reference.

Public Use

Wildlife-dependent recreation can have adverse effects on vegetation and habitats. Hunters, including their vehicles, boats and trailers, other equipment and supplies, and dogs can trample native plants, and potentially introduce or spread exotic and invasive species, including plants, invertebrates, fish, and wildlife. Propellers on hunters' motorboats could cut submergent and emergent plants below the water surface, and increased turbidity generated by boating would reduce water clarity and could reduce growth and survival of aquatic plants and other aquatic organisms. Two-stroke engines on boats discharge fuel, grease, and oil into the water, degrading the quality of this habitat. However, based on the size of the hunt area and level of hunter use, effects of hunting on vegetation and habitat are expected to be minor and localized. Based on visual inspection, hunting-related activities do not appear to have reduced or fragmented wetland habitats or resulted in an increase of non-native plant species such that they are the dominant species in wetland habitats. Although impacts to habitat quality from ongoing hunting and other foot, boat or car traffic have likely occurred at the refuge, they are localized, and negligible or minor.

The construction and maintenance of trails and boardwalks may impact soils, vegetation, and in some instances hydrology around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988). Effects on vegetation and habitat resources are expected to be localized, short term, and minor.

Beneficial Effects

Alternative A is expected to result in a variety of beneficial effects to vegetation and habitat resources. The primary benefits are the management of delivered water to provide permanent and seasonal wetlands, small grains, and green browse (pasture/alfalfa) to meet the habitat needs of migrating and nesting waterfowl and other wildlife. The use of haying, grazing, invasive species control and prescribed burning also provide benefits by improving habitat quality for wildlife, especially waterfowl and other waterbirds. The extent of these benefits varies with the volume and timing of water deliveries. Full water deliveries are a necessity to provide the amount of wetland and agricultural habitats needed to achieve the Kuchel Act mandate for "proper waterfowl management" (Appendices M and N).

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B – Lower Klamath Refuge

In addition to the management activities and associated impacts discussed under Alternative A, the Service would seek to improve management of vegetation and habitat resources under Alternative B. Programmatic changes in management are discussed below, followed by a summary of estimated habitat acreages under different water delivery scenarios. Specific changes in management and their associated effects on vegetation and habitat resources are then discussed.

Under Alternative B, the Service would continue to implement the Fire Management Plan that would allow lease land farmers to contract locally for prescribed burning of fields. The Service would also update the Lower Klamath Refuge Inventory and Monitoring Plan and expand monitoring of changes in vegetation communities to assess the effects of climate change on the refuge. These management changes are expected to improve habitat conditions in the long-term by helping the Service be more strategic in management of fire as well as the implementation if the inventory and monitoring program.

Table 6.2 below presents the estimated acreages for each refuge habitat type and under the six different water delivery scenarios shown in Section 4.2.1, Figure 4.2. This table also includes estimates of the acreage of wetland units that the Service would be unable to flood due to insufficient water deliveries (labeled "Dry Wetland Units").

Table 6.2. Alternative B Estimated Habitat Areas (acres) for Lower Klamath Refuge under Six Different Water Delivery Scenarios

	Permanent Wetland	*Seasonal Wetland*	*Dry Wetland Units*[1]	*Standing Grain (coop/ lease land)*	*Harvested Grain (coop/ lease land)*	*Pasture (coop/ lease land)*	*Nesting Islands*	*Wet Meadow*	*Upland*
Projected Deliveries under the Current Water Allocation System									
0.2	600	3,000	21,800	1,300/0	0/0	900/0	0	0	12,200
0.5	700	8,300	16,400	1,500/0	1,800/540	1,400/1,100	2	5,700	6,500
0.8	1,100	16,000	8,300	1,500/0	1,800/2,400	1,400/2,100	2	5,700	6,500

Table 6.2. Alternative B Estimated Habitat Areas (acres) for Lower Klamath Refuge under Six Different Water Delivery Scenarios

	Permanent Wetland	*Seasonal Wetland*	*Dry Wetland Units*[1]	*Standing Grain (coop/ lease land)*	*Harvested Grain (coop/ lease land)*	*Pasture (coop/ lease land)*	*Nesting Islands*	*Wet Meadow*	*Upland*
Projected Deliveries under the Klamath Basin Restoration Agreement									
0.2	7,500	13,000	4,600	1,500/0	1,800/0	1,400/0	2	0	12,200
0.5	8,100	14,100	3,200	1,500/0	1,800/700	1,400/900	2	5,700	6,500
0.8	8,800	15,200	1,400	1,500/0	1,500/2,400	1,200/2,800	2	5,700	6,500
FULL[2]	9,294	16,114	n/a	1,500	4,034	4,018	2	5,700	6,500

[1]Dry wetland units are seasonal or permanent wetland units that are not flooded due to insufficient water deliveries.
[2]Full acreage objective for each habitat from Appendix F.

Land Management

Wetland Management

Under Alternative B, wetland management activities and associated impacts would be the same as those discussed under Alternative A. In addition, the Service would also seek to leverage more wetland habitat on private lands in the Klamath Basin by expanding the use of preferential permits for cooperatively farmed grain and hay units for farmers that participate in the Walking Wetlands Program on their private lands. The amount of walking wetland habitat provided is impossible to predict since it would depend on the availability of water and the willingness of farmers to participate. Increasing the acreage of local wetlands is especially important for wildlife in the Klamath Basin because water shortages routinely limit the number of wetland units that can be flooded on the refuges (see further discussions of this issue in Section 4.2.1). Adverse effects to vegetation and habitat would be the same as Alternative A.

Farming Programs

In addition to the farming activities and associated impacts discussed under Alternative A, the Service would increase unharvested grain by approximately 500 acres and convert an additional 1,300 acres of harvested grain to pasture/green browse (subject to water availability). The result would be a net decrease of 1,300 acres in units planted to grain and a net increase in units managed for irrigated pasture. Approximately 700 acres would come from units that are currently cooperatively farmed for grain and the remainder would come from Area K lease lands grain fields. Since grain is an annual crop which needs to be replanted each year and pasture grasses are perennial, the result would be less disturbance to vegetation each year. Adverse effects to vegetation and habitat would be the same as Alternative B.

Haying and Grazing Programs

The effects of haying and grazing on vegetation and habitat would be the same as with Alternative A, except that Alternative B includes the expanded use of haying and/or grazing by up to 1,300 acres on the grain units converted to pasture. Haying and grazing would result in the expanded availability of green browse to meet habitat objectives for migrating dabbling ducks and geese in spring. In addition, the expanded haying and grazing programs would increase the area subject to

the potentially adverse effects of haying described under Alternative A, but the overall adverse effects to vegetation and habitat would remain minor.

Pesticide Application

Under Alternative B, the Service would **continue to use the 1998 IPM Plan for lease lands on the Lower Klamath Refuge in addition to** formalizing the ongoing pest management **plan for cooperative farm units, habitat restoration, and general maintenance under a separate IPM Plan (Appendix Q).** In accordance with the IPM Plan contained in Appendix Q, the Service would expand monitoring of weed populations; expand the use of non-pesticide tools to control invasive species in wetland and upland units (e.g., grazing, restoration plantings); and develop a program for managing berms to reduce invasive species cover and improve cover for nesting waterfowl and other species. **The Service would continue to use the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on cooperative farm units. However, the Service will also continue to limit the amount and type of pesticide used at Lower Klamath Refuge as described under Alternative A.** Implementation of the IPM Plan for **cooperative farm units, habitat restoration, and general maintenance** is expected to increase the effectiveness of invasive species management, perhaps reducing the need for pesticide applications. An invasive species monitoring and management plan is expected to help the Service to more quickly identify and control new or expanded infestations of invasive plants. As with Alternative A, Alternative B is expected to have temporary adverse effects on the targeted invasive species and minor to negligible adverse effects on non-target plants. Compared to Alternative A, adverse effects of pesticide use under Alternative B would be reduced to the extent non-pesticide controls are adopted.

To the extent that monitoring results for invasive plant species are used to direct rapid assessment and control actions, new outbreaks of priority invasive species would more likely be controlled when they were smaller in size. Refuge-wide, over time, this would be expected to result in a reduction in the acreage of native and naturalized vegetation on the refuge that was impacted by invasive species and potentially fewer new infestations. Adverse effects to vegetation and habitat would be the same as Alternative A.

Public Use

Effects on vegetation and habitat resources from wildlife-dependent recreational uses under Alternative B would be similar to those under Alternative A. In addition, the construction of a pull-off on State Line Road could remove native habitats and spread invasive plants, depending on the specific locations and details of the facilities. However, the pull-out is expected to encompass a small area (less than 1 acre) and would be sited to avoid wetlands and other sensitive habitats. Invasive plant treatments around the facilities would reduce the potential for invasive plants to establish. Adverse effects of public use on vegetation and habitat would be the same as Alternative A.

Beneficial Effects

Alternative B is expected to result in the same types but greater beneficial effects to vegetation and habitat resources than Alternative A. Alternative B would increase the acreage of unharvested grain and pasture so the refuge can fully support population objectives for waterfowl (see Appendix N). The expansion of the Walking Wetlands Program would result in a long-term

beneficial effect by increasing the area of wetland habitat available in the Klamath Basin to help support waterfowl population objectives. Implementation of the Fire Management Plan (Service 2001) and the Inventory and Monitoring Plan are expected to improve habitat conditions in the long term by helping the Service be more strategic in management and monitoring of refuge resources. Implementation of the IPM Plan **in Appendix Q for cooperative farm units, habitat restoration, and general maintenance on** the refuge is expected to increase the effectiveness of invasive species management, perhaps reducing the need for pesticide applications. In addition, development of a program for managing berms is expected to result in long-term beneficial effects to vegetation and habitat resources by reducing invasive species cover and improving the cover for nesting waterfowl and other species.

Mitigation

Avoidance and mitigation measures are incorporated into the Klamath Reclamation Project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

In addition to the management activities and associated impacts discussed under Alternative B, the Service would seek additional improvements in management of vegetation and habitat resources under Alternative C. Below is a summary of estimated habitat acreages under different water delivery scenarios. Following the summary table, specific changes in management and their associated effects on vegetation and habitat resources are discussed by category.

Table 6.3 presents the estimated acreages for each refuge habitat type and under the six different water delivery scenarios shown in Section 4.2.1, Figure 4.2. This table also includes estimates of the acreage of wetland units that the Service would be unable to flood due to insufficient water deliveries (labeled "Dry Wetland Units").

Table 6.3. Alternative C Estimated Habitat Areas (acres) for Lower Klamath Refuge under Six Different Water Delivery Scenarios

	Permanent Wetland	*Seasonal Wetland*	*Dry Wetland Units*[1]	*Standing Grain (coop/lease land)*	*Harvested Grain (coop/lease land)*	*Pasture (coop/lease land)*	*Nesting Islands*	*Wet Meadow*	*Upland*
Projected Deliveries under the Current Water Allocation System									
0.2	600	3,000	21,800	1,300/200	0/100	900/300	0	0	12,200
0.5	700	9,700	15,000	1,500/0	1,800/1,000	1,400/1,000	2	5,700	6,500
0.8	1,100	16,000	8,300	1,500/0	1,800/2,400	1,400/2,100	2	5,700	6,500
Projected Deliveries under the Klamath Basin Restoration Agreement									
0.2	7,200	13,600	4,600	1,500/0	1,800/0	1,400/700	2	0	12,200
0.5	8,100	14,100	3,200	1,500/0	1,800/700	1,400/900	2	5,700	6,500
0.8	8,800	15,200	1,400	1,500/0	1,800/2,400	1,200/2,800	2	5,700	6,500
FULL[2]	9,294	16,114	n/a	1,500	4,034	4,018	2	5,700	6,500

[1] Dry wetland units are seasonal or permanent wetland units that are not flooded due to insufficient water deliveries.
[2] Full acreage objective for each habitat from Appendix F.

Land Management

Wetland Management

Wetland management activities and impacts under Alternative C would be nearly identical to Alternative B. The only difference would be that in dry years (0.5 percentile or dryer) under the current water allocation system, the Service would have slightly more water available for seasonal wetlands than under Alternative B due to modifications in irrigation methods and timing described below. As a result, the Service would be able to flood approximately 17% more seasonal wetlands (9,700 acres under Alternative C versus 8,300 acres under Alternative B). This would have an intermediate short-term beneficial effect on vegetation and habitat resources and would contribute towards achievement of wetland habitat objectives for waterfowl and other wildlife. In addition, wetland habitat values may also improve under this alternative through the operation of a portable decontamination station(s) near boat launches on the refuge. These stations would help in preventing the spread of invasive species which could otherwise outcompete or damage native wetland vegetation. Adverse effects to vegetation and habitat would be minor as described under Alternative A. Although there could be additional seasonal wetlands under Alternative C, the extent of prescribed burning or mechanical treatment of wetlands would be the same as under Alternative A.

Farming Programs

In addition to the farming activities and associated impacts discussed under Alternative B, the Service would work with Reclamation to modify Lease Land contracts so that if habitat objectives for unharvested standing grain cannot be met on cooperatively farmed units, some Lease Land contract holders would be required to leave 25% of their fields as unharvested standing grain to fully meet objectives. It is estimated that this would only occur during the driest years (0.2 percentile or drier) and would result in approximately 300 acres or less that would be left standing (un-harvested). Subject to the availability of water, the Service would also seek to expand the practice of flood fallowing on lease land fields with expiring contracts if needed to achieve habitat objectives and facilitate the transition to organic status. Adverse effects to vegetation and habitat would be minor as described under Alternative A.

Haying and Grazing Programs

In addition to the haying and grazing actions and associated impacts discussed under Alternative B, the Service would also expand the use of grazing in uplands and dry seasonal wetland units under Alternative C. It is estimated that an additional 2 to 3,000 acres would be grazed under this alternative. The expanded use of grazing is expected to have moderate beneficial effects including improved habitat conditions for waterfowl, reduced wildfire danger, and improved control of invasive plants. Although the expanded grazing program would increase the area subject to the potentially adverse effects of grazing described under Alternative A, adverse effects to vegetation and habitat are considered minor because of the relatively small increase in grazing area and the conditions included in the SUP that focus the grazing on habitat development.

Use of Pesticides

In addition to the pesticide use and associated impacts discussed under Alternative B, the Service would seek to expand areas of lease land and cooperatively farmed units that are managed organically. This expansion would be facilitated by working with Reclamation to increase contract

incentives such as lease extensions for farmers that manage fields organically. The portion of the cooperatively farmed and Lease Land units that would be managed organically is difficult to quantify since it would depend on a number of variables such as the availability of water, market demand for organic products, and the willingness of farmers to participate in the program. Regardless, this alternative is likely to result in some reduction of pesticide use. To the extent that pesticide use is displaced, fewer impacts to vegetation from pesticide application would be beneficial for refuge vegetation compared to current conditions. The adverse effects of pesticide use on vegetation would continue to be negligible.

Public Use

Public use impacts would be the same as described for Alternative B.

Beneficial Effects

Alternative C is expected to result in the same types but greater beneficial effects to vegetation and habitat resources than Alternatives A and B. Expansion of grazing in uplands and dry seasonal wetlands is expected to improve habitat conditions for waterfowl and other wildlife, limit wildfire danger, and provide a non-pesticide alternative for controlling invasive plants. In addition, modifications to the farming program described above are expected to benefit vegetation and habitat resources in the long term by contributing to the achievement of habitat objectives and reducing pesticide use and associated impacts. Finally, the development and operation of portable decontamination station(s) near boat launches is expected to have a long-term beneficial effect on wetland vegetation by helping prevent the introduction of aquatic invasive species.

Mitigation

Avoidance and mitigation measures are incorporated into the Klamath Reclamation Project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative D – Lower Klamath Refuge

In addition to the management activities and associated impacts discussed under Alternative C, the Service would seek additional improvements in management of vegetation and habitat resources under Alternative D. Below is a summary of estimated habitat acreages under different water delivery scenarios. Following the summary table, specific changes in management and their associated effects on vegetation and habitat resources are discussed by category.

Table 6.4 presents the estimated acreages for each refuge habitat type and under the six different water delivery scenarios shown in Section 4.2.1, Figure 4.2. This table also includes estimates of the acreage of wetland units that the Service would be unable to flood due to insufficient water deliveries (labeled “Dry Wetland Units”).

Table 6.4. Alternative D Estimated Habitat Areas (acres) for Lower Klamath Refuge under Six Different Water Delivery Scenarios

	Permanent Wetland	*Seasonal Wetland*	*Dry Wetland Units*[1]	*Standing Grain (coop/lease land)*	*Harvested Grain (coop/lease land)*	*Pasture (coop/lease land)*	*Nesting Islands*	*Wet Meadow*	*Upland*
Projected Deliveries under the Current Water Allocation System									
0.2	0	2,500	22,900	1,300/200	0/100	900/300	0	0	12,200
0.5	400	12,200	13,000	1,500/0	1,800/1,000	1,400/1,000	2	5,700	6,500
0.8	5,100	12,600	9,800	1,500/0	1,800/2,400	1,400/2,300	2	5,700	6,500
Projected Deliveries under the Klamath Basin Restoration Agreement or Similar Agreement									
0.2	6,200	15,700	5,200	1,500/0	1,800/0	1,400/300	2	0	12,200
0.5	6,200	17,000	3,900	1,500/0	1,800/700	1,400/900	2	5,700	6,500
0.8	6,200	17,900	3,100	1,500/0	1,800/2,400	1,400/2,600	2	5,700	6,500
FULL[2]	9,294	16,114	n/a	1,500	4,034	4,018	2	5,700	6,500

[1] Dry wetland units are seasonal or permanent wetland units that are not flooded due to insufficient water deliveries.
[2] Full acreage objective for each habitat from Appendix F.

Land Management

Wetland Management

Wetland management actions and impacts under Alternative D would be similar to Alternative C for the units outside the Big Pond area (see Figure 4.7). However, the actions and impacts within the Big Pond area would be substantially different than the other alternatives. Management within this 9,000-acre unit would focus on capturing water in winter and spring to fill the unit and allow levels to gradually recede during the summer and fall, essentially mimicking conditions on historic Lower Klamath Lake.

In years when sufficient water is available, the Big Pond would likely develop into a large open water expanse in the deeper areas with a 1-mile-wide or greater fringe of emergent seasonal wetlands. Over time pondweeds and duckweeds associated with permanent marsh and goosefoot and sand-spurrey in seasonal marsh would likely return as they did at Lower Klamath Refuge following the return of water to the refuge after the Kuchel Act was implemented (Pederson and Pederson 1981 in Weddell et al. 1998). The seasonal wetlands would occur at elevations high enough for moist soil plants to germinate and mature (i.e., water would draw down early enough). These higher elevations are expected to have food densities similar to other Lower Klamath Refuge seasonal wetland habitats (Appendix N, page 67). However, because these areas would likely be dry in fall, they would not be available to foraging waterfowl until winter or spring when flooded. Permanent wetlands would form in portions of the Big Pond where flooding is sustained year-round. For purposes of this analysis, it is assumed that portions of the Big Pond flooded to greater than 4 feet deep at the end of spring would function as permanent wetlands.

The area of seasonal and permanent wetland that would develop within the Big Pond Unit is expected to vary substantially depending on available water deliveries. Under the current water allocation system (NMFS and Service 2013) during 0.2 and 0.5 percentile water years, the Big Pond Unit would essentially function as spring seasonal wetland with little or no permanent wetland. Compared to Alternatives A, B, and C, there is expected to be less permanent wetland under Alternative D during these water years (see Table 6.4). However, during 0.8 percentile

water years under Alternative D, the amount of permanent wetland on the refuge could be nearly five times that in the other alternatives (see Table 6.4). The total area of seasonal wetland would be less under the 0.2 and 0.8 water years but greater under a 0.5 water year. The adverse effects of wetland management on vegetation and habitat would continue to be minor.

Under Alternative D, if the KBRA or a similar settlement were implemented, 15% to 30% less permanent wetland is expected under all water years (see Table 6.4). Similarly, the area of seasonal wetland is expected to be 18% to 24% less under all water years.

This alternative would also require removal of some water delivery facilities and temporary disturbance to wildlife and changes to their habitats could result. The site-specific impacts of removing facilities would be analyzed further in a project-specific NEPA document if Alternative D is selected.

Farming Programs

Farming actions and impacts would be the same as described for Alternative C, except that the area within the Big Pond footprint would no longer be farmed. However, the overall acreage farmed each year would be similar to Alternative C. The beneficial and adverse impacts of farming described under the other alternatives would shift to units outside the Big Pond footprint. The adverse effects of farming on vegetation and habitat would be the same as Alternative C.

Haying and Grazing Programs

Haying and grazing impacts would be the same as described for Alternative C.

Use of Pesticides

Pesticide use impacts would be the same as described for Alternative C.

Public Use

Public use impacts would be the same as described for Alternative C.

Beneficial Effects

Alternative D is expected to result in the same types of beneficial effects to vegetation and habitat resources from farming, haying, and grazing as Alternatives A, B, and C. The beneficial effects of implementing the Big Pond would vary from minor to major depending on the timing and volume of water delivered to the refuge in a given water year. In addition, management of the Big Pond Unit would more closely mimic the natural flooding and drying cycles in the historic Lower Klamath Lake.

Mitigation

Avoidance and mitigation measures are incorporated into the Klamath Reclamation Project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.2.6 Fish and Wildlife

Methodology to Assess Effects – Lower Klamath Refuge

The various habitat types developed based on a range of water deliveries were assessed to determine their potential to support refuge goals for fish and wildlife. Scientific literature was used to predict the potential effects of various land management and public use activities on fish and wildlife resources. The modeling completed in 2008 for "A Bioenergetic Approach to Conservation Planning for Waterfowl at Lower Klamath and Tule Lake National Wildlife Refuge" (Dugger et al. 2008) was used to assess the relative benefits of each alternative.

Listed here are resource-specific contexts to assess the effects of the alternatives on fish and wildlife resources.

- Waterfowl numbers are dependent on the quantity and timing of water received through the Klamath Reclamation Project.
- Fish resources on the refuge are opportunistic. The source of fish is through the delivery of water through the Ady Canal or through D Plant.
- The primary mandate of the refuge is to conserve wildlife and protect native birds, particularly migratory waterfowl

Alternative A – Lower Klamath Refuge

Land Management

Wetland Management

Wetland management focuses on developing both seasonal and permanent wetlands. The primary key to wetland management is the timing and quantity of water. Table 6.1 in Section 6.2.5 summarizes the approximate acreage of wetland habitats that can be expected under a variety of water year scenarios. Managing water levels and the timing of flood up and draw-downs to optimize the quality of seasonal and permanent wetland habitats for waterfowl and other wetland-dependent wildlife does not have direct adverse effects on fish and wildlife. However, to maintain a mosaic of habitat types to meet refuge objectives for wildlife within wetlands, managers must use a variety of tools such as prescribed fire, disking and plowing, grazing, and haying. Without these tools, wetlands would become dominated by just a few plant species which reduces the numbers and types of wildlife species on the refuge. Prescribed fire is used to control invasive plant species and to improve habitat diversity. Direct effects of prescribed fire to wildlife can include injury or mortality. However, their primary effects on fish and wildlife are beneficial and indirect; through modification to vegetation and other components of habitat (e.g., food, cover, etc.) improved conditions are provided for a variety to species. Because native wildlife species evolved in the presence of natural wildfires, most wildlife is able to flee ahead of the flames or they survive by sheltering in burrows, under logs or rocks, or in low, wet areas. Species that are unable to avoid the flames are able to repopulate burned areas from adjacent unburned habitats. Because of this, adverse impacts to wildlife from prescribed burning have been and would continue to be minor if Alternative A were implemented. Prescribed burning is purposefully conducted in a patchwork fashion across the landscape. As a result, it creates a more-diverse habitat, including an increase in edge effect that often supports a greater diversity of wildlife species (including those that favor a more open habitat). Depending on staffing and funding prescribed burning is used on up to 3,000 acres each year.

Disking and plowing are also used to remove emergent vegetation from wetland units in order to increase the proportion of open water areas for use by fall and spring migrant waterfowl. Disking and plowing can disturb wildlife in the immediate area where work is occurring. Disking and plowing are farming practices that can open up dense stands of vegetation and set back succession in a plant community. This allows sunlight to penetrate, seeds to sprout, and seedlings to grow, creating a more diverse habitat within the wetland basin and across the refuge for a greater diversity of wildlife. These practices can be combined with flooding to generate additional wildlife benefits. The extent of disking and plowing depends on the maturity of emergent vegetation. After a number of dry years it may not be necessary to remove emergent vegetation. No more than 1,000 acres are treated annually by disking and plowing to set back vegetative succession.

Managing invasive animal species can also have direct effects on wildlife. Bag-type repellents are used in an attempt to deter rodents from buildings and equipment. These repellents (whose active ingredients are often based on natural compounds like cedar wood, eucalyptus oil, balsam fir needles, grapefruit oil, lemon oil, mineral concentrate, mint oil, peppers, predator scents, and soap) have no adverse effects on rodents or other wildlife species. Trapping is used to capture and remove selected pest animals, such as muskrats and beavers, which burrow into dikes and roadways or clog water-control structures affecting the integrity or function of these facilities. Trapping is also used to protect office and general maintenance equipment and supplies in buildings by capturing and removing mice that were not successfully deterred from entering by the repellents. Traps are also used on nesting islands to protect white pelican and Caspian tern nests and young by capturing and removing raccoons and relocating great horned owls. The activities only affect a few individuals and would be no more than minor in intensity.

Fish resources are generally confined to the irrigation canals used to move water into the various units. None of the water diversions have fish screens so fish (primarily sunfish, minnows, and perch) can end up in wetland management units and on farm fields. These fish provide a food source for fish-eating birds on the refuge as long as there is sufficient water in the wetland unit. The Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) are known to occur in Stearn's Pond (approximately 5–8 acres) on Lower Klamath Refuge. Stearn's Pond is a permanent wetland area that is unaffected by variation in water deliveries. In a 2013 BiOp (NMFS and Service 2013) for Reclamation on the effects of proposed Klamath Reclamation Project operations, the Service determined that the level of anticipated take related to water delivery and refuge management is not likely to result in jeopardy to Lost River and shortnose suckers; and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service's (NOAA Fisheries) determined that the level of anticipated take is not likely to result in jeopardy to Southern Oregon/Northern California Coast coho salmon evolutionarily significant unit (ESU).

Gray wolf (*Canis lupus*) is listed as endangered under the federal ESA, as amended. Gray wolf is known to occur on the refuge. Although the gray wolf has been seen on the refuge, the habitat on the refuge is transitory in nature.

Intra-Service consultation would be conducted pursuant to Section 7 of the federal ESA, for federally listed species and their critical habitat. Any conservation measures, as well as terms and conditions resulting from consultation under the federal ESA would be implemented to protect listed species and their habitat that occur on the refuge, as applicable. The direct effects of wetland management on fish and wildlife are minor.

Farming Programs

Both lease land and cooperative farming units are limited to grain and pasture. If the Service received full water deliveries needed to meet habitat objectives, the farmed acres on the refuge would total approximately 9,600 acres composed of 7,600 acres of grain and 2,000 acres of pasture. This constitutes about 18% of the refuge land area. However, the actual quantities of crops grown on the refuge will vary from year to year depending on the water year type and the water allocation system that is implemented. The projections of crop types and wetlands on the refuge under a range of scenarios are presented above in Table 6.1. In addition to helping meet habitat objectives for dabbling ducks and geese, farming is also used to control invasive plant species such as perennial pepperweed. In dry years when water is not available for seasonal wetlands, the refuge may choose to increase the acreage of cooperative farm fields by up to 4,000 acres as a method to control invasive plant species instead of using pesticides. In this situation, there may be more cooperative farming than is needed to meet habitat objectives. The additional cropland acreage on the refuge would be used to provide incentives for cooperative farmers to provide wetlands on private lands off of the refuge through the Walking Wetlands Program.

Farmed areas are used to produce food for migratory waterfowl and manage invasive plant species. At least 25% of cooperatively farmed unharvested grains are left standing for wildlife benefit. On grain fields, pre-irrigation starts in November and water is held on the field until right before planting in the spring. Migratory birds will forage on these units while they are flooded. Direct adverse effects to wildlife from farming are minimal and are related primarily to disturbance from general farming activities. Irrigation and flooding of fields/management units can create resting and nesting areas for aquatic birds, and encourage the growth and reproduction of plant and invertebrate species relished by waterfowl and other aquatic birds. Fish contained in the canals can be distributed on to farm fields with irrigation water. These fish will be a food source for fish eating birds and other predators. Fish habitat is not generally available the entire year. The additional cooperative farm fields that may be needed in dry years to control invasive plant species would not adversely affect wildlife. These additional fields would provide some level of habitat on the refuge that would not have otherwise been available in dry years.

The direct effects of farming on fish and wildlife are minor.

Haying and Grazing Programs

Approximately 2,000 acres is hayed annually on the refuge. This includes 200 acres on cooperatively farmed fields and 1,800 acres on lease land units. In total this would be about 4% of the refuge. Haying is another management tool used to create openings in grass and marsh vegetation in order to create a more diverse mosaic of habitats across the landscape, reestablish more structural habitat diversity, set back plant succession, and allow low-growing plants a better chance to flourish (Bossenmaier 1964). Haying can have both direct and indirect adverse effects to wildlife. Haying can reduce nest cover thereby increasing vulnerability to predation, the most common cause of nest loss by cranes (Ivey and Dugger 2008). Haying in one year reduces the area of tall nesting cover sought by some wildlife during the following year. Cutting hay could potentially flush, injure, or kill ground-nesting birds, their eggs, chicks, and other terrestrial wildlife (Bossenmaier 1964; Hammond 1964). Another adverse effect of haying that has both direct and indirect effects is human caused disturbance of wildlife from implementing the haying program. Disturbance and flushing of birds, or even raising their alert levels, is of concern to wildlife managers because this creates stress and requires animals to alter their normal behavior

and expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting and brood-rearing. Disturbance can cause birds to stop feeding, cause abandonment of nests and young, allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual animals (Burger and Gochfeld 1991b; Haysmith and Hunt 1995; Lafferty 2001b). Breeding birds are especially sensitive to human disturbance (Hammitt and Cole 1998; Trulio 2005). A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004). Black-legged kittiwake has been observed on Lower Klamath Refuge. The effects of disturbance on individual animals are likely additive, and are discussed in greater detail below under the Public Use section.

Some species of wildlife are relatively tolerant of farming activities and equipment. For example, cattle egrets (*Bubulcus ibis*) often follow farm machinery (Rodgers and Smith 1997), as can gulls, blackbirds, and raptors. For other more sensitive species the presence of farm machinery in a field could cause them to move elsewhere. Wildlife disturbance from haying would be seasonal, intermittent, and confined to access routes and affected units. In addition, wildlife that is disturbed could move to any of several other protected areas of the refuge.

Prescribed grazing occurs annually on both the lease lands in Area K and on cooperative grazing units. On the lease lands up to 1,280 acres (1,280 AUMs) are grazed in areas that have been hayed earlier in the season. Post haying fall-pasture lots are grazed from September through November. In addition, there are two small lots (less than 30 acres each) with permanent pasture that are grazed from June through November. This acreage makes up less than 3% of the refuge. Prescribed grazing may be used on up to 22% of the refuge in the western, central, and southern areas of the refuge (see Figure 5.7). In recent years 11,225 acres (3,670 AUMs) have been grazed annually. Prescribed grazing also requires the use of a variety of equipment and infrastructure on the refuge such as trucks, trailers, off-road vehicle, fences and gates as well as ranching personnel to operate equipment and manage livestock. Some of this equipment is on the refuge throughout the grazing season and can compact soils in the areas it is used. Grazing is used to create short-grass pastures for migratory waterfowl; limit encroachment on meadows and grasslands by trees and shrubs; and reduce the spread of some invasive plant species. In light of the fact that many waterfowl and other wildlife species and their preferred habitats evolved in the presence of large, terrestrial grazing animals, there is not an inherent ecological conflict between grazing by livestock and wildlife use of an area. However, grazing intensity (magnitude and duration) and time of year must be properly managed to capitalize on its advantages and avoid or minimize its disadvantages. For example, grazing in one year would reduce the area of tall nesting cover sought by some wildlife during the following year (Bossenmaier 1964). This could increase vulnerability to predation (Ivey and Dugger 2008; Sutter and Ritchison 2005). Grazing wildlife food plants before they bore seeds would reduce or eliminate the availability of those seeds for waterfowl and other migratory birds during the fall and winter. Continuous, moderate levels of grazing can result in long-term deterioration of native plant communities and heavy grazing can increase the vulnerability of native habitats to the establishment and spread of invasive plants (Krausman et al. 2009).

Grazing livestock can also prevent nesting attempts; cause nest abandonment; trample nests, eggs, and young; and otherwise disturb ground-nesting birds (Ivey and Dugger 2008; Littlefield and Ivey 2001; Sutter and Ritchison 2005). Disturbance would likely be highest when livestock are

let into and rounded up to be removed from the grazing area. Experience has demonstrated that ducks can successfully nest in the shadow of grazing cattle, geese and cattle often graze in the same fields, and that disturbance and trampling do not become important unless cattle numbers are too high (Bossenmaier 1964; Griffith 1964).

Human disturbance from maintenance activities and the use of vehicles to transport livestock is also a component of the grazing program. Direct adverse effects of haying and grazing would be minor.

Pesticide Application

As part of the ongoing IPM activities, pesticides are used to control weeds for the farming program as well as to control invasive plant species, and maintain refuge facilities. Pesticides can fall on the soil surface as a result of overspray and wind drift; pesticide spray missing its mark; excess pesticide dripping from plant stems, leaves, or other plant parts; or spillage from storage, mixing, loading, equipment cleaning, and disposal areas. Pesticides are only applied after the approval of a PUP. When pesticides are used, the Service follows standard BMPs (Appendix L) to reduce adverse effects to soil, including adherence to all USEPA and Oregon or California EPA warning labels and application requirements. During the PUP process the Service considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the physical environment associated with the proposed site-, time-, and target-specific use of pesticides on the refuge are evaluated using the chemical profile prepared for the pesticide.

Studies of the toxicity and other effects of pesticide use are ongoing, and new findings and recommendations are announced routinely. For example, announcements have recently been made regarding the effects of glyphosate and glyphosate formulations (e.g., Roundup and Roundup WeatherMax). Glyphosate is a broad-spectrum, non-selective, systemic organophosphate herbicide that is one of the most widely used herbicides in the United States, including on Klamath Basin refuges (Henderson et al. 2010). It has commonly been believed to be relatively non-toxic to non-target organisms such as birds, fish, and mammals (Center for Environmental Risk Assessment [CERA] 2002; Folmar et al. 1979). However, studies by Cauble and Wagner (2005), Lanctôt, Robertson, et al. (2013), Lanctôt, Navarro-Martin, et al. (2014), Relyea (2005a, 2005b), and Williams and Semlitsch (2010) suggest or demonstrate that glyphosate formulations at concentrations found in the environment can be toxic to amphibians (a taxonomic group that has experienced pronounced population declines globally in recent years). Additionally, the World Health Organization International Agency for Research on Cancer recently categorized glyphosate as, "…probably carcinogenic to humans" (Guyton et al. 2015).

In the past (1950s–1980s), numerous wildlife deaths on Tule Lake and Lower Klamath Refuges were attributed to pesticide use (Snyder-Conn and Hawkes 2004; Snyder-Conn et al. 1999). However evaluations of over 100 more-recent wildlife mortalities on these refuges during the 1998–2000 growing seasons found that evidence to tie those deaths to pesticide use was generally lacking (Hawkes and Haas 2005). **Pesticide monitoring conducted in 2007 (Cameron 2008) and 2011(unpublished data) shows that of the pesticides applied to croplands on Tule Lake Refuge only a few are present in the waterbody and at concentrations low enough that they should not be adversely affecting fish within the lake. Although monitoring has not been conducted on the Lower Klamath Refuge for the presence of pesticides in waterbodies, given the results of monitoring on the Tule Lake Refuge, it is likely that pesticide concentrations in canals and drains on Lower Klamath Refuge are similarly low.**

Effects of pesticide use on listed species was addressed in the 2007 biological opinion for the 1998 IPM Plan are incorporated by reference (Service 2007b). In 1995, the Service issued a biological opinion on the use of pesticides and fertilizers on federal lease lands (and Acrolein and Herbicide Use on the Klamath Project Rights-of-way located on the Klamath Project), which includes the application of pesticides and fertilizers on federal lease lands within the Tule Lake and Lower Klamath Refuges. In 2007, the Service issued a biological opinion and conference report for the implementation of the PUP on federal lease lands on the Tule Lake and Lower Klamath Refuges. As stated in the biological opinion "The programmatic process set in place by this consultation will eventually supersede all previous consultations related to pesticide use on the federal lease lands. However, due to the large number of existing pesticide use patterns, new pesticide use requests, and the complexity of ecological risk assessments associated with each pesticide use pattern, previous consultations will be systematically superseded in accordance with a prescribed schedule." The reassessment schedule will start immediately following written concurrence from the Service of the terms and conditions of the biological evaluation. Reassessment of previously approved pesticide uses will be by crop type. One crop type will be reassessed per calendar year in addition to new pesticide use requests for all crop types. The reassessments have been completed and thus the 2007 biological opinion governs the use of pesticides on federal lease lands.

In the 2007 biological opinion, the Service determined that the use of pesticides and fertilizers on federal lease lands will not likely adversely affect Lost River sucker or shortnose sucker (as well as bald eagle, which is no longer listed) (Service 2007b). An essential component for the finding of "not likely to adversely affect" is the ongoing implementation of the PUP review process and the use of mandatory BMPs. The analysis in the 2007 biological opinion of pesticides and fertilizers used on federal lease lands is incorporated by reference (Service 2007b).

The PUP (including appropriate BMPs) is approved when scientific evidence indicates that effects to refuge biological resources and its physical environment are likely to be minor, temporary, or localized in nature.

The types of pesticides that have been approved for use are listed in Chapter 5, Tables 5.16 and 5.17. Annual pesticide application on the cooperative farming lands have ranged from 942 acres in 2011 to 688 acres in 2013. Annual pesticide application targeting invasive species management and facility maintenance have ranged from 3,639 acres in 2011 to 652 acres in 2013. Pesticide application on the lease lands in Area K are reported in conjunction with the lease land program on Tule Lake Refuge (see Section 6.4.1).

On the Lower Klamath Refuge cooperative farm units the Service uses the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on cooperative farm units. However, the Service also limits the amount and type of pesticide used at Lower Klamath Refuge. On Lower Klamath Refuge, the restrictions in the SUP limit the types of pesticides that can be used on conventional crops to the following: one ground broadcast application of 2,4,-D amine, MCPA, glyphosate, and/or dicamba. On cooperative farm units that are farmed organically, only pesticides that meet the standards outlined by the National Organic Program criteria are used. However, if crop pests reach levels that will cause significant economic injury either within or adjacent to cooperative farm fields, or if environmental or economic forces affect the attractiveness of refuge cooperative farmland to organic growers, then the spectrum of PUPs approved by the PUP Committee for Lease Land crops, may be used on cooperative farm units. While desirable, the Service will not make organic agriculture a strict requirement of either lease land or

cooperative farm units because organic agriculture is dependent on a consistent water supply and external economic forces.

To supplement the analysis of indirect effects, the Service looked at potential effects of each of the active ingredients as shown in Table 5.16, as well as other pesticide use information available for the refuge (Service 2016a). Because the Service would follow all pesticide label restrictions and BMPs (see Appendices G, L, and Q), pesticides would not be applied directly to, or within the no-spray buffer of[1], surface waters, and pesticide use is limited to herbicides. indirect impacts to aquatic and terrestrial species that use refuge aquatic resources for food, cover, nesting, etc. would not be likely to occur.

Both adverse and beneficial indirect effects could occur to terrestrial plants and animals that are present within, or use, cropland that is treated with pesticides (herbicides only) for food, cover, or reproduction. Pesticide application to treated crops and non-native invasive plant species could result in the following types of indirect impacts.

- **Elimination of weeds through herbicide application could also reduce green matter or seeds for herbivorous and granivorous species (Boatman et al. 2004).**
- **Negligible short-term adverse effects by reducing a potential prey source (animals that consume invertebrates) for raptors that may have to subsequently forage elsewhere.**
- **Elimination of non-native plants would have a negative short-term minor effect but a long-term intermediate beneficial effect by helping to re-establish healthy native plant communities.**

The direct adverse impacts to fish and wildlife from pesticide applications are minor.

Public Use

Activities and public use on the refuge that can adversely affect wildlife are research, environmental education, interpretation, wildlife observation and photography, boating, and hunting. Purdy et al. (1987) and Pomerantz et al. (1988) described the following six categories of impacts to wildlife as a result of visitor activities.

- **Direct mortality**: immediate, on-site death of an animal
- **Indirect mortality**: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death
- **Lowered productivity**: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site
- **Reduced use of refuge**: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity
- **Reduced use of preferred habitat on the refuge**: wildlife use is regulated to less suitable habitat on the refuge due to visitor activity
- **Aberrant behavior/stress**: wildlife demonstrating unusual behavior or signs of stress is likely to result in reduced reproductive or survival rates

Individual animals may be disturbed by human contact to varying degrees. Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and

[1] **Established in the U.S. Fish and Wildlife Service's May 2007 biological opinion (Service 2007b).**

flushed from feeding, resting, or nesting areas. As described under Land Management actions, disturbance can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995).

Studies have shown some types of disturbance have a greater impact than other. For example, wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Burger 1998; Knight and Cole 1995b; Smit and Visser 1993; Stankowich 2008; Taylor and Knight 2003). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993) and others (e.g., deer) habituate to humans in urban/suburban areas where contact is common (Stankowich 2008). Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This variance among species makes forecasting habituation in specific field situations speculative.

The reaction among individuals of a species or between species also differs. Some birds may habituate to some types of recreation disturbance. These birds either are not disturbed or will immediately return after the initial disturbance (Burger et al. 1995; Fox and Madsen 1997; Hockin et al. 1992; Knight and Temple 1995; Madsen 1995). Rodgers and Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing based on experimental flushing distances for 16 species of waders and shorebirds. They recommend 100 meters as an adequate buffer against pedestrian traffic however, they suggest this distance may be reduced if physical barriers (vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Because screening may not effectively buffer noise impacts visitors should be educated on the effects of noise and noise restrictions should be enforced (Bowles 1995; Burger 1981, 1986; Burger and Gochfeld 1998; Klein 1993). Seasonally restricting or prohibiting recreation activity may also be necessary during spring and fall migration to alleviate disturbance to migratory birds (Boyle and Samson 1985; Burger 1981, 1986; Hill et al. 1997; Klein et al. 1995).

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Dobb 1998; Klein 1993; Morton 1995), because they are more likely to approach wildlife (Klein 1993). Even a slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time in an attempt to habituate wildlife to their presence (Dobb 1998) and the tendency of casual photographers with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails.

Although most species are able to relocate to nearby suitable habitat on or off the refuge to avoid disturbance, the visitor use program on the refuge has been designed and implemented to minimize wildlife disturbance. A photo blind is provided on the refuge to reduce disturbance of waterbirds while providing the public with an opportunity to photograph waterbirds, eagles, and raptors. On the auto tour route visitors are asked to use their vehicle as a mobile blind. This reduces disturbance to wildlife while providing visitors a greater opportunity to view wildlife. In

addition, there is a stopping point on the auto-tour route with a wildlife overlook with additional opportunities for visitors to view and photograph wildlife. Visitors are reminded of wildlife friendly behaviors that will enhance their opportunities to see wildlife. Interpretive activities and environmental education are generally conducted at the Refuge Complex Visitor Center and are not a source of wildlife disturbance on the Lower Klamath Refuge. Research studies are authorized by the refuge through a SUP that identifies the appropriate restrictions to minimize disturbance. The combination of these measures currently keeps and would continue to keep impacts from most public use to wildlife to no more than minor. Because hunting is the most common public use at the refuge, it is analyzed in more detail.

Hunting would have direct, lethal effects on individual game animals. The number of animals killed would depend on hunting pressure (i.e., the number of hunters and days of effort) and hunter success rates (i.e., the number of animals harvested by each hunter). In addition, hunting would result in injuries to animals that were shot, but not killed, or at least not immediately. There is also the potential that a hunter could cause death or injury to a non-target species of wildlife.

It is unknown how many animals would be injured, but able to carry on; would be injured, but unable to perform critical activities like foraging, predator avoidance, migrating, and breeding; or would die following a hunting injury. For waterfowl, studies suggest that the number of birds shot but not retrieved while hunting (aka the crippling loss rate) ranges broadly and may be as low as 10.3% or as high as 40.0% of all those shot (Barske 1956; Gleason and Jenks 1997; Hochbaum 1980; Nelson 1980; Norton and Thomas 1994; Van Dyke 1981). This rate increases when birds that are fired on are at a greater distance from hunters (e.g., >27–38 yards) and decreases with the experience (skill) of the hunter (Hochbaum 1980). Crippling loss rates for pheasants generally range from 3.3% to 46.0% (Applegate and Scott 2005).

Harvest figures vary from year to year and are influenced by a number of factors, including breeding success, winter survival, predation pressures, numbers of birds in the Flyway, and hunting regulations (e.g., bag limits); weather during the hunting season; and habitat quantity and quality, including the availability of water for wetland flooding.

In recent years, the average, annual harvest of ducks on the refuge ranged from 3,557 to 14,341 individuals and for geese, from 1,631 to 7,576 individuals. These harvest figures include harvest by sport hunters with and without guides, and represent the worst-case scenario (i.e., they include 100% fatality among animals shot, but not retrieved; that is, crippling loss). Mergansers and coots are included in the harvest statistics for ducks. Both species are rarely harvested by hunters.

The refuge is also open for hunting of common moorhens (*Gallinula chloropus*) and Wilson's snipe (*Gallinago gallinago*). However, these species are rare to uncommon on the refuge and no harvest data are collected for them. It is believed that if these species are harvested on the refuge, the numbers are very low. Data are not available regarding how many pheasants are harvested annually on the refuge.

Hunting and associated activities also have indirect, disturbance effects on wildlife, which may cause animals to experience stress, expend energy, and/or flee from the hunt area. If individual animals are disturbed too often and for extended periods of time, especially during periods of very cold weather, they may spend less time successfully foraging, potentially reducing their fitness, and ability to avoid predators, migrate, breed, and/or survive.

In his study of human disturbance effects on diurnal use of Sacramento Refuge (California) by northern pintails (*Anas acuta*), Wolder (1993) found that pre- and post-season use of refuge hunt units was approximately proportional to the availability of seasonal wetlands in these units. Yet, during the hunting season, pintail use of these units dropped significantly and their use of sanctuary units rose dramatically. In another study of northern pintails in California, Casazza et al. (2012) found that hunting-related disturbance influenced habitat selection and feeding patterns by these ducks. During daylight hours in non-hunting seasons, these birds fed on preferred foods usually outside of sanctuary areas. In contrast, during daytime of the hunting season, these birds moved to permanent pools inside sanctuary areas (despite the fact that these areas provided limited food) and increased feeding at night, including in hunt zones. The authors noted that these results were similar to those of other studies of the effects of hunting-related disturbance on waterfowl. Bregnballe and Madsen (2004) found that different waterbird species responded differently to hunting-related disturbance and that the majority of waterfowl abandoned a hunt area shortly after the first shots were fired. They noted that the existence of a sanctuary area(s) adjacent to a hunt zone reduced the distance of waterbird responses (i.e., the distance birds fled through swimming or flight) associated with shooting.

Activities associated with hunting, including parking vehicles; launching and operating boats; walking to and from shooting areas, and to retrieve shot game; stalking game; deploying and retrieving portable blinds and decoys; shooting; and dogs retrieving shot game could all potentially disturb wildlife in areas of the refuges that are open to hunting. Disturbance effects could also extend to access routes and areas adjacent to hunt zones. Waterfowl and upland game birds that were flushed might fly off the refuge or to another part of the refuge, including the area closed to hunting.

The impacts of disturbance by hunters to both the animals they are hunting and to adjacent wildlife are similar to those related to all public use and described above. However, the addition of dogs and guns in hunting scenarios makes disturbance more likely and perhaps more severe. Beyond some of the factors discussed above, the degree of disturbance from hunting varies depending on the species involved and its age and sex; the time of year and time of day; the breeding cycle stage (if applicable); the activity in which the animals are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock or herd size and characteristics (e.g., large flocks of birds and groups of female mammals with young may be more easily disturbed); whether the species is the one hunted; whether an approach appears to be an attack; the surrounding environment, including the relative openness of the country; whether the disturbing activity involves vehicles; the type, size, intensity, speed, noise, nature, and frequency of the disturbing activity (e.g., dogs versus humans or approaching animals by walking versus in an automobile, airplane, helicopter, motorized boat, or on a bicycle); and the approach angle or directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a, 1995b; Lafferty 2001a, 2001b; Rodgers 1991; Rodgers and Schwikert 2002; Rodgers and Smith 1997; Smit and Visser 1993; Stankowich 2008; Stankowich and Coss 2005; Taylor and Knight 2003). As noted above, disturbance or raising alert levels creates stress, alters behavior and can require energetic output; each of these can reduce energy or time available for essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing. Other impacts such as nest abandonment or increased predation can result.

Waterfowl and pheasant hunters would be allowed to bring trained, retrieving dogs with them to increase the percent of downed birds that were retrieved and reduce the loss of crippled birds.

Studies have shown that use of retrieving dogs can reduce loss of birds injured during hunting by 34% to more than 40% (Barske 1956). It is unknown what percentage of hunters would bring retrievers to the refuge; however, domestic dogs have retained instincts to hunt and chase (Sime 1999) and dogs can chase and kill wildlife (Knight and Cole 1995a). Dogs can also disrupt roosting, foraging, and breeding activities among birds, and flush birds from nests (Sime 1999; Thomas 2000). The mere presence of a dog can cause stress (evidenced by an increased heart rate [Knight and Cole 1995a]) or other disturbance to wildlife and when a dog accompanies a human, the dog can exacerbate the disturbance effects of the human. In a study of disturbance to birds in natural areas, Banks and Bryant (2007) found that on-leash dog walking caused significant reductions in species diversity and abundance, substantially more than when humans walked the same trails without dogs. This occurred even in areas where dog walking was infrequent. When dogs are running free, off leash, they cause even more wildlife disturbance than when being walked on leash (Blanc et al. 2006). Free-roaming dogs can harass, injure, or kill wildlife. Dogs can also transport parasites and non-native seeds into wildlife habitat, and transmit diseases to wildlife (e.g., distemper, parvovirus, rabies, and plague) (Sime 1999). In a wildlife-rich environment, with its stimulating sights, sounds, and smells, not all dogs are controllable with voice commands. Free-roaming dogs at the refuge would be expected to disturb and potentially kill birds and other small animals. Larger animals (e.g., deer) are less disturbed by the presence of dogs than by humans, especially if the humans are off-trail (Stankowich 2008).

There is substantial literature about the threat posed to waterbirds from lead shot that was traditionally used in waterfowl hunting (e.g., see Sanderson and Bellrose 1986; Service 1986b; Tranel and Kimmel 2009). This concern has been addressed through the development of alternative non-lead (non-toxic) shot for shotguns and the prohibition on use of lead shot for waterfowl hunting.

A variety of actions have been taken to reduce the adverse effects to fish and wildlife of current hunting programs on the refuge. These include bag limits consistent with state regulations, limiting the duration of hunting on the refuge to no more than that allowed by relevant state seasons, maintaining sanctuary areas, prohibiting shooting from boats under power, requiring that shotguns be plugged to limit their capacity to a maximum of three shells, and requiring the use of approved, non-toxic shot for waterfowl and pheasant hunting. Additionally, refuge rules require hunters who bring dogs to ensure that they are under their owner's/handler's control at all times while on the refuge; that they are not allowed to chase, harass, injure, or kill wildlife; and that they are leashed except while used for hunting. Dog training and field trials are prohibited on the refuge. Readers are referred to the official regulations for hunting on Klamath Basin refuges (see 50 CFR 32, Hunting and Fishing) and to the compatibility determinations in Appendix G for more specific information about conditions (stipulations) associated with the waterfowl and pheasant hunting opportunities offered on this refuge.

The Service, and California and Oregon fish and wildlife agencies carefully manage game species on the bases of populations, not individuals. Direct mortality from hunting, including crippling losses, would not be expected to have any population-level effects on any of the game species hunted. This system has proven very successful over the years in sustaining healthy populations of resident game species while maintaining associated recreational opportunities, including hunting.

The Service oversees management of migratory birds, including game birds, which occur in the United States to ensure their long-term survival at healthy, sustainable population levels. This occurs in cooperation with all of the U.S. states, federal and state flyway councils, and foreign

nations (e.g., Canada and Mexico, where many of these birds breed and winter). This management program uses long-term and extensive survey and monitoring data on bird populations, their habitats, and harvests. These survey and monitoring data form the largest data set on any wildlife species group in the world (Service 2016b). Using adaptive management principles, the Service then uses these data to establish annual framework regulations within which the states establish their annual migratory bird hunting regulations. This wildlife management approach is continuing to evolve, yet has proven to be highly successful over many years. Sport hunting of waterfowl and other migratory birds has occurred on national wildlife refuges and many other lands across the United States for many decades. Despite this regular harvest, waterfowl populations in the Pacific Flyway are strong and across North America currently number in the tens of millions. These facts are testament to the effectiveness of this overall management approach.

Temporary disturbances to federal- and state-listed species due to public use are similar to those to other wildlife except that no directed killing would take place as these species are not subject to hunting. Some state-listed species including bald eagles and sand hill cranes are large which may keep hunters from mistakenly shooting them. Others, such as peregrine falcons, bank swallows and Swainson's hawks are either distinctive in appearance or occupy different habitat than game birds. In addition, bank swallow does not occur on the refuges during the winter hunting season, so hunting programs would have no effects on this species. Although these species are not hunted, they could be disturbed by gunshots, dogs and the hunters themselves.

In summary, the direct adverse impacts of public use on fish and wildlife at Lower Klamath Refuge are minor. Although the effects of public use are detectable, they are localized, temporary, and of little consequence to wildlife populations on the refuge. Public use programs have been developed and implemented using practices to minimize impacts to wildlife to the maximum extent possible while continuing to provide wildlife-dependent recreation opportunities for the public.

The impacts of visitor use and hunting, in particular, are somewhat mitigated during dryer years when there are fewer hunters on the refuge. Public use in low water years tends to be self-regulating in that fewer wildlife resources attract less visitors and those that do come to the refuge are not likely to stay as long. For example, the annual number of waterfowl hunters on the refuge in recent years has varied from approximately 1,500 to 2,600 depending on whether adequate water was available to flood refuge habitats. In addition, even in dry years 60% of the refuge would be dedicated as sanctuary; as noted above, this provides protection for many individuals during the hunting season.

In summary, although public can disturb wildlife, the public use programs are implemented, as described above, to minimize disturbance and other impacts to wildlife. Under Alternative A, adverse effects to wildlife from public use would be minor.

Beneficial Effects

Beneficial effects for wildlife include the use of water to provide permanent and seasonal wetland habitat as well as forage for migrating and nesting waterfowl and other wildlife. The use of haying, tilling, invasive species control, and prescribed burning also provide benefits by improving habitat quality for wildlife, especially waterfowl and other waterbirds.

The extent of these benefits varies with the amount and season water is delivered. To assess the relative benefits, the Service used the Bioenergetics Study (Appendix N) conducted by the refuge

in 2008 to evaluate the current refuge habitat management practices relative to waterfowl food energy needs as well as a range of potential management alternatives for meeting waterfowl food energy needs. Under full water supply scenario provided at the appropriate time of year the resulting existing habitat conditions at the refuge can provide sufficient food energy to meet population objectives for swans, diving ducks, and dabbling ducks for the entire season (September to April) and could support gadwall and coots from September 1 to November 1. However, the refuge cannot support goose population objectives for the entire season. For geese, food resources would be exhausted 6 weeks before the end of the season (Dugger et al. 2008) shows that. During low water years or years when water is not provided at the appropriate time, fewer food resources are available and conditions would likely be worse for waterfowl in general and for geese in particular.

Mitigation

Direct adverse effects of management programs on the refuge would be reduced through the use of BMPs described in Appendix L.

Alternative B – Lower Klamath Refuge

Land Management

Alternative B would include the same land management tools described under Alternative A. The types of direct adverse effects associated with these tools (e.g., wetland management, farming, haying, grazing, and pesticide applications) would be very similar to those described for Alternative A. Under Alternative B, the refuge would continue to maintain from 600 to 8,800 acres of permanent wetland and 3,000 to 15,200 acres of seasonal wetland. However, the proportion of farmed habitat types would be modified under Alternative B as shown in Table 6.2. These modifications are focused on improving our ability to provide proper waterfowl management and are therefore discussed under the Beneficial Effects section. Under Alternative B, there are two other changes to land management that would also benefit wildlife resources. These proposed changes are also discussed under Beneficial Effects.

As in Alternative A, the adverse effects of continuing to use land management tools on fish and wildlife resources would be long-term, but used on a localized basis throughout the refuge and intermediate in intensity. This would be true for all wildlife, including listed species.

Under Alternative B, the effects of wetland management, farming programs, haying and grazing, and pesticide applications to fish and wildlife are minor.

Public Use

Changes to the public use program under Alternative B that could have a physical effect on the environment are as follows: providing additional wildlife observation opportunities with a new pull-off on State Line Highway; providing a visitor contact station at the entrance of the refuge; and providing drive-in, boat-in wheelchair accessible hunting opportunities. The addition of the pull-off on State Line Highway and a visitor contact station at the entrance of the refuge are anticipated to expand visitor use on the refuge. These additions to the refuge would have a small local increase in wildlife disturbance as visitors exit their cars to view wildlife.

The addition of the pull-off and the visitor contact station would also physically reduce available wildlife habitat by approximately 0.5 acre each. These facilities would be located adjacent to a major road where habitat quality is already reduced; because of the location impacts to wildlife near the pull out or visitor contact station is expected to be minimal. As described under Alternative A, the impacts of visitor use are somewhat mitigated during dryer years when fewer wildlife resources draw few visitors to the refuge.

As with Alternative A, any conservation measures, as well as the terms and conditions resulting from consultation under the ESA shall be implemented to protect listed species and their habitat that occur on the refuge, as applicable.

Under Alternative B, the direct adverse effects of public use on fish and wildlife resources, including all listed species, would be minor.

Beneficial Effects

Based on modeling conducted by Dugger et al. in 2008, the Service proposes to modify the refuge farming program to leave more standing grain and increase the acreage of alfalfa or pasture. As described under Alternative A, food supplies for geese on the refuge were only adequate until late winter. Increasing unharvested grain is the most land-efficient (greatest energy gain for lease amount of land) option for increasing food for geese in the fall and winter while increasing green browse improves foraging conditions for geese in spring, the period when food is currently most limiting. To provide adequate forage for geese in winter and spring, the following changes would be made: the refuge would increase unharvested grain by approximately 500 acres and convert an additional 1,300 acres of unharvested grain to pasture/green browse (subject to water availability). An increase in standing grains would benefit dabbling duck and geese population objectives during winter and spring by providing more forage during migration and nesting periods. More food resources would also be available for wintering bald eagles, potentially increasing their use of the refuge. These changes would slightly increase wetland acreage as well, an action that would provide some additional habitat for waterbirds dependent on wetlands.

Under Alternative B the cooperative farming program would modified by expanding the use of preferential permits for cooperatively farmed grain and hay units on the refuge for farmers that participate in the Walking Wetlands Program on their private land outside the refuge. This modification would expand wetland areas available to waterfowl and waterbirds in the Klamath Basin.

Under Alternative B, the refuge would formalize the ongoing pest management for cooperative farming and refuge maintenance under an IPM program (see Appendix Q). Several changes would be made to ongoing pest management. First, GPS would be used to monitor weed locations, to enable rapid assessment and control actions in order to control invasive species infestations when they are smaller in size. This would be expected to enhance the quality of wildlife habitat refuge-wide by reducing the areal extent of affected habitat. Catching pest infestations early would also reduce the number and magnitude of pest-management efforts, including applications of pesticides needed to control these invasive species when they had expanded elsewhere on the refuge. Reducing these control efforts would also reduce their potential adverse effects on wildlife, a benefit relative to current conditions. In addition, under Alternative B the refuge would expand the use of non-pesticide tools (such as grazing or restoration plantings) to control invasive species

in wetland and upland units. The refuge would also develop a program for managing berms to reduce invasive species cover and improve cover for nesting waterfowl and other species.

Mitigation

Direct adverse effects of management programs on the refuge can be reduced through the use of BMPs described in Appendix L.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Alternative C would implement the same land management tools described under Alternatives A and B. The types of direct adverse effects of wetland management, farming, haying, grazing, and pesticide applications would therefore be very similar to those alternatives. Under Alternative C, the acreage of grazing would increase by 2-3,000 acres annually. This would increase the proportion of grazing on the refuge to 30% annually, which would be an increase of up to 6% from Alternative A. The numbers of livestock grazed, as expressed in AUMs, would be similar to Alternative A. The proportion of habitat types in Alternative C would be modified slightly as shown in Table 6.3. In addition, several modifications would be made to management and farming practices within some of these habitat types. These modifications are focused on improving our ability to provide proper waterfowl management and are therefore discussed under the Beneficial Effects section.

Under Alternative C, the direct adverse effects to fish and wildlife from wetland management, farming programs, haying and grazing, and pesticide applications would be minor.

Public Use

The effects of public use on fish and wildlife, including non-game species, under Alternative C would be the same as under Alternative B, except the Service would phase in a requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge. This modification to boating would slightly reduce wildlife disturbance and would improve aquatic habitat quality.

As with other alternatives, any conservation measures, as well as the terms and conditions resulting from consultation under the ESA shall be implemented to protect listed species and their habitat that occur on the refuge, as applicable.

The effects of public use to fish and wildlife resources would be minor.

Beneficial Effects

Under Alternative C, an additional 1,400 acres of seasonal wetland habitat would be available in average water years. In dry or above average water years the seasonal wetland acreage would not increase over Alternative B. The use of grazing in uplands and dry seasonal wetlands would be increased by 2 to 3,000 acres per year to improve habitat conditions. Under Alternative C the annual acreage of pasture would range from 1,200 to 4,000 acres depending on the water year type. In an average year under the current water allocation system the refuge would grow 2,400 acres of pasture. Grain crops on the refuge would range from 1,600 to 5,700 acres depending on

the water year type. In an average year under the current water allocation system the refuge would grow 4,300 acres of grain. In general, under Alternative C more pasture and less grain would be grown on the refuge. Under Alternative C the refuge would also structure lease land contracts so that if the habitat objective for unharvested standing grain cannot be met on cooperatively farmed units, lease land contract holders would be required to leave 25% of their fields as unharvested standing grain. Under Alternative C, the refuge may convert some fields with expiring contracts to flood/fallow if needed to achieve the habitat objectives. These changes would ensure that food for geese would be available in more water year types without scaling back the resource objective. Increasing unharvested grain is the most land-efficient option for increasing food for geese in the fall and winter.

The application of chemical pesticides used for farming would also decrease under this alternative as the refuge works to expand the area of lease land and cooperative farmland units that are managed organically and by expanding incentives such as lease extensions for farmers that manage fields organically.

Mitigation

Direct adverse effects of management programs on the refuge would be reduced through the use of BMPs described in Appendix L.

Alternative D – Lower Klamath Refuge

Land Management

Alternative D would implement the same land management tools described under other alternatives. The types of direct adverse effects of wetland management, farming, haying, grazing, and pesticide applications would be very similar to those described in Alternative A. However, under Alternative D, the lower quarter of the refuge would be structurally modified to form a Big Pond that has a more natural hydrograph. Implementing Alternative D requires construction of a new levee along the southern border of the refuge in order to protect downstream landowners from flooding. The Service may be able to fashion the levees along the northern, eastern, and western borders of existing units the exterior of the Big Pond, but up to 29 miles of interior levees/roads would be abandoned or removed. Up to 31 water control structures would be removed and 100 miles of interior drain fields would be abandoned. Construction is likely to take several years.

Construction related impacts to fish and wildlife would include disturbance, and the short-term loss of habitat for feeding and nesting.

The Big Pond would encompass 9,000 acres and would consist of permanent and seasonal marsh. The Big Pond would replace some of the existing units that are actively managed as permanent wetland, seasonal wetland, and grain (see Figure 4.7). The Big Pond would not be actively managed, which would reduce some of the direct effects to wildlife from wetland management. However, the refuge may use prescribed burning, tilling, or disking to set back vegetation in other parts of the refuge. Although the adverse effects of wetland management would continue to be minor, direct effects of Alternative D on fish and wildlife are considered intermediate because of the extensive construction work that would be needed to implement this alternative. Agricultural habitat management would be the same as under Alternative C. Pest management would be the

same as described in Alternative B. The long-term direct adverse effects of land management under Alternative D would be the similar to Alternative B because the agricultural acreage would not change., The

Public Use

Under Alternative D, although the refuge would be open to the same types of public uses described in Alternative A, the extent of areas open for these uses would be drastically different. Construction of the Big Pond alternative would reduce the current auto-tour route by half. Under this alternative the areas open for pheasant hunting would be reduced and would not likely be replaced on other units of the refuge. The sanctuary areas and areas open to waterfowl hunting would need to be redrawn. During years when adequate water allows flooding, parts of the Big Pond could be available for hunting. As with other alternatives, any conservation measures, as well as the terms and conditions resulting from consultation under the ESA shall be implemented to protect listed species and their habitat that occur on the refuge, as applicable.

The effects of public use to fish and wildlife resources would be intermediate with the reduction of the auto tour route and reduction of pheasant hunting.

Beneficial Effects

The Big Pond alternative is designed to fill the lower quarter of the refuge during the winter/spring spill period at an elevation designed to enhance wetland values of the refuge for native waterbirds, thereby reducing the need for summer deliveries which is traditionally a time of limited water supply. The Big Pond would provide deep open water areas for fish eating waterbirds, habitat for colonial nesting waterbirds, as well as shallow habitats for shorebirds and other migratory waterbirds. In years when there is sufficient water fish would benefit and may be able to develop sustaining populations. Food resources would be available for geese under this alternative because the agricultural acreage would be the same as under Alternative B. Under this alternative there would be an overall reduction in permanent wetlands which does negatively impact waterfowl guilds dependent on this habitat type. A version of this alternative was evaluated in the Bioenergetics paper (see Appendix N). Based on the bioenergetics model, it is estimated that resources for diving ducks and swans under this alternative would barely meet their needs and coot needs exceed refuge capacity earlier than under Alternative B. However, conditions for dabbling ducks are improved.

Mitigation

Construction-related impacts would be minimized by using the appropriate BMPs listed in Appendix L. These would minimize disturbance during the breeding/nesting season. Under Alternative D there is an overall reduction in permanent wetland which negatively impacts waterfowl guilds. Depending on this habitat type the habitat needs of diving ducks and swans would barely be met during years when water is available. In dryer years fewer resources would be available. The Service would not be able to mitigate these impacts and there would be an overall decline of wildlife resources on the refuge.

6.2.7 Cultural Resources

Methodology to Assess Effects – Lower Klamath Refuge

Compliance with the National Historic Preservation Act (NHPA) is required for all undertakings funded with federal funds or requiring a federal permit, both on Service-owned lands and on private lands. Compliance is accomplished through a process initiated with the submittal of the Request for Cultural Resource Compliance form to the Regional Cultural Resource Team. When the Service commits funds, or prepares specific plans, to an identified project or activity identified in the final CCP, that activity or project will become a Section 106 undertaking for which the Service will comply with the Section 106 review and compliance process prior to the implementation of the activity or project. Projects are reviewed by the Regional Archaeologist, who identifies the steps necessary to ensure compliance with Section 106. As appropriate, consultation, cultural resource survey, identification, and evaluation are implemented according to the procedures set forth in the terms of the Service Programmatic Agreement with the State of California. If the Programmatic Agreement criteria do not apply, further evaluation and consultation are conducted by either Service archaeologists or certified archaeological contractors under the supervision of the Regional Archaeologist. If significant cultural resources are identified within the area of potential effects, the Service, in consultation with the State Historic Preservation Officer (SHPO) and any interested parties, will develop a plan to avoid, minimize, and/or mitigate adverse effects to the significant cultural resources.

Resource-specific contexts for assessing effects of alternatives to cultural resources are as follow.

- The refuge is recognized as an early example of an American attempt at preservation of natural wetlands and wildlife for the future.
- The refuge contains numerous archaeological sites.
- Much of the land base of the refuge has been modified through agricultural practices.

Alternative A – Lower Klamath Refuge

Lower Klamath Refuge is currently listed on the NRHP as a Historic District which recognizes it as an early example of an American attempt at preservation of natural wetlands and wildlife for the future. There are numerous archaeological sites on the Lower Klamath Refuge (Service 2011a). To date, recorded cultural resources known to be within the refuge consist of 44 recorded prehistoric sites (i.e., worked stone, habitation sites, human remains, ground stone, traditional use locus, bedrock mortars) and 14 recorded historic sites (i.e., historic debris scatters, one NRHP District contributing site, 10 NRHP District contributing structures).

Land Management

Wetland Management

Wetland management focuses on developing both seasonal and permanent wetlands. The primary key to wetland management is the timing and quantity of water. Water management to maintain a mosaic of habitat types is unlikely to damage any cultural resources on the refuge. Prescribed fire is a tool that is used for wetland management. When developing a prescribed fire treatment for a wetland area the Service considers and protects any known cultural resources.

Farming, Haying, and Grazing Programs

Since at least 1917, when the Klamath Straits gates were closed and the Klamath River became physically separated from Lower Klamath Lake, the majority of Lower Klamath Refuge has been farmed and/or grazed. In 1929, all of the public land lying in California and Oregon uncovered by the reclaiming [draining] of Lower Klamath Lake were leased by Reclamation for grazing use. Since 1917 ground-disturbing activities associated with farming and grazing have continued on most of the refuge. Because ground-disturbing activities associated with farming, haying, and grazing have occurred throughout the refuge for nearly a century, the Service has concluded that the likelihood is low for continued farming and grazing activities to disturb cultural resources eligible for the NRHP.

Pesticide Application

The Service expects that pest management, including use of pesticides for farming, grazing/haying, and invasive species management would generally have no effects on cultural resources on the refuge. Pesticide application has no ground-disturbing effects.

In summary, the Service concluded that Alternative A would have neutral or negligible adverse effects to cultural resources due to land management activities.

Public Use

Visitors to the refuge use existing paved and gravel roads, auto tour routes, trails, kiosks, parking areas, boat launch areas, and restrooms. In addition to using these developed facilities, hunters and other visitors can access the refuge by foot. Because ground-disturbing activities associated with farming and grazing have occurred throughout the refuge for nearly a century, the Service has concluded that the likelihood is low for public use to disturb cultural resources eligible for the NRHP. Therefore, the Service concluded that Alternative A would have neutral or negligible effects to cultural resources due to public use activities.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Overall management of the refuge is consistent with its designation as an early example of an American attempt at preservation of natural wetlands and wildlife for the future.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing on the NRHP until formally evaluated in consultation with the SHPO.

Alternative B – Lower Klamath Refuge

Land Management

Alternative B would employ the same land management tools described under Alternative A. Although the proportion of habitat types would change slightly under Alternative B, this would not change the potential for cultural resources impacts because the land would continue to be used for wetland management, farming, haying, and grazing as it has been for over a century. Effects of land management on cultural resources under Alternative B would be considered neutral or negligible.

Public Use

Changes to the public use program under Alternative B that could have a physical effect on the environment are as follows: providing additional wildlife observation opportunities with a new pull-off on State Line Highway; providing a visitor contact station at the entrance of the refuge; and providing drive-in, boat-in wheelchair accessible hunting opportunities.

Impacts to cultural resources from the ongoing public use would be neutral or negligible as described under Alternative A. For the proposed additions to the public use program, compliance with Section 106 of the NHPA would be needed beginning with site-specific cultural resource surveys. When the Service commits funds or prepares specific plans, for an identified project or activity in the final CCP, that activity or project will become a Service Section 106 undertaking for which the Service will comply with the Section 106 review and compliance process prior to implementing the project.

Beneficial Effects

Beneficial effects would be the same as described under Alternative A.

Mitigation

Mitigation would be the same as described under Alternative A.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

For cultural resources the effects of land management activities under Alternative C would be the same as Alternative A. Alternative C proposes two changes to farming practices to benefit wildlife resource but neither of these farming practices would result in new areas under cultivation.

Public Use

The effects of public use on cultural resources would be the same as described under Alternative B.

Beneficial Effects

Beneficial effects would be the same as described under Alternative A.

Mitigation

Mitigation would be the same as described under Alternative A.

Alternative D – Lower Klamath Refuge

Land Management

Alternative D would employ the same land management tools described under Alternative A. The ongoing effects of wetland management, farming, haying, grazing, and pesticide application on cultural resources would be very similar to Alternative A. The ongoing effects of land management on cultural resources would be neutral or negligible.

However, under Alternative D, the lower third of the refuge would be structurally modified to form a Big Pond. These structural modifications would require extensive construction for both the exterior ring levee and removal of interior levees and water control structures. Until a site-specific cultural resource review is completed the Service cannot make a significance determination. For the changes proposed under Alternative D, compliance with Section 106 of the NHPA would be needed beginning with site-specific cultural resource surveys.

Public Use

The effects of public use on cultural resources would be the same as described under Alternative A.

Beneficial Effects

Beneficial effects would be the same as described under Alternative A.

Mitigation

Mitigation would be the same as described under Alternative A.

6.2.8 Visitor Services

Recreation Opportunities

Methodology for Assessing Effects – Lower Klamath Refuge

Maps of the refuge showing the locations of visitor services and habitat, in conjunction with professional judgment were used to predict how public use would affect recreational opportunities.

Resource-specific contexts for assessing the effects of alternatives to recreation opportunities are:

- the refuge has historically offered one of the most extensive waterfowl hunt programs in the nation; and
- the refuge provides an extensive variety of wildlife-dependent recreation.

Alternative A – Lower Klamath Refuge

Land Management

Wetland Management

Prescribed burns are used as a tool to provide a greater variety of waterfowl and waterbird habitat in wetland areas as well as manage invasive plant species. The direct effects of prescribed burns can require that portions of the refuge are temporarily closed to public access and use. Refuge visitors could also be threatened by a prescribed burn used for invasive species management that escapes. To reduce the likelihood of this occurring, the refuge would follow the BMPs described for prescribed burning in Appendix L. Also, roads accessing the refuge and on the refuge are well signed and monitored by fire personnel prior to and during a prescribed burn. These signs and monitoring efforts help ensure that refuge visitors are advised of a prescribed burn that is planned or underway, and that they are not in the path of a potential escaped prescribed burn.

Irrigation and flooding, and variation in timing of these practices have no direct effects on recreation opportunities.

Some visitors may find objectionable the knowledge that the Service traps and removes native species (e.g., beavers and muskrats) on the refuge and/or the sight or smell of a prescribed fire, its smoke, or a blackened field/management unit following a burn. The intensity of post-burn green-up and opening up of chocked wetlands may offset some of these concerns.

The potential effects to recreation opportunities is negligible.

Farming Programs

Dust potentially generated through tilling/disking can be a temporary nuisance and/or potential eye, respiratory system, and/or skin irritant for individuals visiting the refuge. Health effects can be more serious for those visitors with respiratory illnesses or compromised immune systems. Dust and smoke can also pose a potential safety hazard for visitors traveling on refuge roads or driving to or from the refuge. These effects are localized and limited in duration and considered negligible to recreational opportunities.

Haying and Grazing Programs

Haying involves similar activities described under Farming. At harvest time, haying can generate dust which could be a temporary nuisance to refuge visitors. The bulk of haying is conducted in Area K, which is north of State Line Highway and has access only for waterfowl and pheasant hunting.

Livestock grazing takes place in Area K north of State Line Highway and in the fields leased for cooperative farming south of State Line Highway. The direct effects to recreational opportunities consist of dust generated by vehicles to transport livestock and fencing to enclose grazing areas as well as the sight of livestock on the refuge. Depending on the location of grazing fields visitors using the auto tour route could see livestock. Some visitors may find the sight of livestock objectionable.

Hunting would not take place at the same time as the harvest and thus would not adversely affect recreational opportunities on the refuge. Livestock grazing would not preclude any recreational opportunities on the refuge and ultimately works to improve habitat which leads to a quality recreational experience. The effects of haying and grazing on recreational opportunities are negligible.

Pesticide Application

Winds can carry the smells of pesticides and their adjuvants, carriers, and solvents great distances (this effect can be especially pronounced with aerial spraying and somewhat less so with pesticides applied through boom-type spray equipment). Some visitors could find objectionable the sight or smell of pesticides being applied on the refuge for the cooperative farming and/or invasive species management programs. Additionally, disturbance associated with the application of pesticides could cause birds and other wildlife to flush and potentially move elsewhere on the refuge or move off of the refuge. Such wildlife movements could either enhance or reduce wildlife viewing and/or photography opportunities for visitors.

Continued operation of the pesticide-use program, consistent with the BMPs included in the approved PUPs, would not be expected to create any future health or safety hazards for individuals visiting or working on the refuge or for those on adjacent lands. The effects of pesticide application on recreational opportunities on the refuge are negligible.

Public Use

This section evaluates how public use of the refuge could affect recreational opportunities on the refuge, including the potential for conflict between user groups. The primary public use of the refuge is for wildlife-dependent recreation consisting of hunting, wildlife observation and photography, interpretation of natural resources on the refuge, and environmental education. Boating and management oriented research are also allowed on the refuge. Environmental education conducted off-refuge is not addressed because there is no physical effect on other refuge user groups. The refuge is accessible by car, boat, or foot. Visitor use is monitored as part of the Klamath Basin Refuge Complex-wide monitoring program. Visitor use numbers may be used to determine what off-site environmental education events the refuge attends but they are not used to modify the location of wildlife-dependent recreation on the refuge.

Potential conflicts between user groups are managed primarily by physically separating hunting from other wildlife-dependent uses. Hunting access is allowed by drive-in, walk-in, or boat-in areas. Because Lower Klamath Refuge is open to both waterfowl and upland game there is a potential for conflicts between hunters pursuing different game species. These potential conflicts are avoided through use of temporal and/or spatial zoning (i.e., the hunts are held at different times and/or in different areas).

Habitat and hunting are evaluated every year and, if deemed necessary, areas are closed. Hunter numbers are typically self-regulating due to the remote location of the refuge (habitat conditions are posted on the web pages and announced in the hunter "hotline" – when there is little habitat most hunters choose not to come). However, if needed, hunter numbers are managed to reduce impacts to waterfowl populations.

Currently, a total of five commercial guides offer waterfowl and pheasant hunting opportunities on Lower Klamath and Tule Lake Refuges (combined). These guides offer safe, quality, wildlife-dependent public use (i.e., hunting) opportunities to a range of individuals, potentially including those new to hunting, those with limited time to devote to hunting, those not familiar with the area, and/or those with disabilities. These professional guides offer hunting experiences as a business using high-quality equipment and supplies. In order to increase the likelihood of a successful hunt by their clients, guides invest more time and money learning about each refuge, studying the availability and condition of habitats and wildlife use, and scouting potential hunting areas than many individual sport hunters. The Service is aware that there are visitors who do not agree with commercial guiding on the refuges. However, the Service believes that permitted guides are an asset to the hunting program. They bring a substantial number of visitors to the refuges who might not otherwise utilize this recreational opportunity and who contribute to the local economy. Under the Service permit, guide behavior and restrictions are spelled out and violations are taken very seriously up to and including the loss of guiding privileges.

In addition to hunting, visitors may also engage in wildlife observation and photography, and environmental interpretation by walking, driving, on the refuge. The 15-mile auto tour route is the primary location where these activities take place. The auto tour route is located mostly in areas closed to hunting (see Figure 5.6, Visitor Services Lower Klamath Refuge). These other visitors could find hunting objectionable on a refuge. Some could be upset at the sound of gunfire; the sight of shot birds falling from the sky; noise from motorized boats; or the potential find of a hunter-crippled game animal, or an injured or dead non-target species. Such experiences could affect the quality of their visit to the refuge. Additionally, hunting-related disturbance could cause birds and other wildlife to flee from hunt zones and potentially move elsewhere on the refuge, including into an area that is closed to hunting, or move off of the refuge. Such wildlife movements could either enhance or reduce wildlife viewing and/or photography opportunities for other visitors.

Research activities authorized by the Service are also considered a public use. The potential to affect recreational opportunities on the refuge would be limited to disturbance of wildlife where researchers may enter sensitive habitats and temporarily displace wildlife. As described above, wildlife movements could either enhance or reduce wildlife-dependent recreation opportunities.

Accordingly, the potential effect of public use on recreational opportunities on the refuge is minor. While there is some interaction between user groups they are generally separated spatially and temporarily and do not conflict.

Beneficial Effects

The indirect effects of land management actions results in stable populations of fish and wildlife which is beneficial for multiple types of wildlife-dependent recreational opportunities. Upgrades to visitor facilities including buildings, roads and trails, parking lots, restrooms, visitor overlooks, kiosks, and signs will also result in beneficial effects. Cleaner facilities and more clear orientation

and way finding will make the refuge visitor experience safer and more enjoyable. Furthermore, human health threats associated with poisonous plants and diseases associated with rodents will be minimized as visitor facilities are cleaned and improved. The beneficial effects of public use on the refuge are numerous and include the following.

- Wildlife-dependent recreation provides visitors with an understanding and appreciation of fish and wildlife ecology.
- Research activities on the refuge can answer habitat or population management questions that facilitate refuge management.

Mitigation

No mitigation is necessary for recreational opportunities.

Alternative B – Lower Klamath Refuge

Land Management

Wetland Management

Under Alternative B, although the proportion of wetland types would change the extent and types of direct effects on recreational opportunities would be the same as described under Alternative A. Adverse effects on recreational opportunities would be negligible.

Farming Programs

Under Alternative B, although the proportion of crop types would change (there would be less grain but more pasture) compared to Alternative A, the extent and types of direct effects on recreational opportunities would be the same as described under Alternative A. Adverse effects on recreational opportunities would be negligible.

Haying and Grazing Programs

Under Alternative B, the haying and grazing programs would continue substantially as described under Alternative A. Grazing would be expanded as a tool to control invasive species in wetland and upland units. The adverse effects on recreational opportunities would continue to be negligible.

Pesticide Use

Under Alternative B pesticide use could be reduced as the use of non-pesticide tools to control invasive species in wetland and upland units using grazing and restoration plantings expands. The reduction of pesticide use could enhance the quality of recreational opportunities for some visitors, although this may be offset with the use of additional grazing. In addition, under Alternative B the ongoing pest management would be formalized under an IPM program (see Appendix Q). Pesticides would continue to be used as needed on the refuge. This change would not affect recreational opportunities on the refuge.

In summary, the potential effect of public use on recreational opportunities on the refuge is minor. While there is some interaction between user groups they are generally separated spatially and temporarily and do not conflict. Land management activities under Alternative B would not be

substantially different from Alternative A. Adverse effects to recreational opportunities would be negligible.

Public Use

With the proposed new and modified public facilities, recreation opportunities for the public would be enhanced at the refuge, but the types of available uses would be the same as Alternative A. Facility modifications for hunting would consist of providing drive-in, boat-in wheelchair accessible hunting access. These modifications could result in disruptions to visitor uses in or near the work sites but would be completed within one season and it would be completed prior to hunting season. Under this alternative, the Service would evaluate the following modifications to the hunt program: 1) whether to maintain or increase the current hunt fees; and 2) whether to maintain, modify, or eliminate the guide program.

In evaluating the guide program, the Service would consider reducing the number of competitively selected guiding permits combined with doubling the minimum number of required use days to increase the likelihood that only guides seriously interested in devoting their time and energy to providing high-quality services on these two refuges would receive permits. With a reduction in guide numbers counteracting the increase in minimum required use days, it is likely that the total number of guided hunter use days or the presence of guides on the refuges would be the same as under Alternative A and would not result in a conflict between user groups. In considering the hunt fees the Service would look at a modest, phased-in increase in hunting fees (from $25/year to perhaps $35–$40/year). This increase in fees would help cover Service actual costs (for staff and facilities) of offering the hunting programs on the refuge. It is expected that such an increase would have no effect on hunter numbers because it represents such a small portion of the total costs to hunters of participating in these programs.

Facility modifications for wildlife observation such as the vehicle pull-off on State Line Highway and the visitor contact station at the entrance of the refuge would provide additional opportunities for wildlife observation. These additions for wildlife observation are located where hunting is prohibited and would not affect user groups focused on hunting.

Accordingly, the potential effect of public use on recreational opportunities on the refuge under Alternative B is minor. While there is some interaction between user groups they are generally separated spatially and temporally and do not conflict. The expanded opportunities under Alternative B would not increase any conflicts between user groups. These effects would be minor.

Beneficial Effects

The proposed changes in land management (changes in the proportions of farmed and wetland areas) should result in additional habitat for waterfowl and waterbirds, thus enhancing the quality of recreational opportunities on the refuge.

Improvements to signs along the auto tour route, updated interpretive and outreach media, additional interpretive programs, development of a walking wetlands curriculum and partnerships with schools will enhance visitors' understanding of the refuge system and their awareness and appreciation of the refuge's wildlife, habitat and cultural resources. The enhanced opportunities would benefit the public, likely resulting in increased visitation. The projected increase in visitors would likely be similar to past trends of visitors, as discussed in the Effects on Social and

Economic Conditions, considering the rural nature of the refuge and would not lead to other substantial impacts (e.g., from increased use of facilities).

Mitigation

No mitigation is necessary.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management

Wetland Management

Under Alternative C, projected deliveries in an average year under the current water allocation system there would be an additional 1,400 acres of seasonal wetlands. Although there would be additional seasonal wetlands the extent and type of wetland management conducted on the refuge would not change. The extent of prescribed burns, tilling or disking and other wetland management activities would be no greater than described under Alternative A. The effects to recreational opportunities would be continue to be negligible. Farming Programs

Under Alternative C in an average water year under the current water allocation system there would be 500 fewer acres of grain grown on the refuge and 1,000 additional acres of pasture of on the refuge. Although the proportions of crops grown on the refuge would change the extent and types of activities used by the farming program (prescribed burns, irrigation, tilling) would remain relatively constant. In addition, under Alternative C the Service would require lease land contract holders to leave 25% of their fields as unharvested standing grain if habitat objectives for unharvested grain cannot be met on cooperatively farmed units. The direct effects to recreational opportunities would be similar to those described under Alternative B.

Haying and Grazing Programs

Under Alternative C, the refuge would expand the use of grazing in uplands and dry seasonal wetland units by 2 to 3,000 acres per year to improve habitat conditions. Management of grazing on uplands and dry wetland units (in terms of AUMs) would be focused on the existing habitat conditions in relation to the desired habitat conditions but would not be any greater than the AUMs described under Alternative A. No changes to the amount of haying are proposed under Alternative C. The effects to recreational opportunities under Alternative C would continue to be negligible.

Pesticide Use

Under Alternative C, the amount of pesticides used on the refuge could be further reduced as the Service facilitates the expansion of organically managed farmed areas on both lease land and cooperatively farmed units. The reduction in pesticide use could enhance the quality of recreational opportunities for some visitors.

The potential effect of pesticide use on recreational opportunities on the refuge would continue to be negligible.

Public Use

The effects of public use on recreational opportunities on the refuge are the same as described under Alternative B except that Alternative C would phase in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge. This new requirement could reduce disturbance to other visitors. The potential effects of public use on recreational opportunities on the refuge are minor. While there is some interaction between user groups they are generally separated spatially and temporally and do not conflict.

Beneficial Effects

In addition to the beneficial effects stated in Alternative B, under Alternative C, recreational opportunities would also be enhanced by the additional amount of unharvested standing grain. The additional food resources for waterfowl should draw more waterfowl and enhance the quality of recreational experiences on the refuge for all user groups.

Mitigation

Alternative D – Lower Klamath Refuge

Land Management

Wetland Management

Alternative D would employ the same wetland management tools described under Alternative B. Prescribed burns, disking, plowing and rotating grain through seasonal wetlands would continue to be used to set back vegetative succession. However, Alternative D would have the largest landscape level change to the refuge. Under Alternative D, the lower quarter of the refuge would be structurally modified to form a "Big Pond" with a more natural hydrograph. The Big Pond would encompass approximately9,000 acres that is currently a combination of upland, seasonal marsh, permanent marsh, and grain. Additional acreage in seasonal wetland would be available but permanent wetland areas would be reduced. The Service estimates that in an average water year under the current water allocation system, permanent wetlands on the refuge would be reduced from 700 acres in Alternatives A, B, and C to 200 acres under Alternative D.

Implementing Alternative D would require construction of a new levee along the southern border of the refuge in order to protect downstream landowners from flooding. The Service may be able to fashion the levees along the northern, eastern, and western borders of existing units the exterior of the Big Pond, but the interior levees would need to be removed. The Service estimates that up to 31 water control structures would need to be removed, 29 miles of interior levees/roads would need to be removed or abandoned, and 100 miles of interior drain fields would be abandoned. Construction is likely to take several years. Because of the extent of construction related impacts and the overall reduction of permanent wetlands on the refuge, impacts to recreational opportunities are considered intermediate.

Farming Programs

Implementing Alternative D would not change the area available for farming. The effects of farming on recreational opportunities would continue to be negligible.

Haying and Grazing Programs

Haying and grazing under Alternative D would be the same as described under Alternative A. The Service would continue to use haying on approximately 2,000 acres in Area K, and grazing would be used on approximately 12,500 acres. The effects of haying and grazing on recreational opportunities would be negligible.

Pesticide Application

Use of pesticides to support the farming program, target invasive weeds, and for general refuge maintenance would be the same as described under Alternative B. The direct adverse effects on recreational opportunities would be negligible.

Public Use

Alternative D is likely to have a major effect on all user groups engaged in wildlife-dependent recreation and these effects may be long-term. Construction of the ring levee needed to implement this alternative would disrupt waterfowl hunting, pheasant, hunting, boating, and the use of the southern portion of the auto-tour route. Although a portion of the auto-tour route would be reconstructed, approximately 3 miles would be permanently lost. Depending on the interior configuration, hunting may still occur on portions of the Big Pond, but the division between hunt units and sanctuary units would need to be redefined. It is likely that three parking areas and one boat launch would be removed from the interior of the pond, thereby limiting access and wildlife-dependent recreation opportunities.

Under Alternative D there would be approximately 30% fewer permanent wetlands available in average water years, although in above average water years there would be almost five times as many permanent wetlands than under Alternative A. Because of the direct construction impacts, the projected reduction of recreational facilities, and projected reduction of permanent wetlands in average water years the adverse effects of Alternative D to recreational opportunities is considered major.

Beneficial Effects

Like under Alternative B, Alternative D calls for improvements to signs along the auto tour route, updated interpretive and outreach media, additional interpretive programs, development of a walking wetlands curriculum, and partnerships with schools. Although these enhanced wildlife-dependent recreation opportunities would benefit the public and improve visitors' experiences of the refuge, they are not likely to compensate for the direct construction impacts, loss of recreational facilities, or reduction of permanent wetlands. The overall quality of visitor experiences on the refuge would likely degrade.

Mitigation

Appropriate BMPs (Appendix L) would be implemented during land management activities and during construction of the levees that would enclose the Big Pond to minimize adverse effects to refuge resources and programs. A portion of recreational opportunities on the refuge may be permanently lost due to construction of the Big Pond. The Service may not be able to mitigate the direct loss of recreational opportunities or the decline of recreational quality on the refuge.

6.2.9 Social and Economic Conditions

Methodology to Assess Effects – Lower Klamath Refuge

The Service prepared the *Economic Analysis of the Klamath Basin Refuge Complex CCP Alternatives*, which is contained in Appendix P. The economic analysis looked at the regional economic conditions and evaluated the economic effects of the various management alternatives.

The resource-specific context for assessing effects of the alternatives on social and economic conditions is:

- refuge management contributes to the local economy through both recreational opportunities and agricultural production.

Alternative A – Lower Klamath Refuge

The Service would continue to operate and manage Lower Klamath Refuge as it has in the past, and the contribution of the refuge to the regional economy from direct and indirect expenditures would be expected to be similar to current conditions. The refuge budget would remain similar to the current budget, which is a portion of the $4 million annual budget for the Refuge Complex, and ongoing management and maintenance projects would continue to be implemented, as feasible within the budget. Agricultural revenue would also be similar to current conditions and would vary annually, depending on the availability of water. The lease land program has generated an average of $3.6 million annually in lease revenue from 2001 through 2015. After accounting for Reclamation's expenses in administering the program, the revenues are distributed as follows: first, Tulelake Irrigation District (TID) receives 10% of the net revenues of lease land within TID boundaries pursuant to the TID Contract Act of 1956; next, Siskiyou, Klamath, and Modoc Counties receive 25% of the net revenues for lease lands within their boundaries pursuant to the Kuchel Act; the remaining revenues are deposited in the Reclamation Fund.

This paragraph summarizes economic effects discussed in more detail in an *Economic Analysis of Klamath Basin Refuge Complex* (Appendix P). In 2015, the Service estimates that under the current water allocation scenario agricultural crop production on the refuge would support from 14 jobs in a dry water year to 84 jobs in an above average water year. Under the KBRA water scenario agriculture would support 43 jobs in a dry year to 84 jobs in an above average water year. Cattle grazing on the refuge is estimated to support 36 jobs annually and visitor related spending throughout the Complex is estimated to support 54 jobs. In addition, the regional economy benefits of administering the refuge program contributes 13.5 jobs to the region. (Appendix P, *Economics Analysis*). Overall effects on the regional economy would continue to be beneficial with the direct and indirect expenditures associated with various industries in the region.

Land Management

Wetland Management

The acreage of wetlands on the refuge is entirely dependent on yearly water deliveries. Active wetland management can have socioeconomic benefits. Some of the non-chemical pest management practices to control invasive species described in Section 4.2.2 have the potential to provide jobs. Some of these practices can offer employment opportunities for local citizens. For example, some trapping and removal work may potentially be contracted to outside sources.

These effects are very limited and do not affect core social and economic conditions in the Klamath Basin.

Dust potentially generated through tilling/disking and smoke caused by prescribed fires can be nuisances for individuals living or working on or visiting adjacent properties, or can be a potential safety hazard for travelers on nearby roads. In the event that large volumes of smoke ever reach populated areas, it can create problems for health-care facilities; can irritate eyes, the respiratory system, and/or skin; and can pose a health hazard for individuals with respiratory illnesses or compromised immune systems. These effects are limited in duration and geographic area, and are unlikely to materialize because of the planning involved prior to igniting a prescribed burn.

Irrigation and flooding, variations in timing of these practices and use of bag-type repellents have no effects on social and economic conditions.

Farming Programs

Farmers and the Service share in the costs and benefits associated with the cooperative farming ventures. This includes pest management activities which can be an expensive component of agricultural management. In theory, the farmer wants the highest net income per acre off of each cooperative field. Therefore, there is tension between the magnitude of pestilence tolerated and the cost of pest management. The Service wants the most and highest quality grain share off of each cooperative field, and few if any adverse effects of agricultural pest management on non-target organisms and the refuge environment. Farming on the refuge generates employment and income flow to the regional economy. However, pest management activities related to farming likely only have a minimal effect on employment and income and therefore the social and economic conditions in the Klamath Basin.

Grazing and Haying Programs

As noted in Section 4.2.2, in addition to their broader habitat-management purposes, the grazing and haying programs are also used to help control invasive species. These activities are undertaken by local ranchers/farmers under Service permit. Therefore, in association with their invasive species management role, they return modest social and economic (employment and financial) benefits to the local community.

It is expected that the grazing and haying programs would continue to operate as presently operated, without the need for pest management, including the use of pesticides. Therefore, no associated effects on social and economic conditions would be expected.

Pesticide Application

Although to a lesser degree, the continued application of pesticides for invasive species management on the refuge will have the same types of effects on social and economic conditions as described above for the farming programs.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

Alternative B – Lower Klamath Refuge

Land Management and Public Use

Under Alternative B, the Service would improve management and operation of the refuge, which would require new temporary expenditures to implement various activities, such as updating and implementing various management plans, acquiring easements, constructing a contact station, and modifying public use facilities. These expenditures are expected to come out of the overall Refuge Complex budget, which would likely be similar to current conditions (about $4million annually), and the net change in expenditures would be minor. With improvements to visitor facilities and recreation opportunities, visitation is expected to increase, particularly for hunting and wildlife observation. As a wildlife-dependent public use, hunting and wildlife observation can also reconnect people, including youth, with the natural world and help address nature-deficit disorder (Louv 2005). The overall number of visitors would be similar to past trends of visitation and could range between 50,000 and 100,000 annual visitors. Visitors to the refuge would continue to contribute to the regional economy with expenditures in retail, food services, and other industries in the region, although the overall increase compared to Alternative A would be relatively negligible.

The following is a summary of potential effects of Alternative B. A more detailed analysis is provided in the economic analysis (Appendix P), and is incorporated by reference.

Under Alternative B for Lower Klamath Refuge, implementation of management activities in the Lower Klamath Refuge may result in:

- a short-term increase in refuge spending and regional economic activity due to construction or modification of facilities;
- negligible net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 0.5);
- a minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation; and
- a possible decrease in agricultural production and related regional economic effects compared to Alternative A due to an increase in unharvested grain by 500 acres and the conversion of 1,300 acres of grain to pasture. This change in agricultural production would decrease agricultural related jobs. In a dry water year there would be a reduction of 1.7 jobs related to agriculture and in an above average water year there could be a reduction of up to 45 jobs. Under a KBRA water allocation scenario in a dry year there could be a reduction of 10 jobs and in an above average water year there would be a reduction of 26 jobs. If changes in agricultural production result in a reduction in lease land revenues, Kuchel Act payments to Klamath County could decrease.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

Alternative C (Preferred Alternative) – Lower Klamath Refuge

Land Management and Public Use

Effects to the refuge management budget would be similar to those described for Alternative B, and any additional expenditures would be expected to come out of the current budget.

The following is a summary of potential effects of Alternative C. A more detailed analysis is provided in the economic analysis (Appendix P). Under Alternative C, implementation of management activities in the Lower Klamath Refuge may result in:

- a short-term increase in refuge spending and regional economic activity due to construction or modification of facilities;
- negligible net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 1.4 jobs);
- a moderate increase in visitation, visitor spending, and regional economic effects compared to Alternative A due to improved recreation; and
- a possible increase in agricultural production and related regional economic effects compared to Alternative A from the increase in grazing (2-3,000 acres); this could result in an increase in 9 jobs;

Crop production changes in the current water allocation scenario would result in an increase of 0.6 job in a dry year to a decrease of 23 jobs in an above average water year. Under the KBRA scenario, in a dry year there would be a reduction of 9.9 jobs and in an above average water year there would be a reduction of 26 jobs. If changes in agricultural production result in a reduction in lease land revenues, Kuchel Act payments to Klamath County could decrease.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

Alternative D – Lower Klamath Refuge

Land Management and Public Use

Effects to the refuge management budget would be similar to those described for Alternative B, and new expenditures would be expected to come out of the current budget to allow for the proposed management activities. Additional temporary expenditures would come from the construction of the Big Pond. Agricultural production and visitation would be the same as Alternative C.

The following is a summary of potential effects of Alternative D. A more detailed analysis is provided in the economic analysis (Appendix P). Under Alternative D, implementation of management activities in the Lower Klamath Refuge may result in:

- a large short-term increase in refuge spending and regional economic activity due to construction of the Big Pond (a temporary increase of 147.6 jobs);

- possible negligible and long-term changes in refuge operations spending associated with changes in water management activities;
- negligible net change in overall refuge operations spending for non-water management activities, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A;
- a moderate increase in visitation, visitor spending, and regional economic effects compared to Alternative A due to improved recreation; and
- a possible change in agricultural production and related regional economic effects compared to Alternative A from the increase in grazing (2 to 3,000 acres); this could result in an increase in nine jobs.

Changes in jobs dependent on crop production would be as follows: under the current water allocation scenario in a dry year there would be an increase in 0.6 job and in an above average year there would be a decrease of 22.7 jobs. Under the KBRA water allocation scenario there would be a reduction of 6.4 jobs in a dry water year and a reduction of 22.7 jobs in an above average water year. If changes in agricultural production result in a reduction in lease land revenues, Kuchel Act payments to Klamath County could decrease.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

Summary of Effects

Table 6.5 summarizes the potential effects of the four alternatives being considered for the Lower Klamath Refuge.

Table 6.5. Summary of Effects for Lower Klamath Refuge

	Alternative A	*Alternative B*	*Alternative C (Preferred Alternative)*	*Alternative D*
Effects on Soils				
Land Management				
Wetland Management	Minor	Minor	Minor	Intermediate
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Minor	Minor	Minor	Minor
Pesticide Applications	Negligible	Negligible	Negligible	Negligible
Public Use	Negligible	Negligible	Negligible	Negligible
Effects on Hydrology				
Land Management				
Wetland Management	Minor	Minor	Minor	Intermediate
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Negligible	Negligible	Negligible	Negligible
Pesticide Applications	Minor	Minor	Minor	Minor
Public Use	Neutral	Neutral	Neutral	Neutral

Table 6.5. Summary of Effects for Lower Klamath Refuge

	Alternative A	*Alternative B*	*Alternative C (Preferred Alternative)*	*Alternative D*
Effects on Water Quality				
Land Management				
Wetland Management	Negligible	Negligible	Negligible	Major
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Minor	Minor	Minor	Minor
Pesticide Applications	Minor	Minor	Minor	Minor
Public Use	Minor	Minor	Minor	Minor
Effects on Air Quality				
Land Management				
Wetland Management	Minor	Minor	Minor	Major
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Minor	Minor	Minor	Minor
Pesticide Applications	Negligible	Minor	Minor	Negligible
Public Use	Negligible	Negligible	Negligible	Negligible
Effects on Vegetation and Habitat Resources				
Land Management				
Wetland Management	Minor	Minor	Minor	Minor
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Minor	Minor	Minor	Minor
Pesticide Applications	Negligible	Negligible	Negligible	Negligible
Public Use	Minor	Minor	Minor	Minor
Effects on Fish and Wildlife				
Land Management				
Wetland Management	Minor	Minor	Minor	Intermediate
Farming Programs	Minor	Minor	Minor	Minor
Haying and Grazing Programs	Minor	Minor	Minor	Minor
Pesticide Applications	Minor	Minor	Minor	Minor
Public Use	Minor	Minor	Minor	Intermediate
Effects on Cultural Resources				
Land Management				
Wetland Management	Neutral	Neutral	Neutral	Neutral
Farming Programs	Neutral	Neutral	Neutral	Neutral
Haying and Grazing Programs	Neutral	Neutral	Neutral	Neutral
Pesticide Applications	Neutral	Neutral	Neutral	Neutral
Public Use	Neutral	Neutral	Neutral	Neutral
Effects on Visitor Services				
Land Management				
Wetland Management	Negligible	Negligible	Negligible	Intermediate
Farming Programs	Negligible	Negligible	Negligible	Negligible
Haying and Grazing Programs	Negligible	Negligible	Negligible	Negligible
Pesticide Applications	Negligible	Negligible	Negligible	Negligible
Public Use	Minor	Minor	Minor	Major

Environmental Justice

The refuge is located in a remote area with low population density in Siskiyou County, California, and Klamath County, Oregon; more than two-thirds of the refuge is in Siskiyou County. For the period from 2009 to 2013, Siskiyou County had slightly higher poverty levels than what is found across the state; 21% in Siskiyou County as compared to nearly 16% in the state of California

(U.S. Census Bureau 2015).The CCP actions proposed in all alternatives focus on continuing existing land management activities, inventory and monitoring, natural and cultural resources conservation and extensive visitor services on the refuge. With consideration of the higher poverty level in Siskiyou County and due to the nature of the CCP actions, the Service concluded that within the spirit and intent of Executive Order (EO) 12898, implementation of the CCP actions at the refuge would not disproportionately affect minority or low income populations.

6.3 Clear Lake National Wildlife Refuge

This section describes the potential impacts of the No Action Alternative and Alternative B for Clear Lake Refuge. Impacts are judged for significance using the thresholds described in the introduction of this chapter. Mitigation measures to avoid and/or minimize potentially adverse effects are described in the list of BMPs (see Appendix L). BMPs are common to all alternatives.

The following resources would not be affected by the alternatives and are not carried forward for further analysis.

- **Geology (not affected)**. Given the limited management actions currently implemented and proposed on the refuge, no effects to geologic resources would occur.
- **Paleontological Resources**: There is potential for as yet undiscovered paleontological resources to be affected during ground-disturbing activities. Should any paleontological resources be discovered by the Service, they would be conserved in place or deposited in an approved repository. On Service-owned land the public is not allowed to remove any paleontological resources from the refuge. As a result of protections under the Paleontological Resources Preservation Act (PL 111-011) (Omnibus Public Land Management Act of 2009), no effects to paleontological resources would occur.

6.3.1 Soils

Methodology for Analyzing Effects – Clear Lake Refuge

Reports on the soil types within the refuge boundary that are available online through the NRCS were consulted to assess relative susceptibility to compaction and erosion of different soils. These finding were applied generally to help understand how land management actions and public use activities might affect the physical qualities of the soil.

Resource-specific contexts for assessing effects of the alternatives to soil resources include the following.

- Construction related impacts would be localized.
- Soils within the refuge boundary and outside of the refuge boundary have been historically disturbed or altered by grazing.

Alternative A – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Fire management on this refuge consists of suppressing all wildfires. Continued successful suppression of wildfires would have minimal effects on soils because the soil profile would be left intact.

Juniper removal results in minimal soil disturbance on the refuge. Between 2006 and 2010, over 90% of the refuge was cleared of western junipers including all of the "U." Invasive western juniper trees and seedlings were felled using chainsaws and bucked up so the bole and branches are no more than four feet above the ground. No material was removed and trees were left to decompose onsite. The initial control of junipers was not likely a permanent conversion since as many as 10 seedlings may be released for every large tree removed (Service 2011b). Under the No Action Alternative, follow up treatments such as cutting with chainsaws and loppers, and herbicide treatments would be pursued. The effect on soils of the kind of mechanical equipment used (chainsaws and loppers) is primarily related to the footsteps of the people using them and is therefore negligible.

These activities can temporarily expose soil to wind and water erosion, but they are subject to standard BMPs to minimize erosion-related impacts. The potential for wind-based erosion at Clear Lake Refuge is very low. The majority of the refuge is ranked 0 on a scale of 0 to 6 (with 6 being high) by the NRCS. The exception is the 550 acres (1.6%) of Stukel soils located near the Peninsula. This soil type is more susceptible to wind based erosion with a rank of 4 (see Figure 5.9). In addition, vegetation tends to naturally re-establish in disturbed areas and protects soils from long-term erosion following the activities.

Grazing Program

Grazing is used in part for management of invasive species (invasive annual grasses like Japanese brome, cheatgrass, and medusahead) and to reduce wildfire fuels on the refuge. Some varieties of goat will even graze juniper seedlings. Grazing has occurred regularly on the refuge for decades. In recent years, approximately 5,500 acres (600 AUMs) in the peninsula area of the refuge have been grazed from mid-August to mid-November. This acreage comprises approximately 23% of the refuge.

In addition, the western boundary of the refuge is not fenced. Modoc County, California, is open range encumbering the land owner to keep undesired livestock off their property. Since 1980, an interagency agreement with Modoc National Forest has allowed cattle grazed under U.S. Forest Service permit to access water on approximately 800 acres within the refuge boundary. The earliest this area is grazed is July 15 and then only for 23 days with approximately 300 head of cattle. Cattle grazing under this interagency agreement provide the refuge biological benefits by enhancing Canada goose grazing and reducing fuels and fire threats.

Heavy grazing can strip off vegetation and expose soil, compact or otherwise disturb soil, enhance the potential for soil erosion, add nutrients to the soil (through manure), and incorporate seed (Wollstein and Rounds 2012), however the extent of grazing allowed on the refuge is not considered heavy. Prescribed grazing is used selectively to target invasive plant species and

reduce wildfire fuels. It can temporarily expose and disturb soils and increase erosion (Gifford and Hawkins 1978; Roberson 1996) Collectively, these management activities may increase the potential for short-term, localized exposure of bare soils that may result in increased water and wind erosion.

Without mitigation measures like the BMPs in Appendix L, the potential erosion hazard from some of these practices could range from intermediate to even locally significant due mainly to the relatively high water runoff rates associated with these types of soils (USDA 1983). However, grazing agreements include stipulations that must be implemented; through these stipulations impacts to soils would be kept to minor and short term. In addition, grazing to control invasive species would be kept localized and of short duration (4 months annually) to help prevent potentially damaging effects related to grazing.

Water fluctuations in Clear Lake Reservoir can expose soils to erosion as water levels recede. However, lake water levels have been managed by Reclamation since installation of Clear Lake Dam, and shoreline erosion is not currently a major concern at the refuge. Invasive plants such as cheatgrass and medusahead tend to colonize the shoreline zone of the lake.

Pesticide Application

Applications of pesticides to control invasive plant species on the refuge have been limited to a research study in 2010 (see Section 4.3.2, Integrated Pest Management). Applications of imazapic and rimsulfuron were successful in controlling medusahead and cheatgrass the year of treatment. Imazapic is weakly adsorbed in high pH soils; adsorption increases as the pH increases and with increasing clay and organic matter content. Rimsulfuron degrades rapidly in soil. Adsorption rates differ among various soil types. The adsorption increases with the increasing amount of organic matter or clay content. Soils at Clear Lake have a low organic content. Potential effects to soils from pesticide application at Clear Lake would be negligible.

Public Use

The Clear Lake Refuge is closed to all public use except for waterfowl and upland game hunting. Potential effects of public use on soils stems from hunters walking on erodible soils. The potential erosion hazard on the refuge ranges from moderate to very high due mainly to the relatively high water runoff rates associated with the types of soils on Clear Lake Refuge. Although hunters would add to the erosion potential, the hunted areas are relatively flat and there are a relatively low number of hunters that hunt on this refuge (50 to 200 annually). Therefore, the Service determined that potentially adverse effects from public use to soils would be minor, localized, and short-term.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced. Catastrophic wildfire can damage the soil structure and ultimately lead to increased erosion.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Under Alternative B the Service would continue to suppress wildfire and remove junipers as needed. Wildfire suppression activities would be prioritized to protect the "U" in order to accelerate sagebrush restoration. Alternative B would develop a habitat management plan and develop a rapid assessment and control program for new invasive species. Wildfire suppression and juniper removal activities would use the same tools that are currently employed for land management. The effects to soils would be the same as described in Alternative A.

Grazing Program

Grazing would continue to be used as a tool to promote sage-steppe habitat. The focus of this tool would be directed by the habitat management plan and the rapid assessment and control program for new invasive species. In addition to the acreage grazed on the "U," two experimental pastures are proposed for habitat restoration of an area damaged by wildfire in 2001. The two pastures would total 3,000 acres and would be grazed with 300 to 500 cattle from March 1 to mid-April. Experimental plots within these pastures would be established to fine tune the strategy (e.g., number of cattle, duration, and timing). Grazing involves a variety of equipment on the refuge including trucks, trailer, off-road vehicles, horses, corrals and the personnel to operate equipment and manage the livestock. **Although the Service would work with the U.S. Forest Service to identify an alternative location/source of water for cattle grazing under the interagency agreement with the U.S. Forest Service under this alternative, the** overall impacts of grazing on soils would be very similar to Alternative A.

Pesticide Application

Alternative B would include the addition of chemical weed control as an ongoing tool. The types of pesticides used would be similar to those described in Alternative A because they were effective in recent studies. Pesticides would not be applied without a completed PUP (see Appendix Q), which would include the appropriate restrictions for application. The effects to soils would be the same as described in Alternative A.

Public Use

Alternative B would also involve construction of a viewing facility or platform on the boundary of the refuge to encourage wildlife viewing and open the refuge to a wider range of wildlife-dependent recreation. Construction activities would result in soil disturbance in a relatively small area (less than 1 acre), but could expose the soil to erosion or result in a loss of topsoil, depending on the specific location and details of the facility. These impacts will be analyzed further in a project-specific NEPA document once specific details on the new facility are available.

Under Alternative B, hunters would be required to use non-toxic ammunition for the pronghorn hunt which would eliminate lead bullets from entering the soil. Overall, adverse public use effects to soils would be minor, short-term, and localized.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced. Catastrophic wildfire can damage the soil structure and ultimately lead to increased erosion. By prioritizing wildfire suppression to protect the "U," Alternative B would provide additional benefits to sage-steppe species.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.3.2 Hydrology

Methodology for Analyzing Effects – Clear Lake Refuge

The resource-specific context for assessing effects of the alternatives to hydrology is:

- Clear Lake is managed by Reclamation for irrigation, flood control, and wildlife habitat.

Alternative A – Clear Lake Refuge

Land Management

Land management activities in the refuge largely focus on sagebrush habitat maintenance.

Fire Management and Juniper Removal

Clear Lake Reservoir receives water from the upper Lost River watershed and water levels are managed by Reclamation. Impacts to hydrology in the reservoir from management at the refuge are primarily limited to a possible occasional discharge of sediment via surface runoff following fire. The extent and severity of a fire determine extent of vegetation and organic matter burned, area of soils exposed, and resulting erosion. Prescribed burns are generally of lower intensity and generally result in less erosion than do larger wildfires in fire-suppressed landscapes. Therefore, although prescribed fires may result in occasional discharge of sediment via surface runoff after a burn, the use of prescribed fires likely reduces the chance of catastrophic wildfire which would result in much greater sediment discharges. These low intensity prescribed fires can thin vegetation, promote herbaceous vegetation, increase ecosystem heterogeneity, and increase plant available nutrients (Neary et al. 1999). Additionally, the removal of old plant growth and increased availability of nutrients can stimulate vegetation growth, ultimately enhancing sediment and nutrient retention over longer time frames (Kotze et al. 2013). Overall sediment accumulation will have negligible effects on hydrology.

Western juniper management includes using pruners and chainsaws to cut trees and seedlings has no significant effect on hydrologic processes associated with erosion of flooding of structures. These occasional impacts are not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation. Impacts would be negligible or minor and would not be significant.

Grazing Program

Grazing, which is also used for management of invasive plants and wildfire fuels, can remove vegetation, expose soil, and enhance the potential for erosion, particularly if heavy grazing is allowed. Excessive grazing could result in vegetation trampling and vegetation clipped at the ground level; expose surface soils; result in soil disturbance/erosion and compaction; and if livestock were allowed access to surface waters, create turbidity. Because grazing to help control invasive species at the refuge is localized and seasonal, these impacts are likely to be only occasional, of short duration and no more than minor. These occasional impacts are not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation.

Pesticide Application

Applications of pesticides to control invasive plant species on the refuge have been limited to a research study in 2010 (see Section 4.3.2, Integrated Pest Management). Applications of imazapic and rimsulfuron were successful in controlling medusahead and cheatgrass the year of treatment. The application of pesticides has no effect on hydrology and effects are considered neutral.

Public Use

This refuge is only open for hunting and boats are not allowed for hunting on the refuge; therefore, this activity would not be expected to generate any effects on hydrology, except minor turbidity associated with a hunter and potentially his/her dog wading into the reservoir. These occasional impacts are not expected to alter the existing drainage pattern of the area in a manner that causes substantial erosion or siltation. Effects are considered negligible.

Beneficial Effects

No beneficial effects to hydrology from current management beyond those related to maintaining relatively undeveloped conditions would result from implementing Alternative A.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative B (Preferred Alternative) – Clear Lake Refuge</u>

Land Management

Land management impacts are the same as Alternative A.

Public Use

Public use impacts are the same as Alternative A.

Beneficial Effects

The beneficial effects impacts are the same as Alternative A.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative. No additional mitigation measures are being proposed.

6.3.3 Water Quality

Methodology for Analyzing Effects – Clear Lake Refuge

Reports on water quality for the overall Klamath Basin are available online. Information from online resources was used to assess the impacts of each alternative on water quality.

The resource-specific context for assessing effects of the alternatives to water quality is:

- Clear Lake is managed by Reclamation for irrigation, flood control, and wildlife habitat.

Alternative A – Clear Lake Refuge

Land Management

As noted in Affected Environment, water quality conditions in Clear Lake have been generally good over a range of water quality and years.

Fire Management and Juniper Removal

Clear Lake Reservoir receives water from the upper Lost River watershed and water levels are managed by Reclamation. Impacts to water quality in the reservoir from management at the refuge are primarily limited to a possible occasional discharge of sediment via surface runoff following fire. Impacts from these occasional discharges would be minor and would not significantly alter the existing water quality. In the Upper Klamath Basin, lightening is prevalent and fires likely occurred when fuel was sufficient. Fire suppression throughout the western United States has resulted in changes to ecosystem structure and diversity, and has been re-introduced as a management tool in the Upper Klamath Basin National Wildlife Refuge Complex (Service 2001).

The extent of water quality effects is moderated by fire extent and severity. Fire severity is a result of many factors including weather conditions, fuel loads, soil moisture, wetland flooding, and burn duration (Kotze et al. 2013; Neary et al. 1999). The extent and severity of a fire determine extent of vegetation and organic matter burned, depth of soil heated, soil temperatures, conversion of nutrients, area of soils exposed, and resulting erosion and water quality impacts. Prescribed burns are generally of lower intensity and usually result in less erosion and nutrient conversion than do larger wildfires in fire-suppressed landscapes.

Therefore, although prescribed fires may result in occasional discharge of sediment via surface runoff after a burn, the use of prescribed fires likely reduces the chance of catastrophic wildfire which would result in much greater sediment and nutrient discharges. These low intensity prescribed fires can thin vegetation, promote herbaceous vegetation, increase ecosystem heterogeneity, and increase plant available nutrients (Neary et al. 1999). Additionally, the removal of old plant growth and increased availability of nutrients can stimulate vegetation growth,

ultimately enhancing sediment and nutrient retention over longer time frames (Kotze et al. 2013). Fire as a management activity on the refuge can impact water quality in and adjacent to the managed lands. Fire management plans, coupled with erosion control measures would diminish such impacts.

Grazing Program

Grazing, which is also used for management of invasive plants and wildfire fuels, can remove vegetation, expose soil, and enhance the potential for erosion, particularly if heavy grazing is allowed. Excessive grazing could result in vegetation trampling and vegetation clipped at the ground level; expose surface soils; result in soil disturbance/erosion and compaction; add nutrients in the form of manure; and if livestock were allowed access to surface waters, create turbidity. Because grazing to help control invasive species at the refuge is localized and seasonal, these impacts are likely to be only occasional, of short duration and no more than minor. These occasional impacts are not expected to significantly alter existing water quality.

In addition to the grazing used by the Service to control invasive plant species, approximately 300 head of cattle are allowed on approximately 800 acres of the refuge along the western shoreline for 23 days in the summer under an interagency agreement with the U.S. Forest Service. California is open range which encumbers the land owner to keep undesired livestock off their property. Fencing the west boundary is not biologically desirable because of the potential for sage-grouse collisions with fences, as well as further impeding movement by deer and pronghorn. Grazing in this area provides the refuge benefits by reducing fuel levels and associated wildfire fire threats. The U.S. Forest Service (2008) prepared an environmental assessment disclosing the effects of grazing on the Tucker Allotment which is adjacent to the refuge.

Pesticide Application

Applications of pesticides to control invasive plant species on the refuge have been limited to a research study in 2010 (see Section 4.3.2, Integrated Pest Management). Applications of imazapic and rimsulfuron were successful in controlling medusahead and cheatgrass the year of treatment. Imazapic is weakly adsorbed in high pH soils; adsorption increases as the pH increases and with increasing clay and organic matter content. Rimsulfuron degrades rapidly in soil. While soils at Clear Lake Refuge have a low organic content, due to the limited applications and lack of applied water the potentially adverse effects from pesticides to water quality are estimated to be localized and short-term, and have a minor effect.

Public Use

This refuge is only open for hunting and boats are not allowed for hunting on the refuge; therefore, this activity would not be expected to generate any water-quality effects, except those associated with a hunter and potentially his/her dog wading into the reservoir.

The effects to water quality are considered neutral or negligible.

Except for limited waterfowl and pronghorn antelope hunting during the regular California State seasons, the refuge (including 20,000 acres of open water) would remain closed to other public access, reducing potentially adverse effects to water quality from public use.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced. Catastrophic wildfire can damage the soil structure which leads to increased erosion that can impact water quality. By prioritizing wildfire suppression Alternative A would provide additional benefits to sage-steppe species and reduce the potential for adverse effects to water quality by increasing vegetative ground cover and reducing erosion.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Land management impacts of fire management, juniper removal, grazing and pesticide use are the same as Alternative A**, except that under Alternative B, the Service would work with the U.S. Forest Service to find an alternative source/location of water for cattle grazing under the interagency agreement for the Tucker Allotment**.

Public Use

Alternative B would involve construction of a viewing facility or platform on the boundary of the refuge to encourage wildlife viewing and open the refuge to a wider range of wildlife-dependent recreation. Construction activities would result in soil disturbance in a relatively small area (less than 1 acre), but could expose the soil to erosion or result in a loss of topsoil, depending on the specific location and details of the facility. These impacts will be analyzed further in a project-specific NEPA document once specific details on the new facility are available.

There would be no changes to the hunt program, so effects on water quality under Alternative B would be the same as under Alternative A.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced. Catastrophic wildfire can damage the soil structure which leads to increased erosion that can impact water quality. By prioritizing wildfire suppression to protect the "U," Alternative B would provide additional benefits to sage-steppe species and reduce the potential for adverse effects to water quality by increasing vegetative ground cover and reducing erosion.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

6.3.4 Air Quality

Methodology for Assessing Effects – Clear Lake Refuge

Air quality was assessed at a basin-wide level using online reports from the States of California and Oregon that identify the general air quality characteristics.

Resource-specific contexts for assessing effects of the alternatives on air quality are:

- land management activities are minimal on this refuge; and
- the refuge has a high risk of wildfires.

Alternative A – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Ongoing fire suppression and juniper removal require the periodic use of vehicles and equipment that causes short-term, minor emissions (engine exhaust and fugitive dust) that may be noticeable on the refuge. Using pruners to cut invasive western juniper seedlings has no effects on air quality. However, chainsaws used to cut juniper trees generate exhaust containing particulates and gases such as hydrocarbons, carbon monoxide, carbon dioxide, nitrogen oxides, and aldehydes. Wildfires generate smoke that can rise to great heights and potentially drift considerable distances. Smoke contains ash particulates, partially consumed fuels, and very small quantities of gases such as carbon monoxide, carbon dioxide, and hydrocarbons. Wildfires are suppressed as quickly as possible which minimizes air quality effects.

Grazing Program

Under this alternative, the grazing program would continue to operate without the need for pesticides or other pest management practices. Ruminant livestock (including cattle, sheep, and goats) generate and emit methane during digestion. As a greenhouse gas, methane contributes to global warming and is more than 20 times more potent than carbon dioxide. In light of the small number of livestock used for invasive species control on the refuge and the short duration of treatments, this effect on air quality would be expected to be minimal, especially compared with the effects of livestock grazing across the Klamath Basin.

Pesticide Application

Pesticide use for invasive species management would likely have no effects on air quality because applications would be very localized and almost exclusively in dry, upland habitats. Pesticide application would need to be approved through the PUP process (see Appendix Q).

Land management effects on air quality are minimal due to the very localized and intermittent nature of the work, and dilution in the atmosphere above this remote refuge.

Public Use

Public access within the refuge is currently limited to walk-ins from adjacent or nearby parking areas, so vehicles contribute negligible emissions at the refuge. Hunting-related air quality effects

are also limited to dust generated by pedestrian travel. Because of the minimal use of the refuge for hunting, this dust would be very limited, it would be dispersed over time and the large acreage of the refuge, and it would not be expected to measurably impact Klamath Basin air quality. In light of the number of years that hunting has occurred on the refuge, it is not expected that continued hunting would further degrade the current situation.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced and habitat for sage-steppe species is improved.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Under Alternative B the Service would continue to remove junipers to control invasive weeds and to improve habitat for the greater sage-grouse. Wildfire suppression activities would be prioritized to protect the "U" in order to accelerate sagebrush restoration. The extent of impacts to air quality would be very similar to Alternative A, although the location of the impacts may change. Under Alternative B the Service would develop a habitat management plan and develop a rapid assessment and control program for new invasive species. These tools would use the same that are currently used for land management.

Grazing Program

Prescribed grazing of domestic livestock, primarily cattle, would continue under Alternative B. The effects to air quality would be the same as described under Alternative A.

Pesticide Application

The impacts to air quality from pesticide use would come from overspray or other factors described in Section 6.2.3 (Lower Klamath Refuge – Air Quality). However, pesticides would continue to be rarely used at this refuge and are likely applied directly or with small backpack sprayers where overspray is minimized. The type of chemicals, application method, acreage of vegetation over which the chemical is used and other factors are considered by the PUP Committee before approval. This oversight ensures the minimum possible impact to resources, including air quality. For these reasons, potential pesticide use for invasive species management would have minimal effects on air quality.

Public Use

In addition to construction related emissions, the provision of a viewing facility reachable by car on the refuge border could increase vehicle traffic to the refuge, although access within the refuge would continue to be limited to walk-ins only. Increased traffic would result in increased vehicle emissions in the vicinity of the refuge, but the impacts on air quality would be negligible based on the estimated visitation to the refuge and would not adversely affect ambient air quality. The hunt program would not change under this alternative and would not contribute any additional emissions.

Beneficial Effects

The beneficial effects of land management activities are to develop a more resilient habitat where the risk of catastrophic fire is reduced and habitat for sage-steppe species is improved.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

6.3.5 Vegetation and Habitat Resources

Methodology to Assess Effects – Clear Lake Refuge

Scientific literature was consulted to predict the types of impacts that could occur due to land management and public use activities.

The resource-specific context for assessing the effects of the alternatives on vegetation and habitat resources is:

- restoring sage-steppe habitat is a priority.

Alternative A – Clear Lake Refuge

Land Management

Fire Management and Juniper Thinning

Land management activities focus on reducing non-native invasive plant species in order to improve and expand the sage-steppe habitat. Using pruners and chainsaws to cut invasive western juniper trees and seedlings would continue to effectively reduce the presence of this species in most areas of the refuge. As a result of such efforts in recent years, juniper has been removed from 90% of the refuge. Removal of juniper facilitates reestablishment of sagebrush plant communities (including other shrubs, forbs, and perennial grasses) and (because groundwater withdrawals by juniper can reduce spring flows) allows vegetation to reestablish around springs and downstream corridors.

Fire suppression can have localized effects on vegetation from engines driving to the fire staging area, laying hose to fight the fire, and from building fire lines to stop the spread of the wildfire. This is a fairly infrequent event since only 11 wildfires have burned on the refuge between 1936

and 2015. The direct impacts of fire suppression activities on vegetation are more than offset by minimizing the damage that wildfire does to sage-steppe habitat.

The adverse impacts of fire management and juniper thinning on vegetation and habitat would be minor.

Grazing Program

Under this alternative, intensively managed grazing would be used to control invasive plant species. Grazing is a common habitat-management technique that can create short-grass pastures for migratory birds, open up areas that are chocked with vegetation, limit tree and shrub encroachment on meadows, and simultaneously consume pest and invasive plants. Grazing for the latter purpose is targeted to those areas most heavily infested. Whether the effects of grazing are most strongly received by grasses, forbs, shrubs, and/or trees depends in part on the species of livestock grazed (e.g., cattle primarily graze grasses; sheep graze grasses and forbs, and browse shrubs and sometimes trees; and goats primarily browse shrubs and trees). However, livestock also graze and/or browse non-pest species of the same plant type (i.e., grasses, forbs, shrubs, and/or trees) that are in the grazed area. In early or middle spring, fast-growing annual grasses like cheatgrass and medusahead can be very palatable and preferentially selected by grazing livestock over native perennial bunchgrasses. High-intensity, short-term, targeted grazing in uplands at this time of year would preclude these exotic annual grasses from maturing, setting seeds, and reproducing yet would be expected to minimally damage the slower growing native perennial bunchgrasses (Strand and Launchbaugh 2013). Grazing during the dormant/late season (summer and fall) would reduce the density of native and exotic grasses, including their thatch, but would be expected to have minimal effects on their long-term health and survival, because they would have already produced seed and senesced. These prescribed grazing strategies would give native perennial grasses and forbs a competitive advantage, help restore native habitats, and reduce the abundance of fine fuels. As a result, the frequency, intensity, and spread of wildfires—which are associated with the abundance of annual grasses—would be reduced (Strand et al. 2014). A reduction in wildfire would enhance the growth and survival of shrubs, such as sagebrush, that are very slow-growing.

The results of a recent, small-scale experiment with high intensity, short-term prescribed grazing on the refuge demonstrated that using cattle and the proper grazing strategy (i.e., short-term, grazing based on habitat objectives) can effectively reduce annual grasses without adversely impacting perennial grasses and forbs. The principal investigator stated that grazing with sheep might be more effective if this treatment is scaled up (Merrill-Davies, undated), that this type of a program can result in a reduction in annual grasses, an increase in perennial grasses and forbs, and no change in bare ground when compared with an ungrazed plot.

In addition to the grazing used by the Service to control invasive plant species, approximately 300 head of cattle are allowed on approximately 800 acres of the refuge along the western shoreline for 23 days in the summer under an interagency agreement with the U.S. Forest Service. California is open range which encumbers the land owner to keep undesired livestock off their property. Fencing the west boundary is not biologically desirable because of the potential for sage-grouse collisions with fences, as well as further impeding movement by deer and pronghorn. Grazing in this area provides the refuge benefits by reducing fuel levels and associated wildfire fire threats. The U.S. Forest Service

(2008) prepared an environmental assessment analyzing the effects of grazing on the Tucker Allotment which is adjacent to the refuge.

If not properly managed, grazing can cause an excessive reduction in vegetation height; therefore, grazing is monitored to ensure that refuge habitat objectives are met without damage to the vegetation community.

Slender Orcutt grass (*Orcuttia tenuis*) is listed as threatened under the federal ESA, as amended. Slender Orcutt grass potentially occurs on the refuge given occurrences within the vicinity, but there are no known modern occurrences. Any conservation measures, as well as terms and conditions resulting from intra-Service consultation under the federal ESA will be implemented to protect listed species and their habitat that occur on the refuge, as applicable. The adverse impacts of grazing on vegetation and habitat would be minor.

Pesticide Application

Pesticide application would be focused on the use of herbicides to reduce populations of cheatgrass and medusahead. A research study conducted in 2010 and 2011 on the refuge evaluated the use of three herbicides to manage annual grasses. Researchers determined that herbicides were unlikely to provide long-term suppression of annual grasses; herbicides may have the best fit in areas managers want to increase forbs important to wildlife since forb and sagebrush cover increased in herbicide-treated plots 2 and 3 years after treatment; treating several small targeted areas over multiple years may be more beneficial to wildlife compared to treating a large area once since herbicide benefits were temporary (Wilson et al. 2015). Using the results of this research, the refuge may use herbicides in targeted areas.

The adverse impacts of pesticide application on vegetation and habitat would be minor.

Public Use

The refuge is open only to hunting at this time. Hunters and their dogs can trample native plants, and potentially introduce or spread exotic and invasive species, including plants, invertebrates, fish, and wildlife. Hunting has occurred on this refuge since establishment without noticeable degradation of vegetation and habitat during the hunting season. Effects on vegetation and habitat resources from continuing the current hunting program on the refuge would not degrade native habitat so that it is no longer suitable for endemic species. The continued closure of refuge roads to the public and limiting overland travel by the Service and cooperators would be expected to reduce the spread of invasive plants.

Impacts to vegetation and wildlife from public use would be minor.

Beneficial Effects

The end result is to reduce the area of nonnative species on the refuge and promote the sage-steppe habitat so that it becomes more cohesive in general. Juniper removal, wildfire suppression, grazing, and herbicide application result in temporary disturbances to the upland habitats at the refuge, but they primarily result in long-term beneficial effects that improve habitat conditions.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative.

Stipulations in the grazing agreements require that ranchers put those livestock used in the refuge grazing program on weed-free feed for at least 48 hours prior to letting them on the refuge. Additionally, prior to arrival on the refuge, ranchers are required to clean all vehicles, machinery, and other equipment of non-native plant and animal matter.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal; Grazing

In addition to the management activities and associated impacts discussed under Alternative A, the Service would prepare both a Habitat Management Plan and a Wildlife Inventory Plan. The purpose of these plans is to identify new or improved techniques to restore sage-steppe habitats and to manage invasive plants. A combination of the land management actions described in Alternative A would likely form the basis of these plans. Under Alternative B the Service would continue to suppress wildfires to protect the "U" to allow for accelerated sagebrush restoration. Wildfire suppression would continue under the Fire Management Plan. Under Alternative B, the same types of control actions presently used would initially be used to combat invasive species. However, as monitoring results are used to direct rapid assessment and control actions, new outbreaks of priority invasive species (including the same or different species as occur on the refuge at present) would more likely be controlled when they were smaller in size. This would benefit the future quality of refuge wildlife habitats.

The adverse effects of fire management and juniper removal would continue to be minor.

Grazing Program

In addition to the grazing program under Alternative A, grazing would be expanded on two experimental plots totaling 3,000 acres to control exotic annual grasses and assist with restoration of habitat on the east side of the "U" Unit that was damaged by the Clear Fire in 2001. Grazing prescriptions would be developed for this additional acreage in order to minimize resource effects while targeting invasive annual grasses. **Grazing allowed under interagency agreement with the U.S. Forest Service would continue to be allowed.** The adverse effects of grazing on vegetation and habitat would continue to be minor.

Pesticide Application

Research partnerships with the University of California Davis Intermountain Research and Extension Station would result in the development of control strategies (grazing, pesticide use, and perhaps other IPM techniques) that targeted exotic annual grasses while protecting native plants. Should studies reveal the effectiveness of new methods; the intent would be to restore the health and diversity of the native plant community (i.e., sagebrush, forbs, and perennial grasses) on the "U" and elsewhere on the refuge. Consistent with the IPM program and in the context of adaptive management, pesticides would remain one of several control methods used to manage

invasive species. The proposed pesticide use would not change under Alternative B. See Section 6.2.4, Land Management/Pesticide Application, for a broader discussion of potential biological effects of pesticide applications.

The adverse effects of pesticide application on vegetation and habitat would be minor.

Public Use

Effects on vegetation and habitat resources from hunting would be the same as under Alternative A.

Construction of a viewing facility on the refuge border could remove native habitats and spread invasive plants, depending on the specific location and details of the facility. However, this facility is expected to encompass a small area (less than 1 acre) and would not require removal of a substantial amount of habitat. Maintenance of the facility would not impact any additional habitat. If necessary, modest pest management actions (perhaps using a brush cutter) would be taken to reduce the height of grasses or shrubs around the new viewing facility and any associated trails and parking lot for refuge visitors. These actions would result in a temporary reduction in the height of adjacent grasses/shrubs. The effects of public use on vegetation and habitats are minor.

Beneficial Effects

The beneficial effects are similar to those described under Alternative A. Additional projects developed under the Habitat Management Plan and the Wildlife Inventory Plan would increase the amount of sage-steppe habitat on the refuge.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative. No additional mitigation measures are proposed.

6.3.6 Fish and Wildlife

Methodology to Assess Effects – Clear Lake Refuge

The various management alternatives were assessed to determine their potential to support refuge goals for fish and wildlife. Scientific literature was used to predict the potential effects of various land management and public use activities on fish and wildlife resources.

Listed here are the resource-specific contexts to assess the effects of the alternatives on fish and wildlife resources.

- The refuge is an important site for colonial waterbirds.
- A 5,000-acre peninsula is used by the greater sage-grouse and is home to the last active lek in the Modoc Plateau.
- Clear Lake Dam controls the lake levels. Clear Lake Dam is operated by Reclamation for irrigation, flood control, and wildlife habitat.

Alternative A – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

As described under Section 6.3.4, Vegetation and Habitat, the Service uses a variety of techniques to improve habitat for native species, reduce the presence of pest species, and improve habitat for sage-grouse and other sage-steppe species.

In the absence of natural fire, juniper out competes native sagebrush plant communities (including other shrubs, forbs, and grasses) and causes sage-grouse (a sagebrush obligate species) to abandon leks. Juniper also withdraws substantial quantities of groundwater and can reduce spring flows, which are essential for antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and many other wildlife species in arid and semi-arid environments. To combat the spread of juniper, pruners and chainsaws are used to cut invasive western juniper trees and seedlings and enhance the quality of habitat for sagebrush, sage-grouse, and other native species across the refuge. This is especially important for sage-grouse, because this species is being considered for listing under the ESA and Clear Lake Refuge is a stronghold for the sage-grouse population in this area of northeastern California and south-central Oregon (Bedell et al. 1993; Clear Lake Sage Grouse Working Group 2010). Approximately 90% of the juniper on the refuge has been removed. The direct effects to wildlife of both wildfire suppression and juniper removal are disturbance. Most species are able to relocate to nearby suitable habitat on or off the refuge to avoid disturbance. Disturbances during the nesting seasons for birds, breeding seasons for other species, or rearing season for fish can be adverse due to possible impacts on young. Bald eagles and peregrine falcons, as well as other migratory birds, use the refuge habitats during migrations. The effects of disturbance on wildlife are discussed in the section on grazing.

The endangered Lost River and shortnose suckers are found in Clear Lake Reservoir. Fire suppression and juniper removal would not have any effect on the lake levels that support these fish species.

The adverse effects of fire management and juniper removal on fish and wildlife are minor.

Grazing Program

For invasive species management the Service uses targeted grazing to reduce the height of vegetation in infested areas. Prescribed grazing would continue to be conduction on about 5,500 acres (600 AUMs) of the refuge to control invasive plant species. **In addition to the grazing used by the Service to control invasive plant species, approximately 300 head of cattle are allowed on approximately 800 acres of the refuge along the western shoreline for 23 days in the summer under an interagency agreement with the U.S. Forest Service. California is open range which encumbers the land owner to keep undesired livestock off their property. Fencing the west boundary is not biologically desirable because of the potential for sage-grouse collisions with fences, as well as further impeding movement by deer and pronghorn. Grazing in this area provides the refuge biological benefit by enhancing Canada goose grazing and reducing fuels and fire threats. The U.S. Forest Service (2008) prepared an environmental assessment analyzing the effects of grazing on the Tucker Allotment which is adjacent to the refuge.**

Grazing is conducted between mid-August and mid-November. In light of the fact that many wildlife species and their preferred habitats evolved in the presence of large, terrestrial grazing animals, there is not an inherent ecological conflict between grazing by livestock and wildlife use of an area. However, grazing intensity and time of year much be properly managed to capitalize on its advantages and avoid or minimize its disadvantages. Continuous, moderate levels of grazing can result in long-term deterioration of native plant communities, and heavy grazing can increase the vulnerability of native habitats to the establishment and spread of invasive plants (Krausman et al. 2009). Fencing used to control livestock movements can kill wildlife, including sage-grouse, or otherwise hinder their movements (Clear Lake Sage Grouse Working Group 2010). Grazing livestock could also prevent nesting attempts; cause nest abandonment; trample nests, eggs, and young; and otherwise disturb ground-nesting birds (Ivey and Dugger 2008; Littlefield and Ivey 2001; Sutter and Ritchison 2005). Disturbance would be highest when livestock are let into and rounded up to be removed from the grazing area. The refuge regulates grazing in order to minimize these types of impacts.

A grazing program, including operations and maintenance activities, and use of vehicles by ranching personnel, could create other types of wildlife disturbance. Human disturbance has differential effects on wildlife and is dependent on many variables, including the species involved and its age; the time of year; the breeding cycle stage (if applicable); the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; the surrounding environment; whether the disturbing activity involves vehicles; the type, size, intensity, speed, noise, nature, and frequency of the disturbing activity; and the approach angle or directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a, 1995b; Lafferty 2001a, 2001b; Rodgers 1991; Rodgers and Schwikert 2002; Rodgers and Smith 1997; Smit and Visser 1993). Disturbance and flushing of birds, or even raising their alert levels (which usually occurs at a greater distance than that for flushing), creates stress and requires animals to alter their normal behavior and expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing. It can cause them to stop feeding, cause abandonment of nests and young, allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual animals, including birds, eggs, nestlings, broods, young, and juveniles (Burger and Gochfeld 1991b; Haysmith and Hunt 1995; Lafferty 2001b). Breeding birds are especially sensitive to human disturbance (Hammitt and Cole 1998; Trulio 2005). For example, a study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004). The effects of disturbance on individual animals are likely additive.

As noted above, some species of wildlife are relatively tolerant of grazing livestock. For other more sensitive species; however, the presence of ranching-related vehicles and personnel in a field could cause them to move elsewhere. Wildlife disturbance from grazing would be seasonal, intermittent, short-lived, and confined to access routes and affected units. Wildlife that was disturbed could move to any of several other protected areas of the refuge. None-the-less, some disturbance impacts would occur. During the mid-August to mid-November dormant season grazing most of the cattle use is on the shoreline. Refuge staff believes there is some completion for food resources on the lakeshore between cattle, mule deer, pronghorn, and sage-grouse; however, the Service is uncertain as to the level of effect between cattle and other species.

Observations in past years show that when areas are enclosed to protect species such as nesting pelicans, grasses and forbs grow tall and become available to deer and sage-grouse broods (as they are able to access the area inside the enclosure while cattle are not able to enter). More forage for native wildlife would be available along the lakeshore if it were not eaten first by cattle. The adverse effects of grazing on fish and wildlife would be minor. Grazing is conducted on 23% of the refuge for 4 months of the year.

The Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*) are listed as endangered under the federal ESA, as amended. These protected suckers are known to occur within the boundaries of Clear Lake Refuge. Grazing can adversely affect aquatic environments. However, in this case, the Service has no empirical data that shows that current grazing practices adversely affect the primary constituent elements (PCEs) of critical habitat for suckers in Clear Lake. Nevertheless, all appropriate evaluations under the ESA (Appendix S) and the NEPA will be completed to ensure protection of all listed species.

Gray wolf (*Canis lupus*) is listed as endangered under the federal ESA, as amended. Gray wolf potentially occurs on the refuge given occurrences within the vicinity, but there are no known modern occurrences.

Intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for federally listed species and their critical habitat. Any conservation measures, as well as terms and conditions resulting from intra-Service consultation under the federal ESA will be implemented to protect listed species and their habitat that occur on the refuge, as applicable.

The direct adverse effects of land management activities on Fish and Wildlife on Clear Lake Refuge are minor.

Pesticide Application

Using the results of a research study conducted in 2010 and 2011, the refuge would consider the use of herbicides in targeted areas. Application of pesticides would follow the procedures outlined in Appendix Q, Refuge Complex IPM Program. **Both adverse and beneficial indirect effects could occur to terrestrial plants and animals that are present within, or use, the area that would be treated with pesticides. Pesticide application to non-native invasive plant species could result in the following types of indirect impacts.**

- **Elimination of weeds through herbicide application could also reduce green matter or seeds for herbivorous and granivorous species (Boatman et al. 2004).**
- **Negligible short-term adverse effects by reducing a potential prey source (animals that consume invertebrates) for raptors that may have to subsequently forage elsewhere.**
- **Elimination of non-native plants would have a negative short-term minor effect but a long-term intermediate beneficial effect by helping to re-establish healthy native plant communities.**

Because the Service would follow all pesticide label restrictions and BMPs (see Appendices G, L, and Q), pesticides would not be applied directly to, or within the no-spray buffer of surface waters, indirect impacts to aquatic and terrestrial species would not be likely to occur.

The direct adverse effects of land management activities to fish and wildlife at Clear Lake Refuge are minor.

Public Use

Unlike Lower Klamath Refuge, Clear Lake Refuge is open for pronghorn hunting and is not open for pheasant hunting. Additionally, the number of waterfowl harvested here is different than at Lower Klamath Refuge. Although specifics vary, hunting on this refuge would have many of the same general effects as described for Lower Klamath Refuge (see Section 6.2.5). For example, hunting would have direct, lethal effects on individual game animals, and some individuals would be shot and not retrieved (crippling loss). See Section 6.2.5 for a description of crippling loss rates for waterfowl hunting. Among pronghorn hunters using rifles, wounding rates may range from 18% to 19% (Yoakum 1957). The Service was unable to locate crippling loss rates for pronghorn hunters using archery equipment. In recent years, only one pronghorn has been harvested by an archery hunter in the entire Clear Lake game management unit (CDFW 2016a).

The Service does not collect data on the number of waterfowl harvested at Clear Lake Refuge; however, because of the remote location of the refuge and the low number of hunters, it is believed that the number is low. The refuge is also open for hunting of common moorhens (*Gallinula chloropus*) and Wilson's snipe (*Gallinago gallinago*). However, these species are rare to uncommon on the refuge and no harvest data are collected for them. It is believed that if these species are harvested on the refuge, the numbers are very low.

The Service also does not collect data on pronghorn harvest at the refuge. The State of California manages pronghorn in this area as part of the Clear Lake game management unit (#2), of which the refuge is only a small part. A maximum of six permits are issued for pronghorn hunting on the refuge each year. Therefore, pronghorn harvest on the refuge totals seven or less each year including crippling loss.

As described in more detail for Lower Klamath Refuge (see Section 6.2.5), hunting and associated activities also have indirect, disturbance effects on both game and non-game wildlife. Because there is no vehicle access on site and use of boats is prohibited, such effects would be limited to those directly associated with actions of hunters and potentially dogs. When compared with non-hunted populations, ungulates (e.g., deer and pronghorn) that are hunted are generally more wary of humans, especially at dawn and dusk, and when humans are on foot, off trail, and approach animals in a threatening manner (Stankowich 2008).

As discussed earlier for Lower Klamath Refuge (see Section 6.2.5), the threat posed to waterbirds from lead shot has been addressed through the development of non-toxic shot for shotguns and the prohibition on use of lead shot for waterfowl and pheasant hunting. However, lead ammunition used for big game hunting can also pose a contaminant risk to wildlife in terrestrial environments, including through secondary poisoning of higher-level predators and scavengers. Lead poisoning can cause numerous physiological effects and behavioral changes, reducing an animal's ability to avoid predators and reproductive success, and increasing their susceptibility to starvation, infection by disease, and death by other causes (Fisher et al. 2006). Pain et al. (2009) reviewed published literature from across the globe on lead poisoning in terrestrial birds. They found that use of lead ammunition posed a threat to raptors such as hawks, eagles, falcons, owls, and vultures that preyed on or scavenged various game species. Additionally, species such as dove, quail, pheasant, and turkey were at risk because they mistook fragments of lead ammunition for grit.

Because lead accumulates in tissues, long-lived and slow-breeding species are of special concern. It has been widely reported that California condors (*Gymnogyps californianus*) have suffered lead poisoning (and associated morbidity and death) as a result of scavenging the carcasses of hunter-killed game animals or their gut piles (e.g., see Church et al. 2006). Kelly and Johnson (2011) found that blood lead concentrations in turkey vultures (*Cathartes aura*) in California were significantly higher during the big game hunting season when compared with those concentrations during the off season. They also found that the vultures' blood lead concentrations were positively correlated with increased big game hunting intensity. Interestingly, a study of four large scavenging mammalian carnivore species in the Yellowstone Ecosystem did not find that blood lead concentrations increased during the big game hunting season (Rogers et al. 2012).

A variety of actions have been taken to reduce the adverse effects to fish and wildlife of current hunting programs on the refuge. These include bag limits consistent with state regulations, limiting the duration of hunting on the refuge to no more than that allowed by relevant state seasons, maintaining sanctuary areas, requiring that shotguns be plugged to limit their capacity to a maximum of three shells, and requiring the use of approved, non-toxic shot. Additionally, refuge rules require hunters who bring dogs to ensure that they are under their owner's/handler's control at all times while on the refuge; that they are not allowed to chase, harass, injure, or kill wildlife; and that they are leashed except while used for hunting. Dog training and field trials are prohibited on the refuge. Readers are referred to the official regulations for hunting on Klamath Basin refuges (see 50 CFR 32, Hunting and Fishing) and to the compatibility determinations in Appendix G for more specific information about conditions (stipulations) associated with the waterfowl and pronghorn hunting opportunities offered on this refuge.

The Service and the California Department of Fish and Wildlife (CDFW) carefully manage game species on the bases of populations, not individuals. Direct mortality from hunting, including crippling losses, would not be expected to have any population-level effects on any of the game species hunted. The state has mandatory harvest reporting for all big-game species. It uses these data, combined with those generated by wildlife population surveys, and in consideration of habitat carrying capacity and depredation concerns, as the bases for establishing wildlife population objectives and making associated management decisions for these species. Such decisions include, for example, annual hunting regulations and allocations of tags among game management units. This system has proven very successful over the years in sustaining healthy populations of resident game species while maintaining associated recreational opportunities, including hunting. For more information about management of these big game species, see California's Final Environmental Document Regarding Pronghorn Antelope Hunting (California Department of Fish and Game 2004) and the 2012 California Pronghorn Antelope Status Report and Management Plan Update (Sommer 2012). See Section 6.5.2 for a description of the Service migratory bird management program.

Threats to suckers at Clear Lake Reservoir include avian predation (primarily by American white pelicans and double-crested cormorants) and prolonged drought (the reservoir is very shallow, evaporation and seepage rates are high, and low water inflows could potentially strand fish, limit their access to spawning areas, and/or concentrate them, increasing their vulnerability to disease, parasitism, and predation) (NMFS and Service 2013). Both suckers occur in the reservoir at Clear Lake Refuge which has been designated as critical habitat for the suckers. Use of boats is prohibited and hunting does not occur on the water at Clear Lake Refuge. Therefore, hunting and related activities would be expected to have no effects on suckers in the reservoir.

The American peregrine falcon and bald eagle are found at Clear Lake Refuge. Disturbance associated with hunting (e.g., vehicle and boat activity, and noise from motorboats and shotguns) may cause these species to relocate. This effect would likely be temporary and seasonal.

The minimal public use reduces the transfer of invasive species on to the refuge. Although maintained to limit the spread of invasive species, the continued closure of refuge roads to the public and limiting overland travel by the Service and cooperators also reduces wildlife disturbance.

The direct adverse effects of public use on fish and wildlife on Clear Lake Refuge are minor.

Beneficial Effects

These ongoing management activities are implemented to benefit wildlife that use the refuge, particularly the sage-grouse, although temporary disturbances can result during the activities. Removal of these invasive species enhances the quality of the habitat for sage-grouse (*Centrocercus urophasianus*), among other species, and there remains an abundance of habitat with a diversity of plant species to support objective levels of wildlife elsewhere across the refuge. **Removing juniper encroachment is highly effective at functionally restoring sage-grouse landscapes (Davies et al. 2011; Baruch-Murdo et al. 2013). Baruch-Murdo et al. (2013) conducted modeling of lek activity as a function of western juniper presence with the results showing that lek activity is reduced where small trees were dispersed, larger trees clustered, or canopy cover is over 4%, whether the areas had active encroachment or more established stands. Lek use by males is linked to female nest settlement (Bradbury et al. 1988).**

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative. No additional mitigation measures are being proposed.

<u>Alternative B (Preferred Alternative) – Clear Lake Refuge</u>

Land Management

Fire Management and Juniper Removal

The effects to fish and wildlife under Alternative B from land management actions would be the same as described in Alternative A. However, in addition to the management activities and associated impacts discussed under Alternative A, the Service would prepare both a Habitat Management Plan and a Wildlife Inventory Plan. The purpose of these plans is to identify new or improved techniques to restore sage-steppe habitats and to manage invasive plants. A combination of the land management actions described in Alternative A would likely form the basis of these plans. Under Alternative B, the Service would prioritize wildfire suppression activities to protect the "U" which would allow for accelerated sagebrush restoration. Wildfire suppression would continue under the Fire Management Plan.

The adverse effects of fire management and juniper removal would be minor.

Grazing Program

In addition to the approximately 5,000 acres that are currently grazed on the "U" unit, two experimental grazing plots for habitat restoration would be developed. During the early spring (wildfire restoration grazing) grazing would occur on two approximately 1,500-acre pastures set up on the east side of the Clear Lake "U" with 300 to 500 cattle. Radio-marked sage-grouse have been monitored since 2005 and no hens are known to nest in that area due to the lack of sage brush cover. By the time the dormant season grazing would begin (on the rest of the "U") all potential bird nesting would be over. **The Service would continue to allow approximately 300 head of cattle to graze on approximately 800 acres of the refuge along the western shoreline for 23 days in the summer under an interagency agreement with the U.S. Forest Service. However, the Service would work with the U.S. Forest Service to identify an alternative location/source of water for these cattle.** The adverse effects to fish and wildlife with the additional grazing areas would continue to be minor.

Pesticide Application

Under Alternative B, the same types of control actions as those presently used would be used initially to combat invasive species at the refuge. However, as monitoring results are used to direct rapid assessment and control actions, new outbreaks of priority invasive species (including the same or different species as occur on the refuge at present) would more likely be controlled when they were smaller in size. This would benefit the future quality of refuge wildlife habitats.

Research partnerships with the University of California Davis Intermountain Research and Extension Station would result in the development of control strategies (grazing, pesticide use, and perhaps other IPM techniques) that targeted exotic annual grasses while protecting native plants. Should studies reveal the effectiveness of new methods; the intent would be to restore the health and diversity of the native plant community (i.e., sagebrush, forbs, and perennial grasses) on the "U" and elsewhere on the refuge. Consistent with the IPM program and in the context of adaptive management, pesticides would remain one of several control methods used to manage invasive species.

The proposed pesticide use would not change under Alternative B. See Section 5.2.2, Biological Resources, Effects of Pesticides on Vegetation and Habitat Resources, and Fish and Wildlife, for a broader discussion of potential biological effects of pesticide applications.

The direct adverse effects to fish and wildlife from land management activities on Clear Lake Refuge would be minor.

Public Use

Wildlife impacts during construction of a viewing facility would also be temporary and limited to the immediate vicinity of the disturbance area. As discussed under Alternative A, temporary disturbances to wildlife could be adverse during the nesting and breeding seasons. These impacts will be analyzed further in project-specific NEPA documents once specific details on the management activities and new facilities are available.

Effects of hunting on fish and wildlife, including non-game species, under Alternative B would be the same as under Alternative A.

The direct adverse effects to fish and wildlife from public use on Clear Lake Refuge would be minor.

Beneficial Effects

Alternative B would have more of the beneficial effects on biological resources described for Alternative A from the increased improvements in habitat, invasive species, and fire management; inventory and monitoring; and visitor services.

Mitigation

BMPs (Appendix L) would be implemented to minimize adverse effects to fish and wildlife.

To reduce the risk of lead contamination of biological resources from the use of lead ammunition, a requirement to use non-toxic ammunition for pronghorn hunting on the refuge would be phased in under Alternative B. Prohibition of the use of lead ammunition for big game species would further reduce the likelihood that wildlife would be exposed to lead toxicity and associated morbidity and mortality as a result of hunting.

6.3.7 Cultural Resources

Methodology to Assess Effects – Clear Lake Refuge

Cultural resources are currently managed on a project-by-project basis as surveys identify resources where activities are proposed. The Service consults with the SHPO in compliance with Section 106 of the NHPA prior to implementation of management activities that could adversely affect historic properties.

The following is the resource-specific context for assessing effects of the alternative to cultural resources.

- Although the area on and around the Clear Lake Refuge was used extensively by Native Americans, and there is an abundance of cultural resource sites, there have not yet been any nominated for inclusion in the NRHP.

Alternative A – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Wildfire suppression would involve moving in fire equipment and crews, the number of which would depend on the size of the wildfire. Suppression activities can involve driving engines across refuge land, digging fire lines, using air tankers, or helicopters with fire buckets. Within the refuge, minimum impact suppression tactics would be used if at all possible. This can include keeping fire lines to a minimum depth and following natural contours, identifying and protecting archaeological sites prior to the fire, and using a cultural resource advisor and resource advisor on all extended attack wildfires. Suppression activities can adversely affect cultural resources. Within the refuge boundary there are 11 recorded prehistoric sites (i.e., worked stone, stacked rocks, cleared areas, bedrock mortar) and one recorded historic site (i.e., rock enclosure). The Service would take all necessary steps to comply with cultural resource laws and regulations on their

discovery. More information about the Service's process for implementing cultural resource protection is provided under the section on Lower Klamath Refuge, Cultural Resources (6.2.7). The adverse effects of fire management and juniper removal on cultural resources would be avoided by prohibiting these activities in areas where it could damage cultural resources. As a result, impacts of Alternative A on cultural resources are considered neutral.

Grazing Program

Livestock grazing can have adverse effects to cultural resources as cattle may trample sites that are exposed through natural erosion or fluctuating lake levels. Grazing would be prohibited in any areas where grazing could adversely affect cultural resources; therefore, potential adverse effects would be neutral.

Pesticide Application

Pesticide application would continue to be evaluated and permitted according to Service and DOI policies. Application of pesticides would not affect cultural resources.

Public Use

The refuge is only open to waterfowl and big game hunting and visitation numbers are low. While hunters could trample cultural resources, or could collect artifacts the Service concluded that Alternative A would have neutral or negligible effects to cultural resources due to public use activities.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing on the NRHP until formally evaluated in consultation with the SHPO.

Stipulations in the grazing agreements shall prohibit ranchers from disturbing, collecting, and removing any archaeological or historic artifacts from the refuge.

Stipulations in the grazing agreements also require that if reservoir levels drop to extremely low elevations, ranchers are required to take appropriate actions to keep livestock away from newly exposed, sensitive areas that contained cultural resources or remove the livestock from the refuge.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

Fire Management and Juniper Removal

Under Alternative B the Service would prepare both a Habitat Management Plan and a Wildlife Inventory Plan. The purpose of these plans is to identify new or improved techniques to restore sage-steppe habitats and to manage invasive plants. A combination of the land management actions described in Alternative A would likely form the basis of these plans. Under Alternative B the Service would continue juniper removal and wildfire suppression activities to protect the "U" which would allow for accelerated sagebrush restoration. Wildfire suppression would continue under the Fire Management Plan.

Grazing Program

In addition to the approximately 5,000 acres that are currently grazed on the "U" unit, two experimental grazing plots for habitat restoration would be developed. During the early spring (wildfire restoration grazing) grazing would occur on two approximately 1,500-acre pastures set up on the east side of the Clear Lake "U" with 300 to 500 cattle. Radio-marked sage-grouse have been monitored since 2005 and no hens are known to nest in that area due to the lack of sage brush cover. By the time the dormant season grazing would begin (on the rest of the "U") all potential bird nesting would be over. Prior to opening these areas to grazing a survey for cultural resources would be conducted. Grazing would be prohibited in any areas where grazing could adversely affect cultural resources; therefore, potential adverse effects would be neutral.

Pesticide Application

Under Alternative B, the same types of control actions as those presently used would be used initially to combat invasive species at the refuge. However, as monitoring results are used to direct rapid assessment and control actions, new outbreaks of priority invasive species (including the same or different species as occur on the refuge at present) would more likely be controlled when they were smaller in size. This would benefit the future quality of refuge wildlife habitats.

Research partnerships with the University of California Davis Intermountain Research and Extension Station would result in the development of control strategies (grazing, pesticide use, and perhaps other IPM techniques) that targeted exotic annual grasses while protecting native plants. Should studies reveal the effectiveness of new methods; the intent would be to restore the health and diversity of the native plant community (i.e., sagebrush, forbs, and perennial grasses) on the "U" and elsewhere on the refuge. Consistent with the IPM program and in the context of adaptive management, pesticides would remain one of several control methods used to manage invasive species.

The proposed pesticide use would not change under Alternative B. See Section 5.2.2, Biological Resources, Effects of Pesticides on Vegetation and Habitat Resources, and Fish and Wildlife, for a broader discussion of potential biological effects of pesticide applications.

The direct adverse effects to cultural resources from land management activities on Clear Lake Refuge are neutral.

Cultural resources effects and management would be similar under Alternative B as described for Alternative A. Under Alternative B, the Service would prioritize wildfire suppression activities to protect the "U" to allow for accelerated sagebrush restoration. Because the "U" is known to have cultural resources**, fire management and juniper removal would be prohibited in areas where those activities could damage cultural resources to ensure there are no** additional effects to cultural resources.

Public Use

Cultural resource effects would be similar under Alternative B as described for Alternative A. Additionally, a cultural resource review would help identify an appropriate location for a wildlife viewing facility on the refuge. If any cultural resources are identified during the review the Service would then evaluate the property to determine the effects and what level of mitigation may be needed.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Mitigation

The measures to mitigate adverse effects to cultural resources would be the same as for Alternative A.

6.3.8 Visitor Services

Recreation Opportunities

Methodology for Assessing Effects – Clear Lake Refuge

Staff knowledge was used to predict the effects of land management and public use on recreational opportunities.

The following is the resource-specific context for assessing the effects of alternative to recreation opportunities.

- The refuge is only open for waterfowl and big game hunting.

Alternative A – Clear Lake Refuge

Land Management

Land Management activities are focused on improving wildlife habitat for sage-steppe species. The refuge is not currently open to public use except for hunting and those effects are described below. Adverse effects to visitor services are considered neutral.

Public Use

The Service currently offers limited recreation opportunities at the refuge. Hunting is allowed by walk-in access, and wildlife viewing is only available from outside the refuge boundaries. Off-site educational programs and outreach are offered at the Refuge Complex Visitor Center, on the Refuge Complex website, and for nearby schools to teach about sage-grouse and sage-steppe habitat. Visitor use is monitored as part of the Refuge Complex-wide monitoring program. The current recreation opportunities provide limited benefits to the public.

The refuge is open to more than one type of hunting (i.e., waterfowl and big game). Conflicts between hunters pursuing different game species are avoided through use of temporal and/or spatial zoning (i.e., the hunts are held at different times and/or in different areas).

Habitat and hunting are evaluated every year and, if deemed necessary, areas will be closed. Hunter numbers are typically self-regulating due to the remote location of the refuge s (habitat conditions are posted on the web pages and announced in the hunter "hotline;" when there is little habitat most hunters choose not to come). However, if needed, hunter numbers are managed to reduce pressure.

There would be no conflicts between hunting and non-hunting visitors on site at the refuge because it is closed to non-hunting visitors. However, visitors observing and photographing wildlife just outside the boundary could find hunting objectionable on a refuge. Some could be upset at the sound of gunfire; the sight of shot birds falling from the sky, or a pronghorn carcass in the back of a pickup truck; or the potential find of a hunter-crippled game animal, or an injured or dead non-target species. Such experiences could affect the quality of their visit. Additionally, hunting-related disturbance could cause birds and other wildlife to flee from hunt zones and potentially move elsewhere on the refuge, including into an area that is closed to hunting, or move off of the refuge. Such wildlife movements could either enhance or reduce wildlife viewing and/or photography opportunities for other visitors. The effects of public use on recreational opportunities are considered neutral.

Beneficial Effects

Although the refuge supports limited wildlife-dependent recreation, waterfowl and big game hunting allows a segment of the public to connect with nature. Additionally, interpretive media and environmental education programs at the Complex Visitor Center along with outreach effort does increase understanding and appreciation of the refuges habitat and wildlife.

Mitigation

The BMPs (in Appendix L) include measure to avoid and minimize adverse effects to refuge resources and are incorporated into this Alternative.

Alternative B (Preferred Alternative) – Clear Lake Refuge

Land Management

The goal of the land management activities is to improve wildlife habitat on the refuge. These improvements can enhance wildlife-dependent recreational opportunities as described below. The effects of land management on visitor services are considered neutral.

Public Use

Under Alternative B, wildlife viewing at the refuge would be improved through construction of a viewing facility on the refuge border. This facility would encourage visitation to the refuge by providing a better viewing area for wildlife observation and photography and interpretation although wildlife viewing would still only be allowed from outside the refuge. To maintain quality observation opportunities from the viewing platform, it will likely be necessary to cut invasive western juniper trees and seedlings.

The projected increase in visitors would likely be similar to past trends of visitors, as discussed in the Effects on Social and Economic Conditions. Considering the rural nature of the refuge, the development of a viewing facility would not lead to other substantial impacts (e.g., from increased use of facilities).

Access within the refuge would continue to be by foot from off-site parking. Walk-in access would continue to be allowed only for hunting, and the hunt program would be modified to require non-toxic ammunition. Under Alternative B the hunt program would be modified by including a requirement that pronghorn hunters on the refuge use non-toxic (non-lead) ammunition. Some hunters (an unknown number) could be dissuaded from hunting on the refuge due to the reduced availability and increased cost of this ammunition. Additional off-site public use opportunities would include expanded interpretive information at the Refuge Complex Visitor Center and expanded environmental education by establishing a sage-grouse monitoring program with local high schools. These opportunities would benefit the local public by providing additional information, more educational and interpretive opportunities, and coordination with the refuge. The effects of public use on recreational opportunities are considered neutral.

Beneficial Effects

The beneficial effects would be the same as Alternative A, plus the construction of a viewing facility would open the refuge to a wider range of wildlife-dependent recreation, increasing the opportunities for a variety of visitors to connect with nature. Also expanded off-site public use opportunities would enhance visitors' understanding of the refuge system and their awareness and appreciation of the refuge's wildlife, habitat and cultural resources.

Mitigation

BMPs (Appendix L) would be implemented to protect refuge resources including recreational opportunities on the refuge.

6.3.9 Social and Economic Conditions

Methodology to Assess Effects – Clear Lake Refuge

The Service prepared an Economic Analysis of the Klamath Basin Refuge Complex CCP alternatives, which is provided in Appendix P. The economic analysis looked at the regional economic conditions and evaluated the economic effects of the various management alternatives.

The following is the resource-specific context for assessing effects of the alternatives on social and economic conditions.

- Refuge management contributes to the local economy through recreational opportunities.

Alternative A– Clear Lake Refuge

The Service would continue to operate and manage Clear Lake Refuge as it has in the past, and the contribution of the refuge to the regional economy from direct and indirect expenditures would be expected to be similar to current conditions. The refuge budget would remain similar to the current budget, which is a portion of the $4 million annual budget for the Refuge Complex, and ongoing management and maintenance projects would continue to be implemented, as feasible within the budget. Visitation to the refuge would likely be similar to current and past trends. In 2015, the Service estimated 75 hunting visitors.

This paragraph summarizes economic effects discussed in more detail in an Economic Analysis of Klamath Basin Refuge Complex (Appendix P). In 2015, the Service estimates that the refuge grazing program on the refuge contributes annual sales of about $600,000 and five jobs to the economy. A portion of the jobs created from visitor related spending is attributable to the hunt program at Clear Lake Refuge. In addition, the regional economy benefits of administering the refuge program at Clear Lake Refuge contributes three jobs to the region. (Appendix P, Economics Analysis).

Alternative B (Preferred Alternative) – Clear Lake Refuge

Under Alternative B for Clear Lake Refuge, implementation of management activities in the Clear Lake Refuge may result in:

- a short-term increase in refuge spending and regional economic activity due to construction or modification of facilities;
- little to no net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase in 0.1);
- a minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation; and
- an increase in agricultural production due to an increase in grazing. Increased productivity could range from a low sales increase of $328,500 to a high of $527,500. This could result in an increase of up to three jobs added to the regional economy.

Summary of Effects – Clear Lake Refuge

Table 6.6 summarizes the potential effects of the two alternatives being considered for the Clear Lake Refuge.

Table 6.6. Summary of Effects for Clear Lake Refuge

	Alternative A	*Alternative B (Preferred Alternative)*
Effects on Soils		
Land Management		
Fire Management and Juniper Removal	Negligible	Negligible
Grazing	Minor	Minor
Pesticide Applications	Negligible	Negligible
Public Use	Minor	Minor
Hydrology		
Land Management		
Fire Management and Juniper Removal	Minor	Minor
Grazing	Minor	Minor
Pesticide Applications	Neutral	Neutral
Public Use	Negligible	Negligible
Effects on Water Quality		
Land Management		
Fire Management and Juniper Removal	Minor	Minor
Grazing	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Negligible	Negligible
Effects on Air Quality		
Land Management		
Fire Management and Juniper Removal	Minor	Minor
Grazing	Minor	Minor
Pesticide Applications	Neutral	Minor
Public Use	Negligible	Minor
Effects on Vegetation and Habitat Resources		
Land Management		
Fire Management and Juniper Removal	Minor	Minor
Grazing	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Minor	Minor
Effects on Fish and Wildlife		
Land Management		
Fire Management and Juniper Removal	Minor	Minor
Grazing	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Minor	Minor
Effects on Cultural Resources		
Land Management		
Fire Management and Juniper Removal	Neutral	Neutral
Grazing	Neutral	Neutral
Pesticide Applications	Neutral	Neutral
Public Use	Neutral	Neutral
Effects on Visitor Services		
Land Management		
Fire Management and Juniper Removal	Neutral	Neutral
Grazing	Neutral	Neutral
Pesticide Applications	Neutral	Neutral
Public Use	Neutral	Neutral

6.4 Tule Lake National Wildlife Refuge

This section describes the potential impacts of the No Action Alternative and two action alternatives for Tule Lake Refuge. Impacts are judged for significance using the thresholds described in the introduction of this chapter. Mitigation measures for potentially adverse effects are described in the list of BMPs (see Appendix L).

The following resources would not be affected by the alternatives and are not carried forward for further analysis.

- **Geology** (not affected). Given the limited management actions currently implemented and proposed on the refuge, no effects to geologic resources would occur.
- **Paleontological Resources**. There is potential for as yet undiscovered paleontological resources to be affected during ground-disturbing activities. Should any paleontological resources be discovered by the Service, they would be conserved in place or deposited in an approved repository. On Service-owned land the public is not allowed to remove any paleontological resources from the refuge. As a result of protections under the Paleontological Resources Preservation Act (PL 111-011) (Omnibus Public Land Management Act of 2009), no effects to paleontological resources would occur.

6.4.1 Soils

Methodology for Analyzing Effects – Tule Lake Refuge

Reports on the soil types within the refuge boundary that are available online through the NRCS were consulted to assess relative susceptibility to compaction and erosion of different soils. These finding were applied generally to help understand how land management actions and public use activities might affect the physical qualities of the soil.

The following are resource-specific contexts for assessing effects of the alternatives to soil resources.

- Construction-related impacts would be localized.
- Soils within the refuge boundary and outside of the refuge boundary have been historically disturbed or altered.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

For the purposes of this CCP, managed wetlands are those managed for wetland functions and where water is intentionally and actively applied annually through a managed process (Service and Reclamation 2000). Walking wetlands (flood fallow lands) are addressed under the *Farming* sections. On Tule Lake Refuge, wetland management is focused on Sumps 1A and 1B. Water levels in these sumps are managed to protect private property from flooding and provide wildlife habitat. Most of the area is comprised of open water dominated by submergent plant communities with extensive periodic blooms of filamentous green algae. The refuge does not use prescribed fire or mechanical treatments to manage wetland habitat on this refuge.

The effects of wetland management on soils is considered minor based on the extent and duration of activities.

Farming Programs

Soils on the Tule Lake Refuge are some of the most productive agricultural soils in the Basin because they are deep and have 5% to 15% organic matter. The soils on the refuge are deep muck soils that were formed with the land was covered by water. The farmed area of the refuge is primarily comprised of Tulebasin mucky silty clay loam. Agricultural activities regularly disturb soils during planting and harvesting of crops. Typical farming practices include prescribed burning, flood irrigation, tilling, rotational flood-fallow, application of pesticides, and variation in the timing of these practices. Tilling and disking have the greatest potential to affect soil because each time soil is tilled or disked, it is exposed to air which can reduce the organic matter level in the soil. Tilling and disking can also disrupt the abundance and diversity of flora and fauna in near-surface soils. Prescribed burning reduces surface vegetation prior to tilling and planting. The vegetative stubble that is burned is a low fuel which means that the fire moves across the landscape so quickly as to have minimal effects on soil. Prescribed fire can be completed on many fields in less than an hour. Croplands may be burned annually. Farm fields are then tilled and disked to eliminate weeds. Fields are then planted with grains or row crops. On Tule Lake Refuge the soil nutrient levels are maintained through the addition of compost/fertilizer. Annually, this process occurs on up to 46% of the refuge (14,800 acres on lease land units and 2,300acres on cooperatively farmed fields).

Flood fallowing (or walking wetlands) is an agricultural practice that enhances soil fertility and crop yields, and suppresses soil pathogens and weeds. Flood fallowing is a process by which a farm field is flooded either seasonally (fall through spring) or year-round for a 1- to 4-year fallow cycle before being returned to agricultural production. Flood fallowing reduces the need for fertilizers and pesticides and some of the adverse effects on soils, water quality, vegetation, and wildlife that can be associated with their use. Between 0 and 2,700 acres of walking wetlands may be on the refuge between lease land units and cooperatively farmed fields. In addition to providing wetland habitat for wildlife, flood fallowing also enhances soil fertility and crop yields, and suppresses soil pathogens and weeds. In addition to environmental benefits, farmers are able to sell organic crops at a higher market price. Under Alternative A, the Service would complete construction of dikes around lease land lots in Sump 3 where walking wetlands management is feasible.

Farming requires the use of a variety of equipment on the refuge including tractors, trucks, hay rakes, hay balers, and the personnel to operate these machines. Personnel is on site as needed throughout the season to monitor the fields/crops and perform appropriate farming related functions.

Farming activities can expose soils on the refuge to wind and water erosion. To minimize wind erosion, the refuge does not allow farmers to burn weeds unless there is sufficient water to flood the field. Other practices to reduce erosion include summer flood fallow and spring levee seeding and irrigation. In years when water is available, a summer flood fallow plan is implemented on some cooperative farming units. A summer flood fallow plan consists of flooding the agreed upon unit immediately after harvest for a period of time determined by refuge management, but no later than February 15 of the second year following the harvest. Fall or spring cover crops planted or other provisions on row crop fields may be required to protect soil from wind erosion. Spring

seeding and irrigating grass plantings on levees is done to control weeds and reduce erosion. Construction of the dikes around lease land lots in Sump 3 would be done in one season and would follow construction BMPs (see Appendix L). The effects of farming on soils are considered intermediate based on the extent of farming on the refuge.

Pesticide Application

As part of the ongoing IPM activities, pesticides are used to control weeds for the farming program as well as to control invasive plant species, and maintain refuge facilities. Pesticides can fall on the soil surface as a result of overspray and wind drift; pesticide spray missing its mark; excess pesticide dripping from plant stems, leaves, or other plant parts; or spillage from storage, mixing, loading, equipment cleaning, and disposal areas. Pesticides are only applied after the approval of a PUP. When pesticides are used, the Service follows standard BMPs (Appendix L) to reduce adverse effects to soil, including adherence to all USEPA and Oregon or California EPA warning labels and application requirements. During the PUP process the Service considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the physical environment associated with the proposed site-, time-, and target-specific use of pesticides on the refuge are evaluated using the chemical profile prepared for the pesticide.

Prior to approval of the PUP, the mobility of the pesticide in soil and their potential toxicity is considered as follows. Once on the ground surface, pesticides can volatilize, be transported by wind or water across the land in their applied form or adsorbed to soil particles, be adsorbed and stay on top of or near the soil surface, or be degraded through exposure to weathering (Fishel 2003; O'Callaghan 2002; van Es and Trautmann 1990). Soil adsorption occurs to a greater degree in drier soils that are high in organic matter or clay and certain pesticides (e.g., glyphosate) are more tightly bound than others (Fishel 2003; van Es and Trautmann 1990). Pesticides on the soil surface or in the soil profile can also be changed into more- or less-toxic forms through microbial actions (metabolization by soil bacteria and fungi), chemical reactions (oxidation, reduction, and hydrolysis), and photochemical reactions (photolysis) (Fishel 2003; NRCS 1998; van Es and Trautmann 1990). These actions are influenced by the physical and chemical properties of the pesticide; exposure to and the intensity of sunlight; the degree the pesticide adsorbs onto soil particles; and soil conditions, such as moisture, temperature, aeration, pH, and amount of organic matter (Fishel 2003; van Es and Trautmann 1990). Depending on their chemical makeup and persistence, some pesticides may remain at or near the soil surface for extended periods of time. Again, depending on their chemical properties, concentrations, and other factors, the existence of some pesticides or their decomposition products in the soil profile could prove toxic to some soil-dwelling organisms and plants, including farm crops (Lindgren et al. 1954). This range of soil/pesticide interaction is considered during the PUP process.

The PUP (including appropriate BMPs) is approved when scientific evidence indicates that effects to refuge biological resources and its physical environment are likely to be minor, temporary, or localized in nature.

The types of pesticides that have been approved for use are listed in the previous chapter in Table 5.25. Annual pesticide application on the cooperative farming lands have ranged from 532 acres in 2011 to 1,735 acres in 2014 (see Table 5.26). Annual pesticide application targeting invasive species management and facility maintenance have ranged from 647 acres in 2011 to 2,004 acres in 2014 (see Table 5.28). Pesticide application on the lease lands has ranged from 53,342 acres in 2011 to

96,691 acres in 2013 (see Table 5.20); this acreage includes lease lands on both Lower Klamath and Tule Lake Refuges.

On cooperative farm units, the Service uses the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on these units. On cooperative farm units that are farmed organically, only pesticides that meet the standards outlined by the National Organic Program criteria are used. However, if environmental or economic forces affect the attractiveness of refuge cooperative farmland to organic growers, then the spectrum of PUPs approved by the PUP Committee for Lease Land crops, may be used on the cooperative farm fields. While desirable, the Service will not make organic agriculture a strict requirement of either lease land or cooperative farm units because organic agriculture is dependent on a consistent water supply and external economic forces.

The effects of pesticide applications on soils are considered negligible.

Public Use

The Tule Lake Refuge is open to the public for wildlife observation and photography, interpretation, environmental education, and hunting. In general, public use activities have minimal effects on soil because the activities are normally conducted on developed trails or in public facilities. Hunters, however, use a wider portion of the refuge and frequently travel off trail. Hunters, including their vehicles, boats and trailers, and dogs, can also compact soils, and generate dust and erosion. These effects would be localized primarily on access roads, trails, and at boat-launch sites. Informal observations by refuge staff have not identified adverse effects to soils from public use. Therefore, the Service anticipates that there would be negligible, short-term adverse effects to soils from public use activities.

Beneficial Effects

Maintaining a balance of wetland and farmed areas improves the long-term productivity of soils on the refuge.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L) and in the conditions that are included in the cooperative farming or lease land agreement. No additional mitigation measures are being proposed.

<u>Alternative B – Tule Lake Refuge</u>

Land Management

Wetland Management

Under Alternative B, the Service would develop and implement a Habitat Management and Wildlife Inventory and Monitoring Plan. This plan is likely to incorporate all of the land management activities described in Alternative A. Under Alternative B, a berm management program would be implemented. The re-vegetation of dikes as part of the berm management program would reduce soil erosion along the dikes by stabilizing and protecting soils and improving cover for nesting waterfowl and other species. The potential for soil erosion under

Alternative B would be somewhat reduced when compared to Alternative A. Adverse effects to soils would be considered minor.

Farming Programs

The aerial extent of farming on the refuge would not change under Alternative B, but the types of crops and some farm management practices would be modified. For example under Alternative B, the amount of standing grain left on the refuge would be increased to 1,500 acres to support dabbling duck and geese populations in the winter and spring. In addition, the Service would strive to ensure a minimum of approximately 1,380 acres of walking wetlands on the refuge, so that all fields are within 1 mile of a wetland. Under the Walking Wetlands Program, fields are rotationally returned to wetlands using specific water management regimes. After several years in wetland status the fields are returned to the farming program. To support an increase in the acreage of walking wetlands the Service would construct small dikes around lease land lots in Sump 2 (an estimated 48 linear miles). The construction of these dikes could result in soil erosion during the construction process. The increased acreage of standing grain and walking wetlands would not increase the potential for soil erosion over that described for Alternative A. Walking wetlands is essentially a farming practice of flood/fallow to allow soils to improve in quality. Adverse effects to soils would be considered intermediate. Although effects to soils would be reduces as compared to Alternative A with the additional walking wetlands, overall, there would be intermediate effects to soil under Alternative B.

Pesticide Application

The effects on soils of pesticide application would be the same as described above for Alternative A. Under Alternative B, the pesticide application process would be formalized in the Integrated Pest Management Program (Appendix Q). Pesticide application would continue to be authorized only after the approval of a PUP. **The Service would continue to use the PUPs authorized through the Lease Land PUP Committee as the master set of pesticides that can be used on Tule Lake Refuge cooperative farm units, as described under Alternative A.** The effects of pesticide applications on soils are considered negligible.

Public Use

In addition to the effects described under Alternative A, Alternative B would involve development of vehicle pull-offs along the auto tour route, construction of a floating boardwalk next to the education center on the permanent pond at Discovery Marsh, modifications to the visitor center entrance, improving the Sheepy Ridge Trail to improve drainage and reduce erosion, work with the National Park Service (NPS) to develop a trail to the top of the Peninsula Unit, and possible modification of the auto tour route to benefit hunting (e.g., if it is realigned or relocated). Construction activities would result in soil disturbance in relatively small areas where these facilities are modified, but could expose the soil to erosion or result in a loss of topsoil, depending on the specific location and details of the facility. For example, construction of the vehicle pull-off or the floating boardwalk would be in level areas and the overall construction area would be fairly small (less than 0.25 acre). The Sheepy Ridge Trail improvement and trail to the top of the Peninsula Unit would be more subject to erosion because of the slope and the higher erosion potential of the soils (see Figure 5.14). These impacts would be analyzed further in project-specific NEPA documents once specific details on the facilities and site-specific location are available. Under Alternative B the Service would pursue a partnership with the State of California to

develop and operate a portable decontamination station(s) near refuge boat launches. This would have no effect on soils.

While ongoing public use would have negligible, short-term effects on soils, potential impacts from visitor services improvements could have minor, short-term effects on soils. Therefore, the overall assessment of public use effects on soils is minor and short-term.

Beneficial Effects

Increasing the acreage of walking wetlands on the refuge would increase the resiliency of soils. Farmers that have participated in walking wetlands rotations have reported suppressed populations of soil pathogens to crops, and enhanced soil fertility and tilth.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative C (Preferred Alternative) – Tule Lake Refuge

Land Management

Wetland Management

Under Alternative C, the Service would develop a plan to manipulate water elevations in Sumps 1A and 1B to improve wetland diversity and productivity. Water manipulation could increase soil erosion along the banks; however, these effects are expected to be minimal due to the presence of emergent wetland vegetation in the sump that helps protect the soils from erosion. All other effects would be the same as described under Alternative B. Adverse effects to soils would continue to be minor.

Farming Programs

The changes made to the farming program under Alternative C consist of expanding the number of units that are farmed organically and increase the **attractiveness of agricultural lands to waterfowl with fall flooding. As under Alternative B, the Service would strive to ensure a minimum of approximately 1,380 acres of walking wetlands on the refuge, so that all fields are within 1 mile of a wetland.** In general, effects to soils would be very similar to Alternative B. Adverse effects to soils would continue to be intermediate given the extent of farming on the refuge.

Pesticide Application

The application of chemical pesticides would be slightly reduced with the conversion of farmed units to organic units. This change would not affect soil erosion. The overall effects to soils would be the same as described under Alternative B. Adverse effects to soils from pesticide application would be negligible.

Public Use

Soil-related impacts under Alternative C would be the same as those described for Alternative B. The requirement under Alternative C to use 4-stroke (4-cycle) or direct injection motors for boating would have no effect on soils. Adverse effects to soils would be minor.

Beneficial Effects

The expanded incentives to manage fields organically are expected to reduce the use of pesticides and associated potentially adverse effects and result in indirect beneficial biological effects to all natural resources on the refuge, including soils. The increased interspersion of wetlands within the farmed areas would reduce soil pests, increasing the soil productivity.

Mitigation

Appropriate BMPs (Appendix L) will be implemented during restoration and construction activities to minimize indirect effects of soil disturbance, including dust, erosion, and sedimentation.

6.4.2 Hydrology

Methodology for Analyzing Effects – Tule Lake Refuge

To evaluate hydrology, the Service obtained information about the annual pattern of water deliveries to the refuge and considered those water deliveries in relation to our management practices.

The following are resource-specific contexts for assessing effects of the alternatives to hydrology.

- Water is delivered to the refuge through the Klamath Reclamation Project.
- The regional hydrology has been greatly altered through development in the Klamath Basin.
- Within the refuge there is a system of canals, ditches, and water control structures that are used to flood various units.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

Wetlands at the refuge are located on the shores and in the lakebeds of sumps. Hydrology of the sumps at the refuge is dependent on the Klamath Reclamation Project managed by Reclamation, which limits the ability of the Service to modify water levels and manage the wetlands in Sumps 1A and 1B. Most of the inflow to the refuge is from return flows for agricultural lands derived from the agricultural allocation from the Klamath Reclamation Project. Because of the restrictions of the Klamath Reclamation Project, the availability of return flows for the refuge is not guaranteed, and shortages can prevent the Service from managing the refuge to fully achieve its purpose (as a refuge and breeding ground for wild birds and animals). Agricultural acres rotated into wetlands may potentially result in a slight reduction of water use during the early part of the growing season, which may potentially increase water availability for other uses during that time. An increase in the acreage in walking wetlands may also result in less agricultural

runoff into Sump 1A at certain times of the year, which would require less water to be pumped out to maintain required water levels in Sump 1A.

Water for the agricultural lands in Sumps 2 and 3 is **delivered by TID to all public lands within the district in equal priority as private lands.** Water shortages can occur and affect the availability of water for agricultural lands on the refuge.

Despite the current restrictions on water availability at the refuge, the Service would continue to improve water conservation and efficiencies to optimize water use. For example, water conveyance structures are maintained in good working condition, flood fallow (the Walking Wetlands Program) is promoted as an agricultural practice (see Farming, below), and slopes on levees are graded to promote greater water recharge. In addition, some fields have been leveled to provide more efficient water flow. Surface water diversions to flood wetlands are expected to remain the same on refuge lands with existing managed wetlands. The effects of wetland management on hydrology would be negligible.

Farming Program

Alternative A includes an average of 1,100 acres (range 0–2,700 acres) in the Walking Wetlands Program on refuge lease lands and cooperatively farmed units. For refuge lands in the Walking Wetlands Program, water diversions to flooded wetlands occur primarily in the later part of the growing season (late summer) to provide waterfowl habitat. For refuge lands in agricultural production, water diversions would be expected to occur in the spring/summer growing season for crops. Implementation of the No Action Alternative (Alternative A) would not result in changes to this allocation, and so is expected have no effect on hydrology relative to existing conditions. Discussion of the changes to natural hydrology at the refuge are available in this document in Sections 1.6.3 and 6.7.3.

Impacts to hydrology in the reservoir from management at the refuge are primarily limited to a possible occasional discharge of sediment via surface runoff following fire. The extent and severity of a fire determine extent of vegetation and organic matter burned, area of soils exposed, and resulting erosion. Prescribed burns are generally of lower intensity and generally result in less erosion than do larger wildfires in fire-suppressed landscapes. Therefore, although prescribed fires may result in occasional discharge of sediment via surface runoff after a burn, the use of prescribed fires likely reduces the chance of catastrophic wildfire which would result in much greater sediment discharges. These low intensity prescribed fires can thin vegetation, promote herbaceous vegetation, increase ecosystem heterogeneity, and increase plant available nutrients (Neary et al. 1999). Additionally, the removal of old plant growth and increased availability of nutrients can stimulate vegetation growth, ultimately enhancing sediment and nutrient retention over longer time frames (Kotze et al. 2013). Overall sediment accumulation from prescribed burns will and have negligible effects on hydrology.

Under Alternative A, because water use on the refuge is not expected to change substantially in the future and BMPs (Appendix L) would be implemented, land management activities are expected to have a neutral effect on hydrology.

Pesticide Application

Effects to hydrology from pesticide use for the cooperative farming and invasive species management programs is minor. Potential effects to water quality are addressed below in Water Quality, Section 6.4.3.

Public Use

Under Alternative A, visitor uses would continue to be confined to existing roads, trails, and viewing platforms on the refuge. Ongoing public use would not alter the existing drainage patterns on the refuge. Public use activities on the refuge are expected to have minor effects on hydrology.

Beneficial Effects

Implementation of the No Action Alternative (Alternative A) is expected to have no significant effect on hydrology.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B – Tule Lake Refuge

Land Management

Wetland Management

Under Alternative B, water management for wetlands would remain substantially the same as with Alternative A except that the area and interspersion of managed wetlands would increase as described under Farming, below.

As another source of water, the Service may consider the use of groundwater in the southern portion of the refuge. Depending on the specific quantity of groundwater pumped for refuge use, impacts to the groundwater aquifer could be substantial. Gannett et al. (2007:62) identified for the Tule Lake sub-basin that "If the post-2000 pumping rates continue in the future, the regional ground-water system possibly will eventually achieve a new state of dynamic equilibrium. This will occur when the depression in the water table is large enough to redirect sufficient regional ground-water flow into the area to offset the increased pumping. At equilibrium, however, the increased discharge in the area of pumping must be offset by decreased discharge elsewhere, likely manifesting itself as a combination of decreased discharge to adjacent basins and decreased discharge to streams, lakes, and wetlands." Effects of using groundwater at the south end of the refuge would be analyzed in a subsequent NEPA document once specific details on the facilities and proposed groundwater usage are available. The effects of wetland management on hydrology under Alternative B would be negligible.

Farming Program

Under Alternative B, the **Service would strive to maintain approximately 1,380 acres in the Walking Wetlands Program** and increase interspersion of **these** wetlands within lease land agricultural crop units. As a result, **it is likely that** more lands would be rotated from agricultural crops to wetlands. Shifting lands into the Walking Wetland Program may result in some changes in the timing of water use (shifting water use slightly from spring/summer to late summer use to provide waterfowl habitat). Agricultural acres rotated into wetlands may potentially result in a slight reduction of water use during the early part of the growing season, which may potentially increase water availability for other uses during that time. An increase in the acreage in walking wetlands may also result in less agricultural runoff into Sump 1A at certain times of the year, which would require less water to be pumped out to maintain required water levels in Sump 1A. However, these changes in timing of water use are expected to have a negligible effect on hydrology.

Pesticide Application

The effects on hydrology from pest management practices, including pesticide use for the cooperative farming and invasive species management programs under this alternative would be the same as described above for Alternative A; no adverse effects to hydrology are expected.

In summary, under Alternative B, because water use on the refuge is not expected to change substantially as compared to Alternative A and BMPs (Appendix L) would be implemented, land management activities are expected to have minor effects on hydrology.

Public Use

Under Alternative B visitor uses would continue to be confined to existing roads, trails, and viewing platforms on the refuge. The additional pull-off areas would be located along existing auto tour routes. Because public use would not alter the existing drainage patterns on the refuge and BMPs (Appendix L) would be implemented, public use under Alternative B would minor effects on hydrology.

Beneficial Effects

Implementation of CCP activities including land management practices of wetland management, farming, and pesticide applications are expected to have no effects on hydrology. None of the changes proposed under Alternative B would alter the existing drainage pattern on the refuge.

Mitigation

With both Alternatives B and C, the use of groundwater as a water source for the refuge may require balancing groundwater withdrawal with aquifer input to minimize adverse effects to the aquifer. Specific measures would be identified and evaluated in a subsequent NEPA document during consideration of this proposed strategy.

Alternative C (Preferred Alternative) – Tule Lake Refuge

Land Management

Wetland Management

Hydrologic management of the refuge under Alternative C would be similar to Alternatives A and B with the same water deliveries, but water distribution would be modified to manipulate water elevations in Sumps 1A and 1B to improve wetland diversity and productivity and to allow flooding of agricultural lands in fall for waterfowl. These modifications would alter hydrology of the refuge, as compared to Alternative A, and overall effects to hydrology in terms of erosion and sedimentation would be minor.

Farming Programs

In addition to the strategies in Alternative B to increase attractiveness of agricultural lands to waterfowl, Alternative C includes additional fall flooding. Alternative C also includes an increase in lease land and cooperatively farmed units (acreage) managed organically and expanded incentives to lease land farmers that manage fields organically. These modifications would alter the hydrology of the refuge, as compared to Alternative A, and these effects would be minor.

Pesticide Application

The effects on hydrology from pest management practices, including pesticide use for the cooperative farming and invasive species management programs under this alternative would be the same as described above for Alternative A; only minor effects to hydrology would be expected.

Public Use

The effects of public use under Alternative C would be the same as Alternative B; public use would have no effect on hydrology.

Beneficial Effects

Alternative C is expected to result in more beneficial effects to refuge resources than Alternatives A or B. Manipulation of water elevations in Sumps 1A and 1B to improve wetland diversity and productivity and to allowing flooding of agricultural lands in fall for waterfowl would alter hydrology of the refuge to improve habitats, increase wildlife use of the sumps, and benefit wildlife.

Mitigation

Mitigation for Alternative C would be the same as Alternative B.

6.4.3 Water Quality

Methodology for Analyzing Effects – Tule Lake Refuge

Reports on water quality of the Klamath Basin are available online through the States of California and Oregon. Information from online resources as well as water quality monitoring data from the refuge was used to assess the impacts of each alternative on water quality.

The following are resource-specific contexts for assessing effects of the alternative to water resources.

- The quality of water reaching the refuge varies seasonally from good in the winter and early spring to poor during the remainder of the year (Reclamation and Service 1998; DOI and California Department of Fish and Game 2012).
- Water on the refuge is from the Lost River and return flow irrigation.
- Pesticide applications are restricted around water sources.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

Water quality on the refuge reflects the sources of water quality to the refuge. Both sources (primarily Upper Klamath Lake via the Lost River Diversion Channel and A Canal) supplying waters to the refuge are generally above state standards during winter and early spring. Water quality declines in the spring and fall due to seasonal impairment and agricultural runoff upstream of the refuge and within refuge sources. The Service continues to utilize monitoring data from Reclamation to assess the quality of water delivered to the refuge and implements BMPs in conjunction with other agencies and partners to improve water quality within and upstream of refuge lands. Wetland plants typically help filter water and improve water quality. Ongoing management activities, such as fire and invasive plant treatments, in and adjacent to the managed wetlands could discharge sediment or other pollutants, which could affect water quality (see fire management section below).

Chapter 5 details current water quality conditions, noting generally Tule Lake experiences poor water quality during summer months, including high water temperature, low dissolved oxygen levels, and elevated nutrient concentrations, a combination that also leads to intensive filamentous green algae growth (Reclamation 2007). Water entering the refuge has elevated levels of nutrients and is eutrophic. Comparison of water quality entering and leaving the refuge shows total nitrogen doubles and total phosphorus remains roughly the same as it passes through the refuge. Wetlands (including permanent, seasonal and those related to flooded farmlands) help in removing some of the excess nutrients, on the order of 25% of inorganic nitrogen and 50% of inorganic phosphorus. Dissolved oxygen conditions are similar upstream and downstream of the refuge.

Partly because inflow water quality is poor and partly because of agricultural runoff and other activities related to refuge management, water quality at the refuge does not meet state standards, a significant impact that would continue if Alternative A were implemented. However, the impact of continuing current management over the lifetime of the CCP (15 years) compared to existing conditions would be negligible.

Although water quality is not likely to become significantly more degraded than is currently the case, it may improve as long-term regulatory processes related to the TMDLs described in Chapter 5 are currently being reconsidered and may result in overall reductions in pollutant loads. Such discussions include multiple responsible parties, are complex and geared to reducing cumulative impacts, and may take substantial time to resolve. As such, specific timelines and specific water quality improvements have not been formally defined at this stage, including the prescriptions for the Service to undertake on the refuge, but are part of a longer-term strategy to improve water quality. If changes result from these discussions, they would have beneficial impacts and be common to all alternatives. If needed, additional NEPA compliance would be conducted in the future to examine alternatives and their impacts in meeting new TDML requirements.

In the Upper Klamath Basin, lightening is prevalent and fires likely occurred when fuel was sufficient. Fire suppression throughout the western United States has resulted in changes to ecosystem structure and diversity, and has been re-introduced as a management tool in the Upper Klamath Basin National Wildlife Refuge Complex (Service 2001).

The extent of water quality effects is moderated by fire extent and severity. Fire severity is a result of many factors including weather conditions, fuel loads, soil moisture, wetland flooding, and burn duration (Kotze et al. 2013; Neary et al. 1999). The extent and severity of a fire determine extent of vegetation and organic matter burned, depth of soil heated, soil temperatures, conversion of nutrients, area of soils exposed, and resulting erosion and water quality impacts. Wildfires on the refuge are suppressed.

As described above, the impact of continuing current management over the lifetime of the CCP (15 years) compared to existing conditions would be negligible.

Farming Programs

The types of impacts to water quality related to farming practices at Tule Lake Refuge would be the same as described in Section 6.2.3 for Lower Klamath Refuge. Although on-refuge irrigation is carefully managed to avoid or minimize any runoff and associated potential adverse water quality effects associated with sediments (from tilling/disking), discharged agricultural runoff can nonetheless carry elevated concentrations of nutrients and potentially salts (as measured by electrical conductivity. Rainstorm events can likewise result in higher-than-normal loads of sediments and dissolved and particulate nutrients. The relatively flat terrain on the refuge lands, wetland and other vegetation, and the slow movement of water in canals and ditches reduces the likelihood that sediment loads are carried beyond the refuge. Crop rotation does not affect water quality.

Added compost/fertilizer can wash from soil surfaces. In light of the cost of these soil amendments and the importance of these nutrients for crop growth, it is expected that this would rarely occur. If this did occur, the effects would likely be localized and minor, and negligible by the time it reaches the Klamath River or other receiving waters. Such water quality impacts would be mitigated with on-refuge BMPs.

Prescribed burns are a tool used by the farming programs to reduce crop stubble. The extent of water quality effects is moderated by fire extent and severity. Fire severity is a result of many factors including weather conditions, fuel loads, soil moisture, wetland flooding, and burn duration

(Kotze et al. 2013; Neary et al. 1999). The extent and severity of a fire determine extent of vegetation and organic matter burned, depth of soil heated, soil temperatures, conversion of nutrients, area of soils exposed, and resulting erosion and water quality impacts. Prescribed burns are generally of lower intensity (particularly on cropland) and therefore will usually result in less erosion and nutrient conversion than do larger wildfires in fire-suppressed landscapes. Therefore, although prescribed fires may result in occasional discharge of sediment via surface runoff after a burn, the use of prescribed fires likely reduces the chance of catastrophic wildfire which could result in much greater sediment and nutrient discharges. These low intensity prescribed fires can thin vegetation, promote herbaceous vegetation, increase ecosystem heterogeneity, and increase plant available nutrient (Neary et al. 1999). Additionally, the removal of old plant growth and increased availability of nutrients can stimulate vegetation growth, ultimately enhancing sediment and nutrient retention over longer time frames (Kotze et al. 2013).

Prescribed fire management (timing, extent, duration, intensity) and associated BMPs are expected to reduce any impacts to minor.

Walking wetlands refer to an experimental rotation of wetlands, which includes flooding former croplands to create additional wetland habitats, then returning farming at some point in time. Flooding of these areas enhances both wetland habitats and resulting crop productivity following flooding, benefiting both wildlife and wetlands. Water quality of walking wetlands previously used for agriculture can potentially diminish water quality if excessive salts have accumulated or if pesticides (see below) were previously used on these lands. On-refuge BMPs are expected to result in minor impacts to water quality compared to current conditions.

Pesticide Application

Pesticides are used for the farming program, to manage invasive plant species, and to maintain refuge structures. Pesticides can enter surface waters as a result of overspray and wind drift; pesticide spray missing its mark; excess pesticide falling from plant stems, leaves, or other plant parts; spillage from storage, mixing, loading, equipment cleaning, and disposal areas; transport by wind or water across the land surface adsorbed onto soil particles or in a dissolved form; and precipitation carrying pesticides through the air (van Es and Trautmann 1990). Pesticides that are soluble, are not adsorbed onto soil particles, and/or are persistent can also travel through the soil and enter groundwater in the applied chemical form, in a dissolved form, or in a degraded form (van Es and Trautmann 1990). Soil characteristics such as texture, amount of organic matter, permeability, and distance to the water table affect leaching of pesticides into groundwater (Fishel 2003). In some situations, applied waters may eventually empty into surface waters. Depending on their chemical makeup and persistence, some pesticides may remain in surface or shallow sub-surface waters for extended periods of time. Others (e.g., glyphosate) degrade quickly and exhibit reduced toxicity (Folmar et al. 1979). Again, depending on their chemical properties, concentrations, and other factors, the existence of some pesticides or their decomposition products in water could prove toxic to some aquatic plants and/or animals.

In decades past, toxic concentrations of pesticides have been found in refuge waters (Snyder-Conn et al. 1999). However, more recently, no pesticides have been documented in refuge waters at concentrations that are toxic to fish and wildlife (Snyder-Conn et al. 1999). Cameron (2008) completed a study on pesticide byproducts in Tule Lake Refuge and found only two detectable pesticide concentrations out of 160 chemicals compounds: 2,4-D and carbaryl, both far below the NOEC and LOEC. **Monitoring conducted in 2011 (unpublished data) suggests that no**

pesticides are entering Tule Lake from the application of pesticides on federal Lease Lands. Section 5.1.1, Environmental Contaminants, provides a more detailed review of these studies. Additionally, Eagles-Smith and Johnson (2012) completed a review of available information on pesticides in the Klamath Basin that encompasses the project area. While the review identified a wide range of data gaps, principal findings included evidence that past organochlorine pesticide use was a major source of avian impacts in the basin, but that the moratorium on organochlorine pesticide resulted in a sharp decrease in exposure, reducing the likelihood that these compounds still pose a threat. Eagles-Smith and Johnson (2012) identified that those degradation products resistant to decay may continue to pose a threat to fauna in the region, but a lack of data limits assessment of this potential legacy effect. Current contaminant threats and impacts were uncertain due lack of monitoring data, and specific assessments do not exist. When applied consistent with PUP-directed BMPs, the concentrations of pesticides in refuge waters would not be expected to be high enough to adversely affect waterbirds or other species of special management attention. Impacts to water quality from pesticide application would be minor.

Public Use

The refuge is open to a variety of public uses from wildlife observation and photography to hunting. Visitors are not generally a cause of water quality degradation. However, hunters could cause soils to be eroded into waterways, sediments to be stirred up, and turbidity to be created and increased when they launch boats into and remove them from the water; when they propel their watercraft with paddles, poles, flippers, and/or propellers; and when boat-generated waves reach shallow waters or shorelines. Water quality effects would be greater when boats traveled at higher speeds. Waterways could also be contaminated by fuels and oils if they were spilled or were otherwise discharged by motorboats (this is a greater concern with traditional 2-stroke boat motors) (Mosisch and Arthington 1998). Although motorboats have been used for hunting on the refuge for the number of years without known substantial effects on water quality, the potential for minor adverse effects to water quality remains. Public use is expected to have minor impacts on water quality.

Beneficial Effects

Maintaining 2,500 acres of cooperatively farmed crops with at least 25% grains on 250 acres; maintaining up to 14,800 acres of lease land crops; and maintaining 0 to 2,700 acres of walking wetlands can improve overall water quality that is discharged from the refuge.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B – Tule Lake Refuge

Land Management

Under Alternative B, the **Service would strive to maintain approximately 1,380 acres in the Walking Wetlands Program** and increase interspersion of **these** wetlands within lease land agricultural crop units. As a result, more lands would be rotated from agricultural crops to wetlands. Shifting lands into the Walking Wetland Program may result in some changes in the timing of water use (shifting water use slightly from spring/summer to late summer use to provide waterfowl habitat). In addition, as noted above for Alternative A and Chapter 5, even flooded farmlands can act to remove excess nutrients from water, a possible benefit from this change. Conversely, water quality of walking wetlands previously used for agriculture can potentially diminish water quality if excessive salts have accumulated or if pesticides were previously used on these lands. These changes could result in some negligible changes to water quality, but the impacts would not be significant. Impacts would be the same as described under Alternative A.

Public Use

Public use of the refuge would not change under Alternative B. Impacts from public use would be the same as described under Alternative A.

Beneficial Effects

Beneficial effects to water quality would be the same as described under Alternative A.

Mitigation

Alternative A is not expected to alter the water quality from current. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management and public use activities to hydrology in the area that exist under current operations.

Alternative C – Tule Lake Refuge

Land Management

Land management of the refuge would not change under Alternative C**, except that the Service would increase the attractiveness of agricultural lands to waterfowl with fall flooding.** Impacts from land management on water quality would be the same as described under Alternative B.

Public Use

Alternative C includes phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge. Switching to 4-stroke engines would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines. Impacts would be the same as described under Alternative B.

Beneficial Effects

Phasing in a new requirement allowing only 4-stroke or direct injection 2-stroke boat engines to be used on the refuge would reduce gasoline, oil, and other hydrocarbons and pollutants associated with the use of 2-stroke engines.

Mitigation

Alternative C is not expected to alter the water quality from current. Ongoing BMPs (Appendix L) would be implemented to mitigate potentially adverse effects of land management and public use activities to hydrology in the area that exist under current operations. **In addition, the Service would periodically conduct water, sediment, and fish and wildlife tissue monitoring in refuge waterbodies to ensure pesticides are at concentrations below those having an adverse effect to listed species and other wildlife.**

6.4.4 Air Quality

Methodology for Analyzing Effects – Tule Lake Refuge

Air quality was assessed at a basin-wide level using online reports from the States of California and Oregon that identify the general air quality characteristics. **Emissions for prescribed fire were calculated using California Air Resources Board's 2000 memo entitled "Agricultural Burning Emissions Factors." Emissions from agricultural land preparation and harvesting were calculated using the Western Regional Air Partnership's Fugitive Dust Handbook, Section 2.2.**

The following are resource-specific contexts for assessing effects of the alternatives on air quality,

- Land management activities occur within a basin dominated by agriculture, with over 500,000 acres of irrigated lands in the Upper Klamath Basin and 220,000 acres of farmland in the Klamath Reclamation Project.
- The Northeast Plateau, which includes Tule Lake Refuge, is designated as in attainment for all seven federal criteria pollutants: ozone, PM2.5, PM10, carbon monoxide, lead, nitrogen dioxide, and sulfur dioxide. The acreage of refuge lands flooded (versus dry lands that may be subject to dust-generating land management practices) is highly dependent on water deliveries controlled by the Klamath Reclamation Project (outside of Service control).

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

For the purposes of this CCP, managed wetlands are those managed for wetland functions and where water is intentionally and actively applied annually through a managed process (Service and Reclamation 2000). Walking wetlands (flood fallow lands) are addressed under the Farming sections. On Tule Lake Refuge, wetland management is focused on Sumps 1A and 1B. Water levels in these sumps are managed to protect private property from flooding and provide wildlife habitat. Most of the area is comprised of open water dominated by submergent plant communities

with extensive periodic blooms of filamentous green algae. The refuge does not use prescribed fire or mechanical treatments to manage wetland habitat on this refuge.

The effects of wetland management on air quality is considered negligible based on the extent and duration of activities.

Farming Programs

Some of the management practices described in Section 4.4.2 and used in the farming programs can affect air quality. Sources of pollutant emissions associated with farming programs include: fugitive windblown dust from fields and unpaved roads; smoke from burning of agricultural fields; tailpipe emissions from vehicles and farm equipment; emissions associated with the use of fertilizers and pesticides, and emissions associated with the cultivation of organic soils.

The majority of areas where the lease land and cooperative farming occur have silt clay loam or silt loam soils (see Figure 5.13). The potential for wind erosion from agricultural practices is relatively low. On a scale of 0 to 6, with 6 being high, the NRCS rates the soils in the farmed area at levels 2 and 3 (see Figure 5.14). Wind erosion on the refuge is primarily confined to the winter and spring during periods of high winds. Harvested row crop acreage is especially susceptible because of lack of soil cover. Lease terms that require a cover crop on harvested row crop fields is expected to minimize this problem. In small grain areas, wind erosion is primarily confined to the spring cultivation period during periods of high winds. **Fugitive dust emissions from different land preparation operations (e.g., root cutting, discing, tilling, chiseling, ripping, land planning, and weeding) can range from 0.3 to 12.5 pounds per acre per pass.** If the weather is dry and windy when refuge fields are tilled or disked, dust is generated and can be carried across the refuge and potentially to adjacent properties. Once crops have emerged, the potential for soil erosion declines sharply. To minimize soil erosion in small grains, the Service would continue to restrict fall work in farmed areas until just prior to cultivation.

Tailpipe emissions (particulates, ROG, and NO_X) would result from the use of combustion engines in farming equipment. As with particulate emissions, tailpipe emissions are expected to vary annually depending on the area farmed which in turns is dependent on the volume of water deliveries. Tailpipe emissions are also expected from the use of passenger vehicles by cooperative and lease land farmers when traveling to and from fields. These emissions are expected to occur year-round, but are considered minor in the context of agricultural and other sources of tailpipe emissions in the region.

Nitrous oxide is produced naturally in soils through the microbial processes of denitrification and nitrification. The natural emissions of nitrous oxide can be increased by a variety of agricultural practices, including the use of synthetic and organic fertilizers, growing of nitrogen-fixing crops (e.g., alfalfa), cultivation of soils with organic matter, and the application of livestock manure to croplands (Aneja et al. 2009). These emissions are expected to occur year-round, but are considered minor in the context of agricultural emissions in the region.

Prescribed burning used to reduce biomass after harvest on agricultural crop land generates smoke that can rise to great heights and potentially drift considerable distances. Smoke contains ash particulates, partially consumed fuels, liquid droplets, and very small quantities of gases such as carbon monoxide, carbon dioxide, and hydrocarbons. **Actual emissions would depend on the**

size of the burn, fuel loading, and fuel moisture content. Estimated pollutant emissions for burning wheat stubble are listed here.

- **PM_{10}: 20 pounds/acre**
- **$PM_{2.5}$: 19 pounds/acre**
- **NO_x: 8 pound/acre**
- **SO_2: 2 pounds/acre**
- **CO: 235 pounds/acre**
- **VOC: 14 pounds/acre**

As noted above under the discussion of wetland management, prescribed fires are conducted consistent with a burn plan that takes into consideration weather, regional air quality, and smoke management to minimize the likelihood that smoke would drift into populated areas or create safety problems for roadways or airports. Also, dilution in the atmosphere greatly reduces potential adverse air quality effects. The effects associated with these management actions are temporary in nature and, in light of the vast acreage of agricultural lands in the area, relatively common in the Klamath Basin. Nonetheless, prescribed burns would be detectable, with temporary minor adverse impacts to air quality.

Lands that are flooded are not subject to dust-generating land management practices; therefore, irrigation/flooding are not expected to adversely affect air quality.

Pesticide Application

Pesticides are used to control pests on farmed areas, for habitat restoration, and around refuge structures. When sprayed, pesticides travel through the air to their intended target. Although generally formulated and propelled to reach and (with the assistance of a surfactant) attach to their target pest, a percentage of some pesticides may volatilize into the air or small pesticide droplets may remain suspended in the air. These effects would be more pronounced with aerial spraying, and less so with ground-level spot spraying and direct injection into the soil. Once airborne, pesticides can move off of the pest control site and drift with the wind or return to surface soils, waters, or plants through precipitation (van Es and Trautmann 1990). High temperatures, low relative humidity, air movement, and small pesticide droplet size all increase volatilization; and pesticides that tightly adsorb onto soil particles are less likely to volatilize (Fishel 2003). **The estimated pesticide VOC emissions on Tule Lake Refuge farmland are 8.8 pounds per acre.**

Land management activities would not result in any substantial changes within the 15-year life of the CCP. Based on the above analysis of land management activities are expected to result in negligible effects to local air quality. No long-term adverse effects on air quality are anticipated as a result of continuing the land management practices under Alternative A.

Public Use

Vehicle use by visitors and Service staff (both during visitor programs and maintenance activities associated with visitor facilities), may create fugitive dust and vehicle emissions. During visitors' use of auto tour routes, traveling to destinations for wildlife observation and photography, and hunting, PM10 is produced by vehicles and by fugitive sources, such as roadway dust from paved and unpaved roads.

Vehicle access is allowed within portions of the refuge, and an auto tour route provides opportunities for visitors to view wildlife. Some parking is available on the refuge at the visitor center, and most hunting is by boat or walk-in access. With the moderate visitor numbers, vehicle emissions from public access contribute minimal emissions at the refuge. Exhaust from hunters' cars, trucks, and motorboats (this is a greater concern with traditional 2-stroke boat motors), and dust from vehicle and pedestrian travel would all contribute to gaseous and particulate air pollution at the refuge. Due to the moderate level of visitation at the refuge, wind dispersal in the basin, and the size of the refuge, adverse effects to local and regional (Klamath Basin) air quality from public use are expected to be negligible.

Public use activities would not result in any substantial changes within the 15-year life of the CCP. Therefore, negligible effects to air quality are anticipated as a result of continuing public use under Alternative A.

Beneficial Effects

Wetlands support the sequestration and long-term storage of carbon dioxide from the atmosphere. However, wetlands are also a natural source of greenhouse gas emissions, especially methane. Although not a criteria pollutant, methane is a potent greenhouse gas with 25 times the global warming potential of carbon dioxide (IPCC 2007). Nevertheless, most wetlands are carbon sinks when balancing carbon sequestration and methane emissions over the long term (centuries) (Mitsch et al. 2013). However, given the fact that many of the wetlands are drained periodically to manage vegetation or due to lack of water, any beneficial effect is likely negligible.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative B – Tule Lake Refuge</u>

Land Management

Wetland Management

Wetland management would not fundamentally change under Alternative B. The Service would develop a Habitat Management and Wildlife Inventory and Monitoring Plan to more closely integrate land management actions, but the actions would not change in scope. Effects to air quality would be the same as described under Alternative A.

Farming Programs

Under Alternative B, the aerial extent of farming would not change, but the crops would be modified so that 1,500 acres of grain are left unharvested to support dabbling duck and geese population objectives during winter and spring and the **Service would strive to maintain approximately 1,380 acres in the Walking Wetlands Program** annually. In order to increase the acreage of walking wetlands in Sump 2, an estimated 48 linear miles of dikes would need to be constructed around the lease land lots. Material for the dikes would come from the previously disturbed, adjacent farm fields. Constructing the dikes would be similar to the ongoing farming activities and would result in some temporary dust and smaller particulates. In addition, a berm

management program for re-vegetating dikes between farm fields would have no effects on air quality. **Otherwise, Alternative B would have the same effects to as described for Alternative A.**

In summary, the air quality effects under Alternative B would be minor.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing review of pesticides in an IPM Program for the Refuge Complex. The effects to air quality under Alternative B would be the same as described under Alternative A.

Public Use

Improvements to the auto tour route could increase vehicle traffic to the refuge, although most uses within the refuge would continue to be by walk-ins from parking areas on and off the refuge and by boats. Increased traffic would result in increased vehicle emissions in the vicinity of the refuge, but the impacts on air quality would be minor based on the estimated visitation to the refuge and would not adversely affect ambient air quality. The pursuit of a partnership with the State of California to develop and operate a portable decontamination station(s) near refuge boat launches would have no effects on air quality.

Beneficial Effects

The increase in the acreage of walking wetlands on the refuge would decrease emissions as the percentage of active agriculture would be reduced.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative C (Preferred Alternative) – Tule Lake Refuge</u>

Land Management

Wetland Management

Under Alternative C, the Service would develop a plan to manipulate water elevations in Sumps 1A and 1B in order to improve wetland diversity and productivity. Manipulating water elevations in the sumps may expose bare soils to be blown by wind, but because vegetation would quickly grow, would have no more than negligible temporary effects on air quality. Otherwise, Alternative C would have the same effects on air quality as described for Alternative B.

Farming Programs

Changes to the farming program under Alternative C are focused on expanding the number of units farmed with organic practices **and increasing the attractiveness of agricultural lands to waterfowl with fall flooding.** Neither of these changes would affect air quality. Alternative C would have the same effects on air quality as described for Alternative B.

Pesticide Application

Under Alternative C, the Service would authorize fewer applications of chemical pesticides as additional units are farmed with organic practices. Alternative C would have the same effects on air quality as described for Alternative B.

Public Use

Under Alternative C, the Service would phase in a requirement allowing only 4-stroke (4-cycle) or direct injection boat motors to be used on the refuge. This change would reduce some pollutant emissions.

Beneficial Effects

The increase in the acreage of walking wetlands on the refuge would decrease emissions as the percentage of active agriculture would be reduced.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize the adverse effects to refuge resources and are incorporated into this Alternative.

6.4.5 Vegetation and Habitat Resources

Methodology for Analyzing Effects – Tule Lake Refuge

Scientific literature was consulted to predict the types of impacts that could occur due to land management and public use activities.

The following are resource-specific contexts for assessing the effects of the alternatives on vegetation and habitat resources.

- Vegetation and habitat resources are managed to achieve the refuge purposes as identified and defined in Appendix M.
- Some vegetation and habitat resources (e.g., agricultural crops and walking wetlands) are dependent on the quantity of water delivered through the Klamath Reclamation Project. Regardless of which alternative is selected for implementation, these habitats may be limited in some years if water deliveries are insufficient.
- The Service currently manages wetland, upland, and agricultural habitats at the refuge based on annual water allocations and in accordance with the 2013 BiOp (NMFS and Service 2013). Fire management activities are implemented in accordance with the Fire Management Plan (Service 2001).

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

The Service would continue to use a variety of techniques to increase habitat value (providing food, water, and vegetative cover) for migratory birds and other wildlife, such as water

management, mowing, disking, prescribed burning, and targeted herbicide treatments to manage vegetation. The Service currently manages wetland, upland, and agricultural habitats at the refuge based on and in accordance with its water deliveries (see Section 4.4.1, Water Resources Management for more information). Invasive plant treatments (see also Pesticide Application, below) and fire management activities cause temporary disturbances to the vegetation and habitats at the refuge, but they primarily result in long-term beneficial effects that improve wildlife habitat conditions. The wetlands and agricultural lands provide forage and cover for waterfowl and other wildlife.

Adverse effects to vegetation and habitat resources from wetland management have been and are expected to continue to be minor with Alternative A and partially offset by the concurrent beneficial effects described below.

Farming Programs

Tule Lake Refuge has an agricultural program that includes lease land and cooperative farming to reach wildlife habitat objectives and fulfill the purposes for which the refuge was established. The effects on vegetation and habitat resources from farming programs at Tule Lake Refuge are the same as those described for Lower Klamath Refuge (see Section 6.2.4, Vegetation and Habitat Resources, Farming), except as follows. Cooperative farmers may apply compost and fertilizers to add nutrients to refuge farmlands. In the event of a rainstorm or over irrigation, some of the compost or fertilizers can run off into refuge canals/ditches. These additional nutrients can enhance the growth of aquatic plants in the canals/ditches, but due to dilution, it is not expected that such effects are seen in the Klamath River or other receiving waters (wetland habitats).

Invasive plant treatments on crop lands would be implemented as needed in accordance with the 1998 IPM Plan (Service 1998a). The effects on vegetation and habitat resources of non-pesticide invasive species management practices (IPM, non-chemical, mechanical and biological methods) at Tule Lake Refuge are the same as those described for Lower Klamath Refuge (see Section 6.2.4, Alternative A, Pesticide Application). Pesticide application is discussed below. Mowing with a brush/deck mower and cutting with a sickle bar mower is done periodically to reduce invasive and undesirable vegetation.

Under Alternative A, because water use on the refuge is not expected to change substantially in the future and BMPs (Appendix L) would be implemented, adverse effects to vegetation and habitat resources from farming have been and are expected to continue to be intermediate with Alternative A partially offset by the concurrent beneficial effects described below.

Pesticide Application

The effects on vegetation and habitat resources of pesticide used for invasive species management at Tule Lake Refuge are very similar to those described for Lower Klamath Refuge (see Section 6.2.4 Alternative A, Pesticide Application). **There is however a difference in the range of pesticides that may be used on Tule Lake Refuge cooperative farm units as compared to cooperative farm units on Lower Klamath Refuge. On the Tule Lake Refuge the same spectrum of pesticides authorized for use on lease lands may be used on cooperative farm units, unless they are in organic production. On cooperative farm units that are farmed organically, only pesticides that meet the standards outlined by the National Organic Program criteria are allowed.** Adverse effects to vegetation and habitat resources from pesticide

applications have been and are expected to continue to be intermediate with Alternative A and partially offset by the concurrent beneficial effects described below.

In a 1995 biological opinion (Service 1995) for Reclamation on the use of pesticides and fertilizers on federal lease lands, the Service described the endangered Applegate's milk-vetch occurrence in a narrow region restricted to seasonally moist meadows/bunchgrass flats near Klamath Falls, Klamath County, Oregon. The specific habitat found supporting these plants is a seasonally moist, lightly vegetated, alkaline grassland community and characterized by poorly drained, alkaline soils (Henley/Malin clay loams). Henley and Malin soils underlie the Lower Klamath Refuge (which lies to the west of Tule Lake Refuge) (Soil Survey Staff 2008). Although other types of clay loam soils underlie Tule Lake Refuge, the Henley and Malin soil series do not. Applegate's milk-vetch potentially occurs on Tule Lake Refuge given the occurrences within the vicinity, but there are no known modern occurrences. There is no designated critical habitat on Tule Lake Refuge. Intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for special-status species and their designated critical habitat. **Any conservation measures, as well as terms and conditions resulting from intra-Service consultation under the federal ESA will be implemented to protect listed species and their habitat that occur on the refuge, as applicable.**

Based on the limited actions proposed in the CCP alternatives and with implementation of the PUP review process and the use of mandatory BMPs (Appendix L), pesticide applications and are expected to be intermediate and are partially offset by the concurrent beneficial effects described below.

Public Use

The effects of public use; including hunting, boating, wildlife observation, interpretation, and photography; under this alternative would be the same as described for Lower Klamath Refuge (see Section 6.2.4). Some impact to vegetation and habitat from these actions has taken place, but it is not noticeable upon visual inspection and therefore negligible. Adverse effects to vegetation and habitat resources from public use have been and are expected to continue to be negligible with Alternative A.

Beneficial Effects

Land management techniques (as described above and under Lower Klamath Refuge [Section 6.2.4]) and the farming program are used to reduce targeted weeds and thatch to achieve habitat objectives. By using these land management techniques in densely vegetated areas, openings can be created to help develop a more diverse mosaic of habitats across the landscape to meet refuge objectives for wildlife, reestablish more structural habitat diversity, set back plant succession, revitalize vegetation, enhance light penetration and facilitate earlier green up, which improve growing conditions for forbs and other low-growing plants. Each of these would also help support additional or more diverse waterfowl and other wildlife at the refuge.

The Service expects that soil fumigants and non-fumigant nematicides, and non-chemical methods used to reduce plant-parasitic nematodes as part of the farming practices on refuge lands would also provide indirect, long-term beneficial effects by also reducing disease on adjacent vegetation and habitat resources on the refuge.

Alternative A includes up to 2,700 acres in the Walking Wetlands Program on refuge lease lands and cooperatively farmed units. The Walking Wetland Program may result in a beneficial effect of a decrease in summer water use on crops and increase in fall/winter use to provide waterfowl habitat. Agricultural acres rotated into wetland habitat may potentially result in reduced water use during the growing season, which may potentially increase water availability for other uses during the summer, such as improving wetland and other habitats on the refuge. In addition to valuable agricultural and habitat benefits (e.g., suppressing soil pathogens and non-target and invasive plants), this program provides additional wetland habitat for waterfowl and other wildlife. Increasing the acreage of local wetland habitat is especially important for wildlife in the Klamath Basin because water shortages routinely limit the number of wetland units that can be flooded on the refuges (additional information is provided in Table 6.1 and Section 4.2.1).

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize the adverse effects to refuge resources and are incorporated into this alternative.

Alternative B – Tule Lake Refuge

Land Management

Wetland Management

In addition to the management activities and associated impacts discussed under Alternative A, the Service would implement a Habitat Management and Wildlife Inventory and Monitoring Plan, increase the acreage and interspersion of walking wetlands in the agricultural lands, revegetate dikes, identify new or improved techniques to manage invasive plants in an IPM program (Appendix Q), and continue fire management to protect habitat through the Fire Management Plan. Additional activities and techniques used to improve habitat conditions would have temporary and localized minor adverse effects on vegetation and habitats, but the long-term benefits would improve habitat conditions to achieve refuge objectives for managing a preserve and breeding ground for wild birds.

Alternative B includes development of a Refuge Habitat Management and Wildlife Inventory and Monitoring Plan. Evaluations and assessments conducted as part of this planning process could also result in changes to the cooperative farming program. For example, potentially the types, acreages, and/or locations of crops grown; and the timing of planting, irrigation/flooding, and/or harvesting of crops could change. It would be speculative to forecast specific changes at this time. The Service would conduct additional NEPA analyses, as appropriate, as part of this future habitat management planning process.

Alternative B includes developing and implementing a plan to manipulate water elevations in Sumps 1A and 1B to improve wetland diversity and productivity. Experience in the Klamath Basin has indicated that manipulating water levels, consistent with historic hydrologic conditions, can result in improved water quality and other improvements to wetland habitat quality, described in the Beneficial Effects section below. Adverse effects to vegetation and habitat resources from wetland management are expected to be minor with Alternative B and partially offset by the concurrent beneficial effects described below.

Farming Programs

In addition to the management activities and associated impacts discussed under Alternative A, Alternative B would increase unharvested standing grain to approximately 1,500 acres to support dabbling duck and geese population objectives during winter and spring. **The Service would also strive to maintain approximately 1,380 acres in the Walking Wetlands Program annually.**

Alternative B is expected to result in an increase in wetland habitat on privately owned lands in the Klamath Basin. Alternative B would expand the use of preferential permits for cooperatively farmed grain and hay units on the refuge for farmers that participate in the Walking Wetlands Program on their private lands; thereby, increasing the incentive to implement walking wetlands (flood fallowing) on private lands.

Alternative B includes constructing an estimated 48 linear miles of dikes around lease land lots in Sump 2 where walking wetlands management is feasible; which would increase the lease land acreage available for wetland habitat on the refuge. Dikes would be constructed of fill material from previously disturbed, adjacent farm fields and would have temporary, short-term, and localized effects on ruderal (weedy) vegetation and crop lands. Adverse effects to vegetation and habitat resources from farming are expected to be intermediate with Alternative B and partially offset by the concurrent beneficial effects described below.

Pesticide Application

The effects on vegetation and habitat resources of pest management practices, including pesticide use for the farming program under this alternative would be the same as described above for Alternative A, except as follows. Development and implementation of a berm management plan for re-vegetating dikes would involve establishment and maintenance of healthy and sustainable stands of native and/or naturalized vegetation on up to 50% of over 80 linear miles of dikes (in Sump 3 that are currently covered with pest or invasive plants) in the lease lands and cooperative farming area of the refuge.

The effects on vegetation and habitat resources of pest management practices, including pesticide use for invasive species management under this alternative would be the same as described above for Alternative A, except as follows. To the extent that monitoring results were used to direct rapid assessment and control actions, new outbreaks of priority invasive species would more likely be controlled when they were smaller in size. Refuge-wide, over time, this would be expected to result in a reduction in the acreage of native and naturalized vegetation on the refuge that was impacted by invasive species, and potentially fewer new infestations. Adverse effects to vegetation and habitat resources from pesticide applications are expected to be intermediate with Alternative B and partially offset by the concurrent beneficial effects described below.

Public Use

Construction or modification of public facilities could remove native habitats and spread invasive plants, depending on the specific locations and details of the facilities. However, these facilities are expected to encompass small areas and would not require removal of a substantial amount of habitat. Habitat impacts associated with the new facilities are expected to be minor. Invasive plant treatments around the facilities would reduce the potential for invasive plants to establish.

Establishment and operation of a portable decontamination station(s) near boat launches on the refuge would educate hunters, wildlife watches and photographers, and other refuge visitors about invasive species issues; and provide boaters a convenient opportunity, away from the water, to check for and remove invasive plants or other invasive aquatic organisms from their boats, trailers, and potentially other equipment. The decontamination stations would reduce instances of visitors w introducing a new invasive species to refuge waters or reintroducing (and increase the population of) an existing pest.

Effects of hunting on vegetation and habitat resources under Alternative B would be the same as under Alternative A. Adverse effects to vegetation and habitat resources from public use are expected to be negligible with Alternative B.

Beneficial Effects

Alternative B is expected to result in more of the same types of beneficial effects to vegetation, habitat, and other refuge resources as described for Alternative A. **Under Alternative B the Service would strive to maintain approximately** 1,380 acres of walking wetlands annually and intersperse these wetlands within the lease lands so that no farm field would be farther than 1 mile from a wetland. Under Alternative B, the expanded walking wetlands program may result in a beneficial effect of reduced water use during the growing season, which may potentially increase water availability for other purposes during the summer. Increased water availability in the summer could benefit wetland vegetation and habitat quality.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize the adverse effects to refuge resources and are incorporated into this Alternative.

<u>Alternative C (Preferred Alternative) – Tule Lake Refuge</u>

Land Management

Wetland Management

Vegetation-related impacts under Alternative C would be similar to those described for Alternatives A and B. The sumps would be managed similar to current conditions, except Sumps 1A and 1B may be managed to manipulate water levels, which would be expected to improve wetland diversity and productivity. The agricultural lands would also be managed slightly different than current conditions, with the lands being flooded in fall, standing grain being increased, and wetlands being interspersed more with the lease lands. These activities would result in long-term improvements in habitat conditions.

Alternative C includes manipulating water levels, consistent with historic hydrologic conditions, to increase germination of emergent plant species and establishment of robust stands of submergent plants, thereby, improving water quality and habitat conditions for waterfowl and other wetland-dependent wildlife. Enhancement of wetland habitats through timed drawdowns using a variety of physical structures (pumps, canals, levees, etc.) is a common and effective wetland management technique (Frederickson 1991; Fredrickson and Taylor 1982; Kadlec 1962), that provides conditions for the germination of desirable plant species, control nuisance vegetation, promote production of aquatic invertebrates, and makes food and habitat available to a wide variety of

wildlife species (Kelley et al. 1993). The aforementioned beneficial effects are anticipated based on the results of planned water drawdowns conducted in 1999. In 1999, the Service, in cooperation with Ducks Unlimited, TID, and Reclamation, blocked passage of water between Sumps 1A and 1B, which allowed for a series of planned water drawdowns in Sump 1B. What was once 3,500 acres of open water with no emergent vegetation was transformed into a diverse productive hemi-emergent marsh that provided nesting habitat to a host of colonial nesting waterbirds that were previously excluded. Nesting species included the western/Clark's grebe, white-faced ibis, snowy and great egrets, black-crowned night-heron, and Franklin's gull. The partial drawdown of Sump 1B was successful because it was timed to coincide with the peak germination of hardstem bulrush, the dominant emergent plant species in the Tule Lake Basin.

The effects on vegetation and habitat resources of pest management practices and invasive species management under this alternative would be the same as described above for Alternative B. See also Pesticide Application, below.

Farming Programs

In addition to the strategies in Alternative B to increase attractiveness of agricultural lands to waterfowl, Alternative C includes additional fall flooding of farm fields. Alternative C also includes an increase in lease land and cooperatively farmed units (acreage) managed organically and expanded incentives to lease land farmers that manage fields organically.

Pesticide Application

The types of effects on vegetation and habitat resources from pest management practices, including pesticide use for the cooperative farming and invasive species management programs under this alternative would be the same as described above for Alternative A; except that increased wetland acreages and an anticipated increase in organically grown crops would be expected to reduce pesticide applications and associated potentially adverse effects of pesticide use.

Public Use

The public use program and the effects of public use on vegetation and habitat resources under Alternative C would be the same as under Alternative B.

Beneficial Effects

Alternative C is expected to result in more beneficial effects to vegetation, wetland habitats, wildlife, and other refuge resources than Alternatives A or B. Further, the additional fall flooding of lease land farm fields (beyond that in Alternative B) are expected to increase attractiveness of agricultural land to waterfowl, thereby increasing waterfowl foraging habitat. The expanded incentives to manage fields organically are expected to reduce the use of pesticides and associated potentially adverse effects and result in beneficial biological effects to all natural resources on the refuge, including vegetation and habitat resources.

Mitigation

Public facilities would be sited in previously disturbed areas, to the extent feasible, and should be designed to avoid sensitive habitats and affect the least amount of native vegetation. BMPs (Appendix L) would be implemented during construction and other ground-disturbing activities.

In addition to BMPs (Appendix L), phasing in a new requirement allowing only 4-stroke (4-cycle) or direct injection 2-stroke boat engines to be used on the refuge would reduce adverse impacts on aquatic plants, as associated with water quality degradation.

6.4.6 Fish and Wildlife

Methodology for Analyzing Effects – Tule Lake Refuge

The various habitat types were assessed to determine their potential to support refuge goals for fish and wildlife. Scientific literature was used to predict the potential effects of various land management and public use activities on fish and wildlife resources. The modeling completed in 2008 for "A Bioenergetic Approach to Conservation Planning for Waterfowl at Lower Klamath and Tule Lake National Wildlife Refuge" (Dugger et al. 2008) was used to assess the relative benefits of each alternative. **Potential indirect effects to fish and wildlife related to pesticide application were assessed by considering reductions in the availability of prey items, exposure through consuming prey items, and disturbance associated with pesticide application.**

The following are resource-specific contexts to assess the effects of the alternatives on fish and wildlife resources.

- The refuge is superimposed on lands already withdrawn for reclamation purposes by the Klamath Reclamation Project.
- Fish resources on the refuge are incidental through the delivery of water through the canals.
- The primary mandate of the refuge is to conserve fish, wildlife, and plants and their habitats, particularly migratory birds.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

Wetland management is focused on the 13,000 acres of wetlands in Sumps 1A and 1B. These sumps are managed under agreement between the Service, Reclamation, and TID. These sumps function to capture return flows during the spring/summer irrigation season, protect private property from flooding, and provide wildlife habitat. Water levels in these sumps are regulated under a contract between the TID and Reclamation and 2013 BiOp to protect the endangered Lost River and shortnose suckers. High fish densities in these sumps make them an important foraging area for fish eating birds such as white pelicans, western and Clark's grebes, and double crested cormorants. Large areas of submerged aquatic vegetation make the area important to migrating diving ducks, especially canvasback, ruddy ducks and lesser scaup. In these wetland areas the Service uses prescribed burning to decrease areas of thick, dead under-layer vegetation which impedes wildlife use. Prescribed burns would temporarily displace wildlife into other areas

of the refuge. Prescribed burns are conducted in a patchwork fashion in the wetland areas of the sumps to create an edge effect that supports a greater diversity of wildlife species as well as to minimize impacts of displacing wildlife.

In addition to prescribed burns, the Service has a moderate ability to manipulate water levels in Sump 1B. In cooperation with Ducks Unlimited, CDFW, TID, and Reclamation, the Service installed water control infrastructure in 1998 to allow for water level manipulation of Sump 1B. During the early 2000s, a series of seasonal water drawdowns were conducted which allowed for the germination of emergent wetland plants and the enhancement of submergent plant communities.

Other direct impacts to wildlife from wetland management includes trapping and removal of problem animals and birds from a nesting island in Sump 1B for white pelicans and several tern species. Ongoing maintenance of infrastructure such as dikes and roadways also includes trapping and removal of muskrats and beavers that burrow into dikes and roadways compromising their integrity.

The Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) are the only federally listed species known to occur on the refuge. They are found in Sump 1A. There is only a small remnant population of each species remaining in the sumps. Water levels in the sump are maintained by Reclamation in accordance with the biological opinion. Wetland management conducted by the Service does not affect these fish species. In a 2013 BiOp (NMFS and Service 2013) for Reclamation on the effects of proposed Klamath project operations, the Service determined that the level of anticipated take is not likely to result in jeopardy to Lost River and shortnose suckers.

The threatened Oregon spotted frog (*Rana pretiosa*) **is unlikely to occur on Tule Lake Refuge because there are no known observations and there is no suitable habitat. The endangered gray wolf is known to occur within the boundaries of the refuge.**

There is no designated critical habitat within Tule Lake Refuge. Intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for listed species and their designated critical habitat. **Any conservation measures, as well as terms and conditions resulting from intra-Service consultation under the federal ESA will be implemented to protect listed species and their habitat that occur on the refuge, as applicable.**

The greater sage-grouse (*Centrocercus urophasianus*) is a state-listed species. In 2005, it was withdrawn as the candidate species for listing under the federal ESA. State-listed birds that have been observed on the refuge are indicated in Appendix H and include white-tailed kite (*Elanus leucurus*) (proposed candidate for state listing [CP]), Swainson's hawk (Oregon Sensitive Species [Northern Basin and Range Subregion] [OSS] and California Threatened [CT]), American peregrine falcon (OSS, California Fully Protected Species [CFPS], California Endangered [CE]), bald eagle (Oregon Threatened, CE), greater sandhill crane (CT, CFPS), and California Species of Special Concern: burrowing owl (*Athene cunicularia*) (OSS, CSSC), short-eared owl (*Asio flammeus*) (CSSC), loggerhead shrike (*Lanius ludovicianus*) (CSSC), yellow-breasted chat (*Icteria virens*) (CSSC), tricolored blackbird (*Agelaius tricolor*) (CSSC), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*) (CSSC).

Other California Species of Special Concern that have been observed on the refuge include blue chub (*Gila caerulea*), Sacramento perch (*Archoplites interruptus*), and marbled sculpin (*Cottus klamathensis*). If they are present, the potential adverse and beneficial effects of implementing CCP actions, as described previously, are expected to be minor for state-listed species.

Adverse effects of wetland management on fish and wildlife are negligible.

Farming Programs

An extensive farming program is conducted on the refuge that includes 14,800 acres of lease land crops of small grains, alfalfa, onions, and potatoes; 2,300 acres of cooperatively farmed units; and 0 to 2,700 acres of walking wetlands. Typical farming equipment would include tractors, trucks, and cultivators. Farming activities that can disturb wildlife are breaking the ground and turning under the soil from the previous crop, planting, cultivating, and harvesting the crop. Prescribed burning can be used on farmed units to reduce all vegetation prior to tillage and planting. The farming program is active on approximately 46% of the refuge.

Walking Wetlands is a program where fields are rotationally returned to wetlands using specific water management regimes. After several years in wetland status the fields are returned to the farming program. Following wetland cycles, no soil fumigation is needed and the soil pest and disease control function of wetlands is sufficient to allow for organic crop production. Small dikes must be constructed around farming units to allow wetland creation. These dikes are typically constructed after crop production when wildlife use of these units is low. Material for these dikes comes from the adjacent fields. Under Alternative A, the refuge would construct dikes around the lease land lots in Sump 3 where walking wetlands management is feasible. This construction would be completed within 1 year and is similar to ongoing farming practices. Although the farming program covers almost half of the refuge, the direct adverse effects to fish and wildlife are minor. The primary adverse effect is likely to be disturbance periodically during the annual farm cycle. The farming program would be maintained on existing farm fields. No areas of native vegetation would be converted to farm units. The rotation of fields through a wetland cycle would benefit wildlife. In addition, the crops grown on the refuge are used to feed waterfowl during their migration.

Pesticide Application

Although pesticides have been used extensively in the farming program, there is no indication that this use has adversely affected wildlife on the refuge. As part of the ongoing IPM activities, pesticides are used to control weeds for the farming program as well as to control invasive plant species, and maintain refuge facilities. The Service follows both DOI and Service policies regarding the use of pesticides (Integrated Pest Management, 517 DM 1 and Integrated Pest Management, 569 FW1). Pesticides are only applied after the approval of a PUP. When pesticides are used, the Service follows standard BMPs (Appendix L) to reduce adverse effects to soil, including adherence to all USEPA and Oregon or California EPA warning labels and application requirements. During the PUP process the Service considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the physical environment associated with the proposed site-, time-, and target-specific use of pesticides on the refuge are evaluated using the chemical profile prepared for the pesticide.

Studies of the toxicity and other effects of pesticide use are ongoing, and new findings and recommendations are announced routinely. As described in Section 6.2.5, Land Management,

Pesticide Applications, for Lower Klamath Refuge, recent studies have not linked wildlife mortalities on the refuge to pesticide use. At Tule Lake Refuge, the acreage affected by pesticides for cooperative farming has ranged from 532 acres in 2011 to 1,735 acres in 2014; for habitat management the application has ranged from 647 acres in 2011 to 2,004 acres in 2014 (see Tables 5.26 and 5.28). Pesticide application on lease lands has ranged from approximately 31,000 acres in 2010 to 96,000 acres in 2013 (see Table 5.20). Acreages of pesticide applications on lease lands include both Tule Lake Refuge and Lower Klamath Refuge. **Pesticide monitoring conducted in 2007 (Cameron 2008) and 2011 (unpublished data) shows that of the pesticides applied to croplands on Tule Lake Refuge only a few are present in the waterbody and at concentrations low enough that they should not be adversely affecting fish within the lake.**

The effects on biological resources of pesticide use for the cooperative farming program and invasive species management at Tule Lake Refuge are very similar to those described for Lower Klamath Refuge (see Section 6.2.4, Vegetation and Habitat Resources, Farming, Pesticide Application, Farming and Invasive Species Management). **The range of pesticides that may be used on Tule Lake Refuge cooperative farm units is broader than those allowed on cooperative farm units at Lower Klamath Refuge. On the Tule Lake Refuge the same spectrum of pesticides authorized for use on lease lands may be used on cooperative farm units, unless they are in organic production. On cooperative farm units that are farmed organically, only pesticides that meet the standards outlined by the National Organic Program criteria are allowed.** In addition, pesticides are used on the refuge to control insects, spiders, nematodes (worms), mice, and diseases in the cooperative farming program and/or for invasive species management.

Insecticides are used to control insects and spiders. There are systemic and contact insecticides that target eggs, larvae, and adults. Many insecticides have the potential for adverse ecological impacts (direct and indirect effects); toxicity to animals, including beneficial insects (e.g., pollinators) and humans; and biomagnification up the food chain. Because of this, insecticides proposed for use on the refuge are very carefully evaluated and those approved for use are mostly derived from plants or bacteria (actual or synthetic products), composed of bacteria or fungus, or otherwise of low to moderate toxicity to non-target organisms.

Grove (1995) studied the declining population of ring-necked pheasants (*Phasianus colchicus*) at the refuge in the early 1990s. He found that the adult pheasants had brain cholinesterase inhibition greater than 55% and that anticholinesterase insecticides (i.e., methamidophos) killed two young pheasants. However, he determined that the declining pheasant population was largely due to the lack of adequate cover, especially in the spring, and that golden eagles (*Aquila chrysaetos*) were preying on the exposed birds. Methamidophos-based insecticides are not currently used in the cooperative farming program or for invasive species management.

Nematodes are controlled through use of fumigants injected into the soil. These nematicides can be broad spectrum and toxic to non-target organisms. Soil injection greatly reduces potential exposure of amphibians, birds, fish, mammals, and reptiles, and thereby ameliorates the potentially toxic effects of these pesticides to focal, non-target species. As discussed previously, analysis of the effects to fish and wildlife of selected soil fumigants as part of an IPM program to suppress plant-parasitic nematodes is provided in the *Biological Assessment for Integrated Nematode Management of the Federal Lease Lands at Lower Klamath and Tule Lake National Wildlife Refuges* (Service 2013) and is incorporated by reference. The use of non-chemical methods to manage nematodes (e.g., prevention, crop rotation, green manure crops, fallow, and

soil solarization) are not expected to directly affect listed suckers, but may have indirect effects. The indirect effects typically associated with reducing or eliminating use of soil fumigants and non-fumigant nematicides are considered beneficial. For example, a green manure crop (green cover crop, later tilled into the soil) can provide erosion protection, weed suppression, nitrogen fixation, improve soil structure, and reduce insect pests. Toxicity of fumigant and non-fumigant nematicides may have the potential for adverse effects to all wildlife including the listed suckers. However, pesticide-specific BMPs are implemented to reduce potential exposure to wildlife and ecological risk can be substantially reduced. These effects of fumigant, non-fumigant nematicides and non-chemical control methods analyzed in the 2013 biological assessment were found to be not likely to adversely affect the protected fish analyzed. In their March 25, 2013 memorandum, the Service Klamath Falls Fish and Wildlife Office concurred with that effects determination. Federal- and state-listed species are discussed in that section below.

If bag-type repellents (with active ingredients often based on natural compounds, like cedar wood, eucalyptus oil, balsam fir needles, grapefruit oil, lemon oil, mineral concentrate, mint oil, peppers, predator scents, and soap), and trapping and removal are not successful in controlling mice in administrative and visitor structures, then anticoagulant rodenticides may be used. Because these pesticides are highly toxic to birds and mammals, they are typically distributed in tamper-resistant bait stations. These stations greatly minimize direct access to the poison bait by non-target organisms, but pet dogs and cats, and wild predators and scavengers can be sickened or killed through secondary poisoning if they feed on rodents that are moribund or dead due to rodenticide poisoning (Khan and Schell 2014; Poppenga, undated). The likelihood of this occurring is lessened by the fact that the target pests are in and around refuge buildings frequented by humans; wild predators typically avoid sites with regular human activity. The repellents and rodenticides affect a few individuals and would be no more than minor in intensity.

Seedling diseases are controlled by fungicides that primarily inhibit the growth of fungi instead of killing them outright. These pesticides generally have moderate to low toxicity to non-target organisms, except for fish. Because they are applied to seeds that are then planted in upland fields, it is unlikely that these fungicides would end up in refuge waters where they could harm fish.

These activities result in temporary disturbances to the habitats at the refuge, but they primarily result in long-term beneficial effects that improve habitat conditions. The wetlands and agricultural lands provide forage and cover for waterfowl and other wildlife. About 60% of the refuge is managed as a sanctuary with minimal disturbance, which helps protect colonial nesting waterbird breeding sites and other migratory species from disturbance. Federal- and state-listed species are addressed below.

In 1995, the Service issued a biological opinion on the use of pesticides and fertilizers on federal lease lands, which includes the application of pesticides and fertilizers on federal lease lands within the Tule Lake and Lower Klamath Refuges. In 2007, the Service issued a biological opinion and conference report for the implementation of the PUP on federal lease lands on the Tule Lake and Lower Klamath Refuges (Service 2007b). As stated in the biological opinion "The programmatic process set in place by this consultation will eventually supersede all previous consultations related to pesticide use on the federal lease lands. However, due to the large number of existing pesticide use patterns, new pesticide use requests, and the complexity of ecological risk assessments associated with each pesticide use pattern, previous consultations will be systematically reassessed and superseded in accordance with a prescribed schedule" (Service

2007b). According to the biological opinion (Service 2007b), "The reassessment schedule will start immediately following written concurrence from the Service of the terms and conditions of the biological evaluation. Reassessment of previously approved pesticide uses will be by crop type. One crop type will be reassessed per calendar year in addition to new pesticide use requests for all crop types." The reassessments have been completed and thus the 2007 biological opinion governs the use of pesticides on federal lease lands.

In the 2007 opinion, the Service determined that the use of pesticides and fertilizers on federal lease lands would not likely adversely affect Lost River sucker or shortnose sucker (as well as bald eagle, which is no longer federally listed, but is state-listed) (Service 2007b). The following paragraphs provide highlights of the discussion in the biological opinion (Service 2007b) of potential direct effects to suckers and their habitat by pesticide exposure and indirect effects through impacts to aquatic organisms that are part of the food chain, and by subsequent impacts to water quality resulting from the decomposition of affected plants and algae in the case of aquatic herbicide applications.

The primary pathway of pesticide exposure of fish is assumed to be particle drift immediately following aerial, ground, or chemigation application. Buffers between the application and waterbodies are prescribed to minimize risk of pesticide drift to listed suckers and other aquatic resources. Two other mechanisms may also contribute to off-target movement of pesticides. These are surface runoff and leaching. Because lease land topography is essentially flat, and rainfall events during most of the pesticide application season are infrequent and low intensity, the potential for runoff and leaching is low (Service 2007b).

For Lost River and shortnose suckers, exposure to chemical mixtures can occur within the water column, and from contact with contaminated sediments and/or food. Haas (2007) evaluated the risk of multiple pesticide products to listed suckers in Tule Lake sump using the toxicological unit approach. Although the toxicological unit analysis by Haas (2007), described above, is based on many assumptions, and likely has other limitations, it is currently the best analysis available for the additive effects of pesticide use on the refuge. Based on the toxicological unit analysis by Haas, the products most likely to pose a risk to listed suckers are 1netam sodium (Vapam) and chlorpyrifos (Lorsban). Results of the revised analysis for these two pesticides suggest their use on federal lease lands does not likely pose a substantial risk to listed suckers. An essential component for the finding of "not likely to adversely affect" is the ongoing implementation of the PUP review process and the use of mandatory BMPs. The analysis in the 2007 biological opinion on pesticides and fertilizers used on federal lease lands are incorporated by reference (Service 2007b).

To supplement the analysis of indirect effects, the Service looked at potential effects of each of the active ingredients as shown in Table 5.25, as well as other pesticide use information available for the refuge (Service 2016). Because the Service would follow all pesticide label restrictions and BMPs (see Appendices G, L, and Q), pesticides would not be applied directly to, or within the no-spray buffer of,[2] surface waters. Therefore, indirect impacts to aquatic and terrestrial species that use refuge aquatic resources for food, cover, nesting, etc. would not be likely to occur.

[2] **Established in the U.S. Fish and Wildlife Service's May 2007 biological opinion (Service 2007b).**

Both adverse and beneficial indirect effects could occur to terrestrial plants and animals that are present within, or use, cropland that is treated with pesticides for cover, or reproduction. Pesticide application to treated crops could result in the following types of indirect impacts.

- **Minor short-term benefits to some plant species by eliminating insect predators.**
- **Minor short-term adverse effects by eliminating potential pollinators that contribute to the successful reproduction of many flowering plants, but compliance with label restrictions to avoid application to blooming plants if pollinators are present would minimize this risk.**
- **Minor adverse short-term effect on some reptile or avian species by reducing prey availability in croplands as a result of pesticide exposure, which could affect body condition and survivorship for affected individuals. Elimination of weeds through herbicide application could also reduce green matter or seeds for herbivorous and granivorous species (Boatman et al. 2004).**
- **Negligible short-term adverse effects by reducing a potential prey source (animals that consume invertebrates) for raptors that may have to subsequently forage elsewhere.**

Other indirect effects considered by the Service in the biological opinion (Service 2007b) include disturbance of bald eagles by pesticide application activities. Pesticides may be applied by aircraft, ground equipment, or through irrigation systems (i.e., chemigation). Aircraft and foot traffic can be a disturbance factor for bald eagles, and other bird species in general(see discussion of disturbance effects from public use in Section 6.2.6). Ground application equipment and irrigation equipment may also disturb nearby eagles (and other birds), but to a lesser extent than aircraft and human foot traffic. Disturbance can be harmful to nesting birds as it may result in inadequate care of incubating eggs or young nest-bound birds, increasing stress and the probability for premature mortality. Nesting bald eagles are unlikely to be disturbed by pesticide applications because the nearest nest is more than 5 miles from the agricultural areas on the refuge. Disturbance can also be harmful during spring and fall migrations when excessive disturbance can reduce migratory birds' overall fitness. The peak period of pesticide application occurs from May through August, which is generally outside of the spring and fall migrations.

The adverse effects to fish and wildlife from pesticide application is considered minor.

Public Use

Activities and public use on the refuge that can adversely affect wildlife are research, environmental education, interpretation, wildlife observation and photography, boating, and hunting. These activities can have a wide variety of effects on wildlife ranging from intermittent stress to direct mortality of an animal. This range of effects is described for Lower Klamath Refuge (see Section 6.2.5). With the exception of the number of waterfowl harvested here, hunting on this refuge would have almost the same direct and indirect effects; including disturbance effects on fish and wildlife as described for Lower Klamath Refuge. In recent years, the average, annual harvest of ducks on the refuge ranged from 6,361 to 11,314 individuals and for geese, from 1,528 to 4,446 individuals. These harvest figures include harvest by sport hunters with and without guides and include 100% fatality among animals shot, but not retrieved (that is, crippling loss). Mergansers and coots are included in the harvest statistics for ducks. Both species are rarely harvested by hunters.

The refuge is also open for hunting of common moorhens (*Gallinula chloropus*) and Wilson's snipe (*Gallinago gallinago*). However, these species are rare to uncommon on the refuge and no harvest data are collected for them. The Service believes that if these species are harvested on the refuge, the numbers are very low. Data are not available regarding how many pheasants are harvested annually on the refuge.

The same actions to reduce the adverse effects to fish and wildlife of current hunting programs described for Lower Klamath Refuge, also occur on this refuge. This refuge also benefits from the very successful programs undertaken by the Service and CDFW to manage migratory birds and resident game species (see descriptions in Section 6.2.5). Readers are referred to the official regulations for hunting on Klamath Basin refuges (see 50 CFR 32, Hunting and Fishing) and to the compatibility determinations in Appendix G for more specific information about conditions (stipulations) associated with the waterfowl and pheasant hunting opportunities offered on this refuge.

Although most species are able to relocate to nearby suitable habitat on or off the refuge to avoid disturbance, the visitor use program on the refuge has been designed to minimize wildlife disturbance. For example, five photo blinds are available to the public on the refuge. These photo blinds reduce the disturbance of waterbirds while providing the public with an opportunity for wildlife photography. On the 17-mile auto tour route visitors are asked to use their vehicle as a mobile blind. This reduces disturbance to wildlife while providing visitors a greater opportunity to view wildlife. In addition, there are two viewing platforms along the auto tour route to allow visitors to view wildlife. This minimizes disturbance to wildlife by reducing the number of areas where visitors would exit their vehicles. Other potential areas of disturbance include the canoe trail in Sump 1A and one in Discovery Marsh near the visitor center. Visitors are most likely to disturb wildlife when entering and exiting the trail. There is also a 1-mile walking path around Discovery Marsh. The canoe trails and walking path are relatively short and would not result in a substantial amount of disturbance to wildlife. Environmental education is conducted at the Dave Menke Education Center on the Discovery Marsh trail, the auto tour route, Sheep Ridge trail, and the visitor center. Using these sites for environmental education would not result in substantial amounts of wildlife disturbance because each of them is relatively contained and students would be reminded of wildlife friendly behavior that would enhance their opportunities to see wildlife.

The Lost River and shortnose suckers are unlikely to be adversely affected by wildlife-dependent recreation. The Tule Lake sump is highly eutrophic because of high concentrations of nutrients, and resultant elevated aquatic plant productivity causes large fluxes in dissolved oxygen, pH, an ammonia (Service 2007b). A small remnant population of both suckers remains at Tule Lake Refuge because of the relatively small areas of the lake that is greater than 3 feet deep and the poor water quality during the summer months. The sumps at Tule Lake Refuge are not designated critical habitat for the suckers. In light of the large size of the sumps at Tule Lake Refuge, the small remnant population of suckers, and the relatively small number of motorboats used by hunters, it is unlikely that the turbidity and petroleum discharges they create adversely affect suckers in these waterbodies.

The Swainson's hawk is also unlikely to be adversely affected by wildlife-dependent recreation on the refuge. Swainson's hawks are rarely observed on the refuge and it is unlikely that the hunting program has an effect on this hawk. Both bald eagles and the greater sandhill crane are found at Tule Lake Refuge. The large size and distinctive markings of these birds and loud and unusual calls of the greater sandhill crane make them unlikely to be mistakenly shot by hunters.

Temporary disturbances to federal- and state-listed species due to public use are similar to those to other wildlife and are discussed previously except that no directed killing would take place as these species are not subject to hunting. Some state-listed species including bald eagles and sandhill cranes are large, which may keep hunters from mistakenly shooting them. Others, such as peregrine falcons, and Swainson's hawks are either distinctive in appearance or occupy different habitat than game birds. Although these species are not hunted, they could be disturbed by gunshots, dogs and the hunters themselves.

The public use program on the refuge has been designed to minimize disturbance to wildlife, therefore, adverse effects of public use on fish and wildlife under Alternative A would be minor.

Beneficial Effects

Although agricultural lands do not provide habitat for some waterfowl species and do not provide a complete balanced diet, agricultural crops, including standing grains do provide a rich source of carbohydrates and provides more food (kcal/acres) for less water than wetland plant crops, which is particularly important for migrating dabbling ducks and geese. This high source of carbohydrates is considered an integral part of achieving waterfowl objectives.

In the *Bioenergetic Approach to Conservation Planning for Waterfowl at Lower Klamath and Tule Lake National Wildlife Refuge*, Dugger et al. (2008) developed a number of model simulations to see how well habitat conditions could meet waterfowl needs given refuge population objectives. The Service determined that under Alternative A all of the energy needs for one or more taxa are not supplied. Currently the refuge provides sufficient food energy to meet population objectives for swans, diving ducks, and gadwall. Food supplies for dabbling ducks were exhausted early in the fall, before the peak of migration in November. Goose needs were met through most of the fall and winter but not spring. Although leafy vegetation met coot needs prior to November 1, survey data indicated coots persist on the refuge longer than would be predicted. This may reflect persistence of submerged aquatic vegetation beyond November 1 or coot use of other food sources.

Mitigation

The direct adverse effects of land management and public use programs on the refuge are minimized through the implementation of the BMPs described in Appendix L. As with all alternatives, the Service will conduct intra-Service federal ESA consultation to protect listed species and their habitat that occur on the refuge.

Pesticide application would continue to be governed by the PUP process.

<u>Alternative B – Tule Lake Refuge</u>

Land Management

Wetland Management

The direct effects under Alternative B would be the same as described under Alternative A. No changes are proposed to wetland management with the exception of creating a Habitat Management and Wildlife Inventory and Monitoring Plan. This plan would help focus future efforts in managing wetlands but is likely to include the same types of management actions

described in Alternative A. One additional activity proposed is to develop a program for managing the berms between the units. Berm management would involve planting the berms with native vegetation to improve cover for nesting waterfowl and reduce invasive species. Wetland management activities would be substantially the same as under Alternative A and the effects would continue to be negligible.

Farming Programs

The direct impacts of the farming program would be the same as described under Alternative A. However, under Alternative B, the Service would require farmers to leave 1,500 acres of standing grain on the refuge to support dabbling duck and geese populations during the winter and spring. Standing grain refers to unharvested fields. Approximately 2,700 acres of harvested potatoes and 3,400 acres of green browse would also be available as forage for waterfowl each year. In addition to these changes, under Alternative B **the Service would strive to maintain approximately 1,380 acres of in the Walking Wetlands Program annually and to** increase the interspersion of **these** wetlands within lease land agriculture so that all fields are within 1 mile of a wetland. Dikes would be constructed around lease land lots in Sump 2 where walking wetlands management is feasible. This construction would be completed within 1 year and is similar to ongoing farming practices.

With the modifications to the farming program, the adverse effects to fish and wildlife would be still be considered minor.

Pesticide Application

Pesticides would continue to be evaluated and permitted on farmed areas, around structures and to control invasive plant species according to Service and DOI policies. The effects of pesticides on wildlife from application would be similar to effects described in Alternative A. Under Alternative B, the Service would formalize the ongoing pest management **for cooperative farm units, habitat restoration, and maintenance** under an IPM Program (Appendix Q). Under Alternative B, the refuge would use GPA to map and monitor invasive plan populations. The effects of pesticide application would be the same as under Alternative A.

Public Use

The physical extent of the facilities that support wildlife-dependent recreation would not change substantially under Alternative B. A slight modification along the auto tour route would include constructing several new pull-off areas on existing auto tour routes to provide additional wildlife observation opportunities. The pull-offs would entail a minor amount of construction to pave or gravel an area adjacent to the auto tour route. This work would be comparable to ongoing road maintenance. The addition of the pull-offs would also physically reduce available wildlife habitat area by approximately 0.5 acre each. These facilities would be located adjacent to the existing road where habitat quality is already reduced; because of this, effects to wildlife near the pull-off are expected to be minimal. A floating boardwalk next to the education center at Discovery Marsh would be constructed and the Sheepy Ridge trail would be improved to reduce erosion. These improvements to the existing auto tour route, the Sheepy Ridge trail and addition of a boardwalk would have a small, localized increase in wildlife disturbance as visitors exit their cars to view wildlife. As with Alternative A, the effects of visitor use are somewhat mitigated during dryer

years when there are likely to be fewer visitors using the refuge (i.e., with less water, there is typically less wildlife and fewer opportunities for wildlife-dependent recreation).

Other changes proposed for the visitor use program would not have physical effects to wildlife. These activities would include providing additional interpretation about the Walking Wetlands Program to the public, providing hands on exhibits in the visitor center, analyzing the cost-effectiveness of current hunt fees, and developing a high school walking wetlands curriculum. See the Alternatives Matrix for a complete list of proposed changes. The direct adverse effects to wildlife would be the same as described in Alternative A.

Establishment and operation of a portable decontamination station(s) near boat launches on the refuge would have the same effects on non-native and invasive fish and wildlife species as described above (under Alternative B in the Vegetation and Habitat Resources Section) for plants.

The adverse effects of public use on fish and wildlife under Alternative B are minor and not likely to adversely affect federal- and state-listed species.

Beneficial Effects

As described previously under Alternative A for Lower Klamath Refuge, food supplies for geese on the refuge were only adequate until late winter. Under Alternative B, increasing unharvested grain is the most land-efficient option (greatest energy gain for lease amount of land) for increasing food for geese in the fall and winter (greatest energy gain for lease amount of land) while increasing green browse improves foraging conditions for geese in spring, the period when food is currently most limiting. Under Alternative B, unharvested grain would be increased to 1,500 acres to support dabbling duck and geese population objectives during winter and spring. An increase in standing grains would benefit geese and other wildlife by providing more forage during migration and nesting periods. More food resources would be available for wintering bald eagles, potentially increasing their use of the refuge. These changes would slightly increase wetland acreage as well, providing some additional habitat for waterbirds dependent on wetlands. The change in the proportions of wetlands and farmed areas and the increase in standing grain would mean that the refuge would be able to meeting the dabbling duck and goose needs. These changes would allow the refuge to meet the energy needs for all waterfowl guilds as well as the foraging habitat objectives for each guild.

Under Alternative B, the farming program would also be modified by expanding the use of preferential permits for cooperatively farmed grain and hay units for farmers that participate in the Walking Wetlands program on their private lands. Under Alternative B, the refuge would **strive to maintain approximately** 1,380 acres of walking wetlands **annually and** intersperse **these wetlands** in the lease lands areas so that no farm field is farther than 1 mile from a wetland. This modification would expand wetland areas available to waterfowl and waterbirds in the Klamath Basin. Approximately 2,700 acres of harvested potatoes and 3,400 acres of green browse would also be available as forage for waterfowl each year

A slight reduction in the amount of pesticides used could occur from the berm management program. Berms (dikes) would be restored by planting species to improve vegetative cover for nesting waterfowl and other species. The replacement of invasive species with plants of higher wildlife habitat value is expected to reduce the need for pesticide applications on the dikes in wetland and upland units in the long term. The reduction of pesticide use is expected to be

beneficial, yet modest (minor) during the 15-year management period considered in this CCP given the size of the refuge (over 39,100 acres).

Establishment and maintenance of healthy and sustainable stands of native and/or naturalized vegetation on refuge dikes near cooperative farmlands would enhance the quantity and quality of refuge wildlife habitat. As discussed earlier, Grove (1995) determined that the lack of adequate cover, especially in the spring, was largely responsible for the declining pheasant population. Re-vegetating the dikes would provide needed thermal and nesting cover, and cover from predators. This program could reverse the decline in the pheasant population, and also benefit other ground-nesting birds, small mammals, and beneficial insects, including pollinators and predators.

Use of GPS to monitor weed locations, and rapid assessment and control actions to control invasive species infestations when they were smaller in size would be expected to enhance the quality of wildlife habitat refuge-wide by reducing the aerial extent of affected habitat. Identifying pest infestations early would also reduce the number and magnitude of pest-management efforts, including applications of pesticides needed to control these invasive species when they had expanded elsewhere on the refuge. Reducing these control efforts would also reduce their potential adverse effects on wildlife, a benefit relative to current conditions.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative C (Preferred Alternative) – Tule Lake Refuge

Land Management

Wetland Management

The direct adverse effects of wetland management activities would be the same as described under Alternative B. Under Alternative C, a plan to manipulate water elevations in Sumps 1A and 1B would be developed. These water level manipulations may provide additional habitat for waterfowl. The adverse effects to fish and wildlife would be negligible.

Farming Programs

The direct effects of the farming program would be similar to those described under Alternative B. Under Alternative C, the Service proposes several changes to farming practices that would benefit wildlife resources. These proposed changes are discussed under Beneficial Effects. While the proportions of farmed and wetland areas would be the same, the locations of wetland areas would be modified to improve the interspersion of wetlands within lease lands. The adverse effects of farming on fish and wildlife would be minor.

Pesticide Application

Under Alternative C, the Service would work to increase the acreage of organically farmed units in both the lease land and cooperative farmland. An increase in the number of organically farmed units would decrease the amount of chemical pesticides applied on the refuge and the potentially

adverse effects of pesticide use. The effects of pesticide application on fish and wildlife would continue to be minor.

Public Use

Under Alternative C, the Service would modify the auto tour route to maximize wildlife viewing opportunities. The effects of public use on fish and wildlife, including non-game species, under Alternative C would be the same as under Alternative B. As with all alternatives, intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA to protect listed species and their habitats that occur on the refuge. The effects of public use would be minor and not likely to adversely affect federal- and state-listed species.

The direct effects of public use on fish and wildlife under Alternative C would be minor.

Beneficial Effects

Under Alternative C, a plan would be implemented to manipulate water elevations in Sumps 1A and 1B to improve wetland habitat diversity and productivity, which would benefit waterfowl and other wetland-dependent wildlife.

Under Alternative C, the farming program would be modified to increase the attractiveness of agricultural lands to waterfowl with additional fall flooding. The acreage of walking wetlands would not change from that proposed under Alternative B. The increased use of fall flooding is expected to improve and increase waterfowl habitat. Other modifications under this alternative are: expanding the area of lease land and cooperatively farmed units that are managed organically and expanding incentives such as lease extensions for farmers that manage fields organically. As a result of these incentives, the application of chemical pesticides used for farming is expected to decrease under this alternative. The expanded incentives to manage fields organically are expected to reduce the use of pesticides and associated potentially adverse effects and result in beneficial biological effects to all natural resources on the refuge, including fish and wildlife. Beneficial effects to wildlife under Alternative C are likely to be somewhat higher than Alternative B because of the **increase in fall flooding of agricultural land** and the potential reduction of chemical pesticides.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). **In addition, the Service proposes to periodically conduct water, sediment, and fish and wildlife tissue monitoring in refuge waterbodies to ensure pesticides are at concentrations below those having an adverse effect to listed species and other wildlife.**

6.4.7 Cultural Resources

Methodology for Assessing Effects – Tule Lake Refuge

Compliance with the NHPA is required for all undertakings funded with federal funds or requiring a federal permit, both on Service-owned lands and on private lands. Compliance is accomplished through a process initiated with the submittal of the Request for Cultural Resource Compliance form to the Regional Cultural Resource Team. When the Service commits funds, or prepares specific plans, to an identified project or activity identified in the final CCP, that activity

or project will become a Section 106 undertaking for which the Service will comply with the Section 106 review and compliance process prior to the implementation of the activity or project. Projects are reviewed by the Regional Archaeologist, who identifies the steps necessary to ensure compliance with Section 106. As appropriate, consultation, cultural resource survey, identification, and evaluation are implemented according to the procedures set forth in the terms of the Service Programmatic Agreement with the State of California. If the Programmatic Agreement criteria do not apply, further evaluation and consultation are conducted by either Service archaeologists or certified archaeological contractors under the supervision of the Regional Archaeologist. If significant cultural resources are identified within the area of potential effects, the Service, in consultation with the SHPO and any interested parties, will develop a plan to avoid, minimize, and/or mitigate adverse effects to the significant cultural resources.

The following are resource-specific contexts for assessing effects of alternatives to cultural resources.

- Much of the land base of the refuge has been modified through agricultural practices.
- Numerous cultural resource sites have been documented on the refuge.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

The area on and around Tule Lake was used extensively by Native Americans and there are a number of prehistoric and historic cultural resources within 1 mile of the refuge. However, the only site that has thus far been determined eligible for the NRHP is the Tule Lake Segregation Center. This site was designated a National Historic Landmark in February 2006 because of its national importance in the historic context of Japanese Americans in World War II. **The Tule Lake Segregation Center is located on NPS property and is managed solely by the NPS. Presidential Proclamation 8327 establishing the World War II Valor in the Pacific National Monument included the Tule Lake Segregation Center, Camp Tulelake, and the Peninsula. The Tule Lake Segregation Center, Camp Tulelake, and The Peninsula comprise the Tule Lake Unit of the World War II Valor in the Pacific National Monument. On Camp Tulelake and the Peninsula which are on refuge property but co-managed with the NPS there are no** wetland or farming areas: therefore, neither of these areas would be affected by wetland or farming practices such as prescribed fire. Mowing invasive weeds from around the structure helps reduce the risk of damage from wildfires. Wetland management would have neutral effects on cultural resources.

Farming Programs

Between 1922 and 1948, most of the exposed Tule Lake bed was passed to private ownership through the homesteading process. Because ground-disturbing activities associated with farming have occurred throughout the refuge for nearly a century, the Service has concluded that the likelihood is low for continued farming activities to disturb cultural resources. Wetland management would have neutral effects on cultural resources.

Pesticide Application

The Service expects that pesticide application needed for farming, habitat management, or facility maintenance would have no effects on cultural resources. Pesticide application generally does not affect subsurface cultural resources. Pesticide applications would have neutral effects on cultural resources.

Public Use

While the refuge is open to hunting and hunters traveling off trail could trample cultural resources, or could collect artifacts**, the potential for this type of impact is low. Hunt areas on Tule Lake Refuge are generally associated with farmed fields. The ground-disturbing activities associated with farming have occurred throughout the refuge for nearly a century which has made the likelihood of disturbing cultural resources low.** The Service therefore concluded that Alternative A would have neutral or negligible effects to cultural resources due to public use activities.

The Service would continue to implement the cooperative agreement with the NPS – Lava Beds National Monument for co-management of portions of the Tule Lake Unit of the World War II Valor in the Pacific National Monument.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing in the NRHP until formally evaluated in consultation with the SHPO.

Alternative B – Tule Lake Refuge

Land Management

Wetland Management

No physical changes to the wetland management program are proposed under Alternative B, therefore the effects would be the same as described under Alternative A.

Farming Programs

The extent of the farming program would remain the same, but the extent of crop types would be modified. Standing grain would be increased to up to 1,500 acres and the **Service would strive to maintain approximately 1,380 acres annually** of walking wetlands. These changes would not affect cultural resources.

Pesticide Application

As described under Alternative A, the Service expects that pesticide application would generally have no effects on cultural resources on the refuge because there would be no ground-disturbing effects.

Public Use

Effects to cultural resource would be similar under Alternative B as described for Alternative A. Additionally, a cultural resource review would help identify an appropriate location for the pull-off areas along the auto tour route. If any cultural resources are identified during the review, the Service would than evaluate the property to determine the effects and what level of mitigation may be needed.

Additionally, the Service would explore land exchange opportunities with the NPS to enable the transfer of Camp Tulelake to the NPS. If a land exchange is identified that proposal would be evaluated in a project-specific NEPA document. The Peninsula Unit (upland area) of the refuge would continue to be managed in cooperation with the NPS.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be

followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing in the NRHP until formally evaluated in consultation with the SHPO.

Alternative C (Preferred Alternative) – Tule Lake Refuge

Land Management

Wetland Management

Under Alternative C the modification to wetland management would consist of developing a plan to manipulate water elevations in Sumps 1A and 1B to improve wetland productivity. This modification is not likely to affect cultural resources because there would not be any ground disturbing activities.

Farming Programs

The modification to the farming program would **consist of increasing the attractiveness of agricultural land to waterfowl with fall flooding and expanding the area of lease land and cooperatively farmed units that are managed organically.** This modification would not change the extent of the farming program and potential impacts to cultural resources would be the same as Alternative B.

Pesticide Application

As described under Alternative A, the Service expects that pesticide application would generally have no effects on cultural resources on the refuge because there would not be any ground-disturbing effects.

Public Use

Cultural resource-related impacts under Alternative C would be the same as those described for Alternatives A and B.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing on the NRHP until formally evaluated in consultation with the SHPO.

6.4.8 Visitor Services

Recreation Opportunities

Methodology for Assessing Effects – Tule Lake Refuge

Maps of the refuge showing the locations of visitor services and habitat, in conjunction with professional judgment were used to predict how public use would affect recreational opportunities.

The following are resource-specific contexts for assessing the effects of alternatives to recreation opportunities.

The refuge has historically offered one of the most extensive waterfowl hunt programs in the nation.

The refuge provides an extensive variety of wildlife-dependent recreation.

Alternative A – Tule Lake Refuge

Land Management

Wetland Management

The Service currently offers diverse recreation opportunities at the refuge. Hunting is allowed by drive-in, walk-in, or boat access and wildlife viewing, interpretation, and environmental education are available via an auto-tour route and walk-ins. The hunting areas are also separated for different users. On-site education, interpretation, and outreach are available at the Refuge Complex Visitor Center. Off-site information about the refuge and outreach are available on the Refuge Complex website and for nearby schools as part of a K-12 curriculum about birds and a K-8 curriculum about wetlands. Prescribed burning is the primary management tool used in wetland areas to improve habitat and manage invasive species. As described for Lower Klamath Refuge,

prescribed burns can mean that portions of the refuge are temporarily closed to public access and use. Some visitors may find objectionable the knowledge that the Service traps and removes native species (e.g., beavers and muskrats) on the refuge and/or the sight or smell of a prescribed fire, its smoke, or a blackened field/management unit following a burn. The intensity of post-burn green-up and opening of choked wetlands may offset some of these concerns. Adverse effects of wetland management to visitor services would be negligible.

Farming Programs

The effects of farming on recreational opportunities at the refuge are the same as described for Lower Klamath Refuge. There can be short-term effects from dust caused by tilling or disking fields, but these are localized and limited in duration. Adverse effects of the farming program on visitor services would be negligible.

Pesticide Application

The effects on recreation opportunities from pesticide application are the same as those described for Lower Klamath Refuge. The addition of compost/fertilizer would have no effects on recreation opportunities. The effects of pesticide application on visitor services would be negligible.

Public Use

This section evaluates how public use of the refuge could affect recreational opportunities on the refuge, including the potential for conflict between user groups. The primary public use of the refuge is for wildlife-dependent recreation consisting of hunting, wildlife observation and photography, interpretation of natural resources on the refuge, and environmental education. Boating and management oriented research are also allowed on the refuge. Environmental education conducted off-refuge is not addressed because there is no physical effect on other refuge user groups. The refuge is accessible by car, boat, or foot. Visitor use is monitored as part of the Klamath Basin Refuge Complex-wide monitoring program. Visitor use numbers may be used to determine what off-site environmental education events the refuge attends but they are not used to modify the location of wildlife-dependent recreation on the refuge.

Potential conflicts between user groups are managed primarily by physically separating hunting from other wildlife-dependent uses. Hunting access is allowed by drive-in, walk-in, or boat-in areas. Because Tule Lake Refuge is open to both waterfowl and upland game (pheasants) there is a potential for conflicts between hunters pursuing different game species. These potential conflicts are avoided through use of temporal and/or spatial zoning (i.e., the hunts are held at different times and/or in different areas).

Habitat and hunting are evaluated every year and, if deemed necessary, areas are closed. Hunter numbers are typically self-regulating due to the remote location of the refuge (habitat conditions are posted on the web pages and announced in the hunter "hotline"); when there is little habitat, most hunters choose not to come. However, if needed, hunter numbers are managed to reduce impacts to waterfowl populations.

Currently, five commercial guides offer waterfowl and pheasant hunting opportunities on Lower Klamath and Tule Lake Refuges (combined). These guides offer safe, quality, wildlife-dependent public use (i.e., hunting) opportunities to a range of individuals, potentially including those new to hunting, those with limited time to devote to hunting, those not familiar with the area, and/or

those with disabilities. These professional guides offer hunting experiences as a business using high-quality equipment and supplies. In order to increase the likelihood of a successful hunt by their clients, guides invest more time and money learning about each refuge, studying the availability and condition of habitats and wildlife use, and scouting potential hunting areas than many individual sport hunters. The Service is aware that there are visitors who do not agree with commercial guiding on the refuges. However, the Service believes that permitted guides are an asset to the hunting program. They bring a substantial number of visitors to the refuges who might not otherwise use this recreational opportunity and who contribute to the local economy. Under the Service permit, guide behavior and restrictions are spelled out and violations are taken very seriously up to and including the loss of guiding privileges.

The effects of public use on recreational opportunities is considered minor.

Beneficial Effects

The indirect effects of land management actions results in stable populations of fish and wildlife which is beneficial for multiple types of wildlife-dependent recreational opportunities. Upgrades to visitor facilities including buildings, roads and trails, parking lots, restrooms, visitor overlooks, kiosks, and signs will also result in beneficial effects. Cleaner facilities and more clear orientation and way finding will make the refuge visitor experience safer and more enjoyable. Furthermore, human health threats associated with poisonous plants and diseases associated with rodents will be minimized as visitor facilities are cleaned and improved. Also by maintaining wildlife-dependent recreation, the Service would continue to provide visitors with an understanding and appreciation of fish and wildlife ecology.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative B – Tule Lake Refuge</u>

Land Management

Wetland Management

Under Alternative B the same types of recreation would be available to the public, but the overall recreational opportunities would be enhanced. Under this alternative, the Service would focus on improving public access at the existing facilities by enhancing the visitor center entrance, incorporating pull-off areas on the auto tour route, and renovating the visitor center so that it is compliant with the Americans with Disabilities Act. Other modifications to the hunt program, such as changes to the hunt fee and using guides, will be further evaluated and will be implemented if determined beneficial to the public and refuge. Additional and improved interpretive programs would be available, and outreach with local schools would be improved. The enhanced opportunities would benefit the public, likely resulting in increased visitation. The projected increase in visitors would likely be similar to past trends of visitors, as discussed in the Effects on Social and Economic Conditions, considering the rural nature of the refuge and would not lead to other substantial impacts (e.g., from increased use of facilities).

Establishment and maintenance of healthy and sustainable stands of native and/or naturalized vegetation on refuge dikes near cooperative farmlands would be expected to enhance the quality of experience for wildlife watchers because it would stabilize or increase populations of ground-nesting birds, small mammals, and other wildlife.

The adverse effects of wetland management on visitor services are considered negligible.

Farming Programs

The Service would develop a Habitat Management and Wildlife Inventory and Monitoring Plan to more closely integrate land management actions, but the actions would not change in scope. The plan would have no effects on recreation opportunities. **In addition, the Service would strive to maintain approximately 1,380 acres annually in the Walking Wetland Program and increase the interspersion of these wetlands so that all fields are within 1 mile of a wetland. The** adverse effects of farming on visitor services are considered negligible.

Pesticide Application

The effects on recreation opportunities of pesticide application under this alternative would be the same as described above for Alternative A, with the exception of a portable decontamination station for boaters. Establishment and operation of a portable decontamination station(s) near boat launches on the refuge would make it more convenient for boaters to clean their boats, trailers, and other equipment of pest and invasive species. Application of pesticides would take place consistent with the IPM program in Appendix Q. This modification would have no effects on recreation opportunities, therefore adverse effects are considered negligible.

Public Use

Facility modifications to the visitor center, auto tour route, Sheepy Ridge trail, and the floating boardwalk near Discovery Marsh could result in temporary disruptions to visitor uses in or near the disturbed areas, but the overall modifications are expected to benefit the visitors. The visitor use programs would be modified as much as is feasible during facility improvements to provide visitors with wildlife-dependent recreational experiences. These impacts would be further analyzed in project-specific NEPA documents once specific details on the new facilities are available. Potential adverse effects would be considered minor.

Beneficial Effects

Improvements to the refuge under Alternative B would result in additional beneficial effects to those articulated under Alternative A including the following.

- Additional interpretive programs, development of a high school walking wetlands curriculum and associated teacher training workshops, partnerships with schools, and hands-on exhibits in the visitor center will enhance visitors' understanding of the refuge system and their awareness and appreciation of the refuge's wildlife, habitat and cultural resources.
- Construction of new facilities such as the floating boardwalk, up to four pull-off areas on the existing auto tour route, and accessibility upgrades to the visitor center will make wildlife-dependent recreation more convenient and increase the quality of the refuge visitor experience.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative C (Preferred Alternative) – Tule Lake Refuge

Land Management

Wetland Management

Under Alternative C, the Service would develop a plan to manipulate water elevations in Sumps 1A and 1B. Recreational opportunities would be improved with the corresponding improvement in wetland diversity and productivity. Adverse effects would be considered negligible.

Farming Programs

The modification to the farming program under Alternative C would be to **increase the attractiveness of agricultural lands to waterfowl with fall flooding** and to increase the number of units that are organically farmed. These changes would have no direct adverse effects to recreational opportunities on the refuge; rather they are likely to improve visitor experience by increasing waterfowl use on the refuge. Adverse effects would be considered negligible.

Pesticide Application

Under Alternative C there would be fewer applications of chemical pesticides which could enhance the quality of recreational experience for some visitors. Adverse effects would be considered negligible.

Public Use

To reduce noise, disturbance, and for other reasons discussed elsewhere herein, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) or direct injection boat motors to be used. Adverse effects would be considered minor.

Beneficial Effects

The indirect effects of land management actions results in stable populations of fish and wildlife for recreational opportunities; and cleaner and clearer visitor facilities, including buildings, roads and trails, parking lots, restrooms, visitor overlooks, kiosks, and signs. This reduces human health threats associated with poisonous plants and diseases associated with rodents, and makes the refuge visitor experience safer and more enjoyable.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.4.9 Social and Economic Conditions

Methodology for Assessing Effects – Tule Lake Refuge

The Service prepared an Economic Analysis of the Klamath Basin Refuge Complex CCP alternatives, which is contained in Appendix P. The economic analysis looked at the regional economic conditions and evaluated the economic effects of the various management alternatives.

The following is the resource-specific context for assessing effects of the alternatives on social and economic conditions.

- Refuge management contributes to the local economy through both recreational opportunities and agricultural production.

Alternative A –Tule Lake Refuge

The Service would continue to operate and manage Tule Lake Refuge as it has in the past, and the contribution of the refuge to the regional economy from direct and indirect expenditures would be expected to be similar to current conditions. The refuge budget would remain similar to the current budget, which is a portion of the $4 million annual budget for the Refuge Complex, and ongoing management and maintenance projects would continue to be implemented, as feasible within the budget. Agricultural revenue would also be similar to current conditions. In 2015, sales from row crops on Tule Lake Refuge were about $25,000,000; grain sales were about $6,800,000; and alfalfa sales were about $1,888,000.

The lease land program has generated an average of $3.6 million annually in lease revenue from 2001 through 2015. After accounting for Reclamation's expenses in administering the program, the revenues are distributed as follows: first, TID receives 10% of the net revenues of lease land within TID boundaries pursuant to the TID Contract Act of 1956; next, Siskiyou, Klamath, and Modoc Counties receive 25% of the net revenues for lease lands within their boundaries pursuant to the Kuchel Act; the remaining revenues are deposited in the Reclamation Fund.

This paragraph summarizes economic effects discussed in more detail in an *Economic Analysis of Klamath Basin Refuge Complex* (Appendix P). In 2015, the Service estimates that agricultural crop production on the refuge supports 574.8 jobs in the region. Visitor related spending is a portion of the overall 54 jobs. In addition, the regional economy benefits of administering the refuge program contributes 10.5 jobs to the region. (Appendix P, *Economics Analysis*).

Alternative B – Tule Lake Refuge

Under Alternative B for Tule Lake Refuge, implementation of management activities may result in the following.

- A short-term increase in refuge spending and regional economic activity due to construction or modification of facilities.
- Little to no net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 0.5).
- An minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation.

- A minor decrease in agricultural production and related regional economic activity compared to Alternative A due to 1,100 acres increase in unharvested grain. This change in agricultural production could result in a reduction of 47.5 agricultural related jobs in the region. If changes in agricultural production result in a reduction in lease land revenues, Kuchel Act payments to TID and Siskiyou and Modoc Counties could decrease.
- **Agricultural production changes from maintaining an average of 1,380 acres annually in the Walking Wetlands Program.**

Alternative C (Preferred Alternative) – Tule Lake Refuge

Under Alternative C, implementation of management activities in the Tule Lake Refuge could result in the following.

- A short-term increase in refuge spending and regional economic activity due to construction or modification of facilities.
- Little to no net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 0.8).
- A minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation.

Environmental Justice

The refuge is located in a remote area with low population density in Siskiyou and Modoc Counties. For the period from 2010 to 2014, Modoc County had slightly higher poverty levels than what is found across the state. Although not directly comparable (U.S. Census Bureau 2016), about 21% of people in Siskiyou County and about 21% of people in Modoc County live in poverty. About 16% of the people in the state of California live in poverty (U.S. Census Bureau 2016). The CCP actions proposed in all alternatives focus on continuing and improving existing habitat management, inventory and monitoring, natural and cultural resources conservation and extensive visitor services on the refuge. With consideration of the higher poverty levels in Siskiyou and Modoc Counties and due to the nature of the CCP actions, the Service concluded that within the spirit and intent of EO 12898, implementation of the CCP actions at the refuge would not disproportionately affect minority or low income populations.

Summary of Effects

Table 6.7 summarizes the potential effects of the three alternatives being considered for the Tule Lake Refuge.

Table 6.7. Summary of Effects for Tule Lake Refuge

	Alternative A	*Alternative B*	*Alternative C (Preferred Alternative)*
Effects on Soils			
Land Management			
Wetland Management	Minor	Minor	Minor
Farming Programs	Intermediate	Intermediate	Intermediate
Pesticide Applications	Negligible	Negligible	Negligible
Public Use	Negligible	Minor	Minor

Table 6.7. Summary of Effects for Tule Lake Refuge

	Alternative A	*Alternative B*	*Alternative C (Preferred Alternative)*
Effects on Hydrology			
Land Management			
Wetland Management	Negligible	Negligible	Minor
Farming Programs	Neutral	Negligible	Minor
Pesticide Applications	Minor	Minor	Minor
Public Use	Minor	Minor	Minor
Effects on Water Quality			
Land Management			
Wetland Management	Negligible	Negligible	Negligible
Farming Programs	Minor	Minor	Minor
Pesticide Applications	Minor	Minor	Minor
Public Use	Minor	Minor	Minor
Effects on Air Quality			
Land Management			
Wetland Management	Negligible	Negligible	Negligible
Farming Programs	Minor	Minor	Minor
Pesticide Applications	Negligible	Negligible	Negligible
Public Use	Negligible	Negligible	Negligible
Effects on Vegetation and Habitat Resources			
Land Management			
Wetland Management	Minor	Minor	Minor
Farming Programs	Intermediate	Intermediate	Intermediate
Pesticide Applications	Intermediate	Intermediate	Intermediate
Public Use	Negligible	Negligible	Negligible
Effects on Fish and Wildlife			
Land Management			
Wetland Management	Negligible	Negligible	Negligible
Farming Programs	Minor	Minor	Minor
Pesticide Applications	Minor	Minor	Minor
Public Use	Minor	Minor	Minor
Effects on Cultural Resources			
Land Management			
Wetland Management	Neutral	Neutral	Neutral
Farming Programs	Neutral	Neutral	Neutral
Pesticide Applications	Neutral	Neutral	Neutral
Public Use	Neutral	Neutral	Neutral
Effects on Visitor Services			
Land Management			
Wetland Management	Negligible	Negligible	Negligible
Farming Programs	Negligible	Negligible	Negligible
Pesticide Applications	Negligible	Negligible	Negligible
Public Use	Minor	Minor	Minor

6.5 Upper Klamath National Wildlife Refuge

This section describes the potential impacts of the No Action Alternative and one action alternative for the Upper Klamath Refuge. Impacts are judged for significance using the thresholds described in the introduction of this chapter. Mitigation measures for potentially adverse effects are identified in the list of BMPs (see Appendix L).

The following resources would not be affected by the alternatives and are not carried forward for further analysis.

- **Geology**: Given the limited management actions currently implemented and proposed on the refuge, no effects to geologic resources would occur.
- **Paleontological Resources**: There is potential for as yet undiscovered paleontological resources to be affected during ground-disturbing activities. Should any paleontological resources be discovered by the Service, they would be conserved in place or deposited in an approved repository. On Service-owned land the public is not allowed to remove any paleontological resources from the refuge. As a result of protections under the Paleontological Resources Preservation Act (PL 111-011) (Omnibus Public Land Management Act of 2009), no effects to paleontological resources would occur.
- **Noise**: There is a negligible direct effect on noise levels in the vicinity of the refuge. The general public in the vicinity of access roads (Westside Road, Crater Lake/Highway 62, County Road 1334, and Agency Lake Loop Road) to the refuge may experience negligible changes in noise due to activities associated with management of the refuge, including use of vehicles (e.g., on-road cars and trucks) associated with land management activities by refuge personnel and contractors, and haying and grazing programs. Furthermore, these noise effects are similar to levels experienced by these residents from other traffic along these access roads in this farming and ranching area. Given that only negligible changes in traffic related noise would occur due to CCP activities, sensitive receptors and the general public located along major access routes to the refuge (i.e., schools, churches, and residents) would not experience any appreciable differences in traffic related noise levels.

6.5.1 Soils

Methodology for Analyzing Effects – Upper Klamath Refuge

Reports on the soil types within the refuge boundary that are available online through the NRCS were consulted to assess relative susceptibility to compaction and erosion of different soils. These finding were applied generally to help understand how land management actions and public use activities might affect the physical qualities of the soil.

Resource-specific contexts for assessing effects of the alternatives to soil resources include:

- The water elevation of the wetland (marsh) throughout Upper Klamath Refuge is controlled by the Reclamation through the Klamath Reclamation Project.
- Construction related impacts would be localized.
- Soils within and outside the refuge boundary have been historically disturbed or altered.
- Refuge waters are primarily accessible to the public through lands of the U.S. Forest Service Fremont-Winema National Forest (i.e., the western boundary of the refuge is several yards off shore from forest lands; the boundary between the refuge and the forest is in the waters of the marsh).
- One of the purposes for which Upper Klamath Refuge was established is to be "…dedicated to wildlife conservation…for the major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent therewith" (Kuchel Act, Sec. 6951).

Alternative A – Upper Klamath Refuge

Land Management

The Service does not actively manage the Hank's Marsh Unit of the refuge, a small freshwater marsh on the southeast side of Upper Klamath Lake. Ongoing land management on the rest of the Upper Klamath Refuge consists of fire suppression, water management, haying, domestic livestock grazing (primarily cattle), and invasive plant treatments.

Wetland Management

Wetlands on Upper Klamath Refuge include Upper Klamath Marsh (13,775 acres), Barnes-Agency Unit (9,796 acres), and Hank's Marsh Unit (approximately 1,191 acres). Upper Klamath Refuge emergent marshes exist above elevation 4,139.5 feet and are inundated when Reclamation managed lake elevations to exceed this level; the marsh becomes dry at approximately 4,139.50 feet. The water elevation of the wetlands is controlled by Reclamation, through the Klamath Reclamation Project. Reclamation maintains the surface elevation of Upper Klamath Lake at 4,137 to 4,143 feet above mean sea level (Oregon Lakes Association 2005), and wetland management by the Service is dependent on water supplied by the Klamath Reclamation Project. Much of the marsh acreage on Upper Klamath Refuge becomes dry in late summer and early fall as lake elevations decline with reduced lake inflows, evapotranspiration, agricultural diversions and downstream releases to maintain Klamath River flows. Barnes-Agency Unit includes extensive diking and seasonal wetland/marsh areas; however, water-level manipulation to dry or saturate soils is limited due to aging water control infrastructure.

Water fluctuations in the marshes can expose soils to erosion when the marshes are dry in the late summer and early fall. Because the refuge lands are relatively flat, more than minor soil erosion is not anticipated. Neither of the soils that underlie the refuge are prone to wind based erosion. They are ranked at the very lowest end of the NRCS scale of wind based soil erodibility. Water fluctuations occur periodically throughout the year and further minimized by the presence of wetland vegetation and re-establishment of the marshes by late fall. The mixture, acreage, locations, and timing of management techniques deployed during any particular year for wetland management would be based on an assessment of current and likely future habitat conditions and wildlife needs, including the potential availability of water; the availability of adequate funding, staff, and equipment; the availability of local farmers, ranchers, and livestock; forage quality; and site conditions (e.g., access, roughness of the terrain, fencing, and other infrastructure). Adverse effects of wetland management on soils would be considered negligible.

Haying and Grazing Programs

Because one of the principal purposes of haying is to create openings in vegetation and thereby enhance habitat diversity, haying operations are rotated around different areas of the refuge. Under Alternative A, approximately 200 acres in the northwest corner of the refuge would be hayed annually. The timing and extent of haying on the refuge is dependent on standing water and soil moisture or saturation. Most areas are too wet to hay earlier than July 1. The majority of haying operations would continue to commence after August 1; however, the Service would allow haying or mowing of small areas earlier than August 1, especially during drought years, if needed to achieve management objectives.

Using a mowing deck to cut hay or cut invasive plants and prevent seed dispersal would have minimal compacting and/or eroding effects on soils. Physical disturbance from equipment used for planting and haying can disturb soils, which would temporarily expose soil to wind and water erosion. **The most common plants hayed on the refuge include pasture grasses, rushes, and sedges. All of these plants grow on the refuge without the need for planting, irrigation, fertilization, and/or pest management.**

Under Alternative A, prescribed cattle grazing would continue annually on approximately 200 to 400 acres (100 AUM) in the northwest corner and approximately 1,200 to 1,800 acres (460 AUMs) in the northern portion of the refuge (Barnes-Agency Unit). Together, these acreages comprise approximately 6 to 10% of the almost 23,100 acres within the approved refuge boundary. **The standard practice of grazing decadent emergent marsh vegetation is allowed when the units are dry.** Depending on precipitation and lake levels, grazing could occur in the spring, summer, and/or fall. The acreage potentially available for grazing in the northwest corner of the refuge during any particular year would depend on how much of the seasonal marsh was flooded by waters from Upper Klamath Lake. As noted above, the Service does not control water levels in the Lake, and so cannot predict beyond the range above how much grazing the refuge will have in a given year.

The area grazed on the Barnes-Agency Unit is currently protected by levees and due to subsidence, is at a lower elevation than the lake. Livestock are not allowed to graze in or drink water from the Lake or canals that drain to the Lake. Instead, livestock would continue to be watered from seeps or springs within existing levees or from stock tanks within the levees that ranchers fill with water pumped from the Lake or a canal.

Both grazing and haying would involve the use of a variety of infrastructure on the refuge such as trucks, trailers, off-road vehicles, corrals, and temporary and permanent fences and gates as well as the personnel to operate the machinery and manage the livestock. **No pesticides are allowed to be used for either haying or grazing activities.**

Grazing and activities related to grazing, such as moving equipment and cattle result in minor soil disturbance on the refuge. Prescribed grazing can temporarily expose and disturb soils and increase erosion (Gifford and Hawkins 1978; Roberson 1996). Areas surrounding watering facilities, mineral blocks, corrals, and loading ramps are especially vulnerable to being denuded by trampling and experiencing soil compaction. Grazing activities may increase the potential for short-term, localized exposure of bare soils that may result in increased water and wind erosion. Loss and compaction of soils would be minimized by implementing BMPs through stipulations incorporated into the grazing agreements. Grazing agreements include stipulations and standard BMPs to minimize the adverse effects of grazing on soils. Adverse effect of haying and grazing on soils would be considered minor.

Pesticide Application

Table 4.15 lists the IPM practices for invasive species on the refuge. IPM methods include prescribed grazing, mowing with a deck mower, and application of pesticides. Prior to applying pesticides on the refuge, the Service completes a PUP that contains BMPs to minimize adverse effects. As part of the ongoing IPM activities, pesticides are used to control l invasive plant species. Pesticides are a component of IPM. Through the IPM process, chemical means for controlling pests are minimized in favor of other nonchemical strategies. Under

Alternative A, herbicide would be applied in some years during the warmer season on the dike roads of the Barnes-Agency Unit. Pesticides are only applied after the approval of a PUP. During the PUP process the Service considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the physical environment associated with the proposed site-, time-, and target-specific use of pesticides on the refuge are evaluated using the chemical profile prepared for the pesticide.

When chemical pest management is used, improper use or overuse of pesticides, or spills or careless management of pesticide containers or application equipment may potentially result in contamination of refuge soils. To avoid these and other effects, the Service follows standard BMPs (Appendix L) to reduce adverse effects to soils and other resources, including adherence to all USEPA and Oregon EPA warning labels and application requirements, as well as the Service's PUP process. Along with the selective use of pesticides, PUPs would also describe other appropriate IPM strategies (biological, physical, mechanical, and cultural methods) to eradicate, control, or contain pest species to achieve resource management objectives.

This highly regulated and integrated process carefully considers the environmental hazards, efficacy, costs, and vulnerability of the pesticide being used. The potential effects to the biological and physical environment associated with the proposed site-, time-, and target-specific use of pesticides PUPs on the refuge would be evaluated using scientific information and analyses. PUPs (including appropriate BMPs) would be approved where scientific evidence indicates that effects to refuge biological resources and its physical environment are likely to be minor, temporary, or localized in nature. Along with the selective use of pesticides, PUPs would also describe other appropriate IPM strategies (biological, physical, mechanical, and cultural methods) to eradicate, control, or contain pest species to achieve resource management objectives.

Because pesticide applications are evaluated and permitted consistent with the DOI and the Service IPM and other relevant policies, and the PUPs process, the Service anticipates that negligible adverse effects to soils would occur due to pesticide applications.

Public Use

Public use on this refuge includes of hunting, fishing, boating (motorized and non-motorized), and wildlife observation and photography. Public opportunities for wildlife observation and photography are primarily along the 9.5-mile canoe trail through the marsh. These types of activities lead to negligible amounts of soil erosion because of the relatively small number of people on the refuge taking part in hunting and other visitor activities. These types of visitor uses have relatively few impacts on soils because they are primarily conducted on developed trails and at facilities such as Rocky Point and Malone Springs boat launches on adjacent U.S. Forest Service lands. The Service estimates that 75% of boats are launched from the U.S. Forest Service Rocky Point, a paved boat ramp and a smaller number from Malone Springs, a shallow, gravel launch area. Because boating access to the marsh is primarily at these two developed boat launches on the adjacent U.S. Forest Service lands, no soil erosion is expected from boating. A few waterfowl hunters also launch from state parks on the eastern shore of Agency Lake and a small number boat into the Hank's Marsh Unit on the eastern shore of Upper Klamath Lake. Boat launching may compact soils and cause erosion; however, these effects would be localized primarily on unpaved access roads, trails, and at boat-launch sites at Agency Lake and Hank's Marsh Units. Informal observations by refuge staff have not noted a degradation of habitat from public use. Based on the limited public use on the refuge and implementation BMPs (Appendix L),

the Service anticipates that there would be negligible, short-term adverse effects to soils from public use activities.

Beneficial Effects

Indirect beneficial effects to soils are expected from land management activities that conserve natural resources and public use activities are expected that increase public appreciation and stewardship of refuge lands.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Land Management

Wetland Management

Under Alternative B, the Service would collaborate with adjoining landowners and other organizations to enhance and restore fringe wetlands on Upper Klamath Lake adjacent to the refuge. Some additional wetland management may occur on the refuge. includes expanded wetland habitat restoration activities would result in additional soil disturbance. The effects would be similar to those identified for Alternative A activities. Potentially adverse effects to soils from wetland habitat restoration projects would be expected to be localized, short-term, and temporary. Updates to refuge management plans and implementation of restoration projects subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document, when site-specific details are available.

As with Alternative A, BMPs to minimize erosion would be implemented to reduce adverse effects to soils. The adverse effects to soils from wetland management would be negligible.

Haying and Grazing Programs

Alternative B would continue the use of prescribed fire, haying, and grazing to improve habitat structure and provide green browse for migrating waterfowl (dabbling ducks and geese). In addition to the 200 acres being hayed in Alternative A, where access, terrain, and water levels allow, haying could also take place in the northern portion of the refuge, on portions of the almost 10,000-acre Barnes-Agency Unit. If the maximum acreage in both of these areas was hayed, it would total approximately 2,500 acres, which comprises approximately 11% of the almost 23,100 acres under Service management jurisdiction. Because one of the principal purposes of haying would be to create openings in vegetation and thereby enhance habitat diversity, haying operations would be rotated around different areas of the refuge and it is unlikely that the maximum acreage would be hayed during a single year. Under Alternative B, the types of effects from haying would be the same types of effects as described for Alternative A and the area over which the effects would occur would increase. Although the potential for exposure of soil to wind and water erosion and other adverse effects would occur over a larger area, because these effects would be temporary, short-term, and localized; and haying agreements would include stipulations

and standard BMPs to minimize erosion-related impacts to soils. Alternative B includes expanding the use of prescribed fire, haying, and grazing to improve habitat structure and provide green browse for migrating waterfowl (dabbling ducks and geese). In addition to the 1,400 to 2,200 acres being grazed in Alternative A, grazing could also take place on additional portions of the almost 10,000-acre Barnes-Agency Unit. Grazing would be used on varying acreages and be rotated around different parts of the refuge. The acreage potentially available for grazing in the northwest corner of the refuge during any particular year would depend on how much of the seasonal marsh was flooded by waters from Upper Klamath Lake.

Under Alternative B, the types of effects from grazing would be the similar to those described for Alternative A except the area over which the effects would occur would increase. Although the potential for exposure of soil to wind and water erosion and other adverse effects would occur over a larger area, because these effects would be temporary, short-term, and localized; and grazing agreements would include stipulations and standard BMPs to minimize erosion-related impacts to soils; adverse effects to soils are expected to be minor The adverse effects to soils from haying and grazing would be minor.

Pesticide Application

Under Alternative B**, the Service would formalize ongoing pest management practices under an IPM program (Appendix Q).** The adverse effects to soils from pesticide applications would be negligible.

Public Use

In addition to ongoing public use described in Alternative A, the Service would pursue a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches. The portable decontamination station would have no adverse effects on refuge soils.

Alternative B would also involve construction of a vehicle pull-off and interpretive kiosk on West Side Road and installation of a contact station and interpretive and directional signs at the refuge. These activities would result in soil disturbance in relatively small areas, and could expose the soil to erosion or result in a loss of topsoil. When the location of these facilities are determined, a site-specific NEPA document would be completed. Based on the limited public use on the refuge and implementation BMPs (Appendix L), the Service anticipates that the effects on soils under Alternatives B would be the same as under Alternative A; there would be negligible, short-term adverse effects to soils from public use activities.

Beneficial Effects

The emergent marsh habitat restoration projects on the fringe wetland habitats on the Upper Klamath Lake and other restoration projects (that will be analyzed under a separate NEPA process) are expected to have beneficial effects to soils. Over the long-term, wind-generated wave erosion would be minimized after plants have established and stabilized the shoreline soils.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

6.5.2 Hydrology

Methodology for Analyzing Effects – Upper Klamath Refuge

To evaluate hydrology the Service obtained information about the annual pattern of water deliveries to the refuge and considered those water deliveries in relation to our management practices.

The following are resource-specific contexts for assessing effects of the alternatives to hydrology.

- The water elevation of the wetland (marsh) throughout Upper Klamath Refuge is controlled by Reclamation through the Klamath Reclamation Project. The maximum depth of Upper Klamath Lake is about 49 feet (Oregon Lakes Association 2005).
- The regional hydrology has been greatly altered through development in the Klamath Basin.
- Within the Barnes-Agency Unit of the refuge there is a system of canals, ditches, and water control structures that may be used to flood various units, when water is available. However, water-level manipulation to dry or saturate soils is limited due to aging water control infrastructure.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

Hydrology of the large freshwater marshes at the refuge is dependent on the Klamath Reclamation Project managed by Reclamation, which establishes and modifies water levels in Upper Klamath Lake. Depending on water availability, the Service floods irrigated pasture/managed wetlands in the Barnes-Agency Unit to provide habitat primarily for migratory waterfowl. At the Barnes-Agency Unit, because ditches are below lake level, water can only be discharged from the unit by pumping, and flows into the unit have been negligible in recent years; therefore, there has been no excess water to discharge. Prolonged flooding of irrigated pasture/managed wetland units under Alternative A could potentially recharge shallow groundwater aquifers; however, flooding is generally done in the summer and units are allowed to dry naturally into mudflats and sloughs. Irrigated pasture/managed wetlands in the Barnes-Agency Unit tend to be dry in the late summer and early fall as water levels in the lake recede. Primarily due to limited water availability, wetland management of the Barnes-Agency Unit is expected to have negligible effects on the hydrology of the area. **Reclamation adheres to agreed-upon minimum water levels consistent with the 2013 BiOp with the Service and NMFS.**

Haying and Grazing Programs

Because haying is confined to approximately 200 acres of suitable land and does not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, haying on the refuge, as

described under the Soils Section 6.5.1 above, is expected to have a negligible effect on hydrology. Potential effects on water quality are described below.

Because grazing is confined to approximately 1,200–1,800 acres of suitable land and does not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, grazing on the refuge, as described under the Soils Section 6.5.1 above, is expected to have a negligible effect on hydrology. Potential effects on water quality are described below.

Pesticide Application

Because pesticide applications do not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, pesticide applications on the refuge, as described under the Soils Section 6.5.1 above, are expected to have no significant effects on hydrology.

Under Alternative A, land management activities on the refuge, are expected to have negligible effects on hydrology.

Public Use

Because public use does not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, public uses on the refuge, are expected to have no effects on hydrology (neutral).

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

<u>Alternative B (Preferred Alternative) – Upper Klamath Refuge</u>

Land Management

Wetland Management

Hydrologic management of the refuge would be the same as Alternative A, unless the Service can work with Reclamation to modify hydrology as a means of restoring wetland habitat on the Barnes-Agency Unit. Activities subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document, when site-specific information is available.

In addition, the Service will work with U.S. Bureau of Land Management (BLM) to evaluate subsidence effects, if any, from water uses and develop strategies to reverse subsidence, as necessary and applicable to refuge management. These actions will also be evaluated in a subsequent NEPA document when sufficient detail is available to determine effects.

Actions resulting from implementation of monitoring and management plans (for invasive species and for trust wildlife and habitats) and a revised Fire Management Plan are expected to have no effects on hydrology.

Haying and Grazing Programs

Because haying is confined to suitable dry land and does not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, haying, as described for Alternative B under the Soils section above, is expected to have a negligible effect on the hydrology of the area.

Because grazing does not affect the water supply or hydrologic cycle for Upper Klamath or Agency Lakes, grazing, as described for Alternative B under the Soils section above, is expected to have a negligible effect on the hydrology of the area.

Pesticide Application

While herbicide may be applied to reduce the extent of invasive plants such as purple loosestrife, applications, as described for Alternative B under the Soils section above, are expected to have no effect on the hydrology of the area. Potential effects of pesticide applications to water quality are discussed below.

Under Alternative B, land management activities on the refuge, are expected to have negligible effects on hydrology.

Public Use

Pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches would have no effects on hydrology. Construction of a pull-off on West Side Road for viewing, interpretive signs and an interpretive kiosk and any resulting increases in visitor use are expected to have no effects on hydrology.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

6.5.3 Water Quality

Methodology for Analyzing Effects – Upper Klamath Refuge

Reports on water quality of the Klamath Basin are available online through the States of California and Oregon, and extensive studies by the U.S. Geological Survey (USGS 2013), as well as other sources. Information from online resources as well as water quality monitoring data from the refuge was used to assess the impacts of each alternative on water quality.

The following are resource-specific contexts for assessing effects of the alternative to water resources.

- Upper Klamath Lake is hypereutrophic and regularly experiences massive blue-green algal blooms and water quality extremes (including high pH and ammonia concentrations, and widely variable dissolved oxygen concentrations) during the summer and fall.

- Upper Klamath Lake levels are regulated by Reclamation via Link Dam as part of the Klamath Reclamation Project. The maximum depth of Upper Klamath Lake is about 49 feet (Oregon Lakes Association 2005).
- Pesticide applications are restricted around Upper Klamath Lake.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

Currently, water quality in the Upper Klamath Lake is considered poor, primarily as a result of eutrophication believed to come from relative high background concentrations and land use practices in the area including the conversion of 35,000 acres of wetlands to pasture and agriculture on the periphery of the lake (see Chapter 5, Affected Environment, for more information). Upper Klamath Lake is hypereutrophic and regularly experiences massive blue-green algal blooms and water quality extremes (including high pH and ammonia concentrations, and widely variable dissolved oxygen concentrations) during the summer and fall. These degraded conditions are associated with unnaturally elevated inputs of nitrogen and phosphorus to the Lake, and seasonally high water temperatures. Water quality degradation in the Upper Klamath Lake watershed has led to large-scale fish kills related to algal bloom cycles in the lake (Kann and Smith 1993) [in Service 1995]).

As described previously in the Hydrology section, under Alternative A, the water supply for the freshwater marshes at the refuge is dependent on the Klamath Reclamation Project managed by Reclamation, which establishes and modifies water levels in Upper Klamath Lake. **Reclamation adheres to agreed-upon minimum water levels consistent with the 2013 BiOp with the Service and NMFS.** Requirements of the Klamath Reclamation Project can affect, and to some extent restrict, how the Service manages the wetlands on the refuge, and can affect water quality. Wetland management on the refuge is dependent on water supplies managed by Reclamation. Natural springs feed into Upper Klamath Lake and the marshes. Algal blooms on the lake in the summer and fall can reduce water quality in the marshes. Under Alternative A, the Service would not manage water quality issues related to algal blooms on the marshes in Upper Klamath Lake.

Wetland management activities that involve equipment use in or near the irrigated pasture/managed wetlands at the Barnes-Agency Unit could discharge pollutants (e.g., sediment, fuel, oil, chemicals) via runoff into the wetlands and adversely affect water quality. These impacts would depend on the specific activities implemented in the habitat. Prescribed burns may also be a future management activity on the refuge if the opportunity and need was present. While fire can reduce soil cover and lead to erosion, implementing BMPs associated with prescribed burns can reduce potential water quality impacts to less than significant.

Wetland management actions by the Service under Alternative A would continue to have negligible effects on water quality.

Haying and Grazing Programs

Some haying and cattle grazing takes place on refuge lands. Haying would increase the potential for short-term, localized exposure of bare soils resulting in increased soil erosion, runoff, and turbidity in receiving waterbodies. Conversely, hay crops and stubble after harvest continue to

provide a measure of soil cover with residual root growth to binding soils and reducing erosion and runoff. Haying under Alternative A is likely to have a minor to intermediate impact on the water quality.

Haying removes vegetation and nutrients from managed fields and long-term haying may require the application of fertilizer to compensate for lost nutrients. Overuse or misapplication of fertilizers could result in water pollution, should it leach into the groundwater or drain into surface waters. If amounts were excessive, then receiving waters could experience localized high rates of growth by algae and other aquatic plants, and potentially eutrophication.

Haying could also involve the application of pesticides (including fungicides, herbicides, and insecticides), potentially including biological controls, discussed below.

Given the very large size of the lake, it is unlikely that these actions associated with haying would have more than a minor, short-term adverse effect on water quality.

As discussed previously under soils, prescribed grazing can result in compaction of soils resulting in increased surface water runoff and erosion, as well as exposing soils from trampling and vegetation removal (Gifford and Hawkins 1978; Roberson 1996) or adding nutrients in the form of manure. Surface erosion and runoff can cause turbidity in receiving waterbodies. Grazing under Alternative A may have minor, short-term and localized adverse effects to water quality. These adverse effects can be reduced through the implementation of BMPs.

Pesticide Application

As noted above, Upper Klamath Lake has experienced fish die-offs associated with poor water quality. These episodes have been correlated with seasonally high temperatures, low lake levels, and adverse water quality associated with algal blooms or the die-offs of those blooms.

Invasive plant treatments, in and adjacent to the marshes could discharge sediment or other pollutants via runoff into the marshes, which could degrade water quality. Although pesticides are applied infrequently, when they are used, the effects of pesticide use on water quality would be the same as described for Lower Klamath Refuge (see Section 6.2.3, Water Quality, Farming Program), although to a much lesser extent. If pesticides were applied from the air or sprayed from the ground during windy conditions, then the product could drift into surface waters, potentially exposing fish, waterbirds, their prey items, and other organisms to harmful effects. As discussed previously under soils, BMPs (Appendix L) and the PUPs process are implemented to avoid adverse effects.

Overall, there is the potential for minor, short-term, and localized adverse effects to water quality when pesticides are applied under Alternative A.

While water quality under Alternative A is not likely to become significantly more degraded than is currently the case, it may improve as long-term regulatory processes related to the TMDLs described in Chapter 5 are currently being reconsidered and may result in overall reductions in pollutant loads. Such discussions include multiple stakeholders, are complex and geared to reducing cumulative impacts, and may take substantial time to resolve. As such, specific timelines and specific water quality improvements have not been formally defined at this stage, including the prescriptions for the Service to undertake on the refuge, but are part of a longer-term strategy to improve water quality. If changes result from these discussions, they would have

beneficial impacts and be common to all alternatives. If needed, additional NEPA compliance would be conducted in the future to examine alternatives and their impacts in meeting new TDML requirements.

Public Use

Effects to water quality from public uses (including hunting, fishing, boating, and wildlife observation and photography) are expected to continue to be negligible. Visitors walking on the refuge could cause a small amount of soils to be eroded into waterways; however, non-hunter visitor use on the refuge is primarily for motorized and non-motorized boating rather than hiking. Within the refuge boundary on Upper Klamath Lake, recreational fishing is primarily done from boats rather than the bank (much of the western shoreline is on U.S. Forest Service land).

Access to boat launches is on the west side of the refuge, on U.S. Forest Service land. Waterfowl hunters primarily use boats to access the refuge, with about 75% of boaters launching from Rocky Point (paved boat ramp) and a smaller number putting in at Malone Springs (shallow, gravel launch area). Both of these boat launches are on the western shore of Upper Klamath Lake, adjacent to the refuge, and on the Fremont-Winema National Forest lands. A few waterfowl hunters also launch from state parks on the eastern shore of Agency Lake and a small number boat into the Hank's Marsh Unit on the eastern shore of Upper Klamath Lake.

Launching boats in and out of the water; stirring up sediments with propellers, paddles, poles, flippers, or boat hulls; and boat-generated waves can cause bank erosion and turbidity. Fuels or oils can spill or otherwise be discharged into waterways by motorboats (this is a greater concern with traditional two-stroke engines). Water quality effects would be greater when boats traveled at higher speeds. These contaminants can adversely impact water clarity and plant growth, and potentially reduce growth and survival of aquatic organisms, including invertebrates, amphibians, and fish. Despite these potential consequences, boating associated with hunting has occurred on the refuge for decades and the Service has no evidence that pollution from motorboats used on the refuge has adversely affected lake water quality. The potential for adverse effects to water quality from public use of the refuge is unknown, but expected to be negligible.

Beneficial Effects

Wetland vegetation in the marshes and managed wetlands filter the water and improve water quality.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. Water quality conditions are not expected to change significantly from current conditions. No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Land Management

Wetland Management

In addition to the minor water quality-related impacts discussed under Alternative A, additional ground disturbance associated with expanded management activities and restoration projects could result in water quality impacts in the marshes and adjacent Upper Klamath Lake. Wetland restoration activities that involve equipment use in or near the wetlands could discharge pollutants (e.g., sediment, fuel, oil, chemicals) via runoff into the marshes and lake and adversely affect water quality. These impacts would depend on the specific activities implemented in the habitat, but could be significant. New wetland restoration activities subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document.

When flood waters are discharged, they can carry elevated concentrations of nutrients and potentially salts. If there is a rainstorm event following a prescribed burn, runoff waters can carry higher-than-normal loads of sediments and dissolved nutrients. The relatively flat terrain on the refuge, vegetation distribution, and the slow movement of water in ditches reduces the likelihood that sediment loads are carried far. Dilution would ensure that these flows would not adversely affect water quality in Upper Klamath Lake.

Haying and Grazing Programs

Alternative B includes the continued use of haying, and grazing to improve habitat structure and provide green browse for migrating waterfowl (dabbling ducks and geese). Any increases in haying or grazing under Alternative B are expected have negligible increases in water quality effects as compared to Alternative A. The overall effects to water quality from haying and grazing would continue to be minor.

Pesticide Application

Alternative B is expected to have similar impacts as Alternative A. There is the potential for minor, short-term, and localized adverse effects to water quality.

Public Use

Alternative B includes pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches to prevent the introduction of aquatic invasive species. Decontamination stations would have a negligible effect on water quality.

Depending on the locations of the public facilities and methods used for construction, construction activities could discharge pollutants (e.g., sediment, fuel, oil, chemicals) via runoff into nearby waterbodies, which could adversely affect water quality, and impacts could be significant, depending on the proximity of the activities to waterbodies and extent of ground disturbance. The effects of public facilities will be analyzed further in project-specific NEPA documents once specific details on the proposed facilities are available. Installation of signs and other facilities using hand tools would not affect water quality of nearby waterbodies.

Increases in public use of the refuge as a result of minor improvements to interpretive facilities (e.g., contact station signage, interpretive signs, and interpretive kiosk) are expected to be negligible. Therefore, effects on water quality from public use would be similar to Alternative A.

Although water quality can be poor during portions of the year, water quality-related impacts associated with public use under Alternative B are expected to be negligible.

Beneficial Effects

Wetland enhancement and restoration activities on the Upper Klamath Refuge support the recommendations to improve water quality in the Revised Lost River Sucker and Shortnose Sucker Recovery Plan (Service 2013): Recovery Action 2.3. "Conserve and restore riparian and wetland areas along…Upper Klamath Lake to improve water quality."

Fluctuations in the water levels of the wetlands and the wetland vegetation in the marshes and managed wetlands filter the water and may improve water quality (Crites and Tchobanoglous 2005;Knight et al 1993).

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative.

6.5.4 Air Quality

Methodology for Assessing Effects – Upper Klamath Refuge

Air quality was assessed at a Basin-wide level using online reports from the State of Oregon that identify the general air quality characteristics.

The following are resource-specific contexts for assessing effects of the alternatives on air quality.

- Land management activities occur within a basin dominated by agriculture.
- For ozone, Oregon (in USEPA Region 10), which includes all of Upper Klamath Refuge, is designated as an unclassified/attainment area (USEPA 2008).
- For PM2.5, part of Klamath County is designated as a nonattainment area (primarily the area around the city of Klamath Falls, approximately 20 miles southeast of the refuge).
- For NO_2 (nitrogen dioxide), all areas of Oregon are designated as an unclassified/attainment area (USEPA 2011).
- Construction-related impacts would be localized.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

Ongoing wetland management and maintenance activities require the periodic use of boats, vehicles, and construction equipment that causes short-term, minor emissions (engine exhaust and fugitive dust) that may be noticeable on the refuge. Current air quality at the refuge is relatively

good due to few sources of pollutants in the vicinity, and wetland management activities result in minimal air quality impacts that do not violate ambient air quality standards.

Wetland management would involve a range of management measures including prescribed burning, prescribed grazing, disking, and mowing, and haying. Occasionally, prescribed burning is considered to reduce the biomass of decadent emergent marsh vegetation, which results in increasing the area of open water in seasonal wetlands. Prescribed burning activities may increase PM10 and carbon emissions temporarily, but such effects would be minor because 1) the Service would develop a prescribed burning plan as part of the grassland Habitat Management Plan and obtain and adhere to the requirements of a burning permit issued by the Air Pollution Control District; 2) effects would be avoided and minimized by coordinating activities with the district, implementing burn prescriptions and cessation requirements based on predetermined levels established by the district, and use of fire breaks around burning units to prevent wildfires; and 3) effects would be mitigated through small unit sizes, wind direction considerations, and distance to receptors. Based on the federal and state requirements that reduce adverse effects of prescribed burning, the Service anticipates that adverse effects to regional air quality from prescribed burning would be negligible and short term. The USEPA review of 2009 through 2011 air quality data shows no violations of the 2010 SO_2 standards in any area of Oregon (USEPA 2015).

Haying and Grazing Programs

The grazing program, including operations and maintenance activities, and use of vehicles, may create fugitive dust and vehicle emissions. Haying activities would result in temporary increases in exposed soil, which would increase fugitive dust emissions, particularly during strong winds. Also, heavy equipment (e.g., tractors, haying machinery) used during haying practices may make soils vulnerable to erosion from clearing and mowing.

Using a mowing deck to cut invasive plants and prevent seed dispersal would generate exhaust containing particulates and gases such as hydrocarbons, carbon monoxide, carbon dioxide, nitrogen oxides, and aldehydes. These effects on air quality are minimal due to the intermittent nature of the work and dilution in the atmosphere above the refuge. Although to a lesser extent, the effects of pesticide use on air quality would be the same as described for Lower Klamath Refuge, air quality.

The prescribed grazing program, including operations and maintenance activities, and use of vehicles by ranching personnel, may create fugitive dust and vehicle emissions. Prescribed grazing activities would result in temporary increases in exposed soil, which would increase fugitive dust emissions, particularly during strong winds. Grazing would result in localized and temporary increases in PM10, ROG, NOx, and carbon emissions.

The Service anticipates that adverse effects to regional and local air quality from land management practices would be negligible. No long-term adverse effects on air quality are anticipated as a result of continuing the land management practices under Alternative A.

Pesticide Application

If pesticides were applied from the air or sprayed from the ground during windy conditions, then the product could drift into non-target areas and surface waters, potentially exposing wildlife and their prey items to harmful effects. As discussed previously under soils, BMPs (Appendix L) and the PUPs process are implemented to avoid adverse effects from pesticide applications.

Overall, there is the potential for minor, short-term, and localized adverse effects to air quality due to land management activities under Alternative A.

Land management activities would not result in any substantial changes within the 15-year life of the CCP. Land management activities are expected to result in negligible effects to local air quality. No long-term adverse effects on air quality are anticipated as a result of continuing the land management practices under Alternative A.

Public Use

Public access within the refuge is currently limited to walk-ins from adjacent or nearby parking areas and boat use along waterbodies, so vehicle emissions from public access contribute negligible emissions at the refuge.

Exhaust from boat motors generates gaseous and particulate emissions. The surface area of Upper Klamath Lake covers about 91,000 acres, of which about 15,000 acres is within the refuge boundary. In light of the relatively small number of motorboats using the relatively large lake, it is not likely that pollution discharges from these motors would adversely affect air quality. Therefore, public use under Alternative B is expected to result in negligible short-term adverse effects to air quality and no long-term adverse effects on air quality are anticipated.

Beneficial Effects

Land management activities would not result in any substantial changes within the 15-year life of the CCP. Land management activities are expected to result in negligible effects to local air quality. No beneficial effects to air quality have been identified as a result of continuing the land management practices under Alternative A.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

<u>Alternative B (Preferred Alternative) – Upper Klamath Refuge</u>

Land Management

Wetland Management

In addition to the minor air quality-related impacts discussed under Alternative A, additional ground disturbance and equipment use associated with expanded fire and invasive plant management activities and restoration projects would increase air emissions on the refuge. The types of impacts would be the same as discussed under Alternative A, but they could be more intense over a short period, depending on the specific activities, resulting in adverse impacts on air quality. Implementation of restoration projects subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document once specific details are available.

Prescribed burning generates smoke that can rise to great heights and potentially drift considerable distances. Smoke contains ash particulates, partially consumed fuels, liquid droplets, and very small quantities of gases such as carbon monoxide, carbon dioxide, and hydrocarbons. Prescribed burning would be conducted consistent with a burn plan that takes into consideration weather, regional air quality, and smoke management to minimize the likelihood that smoke would drift into populated areas or create safety problems and coordinated with the local air quality district. **Prescribed burning would not be conducted during times of the year when peat soils are dry enough to ignite.** Also, dilution in the atmosphere greatly reduces potential adverse air quality effects. The effects associated with prescribed burns are temporary in nature and, in light of the vast acreage of agricultural lands in the area, relatively common in the Klamath Basin.

Haying and Grazing Programs

Alternative B includes expanding the use of prescribed fire, haying, and grazing to improve habitat structure and provide green browse for migrating waterfowl (dabbling ducks and geese). As described under the Soils section, Alternative B, if the maximum acreage in both of these areas was hayed, it would total approximately 2,500 acres, which comprises approximately 11% of the almost 23,100 acres under Service management jurisdiction. Under Alternative B, the types of effects from haying would be the same types of effects as described for Alternative A and the area over which the effects would occur would increase. Although the potential for exposure of soil to wind erosion and other adverse effects would occur over a larger area, because these effects would be temporary, short-term, and localized; and haying agreements would include stipulations and standard BMPs to minimize erosion-related impacts to soils; adverse effects to air quality are expected to be negligible as compared to Alternative A.

Alternative B includes expanding the use of prescribed fire, haying, and grazing to improve habitat structure and provide green browse for migrating waterfowl (dabbling ducks and geese). **In addition to the 200 acres being hayed in Alternative A, haying could also take place on an additional 2,500 acres of the almost 10,000-acre Barnes-Agency Unit.** In addition to the 1,400 to 2,200 acres being grazed in Alternative A, grazing could also take place on additional portions of the almost 10,000-acre Barnes-Agency Unit. Because one of the principal purposes of grazing would be to create openings in vegetation and thereby enhance habitat diversity, grazing would be rotated around different areas of the refuge and it is unlikely that the maximum acreage would be grazed during a single year.

Under Alternative B, the types of effects from grazing would be the same as described for Alternative A and the area over which the effects would occur would increase. Although the potential for exposure of soil to wind erosion and other adverse effects to air quality could potentially occur over a larger area, because these effects would be temporary, short-term, and localized; and grazing agreements would include stipulations and standard BMPs to minimize erosion; adverse effects to air quality are expected to be negligible as compared to Alternative A.

Pesticide Application

Under Alternative B, the Service would formalize pest management practices under an IPM program. The implementation of an IPM plan for invasive species would have no effects on air quality.

Public Use

Pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches would have no effects on air quality.

The addition of a vehicle pull-off on West Side Road could increase vehicle traffic to the refuge, although access within the refuge would continue to be limited to walk-ins and boats only. Increased traffic would result in increased vehicle emissions in the vicinity of the refuge, but the impacts on air quality would be negligible based on the estimated visitation to the refuge and would not adversely affect ambient air quality.

Beneficial Effects

Phasing in a new requirement allowing only 4-stroke (4-cycle) and direct injection 2-stroke boat motors to be used on the refuge and prohibiting boaters from traveling at speeds greater than 10 miles per hour is expected to primarily improve water quality; however, the reduced emissions from direct injection 2-stroke motors may also improve air quality as compared to Alternative A.

Mitigation

In addition to implementing the general BMPs (Appendix L), to reduce potential water pollution, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) and direct injection 2-stroke boat motors to be used on the refuge and prohibiting boaters from traveling at speeds greater than 10 miles per hour.

6.5.5 Vegetation and Habitat Resources

Methodology for Assessing Effects – Upper Klamath Refuge

Scientific literature was consulted to predict the types of impacts that could occur due to land management and public use activities.

The following are resource-specific contexts for assessing the effects of the alternatives on vegetation and habitat resources.

- Vegetation and habitat resources are managed to provide food and rest for waterfowl on the Pacific Flyway.
- Freshwater marsh habitat is dependent on lake levels as managed by Reclamation in accordance with the 2013 BiOp.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

The Service does not actively manage either Hank's Marsh Unit or the Upper Klamath freshwater marshes on the refuge. The freshwater marshes of Upper Klamath Refuge are connected to the open waters of Upper Klamath Lake. Water levels in Upper Klamath Refuge freshwater marsh are dependent on water elevations within Upper Klamath Lake, with

approximately 90% of the emergent wetlands dry when the lake elevation is below 4,139.50 feet. Under some KBRA scenarios, the potential to reach this lake elevation occurs in 11 of 12 months, while under other the KBRA scenarios, the potential exists in 6 of 12 months. Thus, more water is available under some KBRA scenarios for the refuge. Projected lake elevations modeled for future years (2012 to 2111) indicate that the frequency in which Upper Klamath lake levels fall below 4139.50 feet is greater under some KBRA scenarios (82% of years). Although it affects the freshwater marsh of the refuge, the future configuration of the KBRA is not a part of this CCP/EIS and will be determined independently. More information about the KBRA is provided in Chapter 3.

The majority of the irrigated pasture/managed wetlands in Upper Klamath Refuge is in the Barnes-Agency Unit. To maintain a mosaic of habitat types to optimize wildlife habitat quality within the irrigated pasture/managed wetlands, managers use a variety of tools such as water management, haying, prescribed cattle grazing (addressed below), invasive plant treatments (addressed below), fire suppression, and infrequent prescribed burning. Fire management activities are implemented in accordance with the Fire Management Plan (Service 2001). The effects of prescribed fire are as described previously under the Soils section, Alternative A, wetland management. Haying, prescribed cattle grazing and pesticide use are addressed below.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from wetland management activities under Alternative A.

Haying and Grazing Programs

Haying would result in short-term disturbances and long-term benefits vegetation and habitat resources on the refuge. Haying activities would result in short-term loss of habitat for species using those areas for nesting, feeding, or resting. As with prescribed grazing, haying would improve plant species composition and structure so that short-term adverse effects to vegetation would be mitigated by long-term beneficial effects to vegetation and overall wildlife habitat quality. The resulting habitat would improve conditions for most of the species adversely affected by the short-term adverse effects. Control of the timing of haying through stipulations in SUPs would minimize potentially adverse effects.

Wet meadow habitats need periodic removal of vegetation to maintain the plant vigor, diversity, and structure necessary for wildlife use. The rotation and periodic haying of areas also helps to create a mosaic and interspersion of habitats that many species find attractive for feeding, breeding, and protection. Removal of accumulated biomass through haying would reduce unwanted over-story, including dead and decadent vegetation, reduce woody plant invasion, and allow for more vigorous re-growth of desirable plants. These management strategies contribute to the overall health of these vegetative communities and habitat resources, help limit or reduce the spread of invasive species, and slow vegetation succession.

Haying would provide foraging habitat for migratory bird species in the spring including Canada geese, white-fronted geese, pintails, mallards, and a variety of other bird species. During early summer, hayed areas provide foraging habitat for Canada goose broods and greater sandhill cranes.

These management activities result in temporary disturbances to the wetland and marsh habitats at the refuge, but they primarily result in long-term beneficial effects that improve habitat

conditions. The purpose of land management is to reduce the number of nonnative species on the refuge and to preclude fragmentation of native habitats.

No special-status plants are known to occur on the refuge.

Similar to haying, mowing with a deck mower is a common technique to create short-grass habitat for wildlife (e.g., geese and cranes). When properly timed, mowing can also reduce seed distribution by invasive plants such as annual grasses. Mowing may not kill the plant, but with repeated mowing over time, it can reduce the vigor of some species and eventually prevent certain plants from reproducing.

Prescribed domestic livestock grazing (primarily cattle) would be utilized as one of many techniques to potentially reduce targeted weeds and plant biomass, as necessary, to achieve habitat objectives. Although prescribed grazing may provide long-term benefits as an important tool for restoring grassland habitat types, this strategy can generate both beneficial and adverse effects to native plants and plant communities (special-status plant species are address below). Scientific studies on the effects of grazing have shown that successful results are very site-specific and can depend on the interaction between site conditions (e.g., soil type), weather, and grazing practices (Bartolome et al. 2009; Briske 2011; Huntsinger et al. 2007; Kimball and Schiffman 2003; Stahlheber and D'Antonio 2013). Therefore, there is a degree of uncertainty as to what effect prescribed grazing would have on specific plants and vegetation in the area. As such, the Service annually evaluates the effects of prescribed grazing on vegetation, which allows for adjustments to be made in grazing permits to mitigate adverse effects (e.g., stipulations related to timing, stocking density, type, access, maintenance, supplemental feeding, support equipment usage, livestock quarantine and origin restrictions [to reduce invasive species risk from livestock and vehicles used to transport livestock], and monitoring) (Bush 2006; Herrick et al. 2012). Such adverse effects would be mitigated by limiting grazing to targeted resource prescriptions, grazing permit restrictions, and other management techniques based on evaluating both residual dry matter and refuge resource targets. Such methods have been used successfully to manage grazing intensity and distribution, as well as for determining carrying capacity (Bartolome et al. 2006; McDougald 1991).

Overall, land management through prescribed grazing would likely have adverse effects on certain species or groups, while simultaneously providing some beneficial effects to other species or groups. Thus, the effects depend on the frame of reference and would be highly site-specific (Jackson and Bartolome 2007). Cattle are generalist herbivores that prefer grasses of the California annual-type grassland (Van Dyne and Heady 1965), and certain forbs and legumes may benefit from reduction of nonnative annual grass biomass, including standing dead plant material and thatch (Huenneke et al. 1990).

Potential adverse effects of grazing on **wetland and marsh habitats** includes the introduction of non-native and invasive species; trampling sensitive species; trampling of vegetation; trench creation; wallowing during resting; habitat fragmentation; creating gaps for invasive species; overgrazing; habitat fragmentation; soil disturbance (compaction, disruption of soil crusts, and exposure to erosion discussed previously); reduction in soil mycorrhizae; preferential grazing of perennials over annuals; and adverse effects from feces that can smother plants (Van Dyne and Heady 1965). These adverse effects may be partially mitigated through implementing monitoring and adaptive management measures and restrictions measures, including erecting temporary exclusionary fences to prevent riparian, wetlands, and shrub habitat damage; adherence to

restrictions and permit conditions outlined in SUPs (e.g., livestock quarantines and location restrictions to reduce the risk of introducing invasive species from livestock and vehicles used to transport livestock [Bush 2006]); monitoring to reduce the potential for overgrazing effects; and controlled access (**see the list of stipulations in the CD for grazing at Upper Klamath in Appendix G**). The grazing program utilizes adaptive management (considering the potential effects of climate change), research, monitoring, and grassland restoration techniques to ensure that all management regimes achieve intended goals and objectives for **wetland and marsh** habitat. This effort would be enhanced and guided using the adaptive management process, to include consideration of additional research, inventorying, and monitoring.

Grazing would limit encroachment on meadows and grasslands by trees and shrubs, and, if managed carefully, could reduce the spread of some invasive plant species. In the absence of natural or human-created environmental disturbance (e.g., flooding, fire, grazing, or mowing/haying), grass and marsh vegetation can become tall, dense, and decadent, with substantial thatch, resulting in reduced wildlife habitat values (for diversity, foraging, nesting, etc.) (Kirby et al. 1992). Moderate grazing and associated trampling by livestock can be used to create openings in such areas, help create a more diverse mosaic of habitats across the landscape, reestablish more structural habitat diversity, set back plant succession, revitalize vegetation, enhance light penetration, facilitate earlier green up, and allow forbs and other low-growing plants a better chance to flourish (Bossenmaier 1964; Kirby et al. 1992).

Potentially adverse effects of grazing activities on refuge resources would be minimized because sufficient restrictions would be included as part of the SUPs and grazing activities would be monitored by refuge staff.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from haying and grazing under Alternative A.

Pesticide Application

Pesticides may be used on the refuge to manage invasive plant species in wetland **and marsh** areas and along roads, levee, and structures. In some years, herbicide is applied during the warmer season on the dike roads of the Barnes-Agency Unit. In 2015, the following pesticides were applied at Upper Klamath Refuge. Aminopyralid has been used **on 34 acres** as a spot treatment on common St. John's wort; 2,4-D butoxyethyl ester has been used **on 26 acres** for spot treatments on five hook bassia and perennial pepperweed. **AquaNeat, a** glyphosate product, has been used for spot treatments of phragmites, purple loosestrife, and reed canarygrass on 8 acres at **the refuge.**

Chapter 5, Table 5.33 includes a list of invasive species and the pesticides used to target invasive plant species.

Because pesticide applications are evaluated and permitted consistent with the DOI and Service IPM and other relevant policies, and the PUPs process, pesticide applications are expected to be limited to target invasive pest plants, and negligible to other non-target vegetation.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from land management activities under Alternative A.

Public Use

Public uses at Upper Klamath Refuge includes hunting, fishing, and field trips for wildlife observation and photography. Hunters, including their vehicles, boats and trailers, other equipment and supplies, can trample native plants, and potentially introduce or spread exotic and invasive species, including plants, invertebrates, fish, and wildlife. Additionally, propellers on hunters' motorboats could cut submergent and emergent plants below the water surface, and increased turbidity generated by boating would reduce water clarity and could reduce growth and survival of aquatic plants and other aquatic organisms, including invertebrates, amphibians, and fish. However, hunting has occurred on this refuge since establishment and boating has occurred for decades without noticeable degradation of vegetation and habitat. Hunting-related activities do not appear to have reduced or fragmented wetland habitats or resulted in an increase of non-native plant species such that they are the dominant species in wetland habitats. Effects on vegetation and habitat resources of continuing the current public use program on the refuge would be negligible.

Wocus gathering. Floating leaf vegetation called wocus (wokas) or Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*) (synonym of *Nymphaea polysepala*) is a native plant growing within the freshwater marsh on Upper Klamath Lake. The area where plant material is being harvested is typically small, approximately 1 to 2 acres, and is not expected to increase. The refuge contains approximately 15,000 acres of freshwater marsh, of which about 70 acres supports wocus. Wocus gathering would only be allowed on those areas of the refuge that are open to the public for wildlife-dependent recreational use. Based on historical use, it is estimated that less than 25 users per year would directly pursue this activity.

The effects of wocus gathering are expected to be similar to wildlife-dependent recreational day use on the refuge at the Rocky Point and Malone Springs boat launches and boating on the Wocus Cut non-motorized boat trail. The exception would be that wocus seed is harvested seasonally within several weeks in July through September, whereas recreational day use is allowed year-round. Anticipated impacts from this use are minor damage to vegetation, potential littering, and short-term, temporary disturbance to wildlife (discussed below). Habitat can be affected through vegetation trampling, soil compaction, and erosion (Cole 1983, 1990).

The amount of plant material being harvested is very small, less than 2 acres, and would have a negligible effect on the marsh habitat. No long-term or cumulative adverse effects are expected on the freshwater marsh plant community or wildlife habitat. Because gathering occurs only when seeds are ready for harvest, during several weeks in the July through September timeframe, disturbance would not affect birds during the waterfowl nesting season. The Service has concluded that disturbance to wildlife and habitat from plant gathering described herein would be short-term and localized, and have a negligible effect on vegetation and habitat resources. Typically, the harvesting of the seed pods from this perennial water plant is requested which results in no plant mortality. No rare or special-status species would be gathered. This refuge use would be authorized by SUPs, which would ensure that disturbance to the freshwater marsh are avoided or minimized. If adverse effects appear, the activity may be moved to secondary locations or eliminated entirely. While the activity of gathering may have short-term effects on individual plants and wildlife, no adverse long-term effects to wildlife or plant populations are anticipated.

Beneficial Effects

Grazing, haying, and prescribed burning programs that re-invigorate grasses and forbs typically increase the quality of wildlife foraging habitat. Seasonal grazing would improve plant species composition and structure so that short-term impacts to wildlife and vegetation (plant communities) and habitat resources would be mitigated by long-term benefits to refuge vegetation and improve overall wildlife habitat quality. The use of haying and prescribed grazing is expected to benefit migrating waterfowl, including dabbling ducks and geese, by improving habitat structure and providing green browse. Prescribed grazing is expected to provide beneficial effects to certain species or groups of plants. Certain forbs and legumes may benefit from the reduction of nonnative annual grass biomass (Huenneke et al. 1990). Monitoring for purple loosestrife, treating invasive weed infestations, and focusing on new infestations is expected to benefit the health and biodiversity of the plant communities and habitats on the refuge. Prescribed fire would directly affect the vegetation burned, but primarily result in long-term, beneficial effects that improve vegetation vigor and health, and habitat diversity and quality.

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Land Management

Wetland Management

In addition to the management activities and associated impacts discussed under Alternative A, the Service would enhance or restore wetland habitats, identify new or improved techniques to manage invasive plants in an Invasive Species Management Plan, and improve fire management to protect habitat resources consistent with the Fire Management Plan. Also under Alternative B, the Service would expand wetland restoration and use of prescribed fire, haying and grazing to improve habitat structure and provide green browse for migratory waterfowl (effects of haying and grazing are discussed below).

Manipulation of water levels in wetland impoundments is one of the most common means by which the Service manages waterbird habitat across the NWRS. A suite of plant species can be encouraged and another suite discouraged by purposefully manipulating when, for how long, and at what depth wetlands are flooded. Naturally varying bottom contours ensure diversity in the plant community, but also may allow invasive species to establish or increase their presence. Draining a wetland and slowly re-flooding it following a drying cycle can promote the growth of native or naturalized waterfowl food plants such as smartweed (*Polygonum* spp.) and swamp timothy (*Heleochloa schoenoides*) and other desirable wetland species. Drying a wetland basin for an extended period can reduce the vigor of certain plant species such as Phragmites or common reed (*Phragmites australis*). Deep flooding for extended periods can reduce the health and viability of other invasive species like reed canarygrass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*). Sometimes these practices are combined with tilling/disking, mowing, grazing, herbicide treatments, or prescribed fire to enhance the effects of the water manipulations. At the refuge, water would be manipulated to reduce the presence of invasive plant species without greatly harming desirable species.

Prescribed fires can burn grasses, brush, small trees, and invasive species (including some diseases); open up areas that are choked with vegetation; set back plant succession; and return nutrients that were locked up in plants back to the soil where they are once again available for

uptake by plants. Soil and plant moisture, surface water, winds, and other factors cause fires to burn hotter in some areas and not in others, and otherwise burn in a non-uniform manner. This creates a more-natural habitat mosaic of different plant species and open areas across the landscape. Among others, the effects of prescribed fires on post-burn plant growth depend on the species burned and the intensity of the burn. Plants that are resistant to fire or actually require fire for reproduction can thrive after a burn and out-compete other species. However, if a fire burns too hot, it can harm feeder roots, sterilize the soil, and kill more plants and plant species than desired. Prescribed fire planning helps ensure that these burns travel quickly and lightly across the landscape, and result in the desired effects on the plant community and for wildlife habitat.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from wetland management activities under Alternative B.

Haying and Grazing Programs

The effects of haying on vegetation and habitat would be the same as with Alternative A, except that Alternative B includes the expanded use of haying and other methods to improve habitat structure and provide green browse for migrating waterfowl. The expanded haying program would increase the area subject to the potentially adverse effects of haying described previously.

The effects of grazing on vegetation and habitat would be the same as with Alternative A, except that Alternative B includes the expanded use of grazing and other methods to improve habitat structure and provide green browse for migrating waterfowl. The expanded grazing program would increase the area subject to the potentially adverse effects of grazing described previously.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from haying and grazing under Alternative B.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing pest management practices under an IPM plan (see Appendix Q). Implementation of an IPM plan for the refuge is expected to increase the effectiveness of invasive species management. **The IPM plan** is expected to help the Service to more quickly identify and control new or expanded infestations of invasive plants.

As with Alternative A, Alternative B is expected to have temporary adverse effects on the targeted invasive species and potential adverse effects on non-target plants. Temporary adverse impacts on wildlife habitats would be minor to negligible depending on the extent of pesticide applications. Long-term beneficial effects are addressed below.

The Service anticipates that negligible adverse effects to vegetation and habitat resources would occur from one pesticide application under Alternative B.

Public Use

Construction of public facilities, including a pull-off on West Side Road, seasonal contact station, and interpretive signs and kiosk, could remove vegetation and habitat resources and spread invasive plants, depending on the specific locations and details of the facilities. However, these facilities are expected to encompass small areas and would not require removal of a substantial

amount of habitat. Habitat impacts associated with the new facilities are expected to be minor. Projects subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document, when site-specific details are available. Effects on vegetation and habitat resources from hunting and fishing would be the same as under Alternative A. Invasive plant treatments around the facilities would reduce the potential for invasive plants to establish.

Under Alternative B, the effects of public use and wocus gathering are expected to be the same as under Alternative A, negligible.

Beneficial Effects

Alternative B includes wetland restoration and the expanded use of haying, prescribed grazing, and prescribed fire; which is expected to benefit migrating waterfowl, including dabbling ducks and geese, by improving habitat structure and providing green browse as described under Alternative A. Long-term benefits of invasive species management include improving wildlife habitat conditions to achieve refuge objectives for managing a preserve and breeding ground for wild birds and animals. **Updating the inventory and monitoring plan with an emphasis on priority wildlife species and habitats** is expected to benefit the health and biodiversity of the plant communities and habitats on the refuge. The emergent marsh habitat restoration projects on the fringe wetland habitats on the Upper Klamath Lake and other restoration projects (that will be analyzed under a separate NEPA process) are expected to have beneficial effects to wetland habitat resources.

Pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches would help would education hunters, canoeists, wildlife watchers and photographers, and other refuge visitors about invasive species issues; and provide boaters a convenient opportunity, away from the water, to check for and remove invasive plants from their boats, trailers, and potentially other equipment. This would reduce the potential that these visitors would introduce a new invasive species to the refuge or reintroduce (and increase the population of) an existing pest.

Alternative B is expected to have more beneficial effects than Alternative A because of the wetland restoration and expanded land management programs.

Mitigation

In addition to implementing the general BMPs (Appendix L), to reduce potential water pollution, which would indirectly mitigate adverse effects to aquatic plants, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) and direct injection 2-stroke boat motors to be used on the refuge and prohibiting boaters from traveling at speeds greater than 10 miles per hour.

To reduce the likelihood that hunting-related activities would contribute to invasive species problems on the refuge, the Service would pursue partnerships with the State of Oregon and the U.S. Forest Service to develop and operate portable decontamination stations near boat launches on or near the refuge that are popular with hunters.

6.5.6 Fish and Wildlife

Methodology to Assess Effects – Upper Klamath Refuge

Scientific literature was used to predict the potential effects of various land management and public use activities on fish and wildlife resources.

The following are resource-specific contexts to assess the effects of the alternatives on fish and wildlife resources.

- The water elevation of the wetland (freshwater marsh) throughout Upper Klamath Refuge is controlled by Reclamation through the Klamath Reclamation Project. The maximum depth of Upper Klamath Lake is about 49 feet (Oregon Lakes Association 2005).
- Waterfowl numbers are dependent on the quantity and timing of water received through the Klamath Reclamation Project.
- Two federally listed species area known to occur on the Upper Klamath Refuge: Lost River sucker and shortnose sucker. These fish inhabit the waters of Upper Klamath Lake and/or Agency Lake, where lake water levels are controlled by Reclamation.
- The Service does not actively manage the Hank's Marsh Unit of the refuge. There are no levees that allow for specific water level management of the freshwater marshes.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

The Service does not actively manage the Hank's Marsh Unit or the freshwater marsh of the refuge. To maintain a mosaic of habitat types to optimize wildlife habitat quality within managed wetlands, managers use a variety of tools such as water management, haying, prescribed cattle grazing (addressed below), invasive plant treatments (haying, grazing, and pesticide applications are addressed below), fire suppression, and infrequent prescribed burning. Without these tools wetlands would become dominated by just a few plant species, which reduce habitat diversity and quality, and typically reduce the numbers and types of wildlife species on the refuge.

Water-level manipulation is a powerful tool for the wetland manager to discourage the vigor of invasive plants and encourage the growth of desirable plants that provide food, cover, oviposition habitat, and other attributes. Water depth is an important consideration for feeding birds. Shorebirds, ducks, swans, and long-legged wading birds have different optimal feeding depths. Using water-level manipulation, managers can provide wetlands with food plants, invertebrates, fish, amphibians, and other morsels at various water depths within the same wetland basin or in different basins across a wetland landscape.

Prescribed fires is not typically used on the refuge because of the risks of burning on peat soils. However, it would be retained as a tool if the appropriate circumstances are present. When used, prescribed fire can injure or kill wildlife; however, the primary effects on fish and wildlife are indirect, through modification to vegetation and other habitat components (e.g., food, cover, etc.). Native wildlife species evolved in the presence of natural wildfires, so most wildlife are able to flee ahead of the flames or they survive by sheltering in burrows, under logs or rocks, or in low, wet areas. Species that are unable to avoid the flames are able to repopulate burned areas from

adjacent unburned habitats. The benefit of prescribed burning is that it creates a more diverse habitat, including an increase in edge effect that often supports a greater diversity of wildlife species (including those that favor a more open habitat).

Wetland management can involve vehicles, boats, and other equipment. Wildlife respond differently to boats based on their size, speed, the amount of noise they make, and how close the craft gets to the animals (DeLong 2002). Wildlife response to disturbance by boats on Upper Klamath Refuge would be the same as described below under Public Use.

In the Barnes-Agency Unit of the refuge, approximately 7,500 acres of irrigated pasture/managed wetland provide habitat (about 77% of the 9,796-acre unit) for various wildlife, discussed previously. The only listed species that has been documented at the irrigated pasture/managed wetlands of the Barnes-Agency Unit is the federal- and state-listed as threatened northern spotted owl (Oregon Biodiversity Information Center 2015). The types of potentially adverse indirect effects of wetland management to federal- and state-listed species on Upper Klamath Refuge are the same as those described previously under Lower Klamath Refuge, Fish and Wildlife Section, Alternative A. The magnitude of the effects of wetland management activities at Upper Klamath Refuge is expected to be commensurately less than that at Lower Klamath Refuge; Upper Klamath has about 7,500 acres, while Lower Klamath Refuge has about 35,000 acres of managed wetlands.

The Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*) are listed as endangered under the federal ESA, as amended. The Lost River and shortnose suckers are endemic to the upper Klamath River Basin, including the Lost River and Lower Klamath sub-basins (Moyle 2002).

Bull trout (*Salvelinus confluentus*), listed as threatened under the federal ESA as amended, do not occur in Upper Klamath Lake; however, bull trout designated critical habitat is in the lake itself, on or adjacent to the refuge.

Oregon spotted frog (*Rana pretiosa*) is listed as threatened under the federal ESA, as amended. Oregon spotted frog potentially occurs on the refuge given occurrences within the vicinity, but there are no known modern occurrences. There is no designated critical habitat within the refuge boundaries.

Gray wolf is listed as endangered under the federal ESA, as amended. Gray wolf potentially occurs on the refuge given occurrences within the vicinity, but there are no known modern occurrences.

The Service anticipates that negligible adverse effects to fish and wildlife resources would occur from the minimal wetland management activities under Alternative A.

Haying and Grazing Programs

The types of direct and indirect adverse effects to wildlife from haying at Upper Klamath Refuge would be the same as those described for Lower Klamath Refuge, Fish and Wildlife Section. Under Alternative A, approximately 200 acres in the northwest corner of the refuge would be hayed annually. However, the magnitude of effects from haying at Upper Klamath Refuge would be commensurately less because the area hayed at Upper Klamath Refuge is less than 12% of the area recently hayed at Lower Klamath Refuge (1,765 acres).

Haying is another management tool used to improve wildlife habitat. Haying is used to create openings in grass and marsh vegetation in order to create a more diverse mosaic of habitats across the landscape, reestablish more structural habitat diversity, set back plant succession, and allow low-growing plants a better chance to flourish (Bossenmaier 1964). Although targeted at improving habitat, mowing can injure or kill wildlife. Ground-nesting birds and young wildlife are most vulnerable (as described below). Proper timing of these management practices increases their effectiveness in controlling invasive species and reduces the likelihood for adverse effects on wildlife.

In hayed areas, birds and other wildlife can readily loaf, court, travel, and access various foods (e.g., seeds/grains, leaves, roots, and other plant materials; invertebrates; and small mammals, reptiles, and amphibians); yet remain vigilant to approaching terrestrial predators. These areas are attractive for foraging by greater sandhill cranes, egrets, herons, passerines, shorebirds, geese, dabbling ducks, and American coots. If the hayed crop is a small grain or grass, then some amount of residual grain/seed would end up on the ground and be available to help satisfy the energy needs of migrating geese (e.g., Canada geese [*Branta canadensis*] and greater white-fronted geese [*Anser albifrons*]), mallards [*Anas platyrhynchos*], northern pintails [*Anas acuta*], other waterfowl, and other wildlife) (Bellrose 1976; Hammond 1964). Haying, followed by fall precipitation, would also stimulate succulent new plant growth that would be available for both fall and spring migrating geese and other grazing wildlife (Givens et al. 1964). Mallards are nesting generalists and will readily nest in hayed meadows and stubble fields, and northern pintails seem to prefer it (Bellrose 1976; Hammond 1964). Hayed fields that were later flooded could become more attractive foraging habitat for geese and dabbling ducks, and also provide breeding or nesting habitat for other species (e.g., Oregon spotted frogs and greater sandhill cranes) (Ivey and Dugger 2008; Littlefield and Ivey 2001). Haying can also be used to create fire breaks.

However, haying would reduce nest cover thereby increasing vulnerability to predation, the most common cause of nest loss by cranes (Ivey and Dugger 2008). Haying could also generate other conflicts with wildlife. Cutting hay could potentially flush, injure, or kill ground-nesting birds, their eggs, chicks, and other terrestrial wildlife (Bossenmaier 1964; Hammond 1964). At Upper Klamath Refuge, all ground-nesting duck eggs have generally hatched by mid-July (Service 2003c). Eggs of other ground-nesting birds also generally hatch before this date (e.g., geese by early May, pheasants by mid-June, and cranes by late June). Adverse effects on these birds would be avoided because conditions in the haying SUPs would generally prohibit cutting prior to July 15. Haying the refuge is dependent on standing water and soil moisture or saturation. Most areas are too wet to hay earlier than July 1. **Prior to July 15 each year, the Service may survey hay fields for the presence of unfledged greater sandhill cranes to ensure that the proposed date for hay cutting would not pose a threat to these species.** Although the majority of haying operations would continue to commence after August 1, the Service would allow haying or mowing of small areas earlier than August 1, especially during drought years, if needed to achieve management objectives. Examples could include creating habitat openings or corridors in dense vegetation, setting back the growth of noxious weeds, creating fire breaks, and creating open lanes for boundary/fence maintenance or placement of electric fences.

Haying in one year reduces the area of tall nesting cover sought by some wildlife during the following year. This potential impact would be addressed through habitat and wildlife monitoring, and appropriate rotation of haying and other habitat treatments to ensure that the refuge had adequate stands of tall and decadent vegetation for those ducks and other species that prefer dense nesting cover.

With implementation of the BMPs (Appendix L), haying operations are not expected to have adverse effects on sandhill cranes. While there could be some short-term disturbance associated with haying activities, hayed areas can provide excellent foraging sites for nesting and migrating cranes. Haying would result in a temporary reduction of residual nesting cover for sandhill cranes for the first spring period after haying.

Haying and related activities, such as planting, applying fertilizers or pesticides, and transporting equipment, would be potential sources of wildlife disturbance. Potential effects to wildlife from human disturbance are described in more detail previously under Lower Klamath Refuge, Fish and Wildlife Section, Alternative A. BMPs (Appendix L) to reduce adverse effects to wildlife include delaying haying to prevent the mowing mortality of young sandhill cranes.

Because activities associated with haying would not be ongoing and would be infrequent, temporary, short-term, and localized, adverse effects of haying to fish and wildlife are expected to be negligible.

Because activities associated with haying would not be ongoing and would be infrequent, temporary, short-term, and localized; adverse effects of haying to listed species are expected to be negligible. The effects of haying will be considered during intra-Service consultation pursuant to Section 7 of the federal ESA, for species listed as threatened or endangered, or proposed for listing, and their designated critical habitat.

Grazing

In recent years, approximately 200 to 400 acres in the northwest corner and approximately 1,200 to 1,800 acres in the northern portion of the refuge (Barnes-Agency Unit) have been grazed annually. As described previously grazing is used to create short-grass pastures for migratory waterfowl and help create a more diverse mosaic of habitats. Potential adverse effects of grazing on grasslands and riparian areas would be the same as those described previously under the effects to vegetation and habitat resources. Human disturbance from the use of vehicles to transport livestock and other ranching activities to support grazing are also a component of the grazing program and would be similar to human disturbance from public use described below.

The types of direct and indirect adverse effects to fish and wildlife from livestock grazing at Upper Klamath Refuge would be the same as those described for Lower Klamath Refuge. The magnitude of effects from grazing at Upper Klamath Refuge would be much less because the area grazed at Upper Klamath Refuge is less than 20% of the area recently grazed at Lower Klamath Refuge.

Because activities associated with grazing would not be ongoing and would be infrequent, temporary, short-term, and localized; adverse effects of grazing to fish and wildlife are expected to be negligible.

Adverse effects of grazing to listed species are expected to be negligible. The effects of grazing will be considered during an intra-Service consultation pursuant to Section 7 of the federal ESA, for species listed as threatened or endangered, or proposed for listing, and their designated critical habitat.

Pesticide Application

The types of pesticides that may be used at Upper Klamath Refuge are described under the section on vegetation and habitat resources, Alternative A. The types of direct and indirect adverse effects to fish and wildlife from pesticide applications at Upper Klamath Refuge would be the same as those described for Lower Klamath Refuge. The magnitude of effects from pesticide use at Upper Klamath would be much less because the area potential treated at Upper Klamath Refuge is less than 20% of the area recently treated at Lower Klamath Refuge. **In fact, pesticide use has been relatively rare at Upper Klamath Refuge. In 2015, approximately 68 acres of the refuge were treated for invasive plant species such as five-hook brassia, reed canarygrass, and perennial pepperweed. This is less than 0.45% of the refuge.**

Pesticide applications on the refuge are very closely regulated by the Service to greatly minimize the potential for adverse effects to fish and wildlife, as previously described under Alternative A in the Soils section. Because pesticide applications are evaluated and permitted consistent with the DOI and Service IPM and other relevant policies, and the PUPs process, the Service anticipates that negligible adverse effects to fish and wildlife would occur due to pesticide applications.

While past studies analyzed wildlife deaths on other refuges in the Refuge Complex, Tule Lake and Lower Klamath Refuges have significantly more pesticide applications on lands included in cooperative and lease land farming programs on those refuges (Hawkes and Haas 2005; Snyder-Conn and Hawkes 2004; Snyder-Conn et al. 1999;). Upper Klamath Refuge has no farming programs.

Both adverse and beneficial indirect effects could occur to terrestrial plants and animals that are present within, or use, the area that would be treated with pesticides. Pesticide application to non-native invasive plant species could result in the following types of indirect impacts.

- **Elimination of weeds through herbicide application could also reduce green matter or seeds for herbivorous and granivorous species (Boatman et al. 2004).**
- **Negligible short-term adverse effects by reducing a potential prey source (animals that consume invertebrates) for raptors that may have to subsequently forage elsewhere.**
- **Elimination of non-native plants would have a negative short-term minor effect but a long-term intermediate beneficial effect by helping to re-establish healthy native plant communities**

Because the Service would follow all pesticide label restrictions and BMPs (see Appendices G, L, and Q), pesticides would not be applied directly to, or within the no-spray buffer of surface waters, indirect impacts to aquatic and terrestrial species would not be likely to occur.

The Service anticipates that negligible adverse effects to fish and wildlife resources would occur from pesticide applications under Alternative A.

Temporary disturbances to federally and state-listed species due to land management activities, including wetland management, haying, grazing, and pesticide application are the same as those to other wildlife. An intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for species listed as threatened or endangered, or proposed for listing, and their designated critical habitat.

Public Use

The refuge is open to visitors from sunrise to sunset throughout the year, including during the waterfowl hunting season. Waterfowl hunting, fishing, wildlife observation and photography, and interpretation are permitted on the refuge, which provide recreation opportunities for the public, but can also result in temporary disturbances to other wildlife, such as other waterbirds, and fish that also use the hunting areas or are found in the marshes. The most popular public use activities on the refuge are boating on the Upper Klamath Canoe Trail and waterfowl hunting.

Dahlgren and Korschgen (1992) categorized the following human activities in order of decreasing disturbance to waterfowl.

- Rapid overwater movement and loud noise (power-boating, water skiing, aircraft).
- Overwater movement with little noise (canoeing, kayaking, sailing, and rowing).
- Little overwater movement or noise (wading, swimming).
- Activities along shorelines (fishing, bird watching, hiking, and traffic).

Many waterbirds are wary and flush when approached too closely. Human disturbance has differential effects on wildlife and is dependent on many variables, including the species involved and its age; the time of year; the breeding cycle stage (if applicable); the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; the surrounding environment; whether the disturbing activity involves vehicles; the type, size, intensity, speed, noise, nature, and frequency of the disturbing activity (e.g., dogs versus humans or approaching birds by walking versus in a motorized boat); and the approach angle or directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a, 1995b; Lafferty 2001a, 2001b; Rodgers 1991; Rodgers and Schwikert 2002; Rodgers and Smith 1997; Smit and Visser 1993). Disturbance and flushing of birds, or even raising their alert levels (which usually occurs at a greater distance than that for flushing), creates stress and requires animals to alter their normal behavior and expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing. It can cause them to stop feeding, cause abandonment of nests and young, allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual animals, including birds, eggs, nestlings, broods, young, and juveniles (Burger and Gochfeld 1991a; Haysmith and Hunt 1995; Lafferty 2001b). Breeding birds are especially sensitive to human disturbance (Hammitt and Cole 1998; Trulio 2005). A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004). The effects of disturbance on individual animals are likely additive.

Boating can alter bird distribution, reduce use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995a). The effects of various watercraft, including canoes and motorboats, on behavior of green-backed herons (*Butorides striatus*) on rivers in Missouri were investigated by Kaiser and Fritzell (1984). They found that as the number of recreationists increased, feeding time by the herons and their numbers on the river channels decreased. Bratton (1990) studied the effects of small motorboats on resting and foraging wading birds in Georgia. She found that birds in tidal creeks were more sensitive to boat disturbance than birds on the

shore and that birds in trees were less disturbed by boats than birds on the water, shore, or in the marsh. In a study of the effects of personal water craft (known as jetboats) and motorboats on breeding common terns (*Sterna hirundo*) in New Jersey, Burger (1998) found that flushing (upflights) of birds was greatest when boats moved faster and when they were outside the navigation channel and closer to the colony. These effects were most pronounced during the early breeding stage. Studies with birds have generally shown that motorized boats that move faster, are noisier, and approach birds more directly are the most disturbing.

Canoes and kayaks can also cause significant disturbance effects based on their ability to penetrate into shallower marsh areas (Knight and Cole 1995a; Speight 1973). Canoes or slow-moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985) and Huffman (1999) found that non-motorized boats within 30 meters of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorized boats, canoes and kayaks appear to have fewer disturbance effects on most wildlife species (DeLong 2002; Huffman 1999; Jahn and Hunt 1964).

The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Knight and Knight 1984; Tuite et al. 1983). Even a low level of boating activity affects the duration and pattern of use by wildlife (Bratton 1990).

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Burger 1998; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Launching boats in and out of the water; stirring up sediments with propellers, paddles, poles, flippers, or boat hulls; and boat-generated waves can cause erosion and turbidity. Motorboat propellers can cut submergent and emergent plants below the water surface. Fuels or oils can spill or otherwise be discharged into waterways by motorboats (this is a greater concern with traditional two-stroke engines). These contaminants can adversely impact water clarity and plant growth, and potentially impact growth and survival of aquatic organisms, including invertebrates, amphibians, and fish. Exhaust from boat motors also generates gaseous and particulate air pollution that can indirectly affect fish and wildlife.

Boating associated with hunting has occurred on the refuge for decades. In light of the relatively small number of motorboats using the relatively large lake, it is not likely that pollution discharges from these motors would adversely affect fish or other biota. The Service is aware of no evidence that pollution from motorboats used for waterfowl hunting on the refuge has killed or otherwise adversely affected aquatic organisms of the lake.

Although these are all undesirable effects, in light of the number of years that boating has occurred on the refuge, it is unlikely that continued boating is not expected to further degrade the existing conditions. At present, Oregon has no law requiring boat owners to decontaminate their watercraft and related equipment prior to launching at the refuge; however, there are signs at the primary launch sites alerting visitors to problems associated with invasive species and actions they can take to reduce the likelihood of such problems developing.

Waterfowl and other wildlife would be able to escape the disturbance effects of boating and related activities by flying or otherwise traveling to the 16,983-acre sanctuary area (~68% of the almost 24,983 acres within the refuge). Along with continued conservation of habitat in the sanctuary area, hunting- and boating-related BMPs (Appendix L) posted at boat launches would greatly reduce the likelihood and magnitude of potential adverse effects of boating on native fish, wildlife, plants, and their habitats. These disturbances to non-game wildlife are short-term, and localized around the disturbance area.

Anticipated Direct and Indirect Impacts of Hunting on Fish and Wildlife, including Non-Game Species

The Service does not collect data on the number of waterfowl harvested at the Upper Klamath Refuge. The Service estimates that, in recent years, the average, annual harvest of ducks on the refuge ranged from 500 to 750 individuals and for geese, from 220 to 335 individuals. These harvest figures include harvest by sport hunters with and without guides, and represent the worst-case scenario (i.e., they include 100% fatality among animals shot, but not retrieved, which is, crippling loss). Mergansers and coots are included in the harvest statistics for ducks. Both species are rarely harvested by hunters.

The refuge is also open for hunting of common moorhens (*Gallinula chloropus*) and Wilson's snipe (*Gallinago gallinago*). However, these species are rare to uncommon on the refuge and no harvest data are collected for them. It is believed that if these species are harvested on the refuge, the numbers are very low. The effects to game and non-game wildlife would be the same as described previously for Lower Klamath Refuge in the Fish and Wildlife section under Alternative A.

This refuge also benefits from the very successful programs undertaken by the Service and Oregon Department of Fish and Wildlife (ODFW) to manage migratory birds (see descriptions in Section 5.2.2). Readers are referred to the official regulations for hunting on Klamath Basin refuges (see 50 CFR 32, Hunting and Fishing) and to the compatibility determinations in Appendix G for more specific information about conditions (stipulations) associated with the waterfowl hunting opportunities offered on this refuge.

The types of direct, indirect, and disturbance effects on fish and wildlife from hunting would be the same as those described previously under Lower Klamath Refuge. Given harvest estimates, the occurrence and magnitude of effects from hunting on Upper Klamath Refuge would be much less than hunting on Lower Klamath Refuge. Both duck and goose harvests at Upper Klamath Refuge are estimated to be less than about 45% of that at Lower Klamath Refuge. In light of the large size of Upper Klamath Refuge, and the relatively small number of motorboats used by hunters, it is unlikely that the turbidity and petroleum discharges they create adversely affect suckers in these waterbodies.

Effects of wocus gathering on wildlife

As discussed previously under vegetation and habitat resources, wocus is typically harvested over a 1- to 2-acre area within approximately 70 acres that support wocus. Wocus gathering has been, and will continue to be, confined to areas already open to and accessible by the public for wildlife-dependent recreation. Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995b). The types of disturbance may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions, as discussed above.

The types of wildlife responses to human disturbance include avoidance, habituation, and attraction (as described by Gabrielson and Smith 1995; Knight and Cole 1991); these are discussed above. However, no long-term or cumulative adverse effects from wocus gathering are expected on wildlife or habitat. Although wildlife may be disturbed during gathering activities, gathering takes place in open water areas supporting wocus where wildlife could disperse to other undisturbed areas. Because the amount of plant material being harvested is on 1 to 3% of the available area that supports wocus, gathering is short-term (seasonally within several weeks in July through September), and wildlife can relocate to other areas within the approximately 91,000-acre Upper Klamath Lake, the effects of wocus gathering on fish and wildlife are expected to be negligible.

The direct effects of public use on fish and wildlife under Alternative A would be negligible.

Beneficial Effects

Land management activities including haying, grazing, and prescribed fire can be effective management tools to improve and maintain wet meadows for the benefit of migratory birds and other species. Hayed areas may be used by a variety of wildlife species during different parts of the year to meet specific life-cycle needs (e.g., cover, nesting, foraging). Wetland vegetation in the freshwater marshes and in the irrigated pasture/managed wetlands may help circulate and filter the water and improve water quality.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into the Alternative. No additional mitigation measures are being proposed.

Consultation with the NOAA Fisheries and an intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for species listed as threatened or endangered, or proposed for listing, and their designated critical habitat. The Service will consult with NOAA Fisheries and complete intra-Service consultation on CCP actions and comply with the terms of the consultations.

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative.

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Land Management

Wetland Management

Disturbance to wildlife under Alternative B would be the same as described in Alternative A. Wetland management would continue as described in Alternative A except for the following changes. The refuge would collaborate with adjoining landowners and other organizations to enhance and restore fringe wetland habitats on Upper Klamath Lake adjacent to the refuge. In addition, the refuge would pursue a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches would help maintain the quality of wildlife habitat by reducing the potential for introduction of a new invasive species to refuge waters or reintroduction (and increasing the population) of an existing pest.

The types of potentially adverse effects of wetland management on federal- and state-listed species would be the same as those described for other fish and wildlife resources. Under Alternative B, the level of adverse effects on federal- and state-listed species from wetland management would be the same as that described for Alternative A. More beneficial effects from wetland restoration projects would be expected, as described below.

Overall, use of refuge habitats by migratory waterfowl and other wetland-dependent wildlife is dependent on the water deliveries (both the timing of deliver and the amount of delivery), which determine the extent of managed wetlands available to wildlife in a given year. During low water years or years when water is not provided at the appropriate time, the Service would be able to provide fewer managed wetland resources and conditions are likely to worsen for waterfowl in general and for geese in particular. The Service anticipates that negligible adverse effects to fish and wildlife resources would occur from wetland management activities under Alternative B.

Haying and Grazing Programs

The effects of haying on fish and wildlife and their habitat would be the same as with Alternative A, except that Alternative B includes the expanded use of haying and other methods to improve habitat structure and provide green browse for migrating waterfowl. The expanded haying program would increase the area subject to the potentially adverse effects of haying described above.

Under Alternative B, the effects on federal- and state-listed species from haying would be the same as those described for other fish and wildlife resources.

The effects of grazing on fish and wildlife and their habitat would be the same as with Alternative A, except that Alternative B includes the expanded use of grazing and other methods to improve habitat structure and provide green browse for migrating waterfowl. The expanded grazing program would increase the area subject to the potentially adverse effects of grazing described previously.

Under Alternative B, the types of effects on federal- and state-listed species from grazing would be the same as those described for other fish and wildlife. In addition to the 1,400 to 2,200 acres being grazed in Alternative A, grazing could also take place on additional portions of the almost

10,000-acre Barnes-Agency Unit. Because one of the principle purposes of grazing would be to create openings in vegetation and thereby enhance habitat diversity, grazing would be rotated around different areas of the refuge and it is unlikely that the maximum acreage would be grazed during a single year.

The Service anticipates that negligible adverse effects to fish and wildlife resources would occur from haying and grazing under Alternative B.

Pesticide Application

Under Alternative B, **the Service would formalize pest management practices under an IPM program. The IPM is expected to help the Service more quickly identify and control new or expanded infestations of invasive plants thereby** increasing the effectiveness of invasive species management.

As with Alternative A, Alternative B is expected to have temporary adverse effects on non-target wildlife habitat, as previously described under Alternative A in the Soils section. Because pesticide applications are evaluated and permitted consistent with the DOI and Service IPM and other relevant policies, and the PUPs process, the Service anticipates that negligible adverse effects to fish and wildlife would occur due to pesticide applications. Long-term beneficial effects are addressed below.

The Service anticipates that negligible adverse effects to fish and wildlife resources would occur from pesticide applications under Alternative B.

Under Alternative B, the effects on federal- and state-listed species from pesticide applications would be the same as those described for other fish and wildlife resources.

Public Use

Construction of public facilities, including a pull-off on West Side Road, seasonal contact station, and interpretive signs and kiosk, could directly affect wildlife by removing habitat resources, depending on the specific locations and details of the facilities. The area affected by construction is likely to be less than 0.5 acre. Effects to wildlife during construction of public facilities would be temporary and limited to the immediate vicinity of the disturbance area. As discussed under Alternative A, temporary disturbances to wildlife could be adverse during the nesting and breeding seasons. However, these facilities are expected to encompass small areas and would not require removal of a substantial amount of habitat. Habitat impacts associated with the new facilities are expected to be minor. Projects subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail in the applicable NEPA document, when site-specific details are available. Effects on fish, wildlife, and habitat resources from hunting and fishing would be the same as under Alternative A.

The northern spotted owl is a rare visitor to the forest habitat fringing Upper Klamath Refuge. Because the owl typically uses forest habitat on the lakeshore and waterfowl hunters typically use the marsh or open lake, no direct effects from waterfowl hunters on the owl are expected. It is unlikely that the hunting programs have an effect on special-status owls or hawks. Likewise, the very large size, distinctive markings, and loud and unusual calls of the bald eagle and greater sandhill crane make it unlikely that these birds would be mistakenly shot by hunters. As described previously for other wildlife, disturbance associated with hunting (e.g., vehicle and boat activity,

and noise from motorboats and shotguns) may cause special-status species in the area to relocate further into the vast forest that stretches west from the lake, however, this effect would likely be temporary and seasonal.

The types of temporary disturbances and wildlife response to disturbance by boats and other public uses on Upper Klamath Refuge would be the same as described previously for Lower Klamath Refuge in the Fish and Wildlife section of Alternative A. The Service would consult with NOAA Fisheries and complete intra-Service consultation on CCP actions and comply with the terms of the consultations.

Effects on fish and wildlife and federally and state listed fish and wildlife from public use would be negligible.

Beneficial Effects

Alternative B includes wetland restoration and the expanded use of haying, prescribed grazing, and prescribed fire; which is expected to benefit migrating waterfowl and other wildlife, by improving habitat structure, as described under Alternative A, and providing green browse.

As with Alternative A, wetland enhancement and restoration activities on the Upper Klamath Refuge support the recommendations in the Revised Lost River Sucker and Shortnose sucker Recovery Plan (Service 2013), Recovery Action 1.4: *Conserve and restore wetland and riparian areas*, and Recovery Action 2.3. *Conserve and restore riparian and wetland areas along…Upper Klamath Lake to improve water quality*.

The short spring vegetation structure produced from haying or grazing may also enhance breeding sites for the state sensitive and federal candidate Oregon spotted frog.

Alternative B is expected to have more beneficial effects than Alternative A because of the potential for wetland restoration at the Barnes-Agency Unit and expanded land management programs implemented to improve wildlife habitat quality.

Mitigation

In addition to implementing the general BMPs (Appendix L), to reduce potential water pollution, which would indirectly mitigate adverse effects to fish and aquatic plants, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) and direct injection 2-stroke boat motors to be used on the refuge and prohibiting boaters from traveling at speeds greater than 10 miles per hour. This mitigation measure to reduce potential water pollution, which would indirectly mitigate adverse effects to fish and wildlife, including federal- and state-listed species.

To reduce the likelihood that hunting-related activities would contribute to invasive species problems on the refuge, the Service would pursue partnerships with the State of Oregon and the U.S. Forest Service to develop and operate portable decontamination stations near boat launches on or near the refuge that are popular with hunters.

Direct adverse effects of management programs on the refuge can be reduced through the use of BMPs described in Appendix L. The Service will complete an intra-Service consultation pursuant to Section 7 of the federal ESA, for species listed as threatened or endangered, or proposed for listing, and their designated critical habitat.

6.5.7 Cultural Resources

Methodology to Assess Effects – Upper Klamath Refuge

Compliance with the NHPA is required for all undertakings funded with federal funds or requiring a federal permit, both on Service-owned lands and on private lands. Compliance is accomplished through a process initiated with the submittal of the Request for Cultural Resource Compliance form to the Regional Cultural Resource Team. When the Service commits funds, or prepares specific plans, to an identified project or activity identified in the final CCP, that activity or project will become a Section 106 undertaking for which the Service will comply with the Section 106 review and compliance process prior to the implementation of the activity or project. Projects are reviewed by the Regional Archaeologist, who identifies the steps necessary to ensure compliance with Section 106. As appropriate, consultation, cultural resource survey, identification, and evaluation are implemented. If Programmatic Agreement criteria do not apply, further evaluation and consultation are conducted by either Service archaeologists or certified archaeological contractors under the supervision of the Regional Archaeologist. If significant cultural resources are identified within the area of potential effects, the Service, in consultation with the SHPO and any interested parties, will develop a plan to avoid, minimize, and/or mitigate adverse effects to the significant cultural resources.

The following are resource-specific contexts for assessing effects of alternatives to cultural resources.

- Numerous archaeological sites and sites of historic significance occur in the Upper Klamath Basin and on the refuge.
- Much of the land base of the refuge has been modified through agricultural practices.

Additional information about the Service's process for implementing these protections is provided under the Cultural Resources section for Lower Klamath Refuge.

Alternative A – Upper Klamath Refuge

Cultural resources are currently managed on a project-by-project basis as surveys identify resources where activities are proposed. The Service consults with the SHPO in compliance with Section 106 of the NHPA prior to implementation of management activities that could adversely affect historic properties. When necessary, measures, such as avoidance of the resources, are implemented to protect cultural resources from adverse impacts associated with ongoing land management activities. Therefore, potential effects are considered neutral.

Mowing has no effects on cultural resources.

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Cultural resources management would be the same under Alternative B as described for Alternative A. Additional management activities, restoration projects, and minor construction projects would increase the potential for impacts on cultural resources. No historic properties have been documented at the refuge, but other cultural resources could be important to the history of the area. Impacts on cultural resources under Alternative B could be significant if the activities damage or otherwise reduce the quality of the resource. Projects subject to subsequent NEPA compliance and the specific effects of proposed activities will be analyzed in further detail

in the applicable NEPA document, when site-specific details are available. When necessary, measures, such as avoidance of the resources, are implemented to protect cultural resources from adverse impacts associated with ongoing land management activities. Therefore, potential effects are considered neutral.

An escaped prescribed burn can threaten older wooden structures or artifacts.

Water-level manipulation, pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches, and implementation of an invasive species monitoring and management plan would not affect cultural resources.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA. Under all alternatives, if any cultural resources are discovered on the refuge, the Service would take all necessary steps to comply with the above-mentioned laws and promulgated regulations.

Mitigation

To prevent adverse effects on cultural resources during ground-disturbing land management and construction activities, the Service will comply with the Section 106 review and compliance process prior to the implementation of the activity or project. If significant cultural resources are identified within the area of potential effects, the Service, in consultation with the SHPO and any interested parties, will develop a plan to avoid, minimize, and/or mitigate adverse effects to the significant cultural resources.

6.5.8 Visitor Services

Recreation Opportunities

Methodology for Assessing Effects – Upper Klamath Refuge

Maps of the refuge showing the locations of visitor services and habitat, in conjunction with professional judgment were used to predict how public use would affect recreational opportunities.

The following is the resource-specific context for assessing the effects of alternatives to recreation opportunities.

- The refuge provides an extensive variety of wildlife-dependent recreation.

Alternative A – Upper Klamath Refuge

Land Management

Wetland Management

Prescribed burns are used as a tool to provide a greater variety of waterfowl and waterbird habitat in wetland areas as well as manage invasive plant species. The direct effects of prescribed burns can require that portions of the refuge are temporarily closed to public access and use. Refuge visitors could also be threatened by a prescribed burn used for invasive species management that escapes. To reduce the likelihood of this occurring, the refuge would follow the BMPs described for prescribed burning in Appendix L. Also, roads accessing the refuge and on the refuge are well signed and monitored by fire personnel prior to and during a prescribed burn. These signs and monitoring efforts help ensure that visitors are advised of a prescribed burn that is planned or underway, and that they are not in the path of a potential escaped prescribed burn. Some visitors may find objectionable the sight or smell of a prescribed fire, its smoke, or a blackened field/management unit following a burn. The intensity of post-burn green-up and opening up of choked wetlands may offset some of these concerns.

Flooding and variation in timing of these wetland management practices have no direct effects on recreation opportunities.

The Service anticipates that negligible adverse effects to recreation opportunities would occur from wetland management activities under Alternative A.

Haying and Grazing Programs

The majority of haying is conducted in the northwestern corner of the refuge, as described in Chapter 4. The activities involved in haying are described previously under the Soils section, Alternative A. At harvest time, haying can generate dust which could be a temporary nuisance to refuge visitors. The migratory game bird hunt zone totals almost 9,100 acres, including the Hank's Marsh Unit; and the northern, eastern, and southern portions of the emergent marsh in the northwestern corner of Upper Klamath Lake. This total hunt area comprises approximately 39% of the almost 23,100 acres under Service management jurisdiction. The remainder of the refuge is closed to migratory bird hunting and serves as a sanctuary area for waterfowl during the hunting season.

Hunting would not take place at the same time as the harvest and thus the direct effects to recreational opportunities are minor.

Prescribed cattle grazing takes place annually on approximately 200 to 400 acres in the northwest corner and approximately 1,200 to 1,800 acres in the northern portion of the refuge (Barnes-Agency Unit), as described in Chapter 4. The activities involved in grazing are described previously under the Soils section, Alternative A. The direct effects of grazing on recreational opportunities consist of dust generated by vehicles to transport livestock and fencing to enclose grazing areas as well as the sight of livestock on the refuge. Depending on the location of grazing fields, visitors could see livestock. Some visitors may find the sight of livestock on a refuge objectionable.

The Service anticipates that negligible adverse effects to recreational opportunities would occur from grazing and haying under Alternative A.

Pesticide Applications

Herbicides are typically applied only in the Barnes-Agency Unit of the Upper Klamath Refuge for invasive plant management during the warmer season (approximately May through mid-August). Public access is allowed on the Barnes-Agency Unit only during hunting season, which is approximately October through December. No herbicide spraying has been done by the Service on refuge lands in the Upper Klamath canoe trail area. However, if herbicide is needed in the vicinity of the canoe trail in the future, herbicide application timing, potential closures to public use, and the PUPs process would avoid potentially adverse effects to visitors. Continued operation of the pesticide-use program, consistent with the BMPs included in the approved PUPs, would not be expected to create any future health or safety hazards for individuals visiting the refuge.

The following are potential effects pesticide applications may have on other recreational opportunities. Winds can carry the smells of pesticides and their adjuvants, carriers, and solvents great distances (this effect can be especially pronounced with aerial spraying and somewhat less so with pesticides applied through boom-type and hand-held spray equipment). Some visitors could find objectionable the sight or smell of pesticides being applied on the refuge for the invasive species management programs. Additionally, disturbance associated with the application of pesticides could cause birds and other wildlife to flush and potentially move elsewhere on the refuge or move off of the refuge. Such wildlife movements could either enhance or reduce wildlife viewing and/or photography opportunities for visitors. Continued operation of the pesticide-use program, consistent with the BMPs included in the approved PUPs, would not be expected to create any future health or safety hazards for individuals visiting or working on the refuge or for those on adjacent lands.

The Service anticipates that negligible adverse effects to recreational opportunities would occur from pesticide applications under Alternative A.

Public Use

This section evaluates how public use of the refuge could affect recreational opportunities on the refuge, including the potential for conflict between user groups. The primary public use of the refuge is for wildlife-dependent recreation consisting of hunting, wildlife observation and photography on the refuge. Boating and management-oriented research are also allowed on the refuge. The refuge is accessible by car, boat, or foot.

The Service currently offers diverse recreation opportunities at the refuge. Hunting is allowed by walk-in or boat access; fishing is allowed by boat; and wildlife viewing, interpretation, and photography opportunities are available via walk-ins and the canoe trail. Off-site information about the refuge and outreach are offered at the Refuge Complex visitor center, at the Rocky Point and Malone Springs boat launches, on the Refuge Complex website, and for nearby schools as part of field trips to the refuge. Visitor use is monitored by the Rocky Point Resort. The current recreation opportunities target diverse user groups, but may limit visitation due to the need to use a boat or access the refuge on foot.

Habitat and hunting are evaluated every year and, if deemed necessary, areas will be closed to hunting. Hunter numbers are typically self-regulating due to the remote location of the refuges

(habitat conditions are posted on the web pages and announced in the hunter "hotline"); when there is little habitat, most hunters choose not to come. However, if needed, hunter numbers are managed to reduce pressure.

Currently, two guides offer waterfowl hunting opportunities on the refuge. These guides offer safe, quality, wildlife-dependent public use (i.e., hunting) opportunities to a range of individuals, including those new to hunting, those with limited time to devote to hunting, those not familiar with the area, and/or those with disabilities. These professional guides offer hunting experiences as a business using high-quality equipment and supplies. To increase the likelihood of a successful hunt by their clients, guides invest more time and money learning about each refuge, studying the availability and condition of habitats and wildlife use, and scouting potential hunting areas than many individual sport hunters. The Service is aware that there are visitors who do not agree with commercial guiding on the refuges. However, the Service believes that permitted guides are an asset to the hunting program. They bring a substantial number of visitors to the refuges who might not otherwise utilize this recreational opportunity and who contribute to the local economy. Under the Service permit, guide behavior and restrictions are stipulated and penalties for violations may include the loss of guiding privileges.

The refuge is open to non-hunting visitors, oftentimes during the hunting seasons. These other visitors enjoy wildlife observation and photography, and natural resource interpretation by canoeing on the refuge. Non-hunting visitors may find hunting objectionable on a refuge. Some could be upset at the sound of gunfire; the sight of shot birds falling from the sky; noise from motorized boats; or the potential find of a hunter-crippled game animal, or an injured or dead non-target species. Such experiences could affect the quality of their visit to the refuge. Additionally, hunting-related disturbance could cause birds and other wildlife to flee from hunt zones and potentially move elsewhere on the refuge, including into an area that is closed to hunting, or move off of the refuge. Such wildlife movements could either enhance or reduce wildlife viewing and/or photography opportunities for other visitors.

Accordingly, the potential effect of public use on recreational opportunities on the refuge is negligible. While there is some interaction between user groups they are generally separated spatially and temporarily and do not conflict.

Beneficial Effects

The indirect effects of land management actions result in stable populations of fish and wildlife for recreational opportunities. Additionally, the availability of access roads, trails, parking areas, and signage makes the refuge visitor experience safer and more enjoyable. Removal of pest and invasive species (potentially including poisonous plants) through mowing and the ability to apply pesticides if conditions warrant make the refuge visitor experience safer and more enjoyable.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and visitors and are incorporated into the alternative. No additional mitigation measures are being proposed. No mitigation is necessary for recreational opportunities.

Alternative B(Preferred Alternative) – Upper Klamath Refuge

Land Management

Wetland Management

Under Alternative B, although the specific areas within the refuge that are managed as irrigated pasture/managed wetland could rotate or change, the extent and types of direct effects on recreational opportunities would be the same as described under Alternative A.

Haying and Grazing Programs

Hunting would not take place at the same time as the harvest and thus the direct effects to recreational opportunities are minor. Under Alternative B, although the specific areas within the refuge that are hayed may change, the extent and types of direct effects on recreational opportunities would be the same as described under Alternative A.

Under Alternative B, although the specific areas within the refuge that are grazed may change, the extent and types of direct effects on recreational opportunities would be the same as described under Alternative A.

Pesticide Application

Under Alternative B pesticide use could be reduced as the use of non-pesticide methods to control invasive species are expanded in wetland and upland units using grazing, haying (mowing), and restoration plantings. The reduction of pesticide use could enhance the quality of recreational opportunities for some visitors, although this may be offset with the potential use of additional grazing.

In summary, the potential effect of public use on recreational opportunities on the refuge is minor. While there is some interaction between user groups they are generally separated spatially and temporarily and do not conflict. Land management activities under Alternative B would not be substantially different from Alternative A.

Public Use

Under Alternative B, recreation opportunities would be similar to the current opportunities, with some improvements and new public facilities: construction of a vehicle pull-off and interpretive kiosk on West Side Road and installation of a contact station and interpretive and directional signs at the refuge. Additional opportunities for wildlife observation, photography, and interpretation would benefit the public, which would be expected to increase visitation. The projected increase in visitors would likely be similar to past trends of visitors, as discussed in the Effects on Social and Economic Conditions, considering the rural nature of the refuge and would not lead to other substantial impacts from increased use.

Construction of new facilities could result in temporary disruptions in some areas to existing recreation opportunities and visitors, but these disruptions would affect a low number of people and small areas of the refuge at one time, resulting in negligible impacts.

Effects on recreation opportunities for hunting under Alternative B would be the same as under Alternative A.

It is not expected that pursuing a partnership(s) with the U.S. Forest Service and the State of Oregon to develop and operate a portable decontamination station(s) near Upper Klamath Lake boat launches, water-level manipulation, or implementation of an invasive species monitoring and management plan would affect recreation opportunities on the refuge.

Beneficial Effects

The additional public use improvements called for under Alternative B would result in more beneficial effects on visitor services. Construction of a vehicle pull-off and interpretive kiosk on West Side Road and installation of a contact station and interpretive and directional signs at the refuge are expected to provide additional opportunities for interpretation and environmental education to benefit the public.

Mitigation

In addition to implementing the general BMPs (Appendix L), to reduce water pollution, noise, and disturbance, the Service would phase in a new requirement allowing only 4-stroke (4-cycle) and direct injection 2-stroke boat motors to be used on the refuge and prohibiting boaters from traveling at speeds greater than 10 miles per hour.

6.5.9 Social and Economic Conditions

Methodology to Assess Effects – Upper Klamath Refuge

The Service prepared an Economic Analysis of the Klamath Basin Refuge Complex CCP alternatives, which is contained in Appendix P. The economic analysis looked at the regional economic conditions and evaluated the economic effects of the various management alternatives.

The following is the resource-specific context for assessing effects of the alternatives on social and economic conditions:

- Refuge management contributes to the local economy through recreational opportunities, haying, and grazing.

Alternative A – Upper Klamath Refuge

The Service would continue to operate and manage Upper Klamath Refuge as it has in the past, and the contribution of the refuge to the regional economy from direct and indirect expenditures would be expected to be similar to current conditions. The refuge budget would remain similar to the current budget, which is a portion of the $4 million annual budget for the Refuge Complex, and ongoing management and maintenance projects would continue to be implemented, as feasible within the budget. Visitation to the refuge would likely be similar to current and past trends. In 2015, the Service estimated 4,000 visits from hunting, 5,000 from fishing, and 10,000 from wildlife observation and non-consumptive uses.

This paragraph summarizes economic effects discussed in more detail in an Economic Analysis of Klamath Basin Refuge Complex (Appendix P). In 2015, the Service estimates that the refuge

grazing program on the refuge contributes annual sales of about $613,000 and 5.1 jobs to the economy. A portion of the jobs created from visitor related spending is attributable to visitors at the Upper Klamath Refuge. In addition, the regional economy benefits of administering the refuge program at Upper Klamath Refuge contributes 1.6 jobs to the region. (Appendix P, Economics Analysis).

Alternative B (Preferred Alternative) – Upper Klamath Refuge

Under Alternative B for Upper Klamath Refuge, implementation of management activities in the Upper Klamath Refuge may result in:

- a short-term increase in refuge spending and regional economic activity due to construction of facilities;
- little to no net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 0.1); and
- a minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation.

Summary of Effects

Table 6.8 summarizes the potential effects of the two alternatives being considered for the Upper Klamath Refuge.

Table 6.8. Summary of Effects for Upper Klamath Refuge

	Alternative A	*Alternative B (Preferred Alternative)*
Effects on Soils		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Minor	Minor
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible
Effects on Hydrology		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Neutral	Neutral
Effects on Water Quality		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Negligible	Negligible
Effects on Air Quality		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible

Table 6.8. Summary of Effects for Upper Klamath Refuge

	Alternative A	*Alternative B (Preferred Alternative)*
Effects on Vegetation and Habitat Resources		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible
Effects on Fish and Wildlife		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible
Effects on Cultural Resources		
Land Management		
Wetland Management	Neutral	Neutral
Haying and Grazing	Neutral	Neutral
Pesticide Applications	Neutral	Neutral
Public Use	Neutral	Neutral
Effects on Visitor Services		
Land Management		
Wetland Management	Negligible	Negligible
Haying and Grazing	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible

Environmental Justice

The refuge is located in a remote area with low population density. In 2013, Klamath County had a poverty level of 18.2% (U.S. Census Bureau 2015). While not directly comparable, this estimate falls between the national and Klamath County poverty estimates. The CCP actions proposed in all alternatives focus on continuing existing land management, inventory and monitoring, natural and cultural resources conservation and visitor services on the refuge. With consideration of the higher poverty level in Klamath County and due to the nature of the CCP actions, the Service concluded that within the spirit and intent of EO 12898, implementation of the CCP actions at the refuge would not disproportionately affect minority or low income populations.

6.6 Bear Valley National Wildlife Refuge

This section describes the potential impacts of the No Action Alternative and one action alternative for the Bear Valley Refuge. Impacts are analyzed for significance using the thresholds described in the introduction to this chapter. Mitigation measures to avoid and/or minimize potentially adverse effects are described in the list of BMPs (see Appendix L). BMPs are common to all alternatives.

The following resources would not be affected by the alternatives and are not carried forward for further analysis.

- **Geology (not affected)**. Given the limited management actions currently implemented and proposed on the refuge, no effects to geologic resources would occur.

- **Hydrology (not affected)**. Surface water resources are limited to a few intermittent streams that carry water during high rain events and following snowmelt in the spring. There are no current management actions or proposed management actions on the refuge that would affect hydrologic resources.
- **Noise**. Noise-related effects are discussed as they relate to land management or public use in the resource sections below.
- **Paleontological Resources**. There is potential for as yet undiscovered paleontological resources to be affected during ground-disturbing activities. Should any paleontological resources be discovered by the Service, they would be conserved in place or deposited in an approved repository. On Service-owned land, the public is not allowed to remove any paleontological resources from the refuge. As a result of protections under the Paleontological Resources Preservation Act (PL 111-011) (Omnibus Public Land Management Act of 2009), no effects to paleontological resources would occur.

6.6.1 Soils

Methodology for Analyzing Effects – Bear Valley Refuge

Reports on the soil types within the refuge boundary that are available online through the NRCS were consulted to assess relative susceptibility to compaction and erosion of different soils. These finding were applied generally to help understand how land management actions and public use activities might affect the physical qualities of the soil.

The following are resource-specific contexts for assessing effects of the alternatives to soil resources.

- Construction-related impacts would be localized.
- Soils within the refuge boundary and outside of the refuge boundary have not been historically disturbed or altered.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Thinning

At Bear Valley Refuge the Service uses mechanical and prescribed fire treatments to improve habitat conditions for the bald eagle. The prescribed burns conducted on the refuge consist of two types of pile burns. Landing piles are large piles (often covering an area up to 0.5 acre) generated from a commercial timber sale. A series of three commercial timber sales generated numerous landing piles. Although the majority of these landing piles have been burned, there are a few residual piles that will be burned in the future. Landing piles can only be burned when soils are moist and usually when there is snow on the ground. This restriction minimizes effects to soils.

The second type of prescribed burn are pile burns. Pile burns are generated from the ongoing thinning projects. Piles generated from ongoing thinning projects are on average 6 feet in diameter and less than 4 feet high. On average, 10 to 15 piles per acre are produced during thinning, but the number per acre does increase in thickly vegetated areas. The amount of thinning done annually is dependent of staffing and budgets. Currently the Service thins less than 5 acres per year. These hand piles are covered with plastic until they can be burned in the winter.

Piles are only burned when there is significant snow or completely saturated soils. No pile burning is done in dry years when there is no snow or inadequate soil moisture. These restrictions minimize the effects of pile burning on soil (Hubbert et al. 2013). Pile burning also returns nutrients that were locked up in plants back to the soil where they are once again available for uptake by plants. On average, 25 to 50 hand piles are burned per year, but this number can increase if there is a backlog of piles from previous years.

Removing the vegetation cover from forest soils through prescribed burning or silvicultural thinning can make them vulnerable to erosion, but the scattered nature of either greatly lessens this impact.

There are areas of bunchgrass grassland on calimus fine sandy loam in the southeastern corner of the refuge. The NRCS classifies this area with a higher erodibility than the rest of the refuge (see Figures 5.21 and 5.22). BMPs (Appendix L) and other preventative measures in the Fire Management Plan (Service 2001) would be implemented specifically to reduce erosion during soil disturbing activities in this area.

The adverse effects to soils from prescribed fire and silvicultural thinning would be minor.

Pesticide Application

Pesticide applications are evaluated and permitted consistent with a PUP. Pesticide applications have very few direct effects on soils.

Over the last 4 years of records (see Table 5.35), the area treated with pesticide to reduce invasive species ranged between 1 and 10 acres per year. Pesticide application consisted of Milestone Specialty. Aminopyralid is the active ingredient in Milestone Specialty. This is a selective herbicide used for control of broadleaf weeds with limited mobility in soil. Given the required PUP process and the limited use of pesticides on the refuge, and the use of BMPs, the Service concludes that pesticides would have a minor adverse effect on soils, while providing a net beneficial effect to biological resources as described in the sections to follow.

The potential adverse effects to soils from pesticide application would be negligible.

Public Use

Public use at Bear Valley Refuge is currently limited to hunting. The effects of hunting on soils under this alternative are limited to foot traffic during hunting season. Environmental education and interpretation of the resources at Bear Valley Refuge are conducted remotely from the Refuge Complex Visitor Center near Tulelake, California. Therefore, the Service has concluded that potentially adverse effects from public use (hunting) to soils would be negligible, localized, and short term.

Beneficial Effects

The beneficial effect of land management activities is to develop a more resilient habitat where the risk of catastrophic fire is reduced. Catastrophic wildfire can damage the soil structure and ultimately lead to increased erosion.

Mitigation

Land management activities can temporarily expose soil to wind and water erosion, but they are subject to standard BMPs to minimize erosion-related impacts. In addition, vegetation tends to naturally re-establish in disturbed areas and protects soils from long-term erosion following the activities. Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Thinning

In addition to the ongoing effects to soils from prescribed fire discussed under Alternative A, the Service would consider some additional tree thinning in small areas of the refuge and in the riparian habitats along Bear Valley Creek. The impacts would be similar to those identified for Alternative A activities. Because the Fire Hazard Reduction Project (Service 2002a) has been implemented there are only a few additional areas where tree thinning would be considered. As described in the 2002 Environmental Assessment for the Fire Hazard Reduction Project (incorporated by reference), thinning activities that involve heavy machinery can result in compaction of soils in localized areas of ingress and egress. The degree of soil compaction would depend on the number of passes over a particular area as well as the type of vehicle. Slash generated from mechanical thinning activities would be spread on the pathways of equipment to minimize soil compaction. If additional areas are identified for thinning the prescribed pile burning would be conducted as described under Alternative A and would be subject to the same restrictions.

Potential adverse effects of prescribed fire and silvicultural thinning would be minor.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing pest management practices under an IPM program. Use of pesticides would continue as needed and the impacts to soils from pesticide applications would be the same as described under Alternative A.

Public Use

Under Alternative B the Service would investigate construction of public parking areas at the north and south entrances and a viewing area at the south entrance and establishment of a road for public access to the south entrance. These public access areas would be available for hunters as well as visitors engaging in other wildlife-dependent activities such as wildlife observation and photography. The refuge would remain closed to public use except for hunting until these access areas are constructed. Construction of the public parking areas would generate dust and potentially some erosion. Due to the small size of this project, these effects would be very limited in both magnitude and duration. Access to this new parking area would be on an existing road (for which the Service would seek an easement) and involve no additional construction or effects on soils. Effects on soils would be further assessed in a project-specific NEPA document once specific details on the new facilities are available.

In developing the site-specific project for the proposed vehicle parking area, the Service will consider potential use conflicts for the expansion of recreation opportunities at the refuge. Measures to reduce potential conflicting uses may involve establishing schedules for allowed public uses or designating areas for each type of public use. Should parking areas be added, then interpretative materials would be placed on site that discuss the need for habitat management.

Under Alternative B, the Service would also restrict hunter to the use of non-toxic ammunition. This would reduce the potential for lead bullets to enter the soil.

The Service has concluded that potentially adverse effects from public use (hunting) to soils would be negligible, localized, and short term.

Beneficial Effects

Beneficial effects to soils under Alternative B would be the same as described for Alternative A.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.6.2 Water Quality

Methodology for Analyzing Effects – Bear Valley Refuge

Reports on water quality of the Klamath Basin are available online through the States of California and Oregon. Information from online resources was used to assess the impacts of each alternative on water quality.

The resource-specific context for assessing effects of the alternative to water resources is listed here.

- There are no bodies of open water or year-round streams on the refuge.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Burns and Silvicultural Thinning

The streams on the refuge are fed by natural sources and do not currently have water quality issues. Ongoing land management activities could discharge sediment or other pollutants via runoff into the streams, but no activities are currently implemented in riparian habitat, reducing the potential for water quality-related impacts from ongoing activities. Because the streams occur in upland areas and at scattered sites across the refuge, and there are few surface waters on site, cutting and piling of small trees and brush would not be expected to affect water quality.

Prescribed burning occurs over larger areas in a patchwork fashion and consumes vegetation exposing the soil surface. If such a burn is immediately followed by a major rainstorm, some erosion and associated sediment and nutrient inputs to surface waters could occur. However,

because there are few surface waters on site and they are intermittent, the potential to affect water quality is very low.

Pesticide Application

There would be no measurable effect of pesticide applications on water quality because pesticides are not applied near streams and the amount of pesticides applied annually is small. Pesticides are only applied after a PUP is approved. Considerations in approving the PUP include the soil organic matter, distance to the nearest stream, depth to groundwater and whether the treated area is naturally flooded or irrigated.

In summary, water quality-related impacts from land management activities under Alternative A would be no more than minor.

Public Use

Bear Valley Refuge is currently only open to hunting, which results in infrequent and low public use. Surface waters on the refuge are limited to intermittent streams generated by rain events. Hunting-associated water-quality effects would be limited to localized turbidity associated with a hunter wading through one of these streams, and likely would be negligible.

Beneficial Effects

Beneficial effects to water quality from management activities would result in a more resilient landscape that is not as prone to intense fires that can increase associated siltation and large nutrient influxes to streams.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

<u>Alternative B (Preferred Alternative) – Bear Valley Refuge</u>

Land Management

Prescribed Fire and Silvicultural Management

In addition to the minor water quality-related impacts discussed under Alternative A, additional ground disturbance associated with managing riparian habitats in Bear Valley Creek could result in water quality impacts in the streams on the refuge. Riparian land management could result in activities near the existing streams, which could discharge pollutants (e.g., sediment, fuel, oil, chemicals) via runoff into streams and adversely affect water quality of the streams. These impacts would depend on the specific treatments or activities implemented in the riparian habitat. As site-specific land management activities are identified, their specific effects would be analyzed in a subsequent NEPA document.

Pesticide Application

No changes are proposed under Alternative B. The effects of pesticide application would be the same as described under Alternative A.

Water quality-related impacts from land management activities under Alternative B would be no more than minor.

Public Use

Depending on the locations of the proposed public access facilities, construction activities could discharge pollutants (e.g., sediment, fuel, oil, chemicals) via runoff into nearby streams, which could adversely affect water quality of the streams, depending on the proximity of the activities to waterbodies and extent of ground disturbance. These impacts will be analyzed in a project-specific NEPA document once specific details on the new facilities are available.

Under this alternative, the Service would require non-toxic ammunition to be used for deer hunting. This change would reduce the potential for lead shot to enter streams on the refuge. Water quality related impacts from public use are likely to be no more than minor under Alternative B.

Beneficial Effects

In addition to creating a more resilient landscape for bald eagles, under Alternative B, the Service would reduce the potential for lead shot to enter streams on the refuge.

Mitigation

The BMPs (in Appendix L) include measure to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative. No additional mitigation measures are being proposed.

6.6.3 Air Quality

Methodology for Assessing Effects – Bear Valley Refuge

Air quality was assessed at a Basin-wide level using online reports from the States of California and Oregon that identify the general air quality characteristics.

Following is the resource-specific context for assessing effects of the alternatives on air quality.

- Land management activities occur within a basin dominated by agriculture.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Burning and Silvicultural Management

Ongoing land management and maintenance activities require the periodic use of vehicles and construction equipment that causes short-term, minor emissions (engine exhaust and fugitive dust) that may be noticeable on the refuge. Current air quality at the refuge is relatively good due to few sources of pollutants in the vicinity, although there is a current PM2.5 non-attainment designation for the Klamath Falls area. Cutting brush would have no adverse effects on air quality.

Prescribed burning, including pile burning, generates smoke that can rise to great heights and potentially drift considerable distances. Smoke contains ash particulates, partially consumed fuels, liquid droplets, and very small quantities of gases such as carbon monoxide, carbon dioxide, and hydrocarbons. Prescribed fires are conducted consistent with a burn plan that takes into consideration weather, regional air quality, and smoke management to minimize the likelihood that smoke would drift into populated areas or create safety problems for roadways or airports. In addition, prescribed burning is restricted to days when wind would not allow smoke to impact the non-attainment area. Also, dilution in the atmosphere greatly reduces potential adverse air quality effects. The effects associated with prescribed burns are temporary in nature and, in light of the vast acreage of agricultural lands in the area, relatively common in the Klamath Basin. Because burn plans would minimize the chance of poor air quality related to the burns to reach receptors, impacts are likely to be minor.

Pesticide Application

When sprayed, pesticides travel through the air to their intended target. Although generally formulated a propelled to reach and (with the assistance of a surfactant) attach to the target pest, a percentage of some pesticides may volatilize into the air. This effect is less pronounced with ground-level spot spraying which is the method of application on Bear Valley Refuge. In addition, only a small number of acres are targeted for invasive plant control on Bear Valley Refuge.

In summary, land management activities result in minor air quality impacts that do not violate ambient air quality standards.

Public Use

Public access within the refuge is currently limited to walk-ins from adjacent parking areas, so vehicle emissions from public access contribute negligible emissions at the refuge. Dust and exhaust from hunters' cars and trucks approaching the refuge boundary, and dust from pedestrian travel onsite would all contribute to gaseous and particulate air pollution at the refuge. These effects would be dispersed over time and the large acreage of the refuge, and would not be expected to measurably impact Klamath Basin air quality. In light of the number of years that hunting has occurred on the refuge, it is not expected that continued hunting would degrade the current situation. The effects of public use on air quality would be neutral or negligible.

Beneficial Effects

The beneficial effects to air quality would come from the overall reduction of catastrophic wildfires that degrade the overall air quality.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Burning and Silvicultural Management

In addition to the minor air quality-related impacts discussed under Alternative A, additional ground disturbance and equipment use associated with expanded land management activities near Bear Valley Creek would increase air emissions on the refuge. The types of impacts would be the same as discussed under Alternative A, but they could more particulate matter over a short period, depending on the specific activities, resulting in localized adverse impacts on air quality. These impacts will be analyzed further in project-specific NEPA documents once specific details on the management activities are available.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing pest management practices under an IPM program. Use of pesticides would continue as needed and the impacts to soils from pesticide applications would be the same as described under Alternative A.

The overall effects of land management activities under Alternative B would be minor.

Public Use

The provision of public access facilities could increase vehicle traffic to the refuge, although access within the refuge would continue to be limited to walk-ins only. Increased traffic would result in increased vehicle emissions in the vicinity of the refuge, but the impacts on air quality would be minor based on the estimated visitation to the refuge and would not adversely affect ambient air quality.

Effects on air quality under Alternative B would focus on construction activities for the proposed parking areas for public access. Following acquisition of the needed property or an access easement/right-of-way, earth movement associated with construction of a new parking area for hunters at Bear Valley Refuge would generate some dust. In light of the small size of this area (0.75 acre estimated), construction would occur quickly, and these effects would be localized and short-lived. Additional dust would be generated along the access road by the vehicles of hunters attracted by the new parking area. The duration of additional vehicle-generated dust would be limited because the deer hunting season on this refuge is only open approximately 3 weeks per year. Effects on air quality would be further assessed in a project-specific NEPA document. The overall effects of public use on air quality would be neutral or negligible.

Beneficial Effects

The beneficial effects of Alternative B would be the same as described under Alternative A.

Mitigation

The BMPs (in Appendix L) include measures to avoid and minimize adverse effects to refuge resources and are incorporated into this alternative. No additional mitigation measures are being proposed.

6.6.4 Vegetation and Habitat Resources

Methodology for Assessing Effects – Bear Valley Refuge

Scientific literature was consulted to predict the types of impacts that could occur due to land management and public use activities.

The resource-specific context for assessing the effects of the alternatives on vegetation and habitat resources is as follows.

- Vegetation and habitat resources are managed to provide winter roosting habitat for the bald eagle.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

The Service currently manages habitat at the refuge using a variety of techniques to promote conifer habitat and develop old-growth and mature forest characteristics. Hand cutting with a chainsaw(s) is used to reduce tree densities and thereby encourage the growth and maintenance of larger trees. Prescribed burning is used to clear understory (including grasses, herbs, shrubs, fine wildfire fuels, and smaller, fire-intolerant and shade-tolerant trees such as white fir) to encourage a healthier and more open stand of trees, especially older and larger, fire-tolerant trees. Invasive plant treatments are also implemented annually, and fire management activities are implemented in accordance with the Fire Management Plan (Service 2001), which involves suppressing all fires and implementing fuel treatment projects on a 5- to 10-year cycle. Prescribed fire is also used for forest land management. Although these activities can help protect refuge habitats and resources from detrimental fires, the suppression of fires has also modified the historic fire regime at the refuge. The Fire Hazard Reduction Project has been fully implemented and has reduced the risk of catastrophic fires on the refuge.

Conducting prescribed burns to control invasive plant species and to improve habitat for bald eagles can generate fire hazards. Prescribed fires can escape fire lines and become wildfires which can threaten lands, structures, and people on and adjacent to the refuge. Because of the extensive and continued training of personnel, planning involved, establishment of fire lines, and strategic positioning of equipment and personnel prior to igniting a prescribed burn, these occurrences are rare (estimated to occur at approximately 1% of prescribed burns [Dether 2005]). Prescribed fire and silvicultural management result in the localized loss of vegetation. Negative impacts to vegetation from prescribed fire include the trampling, crushing, or removal of vegetation by equipment to create fire lines for controlling burns; the creation of temporary roads for equipment access; and the potential to introduce invasive plant species from equipment used during fire operations.

Riparian habitat is not currently managed at the refuge, except as needed in association with the invasive plant and fire management activities. No special status plants are known to occur on the refuge.

The adverse effects of prescribed fire and silvicultural thinning on vegetation and habitat would be minor.

Pesticide Application

Pesticides are applied selectively to reduce the populations of non-native and invasive plants on the refuge. Over the last 4 years the range of pesticide application has varied from 1 to 10 acres over a 4,200-acre refuge. Pesticides commonly used on the refuge are Milestone Specialty and Telar DF. Pesticides are applied using backpack sprayers or by truck in order to target only the invasive plant species. Pesticides used at the refuge are herbicides that eliminate non-native plant species.

Pesticide applications would have a minor adverse effect on the vegetation and habitat resources on the refuge.

Public Use

The refuge is closed to the public except for deer hunting. Potential effects to vegetation and habitat from hunters are primarily from disturbance. Hunters can trample native plants, and potentially introduce or spread exotic and invasive species, including plants, invertebrates, fish, and wildlife. Hunting has occurred on this refuge since establishment without noticeable degradation of vegetation and habitat. Hunting-related activities do not appear to have reduced or fragmented important habitats or resulted in an increase of non-native plant species such that they are the dominant species in these habitats. Public use effects on vegetation and habitat resources are neutral or negligible.

Beneficial Effects

Land management activities are used to reduce tree densities and prescribed burns are used to clear the forest understory helping to restore a healthier and more open stand of trees on the refuge, especially older and larger trees that were more tolerant of natural wildfires. Eliminating finer ground fuels, including smaller trees that were more susceptible to fire and served as fire ladders to the canopy (e.g., white fir [*Abies concolor*]) would discourage the spread of wildfire and reduce the likelihood of canopy fires in the event of a wildfire. These practices would facilitate establishment of old-growth characteristics in the refuge forest. These activities result in localized losses of vegetation on the refuge, but they primarily result in long-term beneficial effects that improve habitat conditions.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

Under Alternative B, the Service would continue to use prescribed fire to manage invasive plant species and to promote old growth and mature forest characteristics. Although the Fire Hazard Reduction Project has been implemented, under Alternative B the Service may consider additional tree thinning in bald eagle habitat, which would have a localized impact to vegetation. Under Alternative B, tree thinning (e.g., ponderosa pine) would also be conducted in riparian areas along Bear Valley Creek. This would also result in localized impacts to vegetation. In addition to the land management activities and associated impacts discussed under Alternative A, the Service would improve land management of forests and riparian habitats, identify new or improved techniques to manage invasive plants in an Invasive Species Management Plan, and improve fire management to protect habitat through a revised Fire Management Plan**. The Service would also work with partners that are leading efforts to assess the effects of climate change on the rate of snag creation and deterioration, and development of snag retention guidelines to benefit tree cavity-dependent wildlife.**

Under Alternative B, the Service would identify the potential to acquire additional lands for the benefit of wildlife, and these acquisitions would expand the amount of habitat managed at the refuge. Future activities within acquired lands would be subject to subsequent NEPA compliance to evaluate impacts.

Prescribed fire and silvicultural management would have a minor adverse effect to vegetation and wildlife.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing pest management practices under an IPM program. Use of pesticides would continue as needed and the impacts to soils from pesticide applications would be the same as described under Alternative A. Pesticide applications would have a minor adverse effect to vegetation and habitat.

Public Use

Construction of public access facilities could remove native habitats and spread invasive plants, depending on the specific locations and details of the facilities. Although much of the potential site is currently open unvegetated earth, there is some scrub on site (e.g., sagebrush [*Artemisia* spp.], rabbitbrush [*Chrysothamnus viscidiflorus*], various grasses, and roadside weeds). However, the proposed public access facilities are expected to encompass a small area (less than an acre in size) and would not require removal of a substantial amount of habitat. Therefore, habitat impacts associated with the new facilities are expected to be minor. Invasive plant treatments around the facilities would reduce the potential for invasive plants to establish. Effects on vegetation would be analyzed in a project-specific NEPA document.

Impacts to vegetation and habitat from public use would be minor.

Beneficial Effects

As a modification to the fire management activities under Alternative A, new or modified fire management activities would be identified in a revised Fire Management Plan under Alternative B. These activities could reduce the high fire hazard by incorporating techniques that return the fire regime to conditions that more closely reflect historic conditions. Improvements to the fire management activities would benefit the habitats and resources at the refuge by protecting them against detrimental fires. Additional tree thinning in the forest and along Bear Valley Creek would improve the overall vegetative structure. **Tree cavity-dependent species are expected to benefit from implementation of Alternative B as the Service coordinates with partners who are assessing the effects of climate change on the rate of snag creation and deteriorations and applies the results of these assessments to habitat on the refuge.**

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.6.5 Fish and Wildlife

Methodology to Assess Effects – Bear Valley Refuge

The various management alternatives were assessed to determine their potential to support refuge goals for fish and wildlife. Scientific literature was used to predict the potential effects of various land management and public use activities on fish and wildlife resources.

Resource-specific contexts to assess the effects of the alternatives on fish and wildlife resources are:

- This refuge was established to benefit the bald eagle.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

Prescribed fire and silvicultural management can result in the temporary displacement of wildlife or isolated mortality of individuals. Disturbed wildlife may relocate to nearby suitable habitat on or off the refuge to avoid disturbance. Disturbances during the nesting seasons for birds or breeding seasons for other species can be adverse due to possible impacts on young. No sensitive wildlife species have been documented at the refuge, but migratory birds and the bald eagle are found at the refuge. Bald eagles roost at the refuge in the winter, when land management activities are not as likely to be implemented. The use of a chainsaw to remove trees and prescribed burns to reduce tree densities, clearing understory vegetation and fine wildfire fuels, and encouraging larger trees would help restore and maintain quality roosting habitat for wintering bald eagles. This would also support use by other wildlife that preferred more open, older-growth forests (e.g., nesting by raptors, cavity-nesting birds and mammals, and use by deer and other wildlife). There are several potential noise sources associated with thinning and prescribed fire activities. Sound levels from chainsaws, harvesters, and trucks can be elevated at a

distance of 50 feet from the noise source. The farther away from the noise source the more the sound is attenuated. Disturbance to wildlife would be temporary. There are no permanent bodies of water on the refuge and no fish; therefore, none of the actions would directly affect fish. Based on satellite imagery, there are no bodies of water directly adjacent to the refuge boundaries. Currently the refuge thins less than 5 acres per year. The adverse effects of prescribed fire and silvicultural thinning are minor.

Pesticide Application

Pesticides are applied selectively to reduce the populations of non-native and invasive plants on the refuge. Pesticide application on this refuge is minimal. Between 2011 and 2014 the range of pesticide application has varied from 1 to 10 acres over a 4,200-acre refuge (see Table 5.35). Pesticides commonly used on the refuge are Milestone Specialty and Telar DF. Pesticides are applied using backpack sprayers or by truck in order to target only the invasive plant species. Pesticides would be used to reduce populations of non-native and invasive plants thereby enhancing the quality of refuge habitats. In laboratory testing these pesticides have been shown to be "practically nontoxic" to birds, fish, honeybees, earthworms and aquatic invertebrates. The USEPA considers them to be a very low risk to animals.

The effects of pesticide applications on fish and wildlife are negligible. The endangered gray wolf (*Canis lupus*) is federally listed wildlife for which habitat occurs on Bear Valley Refuge. **Gray wolf potentially occurs on the refuge given occurrences within the vicinity, but there are no known modern occurrences.** As discussed in the Affected Environment chapter, intra-Service consultation will be conducted pursuant to Section 7 of the federal ESA, for listed species and their designated critical habitat. There is no designated critical habitat within the refuge. Based on the limited actions proposed in the CCP alternatives and with implementation of the PUP review process and the use of mandatory BMPs (Appendix L), pesticide applications and other land management activities **are expected to be minor** and are partially offset by the concurrent beneficial effects described below.

Public Use

Unlike other refuges in the Refuge Complex, Bear Valley Refuge is open for deer hunting and not for waterfowl or pheasant hunting. There is an archery-only hunting season prior to and after a season that allows both archery and rifle hunting simultaneously. Rifle hunting is prohibited during the archery-only seasons. Although specifics vary, hunting on this refuge would have many of the same general effects as described for Lower Klamath Refuge (see Section 6.2.5). For example, hunting would have direct, lethal effects on individual game animals, and some individuals would be shot and not retrieved (crippling loss). Among deer hunters using rifles or shotguns (with buckshot or slugs), wounding rates range from 4% to 31% (Downing 1971; Grau and Grau 1980; Langenau 1986) and from 7% to 50% among deer hunters using archery equipment (Downing 1971; Langenau 1986; Pedersen et al. 2008). Crippling loss rates for deer are believed to increase when hunters shoot from too great of a distance or when the animal is traveling at too great of a speed, and to decrease as hunter density increases (Downing 1971).

The Service does not collect data on deer harvested at the refuge. The State of Oregon manages deer in this area as part of the Keno game management unit (#31). In recent years, annual harvests in this unit have ranged from 223 to 495 deer (ODFW 2012a. Because the refuge is only a small part of the state's game management unit and has a shorter season than the unit as a whole,

it is expected that the number of deer harvested there is a small percentage of the total number harvested in the unit.

As described in more detail for Lower Klamath Refuge (see Section 6.2.5), hunting and associated activities also have indirect, disturbance effects on both game and non-game wildlife. Because there is no vehicle access on site and use of boats and dogs are prohibited, such effects would be limited to those directly associated with actions of hunters. When compared with non-hunted populations, ungulates (e.g., deer and pronghorn) that are hunted are generally more wary of humans, especially at dawn and dusk, and when humans are on foot, off trail, and approach animals in a threatening manner (Stankowich 2008). In a study of white-tailed deer (*Odocoileus virginianus*) hunting, Grau and Grau (1980) found that hunted deer changed their flight behavior by slowly moving away from disturbance at relatively long distances instead of quickly moving away in a more attention-attracting manner. Kilgo, Labisky, and Fritzen (1998) also studied the behavior of white-tailed deer and found that, during the hunting season, these deer increased their nocturnal activity; and avoided roads, railroads, rights-of-way, and other areas of human activity. During the hunting season, these deer also avoided more open habitats (e.g., clear cuts, very young forests, and old fields) and preferred habitats that provided more cover and were further from roads (e.g., older forests and swamps).

As discussed earlier (see Sections 6.2.5 and 6.3.5), the threat posed to waterbirds from lead shot has been addressed through the development of non-toxic shot for shotguns and the prohibition on use of lead shot for waterfowl and pheasant hunting. However, lead ammunition used for big game hunting can also pose a contaminant risk to wildlife in terrestrial environments, including through secondary poisoning of higher-level predators and scavengers.

A variety of actions have been taken to reduce the adverse effects to fish and wildlife of current hunting programs on the refuge. These include bag limits consistent with state regulations and limiting the duration of hunting on the refuge to no more than that allowed by relevant state seasons. Readers are referred to the official regulations for hunting on Klamath Basin refuges (see 50 CFR 32, Hunting and Fishing) and to the compatibility determinations in Appendix G for more specific information about conditions (stipulations) associated with the deer hunting opportunities offered on this refuge.

The Oregon's Mule Deer Management Plan calls for the careful management of game species on the basis of populations, not individuals. Direct mortality from hunting, including crippling losses, would not be expected to have any population-level effects on any of the game species hunted. The state has mandatory harvest reporting for all big-game species. It uses these data, combined with those generated by wildlife population surveys, and in consideration of habitat carrying capacity and depredation concerns, as the bases for establishing wildlife population objectives and making associated management decisions for these species. Such decisions include, for example, annual hunting regulations and allocations of tags among game management units. This system has proven very successful over the years in sustaining healthy populations of resident game species while maintaining associated recreational opportunities, including hunting. For more information about management of these big game species, see Oregon's Mule Deer Management Plan (ODFW 2003).

Bear Valley Refuge was established primarily to protect a valuable wintering roost site for the bald eagle. Deer hunting on the refuge would not be expected to affect this species because the hunt season closes earlier (on October 31 annually) than other lands in the Keno game

management unit specifically to avoid hunter disturbance to the wintering birds (the eagles begin arriving in November). In light of the large size and distinctive markings of this species, it is unlikely that it would be mistakenly shot by hunters on this refuge or others in the Basin.

The adverse effects to fish and non-game wildlife from public use of the refuge are minor. The refuge is open only for a few months for hunting.

Beneficial Effects

The indirect and long-term effects of prescribed fire and silvicultural management on the refuge result in habitat that benefits bald eagle in the following ways. Thinning of the ponderosa pine stands reduces the percentage of canopy closure and fosters a more productive understory. Prescribed fire removes much of the hazardous fuels on the refuge and lessens the potential in the short-term that the roost and nest trees would be destroyed in a large high-severity fire. This is a benefit to bald eagles as well as other forest-dependent wildlife species. Prescribed fire and tree thinning also encourage the growth of large diameter ponderosa pine, Douglas fir, and other conifer species that provide future nesting and roosting habitat for the bald eagle.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

Under Alternative B, the Service would continue to use prescribed fire to control invasive species and to improve habitat conditions. Additional tree thinning could take place in the forest and in riparian areas along Bear Valley Creek. This additional work would have temporary disturbances to wildlife as discussed under Alternative A and would result in an additional localized loss of wildlife habitat. The impacts would be very similar to Alternative A. The adverse effects would be considered minor.

Pesticide Applications

Under Alternative B the Service would formalize pest management practices, including pesticide applications under an IPM program (see Appendix Q). The adverse effects of pesticide applications to fish and wildlife would continue to be negligible.

Public Use

Effects on fish and wildlife, including non-game species, under Alternative B would be similar to Alternative A. Under Alternative B, the Service would pursue installation of two parking areas in order to improve access for hunting and to open the refuge to wildlife observation, photography, and interpretation. The addition of new parking areas at Bear Valley Refuge would be expected to result in a slight (perhaps 10%) increase in the number of deer hunters who visited this refuge as well as visitors pursuing non-consumptive wildlife-dependent activities. It is likely that the

majority of these new visitors would visit in the fall and winter to observe bald eagles. Hunter success (i.e., number of animals harvested per hunter) would be expected to remain the same. The total number of deer harvested would be expected to increase (by perhaps 10%); however, the incremental change in and total numbers of deer harvested are unknown because the Service does not collect data on the number of deer harvested at this refuge. The increase in other types of visitors could increase disturbance to wildlife. However, since the parking areas are likely to be relatively small, it is unlikely that the increase number of visitors would adversely affect wildlife. In addition to the increase in the number of visitors, under Alternative B, the refuge would only permit deer hunting with non-toxic shot. This requirement would be phased in over several years. As discussed under Alternative A, studies have found that the use of lead ammunition for hunting in terrestrial environments can pose a contaminant risk to wildlife. This can occur through direct feeding on ammunition fragments (e.g., by dove, quail, pheasant, and turkey) and through secondary poisoning of higher-level predators and scavengers (e.g., condors, hawks, eagles, falcons, owls, and vultures). This change would reduce the potential for secondary poisoning of higher-level predators and scavengers. This prohibition on use of lead ammunition for big game species would further reduce the likelihood that wildlife were exposed to lead toxicity and associated morbidity and mortality as a result of hunting.

Wildlife impacts during construction of public access facilities would also be temporary and limited to the immediate vicinity of the disturbance area. As discussed under Alternative A, temporary disturbances to wildlife could be adverse during the nesting and breeding seasons. These impacts will be analyzed further in project-specific NEPA documents once specific details on the management activities and new facilities are available.

The adverse effects of public use on fish and wildlife would be minor. The additional public access would be limited to a small portion of the refuge where the viewing facility would be constructed.

Beneficial Effects

The beneficial effects of prescribed fire and tree thinning are the same as described under Alternative A. The possible acquisition of additional habitats, as discussed under Vegetation and Habitat Resources above, would improve wildlife management through the expansion of managed and protected habitat as part of the refuge.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.6.6 Cultural Resources

Methodology to Assess Effects – Bear Valley Refuge

Cultural resources are evaluated on a project-by-project basis as surveys identify resources where activities are proposed. The Service consults with the SHPO in compliance with Section 106 of the National Historic Preservation Act prior to implementation of management activities that could adversely affect historic properties. When necessary, measures, such as avoidance of the resources, are implemented to protect important cultural resources from adverse impacts associated with ongoing land management activities.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

Both historic and prehistoric cultural resources are known to occur on this refuge (Appendix O). Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act of 1979, Archeological and Historic Preservation Act, Native American Graves Protection and Repatriation Act of 1990, and NHPA. Cultural resource sites that could be affected by prescribed fire or tree thinning would be avoided to eliminate potential damage. Site boundaries would be clearly marked for avoidance and sites would be monitored during and after completion of the work. Cultural resource surveys would be completed prior to initiating work in any new areas. These management activities would have negligible impacts to cultural resources.

Pesticide Application

Pesticide application would have no effects on cultural resources. Pesticides are used to control invasive plant species and would have no physical effects on cultural resources.

Pesticide application would have neutral or negligible effects on cultural resources.

Public Use

Public use on this refuge is limited to deer hunting. Because there are very few people accessing the refuge the potential to affect cultural resources is neutral or negligible.

Beneficial Effects

Under federal ownership or management, archaeological and historical resources within a refuge receive protection under federal laws mandating the management of cultural resources as described above.

Mitigation

The Service would continue to manage and conserve cultural resources at the refuge and comply with Section 106 of the NHPA, including consultation with the SHPO and pertinent tribes, to eliminate or minimize adverse effects. Prior to ground-disturbing activities other than those related to areas previously farmed, hayed, or grazed, surveys and other requirements would be followed to minimize the potential for adverse effects to cultural resource sites that have yet to be discovered in accordance with applicable regulations and guidance.

Potentially adverse effects to cultural resource sites that have yet to be discovered would be minimized through cultural resource reviews, surveys, and compliance with Section 106 of the NHPA when a site-specific action is being considered, and prior to ground-disturbing activities. The Service would identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects; evaluate threatened and impacted sites and structures for eligibility to the NRHP; and prepare and implement activities to avoid and mitigate

impacts to sites and structures as necessary. All sites discovered in the future would be treated as eligible for listing on the NRHP until formally evaluated in consultation with the SHPO.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Management

Cultural resources management would be the same under Alternative B as described for Alternative A. As additional sites for thinning are considered a cultural resource survey would be conducted prior to implementation.

Pesticide Application

Under Alternative B, the Service would formalize the ongoing pest management practices under an IPM program. Use of pesticides would continue as needed and the impacts to soils from pesticide applications would be the same as described under Alternative A.

Public Use

Additional land management activities and minor construction projects would increase the potential for impacts on cultural resources. No historic properties have been documented at the refuge, but other cultural resources could be important to the history of the area. Potential effects to cultural resources under Alternative B will be analyzed further in project-specific NEPA documents once specific details on the management activities and new facilities are available.

Beneficial Effects

Beneficial effects are the same as described under Alternative A.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

6.6.7 Visitor Services

Recreation Opportunities

Methodology for Assessing Effects – Bear Valley Refuge

Scientific literature was used to predict the effects of land management activities on recreational opportunities.

Resource-specific contexts for assessing the effects of alternatives to recreation opportunities are:

- The refuge is only open for deer hunting.

Alternative A – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Thinning

The refuge is currently closed to all public use except for a short deer hunting season in the fall (it closes on October 31 to reduce disturbance to wintering bald eagles). Silvicultural management occurs for a few months in the spring and summer while prescribed pile burning would take place in the winter when soils are wet or there is snow on the ground. This work would not coincide with hunting on the refuge. Therefore, land management practices are expected to have neutral or negligible effects on the recreation opportunities or hunters.

Pesticide Applications

Pesticide applications on this refuge are minimal. Between 2011 and 2014 the refuge treated a maximum of 10 acres on the refuge (see Table 5.35). This work is not likely to take place at the same time that hunters are on the refuge. Therefore, this work would have negligible effects on recreational opportunities.

Public Use

The Service currently offers limited recreation opportunities at the refuge. Hunting is allowed by walk-in access, and wildlife viewing is only available from outside the refuge boundaries. Off-site educational programs and outreach are offered at the Refuge Complex Visitor Center, on the Refuge Complex website, and for nearby schools as part of a K-12 curriculum about wintering bald eagles. Visitor use is monitored as part of the Refuge Complex-wide monitoring program. The current recreation opportunities provide limited benefits to the public. Off-site educational programs and outreach have no physical effect on refuge resources.

Habitat and hunting are evaluated every year and, if deemed necessary, areas will be closed. Hunter numbers are typically self-regulating due to the remote location of the refuge (habitat conditions are posted on the web pages and announced in the hunter "hotline" – when there is little habitat most hunters choose not to come). However, if needed, hunter numbers are managed to reduce pressure.

Although the refuge is closed to non-hunting visitors, the potential exists for conflicts between hunters and non-hunting visitors observing and photographing wildlife just outside the boundary. These potential effects would mostly be avoided at Bear Valley Refuge, because deer hunting on the refuge closes on October 31 each year, the same time when bald eagles begin arriving to winter. It is the fly out of these birds that attract wildlife observers and photographers to the boundary of the refuge.

There are negligible adverse effects to recreational opportunities from public use.

Beneficial Effects

Although the refuge supports limited wildlife-dependent recreation, deer hunting allows a segment of the public to connect with nature.

Mitigation

Avoidance and mitigation measures are incorporated into the project with the BMPs (Appendix L). No additional mitigation measures are being proposed.

Alternative B (Preferred Alternative) – Bear Valley Refuge

Land Management

Prescribed Fire and Silvicultural Thinning

Under Alternative B, the Service would explore siting a viewing area and parking site at the south entrance of the refuge. The refuge would remain open for deer hunting in the fall. Silvicultural thinning takes place for a few months in the spring and early summer and prescribed burning takes place in the winter when the soils is moist or there is snow on the ground. With the additional visitor access to the refuge it is possible for some of the thinning or prescribed fire to occur on a day when there are visitors present. There may be potentially minor effects on visitors if there happened to be a prescribed burn on the same day that the public was there to view eagles. Visitors are not likely to see any forest thinning because this work is spread out within the refuge in the spring and summer and non-hunting visitor access would be limited to the viewing platform.

Pesticide Application

Pesticide applications are minimal on this refuge. Between 2011 and 2014 (see Table 5.35) the Service treated a maximum of 10 acres. This work would be spread out on the refuge in the spring and summer and visitors are unlikely to even see this activity, except at the newly constructed parking area or viewing facility. Therefore, this work would have negligible effects on recreational opportunities.

Public Use

With the proposed public access facilities and viewing area at the refuge entrances, recreation opportunities for the public would be expanded to include wildlife observation and photography and interpretation. Walk-in access would be allowed for wildlife viewing and interpretation in addition to hunting, but would likely have some restrictions to prevent conflicts. Bald eagle viewing would not likely conflict with hunting, however, because of the different timeframes of each activity (prior to November 1 for hunting, December through mid-March for eagle viewing).

On-site interpretive programs would be established through the use of interpretive signs and media, and educational field trips would be provided for nearby schools. The hunt program would be modified to require non-toxic ammunition, and the hunt plan would be updated to establish additional hunting opportunities.

These facilities and programs would provide additional public uses at the refuge and benefit the public, likely resulting in increased visitation. The projected increase in visitors would likely be similar to past trends of visitors, as discussed in the Effects on Social and Economic Conditions, considering the rural nature of the refuge and would not lead to other substantial impacts (e.g., from increased use of facilities).

Recreation opportunities would increase under Alternative B because the proposed parking area would facilitate existing hunting access and open the refuge to other wildlife-dependent recreational uses. The increase of hunters using the refuge is not expected to increase substantially (perhaps 10% more). The new parking areas would allow visitors to enjoy the refuge and would enhance the quality of their visit.

In developing the site-specific project for the proposed vehicle parking area, the Service will consider potential use conflicts for the expansion of recreation opportunities at the refuge. Measures to reduce potential conflicting uses may involve establishing schedules for allowed public uses or designating areas for each type of public use. Should parking areas be added, then interpretative materials would be placed on site that discuss the need for habitat management. The additional recreational uses would not limit hunting and therefore potential effects are considered neutral.

Beneficial Effects

The expansion of wildlife-dependent recreation opportunities under Alternative B will result in beneficial impacts on visitor services. The addition of interpretive programs and signs, educational field trips, and a viewing area for wildlife observation will increase visitors' awareness and appreciation of the refuge's wildlife and habitat. Likewise, the new parking areas would provide more convenient access for wildlife-dependent recreation, allowing more visitors to enjoy the refuge and enhance the quality of their visit.

Mitigation

BMPs (Appendix L) would be implemented to protect refuge resources including recreational opportunities on the refuge.

6.6.8 Social and Economic Conditions

Methodology to Assess Effects – Bear Valley Refuge

The Service prepared the *Economic Analysis of the Klamath Basin Refuge Complex CCP alternatives*, which is contained in Appendix P. The economic analysis looked at the regional economic conditions and evaluated the economic effects of the various management alternatives.

Resource-specific contexts for assessing effects of the alternatives on Social and Economic conditions are:

- Refuge management contributes to the local economy through recreational opportunities.

Alternative A – Bear Valley Refuge

The Service would continue to operate and manage Bear Valley Refuge as it has in the past, and the contribution of the refuge to the regional economy from direct and indirect expenditures would be expected to be similar to current conditions. The refuge budget would remain similar to the current budget, which is a portion of the $4 million annual budget for the Refuge Complex, and ongoing management and maintenance projects would continue to be implemented, as feasible within the budget. Visitation to the refuge would likely be similar to current and past trends. In 2015, the Service estimated 280 visits from hunting at the refuge.

This paragraph summarizes economic effects discussed in more detail in an Economic Analysis of Klamath Basin Refuge Complex (Appendix P). The economic benefits that Bear Valley Refuge contributes to the region is a portion of the 54 jobs supported by visitor related spending. In addition, the regional economy benefits of administering the refuge program at Upper Klamath Refuge contributes 1.5 jobs to the region. (Appendix P, Economics Analysis).

Alternative B (Preferred Alternative) – Bear Valley Refuge

Under Alternative B for Upper Klamath Refuge, implementation of management activities in the Upper Klamath Refuge may result in:

- A short-term increase in refuge spending and regional economic activity due to construction of facilities;
- Little to no net change in overall refuge operations spending, thereby resulting in operations spending levels and related regional economic effects that would be similar to those for Alternative A (an increase of 0.1);
- A minor increase in visitation, visitor spending, and related regional economic effects compared to Alternative A due to improved recreation.

Environmental Justice

On February 11, 1994, the President issued EO 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*) requiring that all federal agencies achieve environmental justice by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Environmental justice is defined as the "fair treatment for peoples of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies."

The Refuge is located in a remote area with low population density. Although not directly comparable (U.S. Census Bureau 2016), for the period from 2010 to 2014, Klamath County, Oregon had higher poverty levels than what is found across the state; about 22% in Klamath County as compared to about 17% in the state of Oregon (U.S. Census Bureau 2016). The CCP actions proposed in all alternatives focus on continuing existing habitat management, inventory and monitoring, natural and cultural resources conservation, and minimal visitor services on the refuge. With consideration of the higher poverty level in Klamath County and due to the nature of the CCP actions, the Service concluded that, within the spirit and intent of EO 12898, implementation of the CCP actions at the refuge would not disproportionately affect minority or low income populations under any of the alternatives.

Summary of Effects

Table 6.9 summarizes the potential effects of the two alternatives being considered for the Bear Valley Refuge.

Table 6.9 Summary of Effects at Bear Valley Refuge

	Alternative A	*Alternative B (Preferred Alternative)*
Effects on Soils		
Land Management		
Prescribed Fire and Silvicultural Thinning	Minor	Minor
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible
Effects on Water Quality		
Land Management		
Prescribed Fire and Silvicultural Thinning	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Negligible	Negligible
Effects on Air Quality		
Land Management		
Prescribed Fire and Silvicultural Thinning	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Negligible	Negligible
Effects on Vegetation and Habitat Resources		
Land Management		
Prescribed Fire and Silvicultural Thinning	Minor	Minor
Pesticide Applications	Minor	Minor
Public Use	Negligible	Minor
Effects on Fish and Wildlife		
Land Management		
Prescribed Fire and Silvicultural Thinning	Minor	Minor
Pesticide Applications	Negligible	Negligible
Public Use	Minor	Minor
Effects on Cultural Resources		
Land Management		
Prescribed Fire and Silvicultural Thinning	Negligible	Negligible
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Negligible
Effects on Visitor Services		
Land Management		
Prescribed Fire and Silvicultural Thinning	Negligible	Minor
Pesticide Applications	Negligible	Negligible
Public Use	Negligible	Neutral

6.7 Cumulative Impacts

6.7.1 Introduction

Cumulative impacts are those effects on the environment resulting from incremental consequences of actions proposed in the alternatives when added to other past, present, and reasonably foreseeable future actions regardless of who undertakes these actions. Another term for cumulative is "additive," although beneficial effects offset or "subtract" from cumulative adverse effects. Cumulative impacts can be the result of individually minor impacts, which can become significant when added over a period of time.

The following programs or projects are considered in the cumulative impact analysis

- Klamath Agreements
- Past actions such as development of the Klamath Basin for agriculture since it was first settled in the late 19th century and historical changes to water supply to help in facilitating agricultural development.
- Actions in the watershed or region such as farming, water diversion, development or farming along the Pacific Flyway
- Climate change

Different actions in this group affect different resources. For example, while agriculture has changed soil conditions throughout the basin, it may have no direct cumulative impact to air quality.

Klamath Agreements

Historically and currently, the delivery of water to the areas now known as the Lower Klamath and Tule wildlife refuges has been governed by a series of agreements and laws. These are laid out in detail in Weddell et al. (1998) with the more significant ones summarized below.

White settlers to the Klamath Basin were modifying its habitat through burning and grazing as early as the early 1900s. Hunting of waterfowl for food and sport and to obtain commercially valuable products began a few years after settlement and continued for decades as the plumes of waterbirds, grebes, and terns continued to be desirable for hats, and ducks and geese for eating.

In 1914, gates were installed at the Klamath Straits, which were used to control water entering Lower Klamath Lake. These were permanently closed in late 1917. Similarly, diversion of water flowing into Tule Lake was controlled in 1912 with the construction of the Lost River Diversion Dam. By the early 1920s much of Tule Lake had dried and shallow water covered areas that had formerly been deeper, leading to a concern about disease among waterfowl. Later in the decade, some of Tule Lake was diked to capture and hold used irrigation and excess precipitation, forming a series of deeper sumps. In part due to letters from wildlife conservation advocates, the Tule Lake Bird Refuge was established in 1928. Because the Tule sumps were too deep to support much variety or numbers of waterfowl and Lower Klamath Lakebed continued to dry, a proposal to take water from an agricultural return sump at Tule Lake and send it to parts of Lower Klamath Lake considered unsuitable for farming was signed in 1942. The Klamath River Basin Compact signed in 1957, designated how water in the system would be used, with domestic use and irrigation use prioritized over that for fish and wildlife. The importance of fish and wildlife was later recognized in the 1964 Kuchel Act, which clarified purposes of both refuges and declared the Tule Lake sump could not be reduced to less than 13,000 acres.

In recent years, substantial effort has been made by a broad range of interests to address significant environmental and economic issues in the Klamath Basin. Representatives of more than 50 organizations, including federal agencies, California and Oregon, Native American tribes, counties, irrigators, and conservation and fishing groups have developed comprehensive solutions to resolve many of the complex water-related issues of the Klamath Basin. These efforts have resulted in signing of the Klamath Agreements, which include the KBRA, Klamath Hydroelectric Settlement Agreement (KHSA), and Upper Klamath Basin Comprehensive Agreement. Among other things, these agreements seek to restore wetlands, riparian corridors, and other habitats, reduce water quality degradation in Upper Klamath Lake, and help restore populations of

endangered suckers; remove four hydroelectric dams on the Lower Klamath River; increase in-stream flows and re-establish anadromous fish runs throughout the Klamath Basin; provide reliable water and power supplies to agriculture, towns/cities, and refuges; support continuation of flood-fallow operations; and support sustainable human communities. The KBRA and KHSA were signed on February 18, 2010. Some aspects of the KBRA require Congressional action, but the federal agencies also have existing authorities to implement some provisions. The Upper Klamath Basin Settlement was signed March 4, 2014. The deadline for Congressional action on the KBRA was December 31, 2015. **However, the U.S. Congress adjourned last year without taking action to implement the KBRA, which then expired on January 1, 2016. The KHSA remained in force until it was superseded by the amended version in April 2016. The amended KHSA was signed on April 6, 2016 to achieve removal of four Klamath River dams through the FERC relicensing process, and parties to the KBRA continue to work to realize the other bargained for benefits of the agreements, including firm water supply for the refuges. The Upper Klamath Basin Comprehensive Agreement remains in force.**

Klamath Basin Restoration Agreement

The KBRA is intended to:

- Restore and sustain natural fish production and provide for full participation in ocean and river harvest opportunities of fish species throughout the Klamath Basin;
- Establish reliable water and power supplies which sustain agricultural uses, communities, and refuges; and
- Contribute to the public welfare and the sustainability of all Klamath Basin communities.

Klamath Hydroelectric Settlement Agreement

The Hydroelectric Settlement lays out the process for additional studies, environmental review and a decision by the Secretary of the Interior regarding whether removal of four dams owned by PacifiCorp:

- Will advance restoration of the salmonid fisheries of the Klamath Basin; and
- Is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and tribes.

Upper Klamath Basin Comprehensive Agreement

The purposes the Upper Klamath Basin Comprehensive Agreement are to achieve four co-equal goals:

- To support the economic development interests of the Klamath Tribes;
- To provide a stable, sustainable basis for the continuation of agriculture in the Upper Klamath Basin;
- To manage and restore riparian corridors along streams that flow into Upper Klamath Lake in order to achieve proper functioning conditions permanently; and
- To resolve controversies regarding certain water right claims, contests, and exceptions in the ongoing Klamath Adjudication in the Klamath County Circuit Court.

6.7.2 Soils

The geographical area of consideration consists of Klamath County in Oregon, and Modoc and Siskiyou Counties in California. As described in Section 1.6 and by Weddell et al. (1998), the geographic area of the Refuge Complex as well as the counties in general have been subject to extensive reclamation over the past 150 years. According to the 2012 Census of Agriculture (USDA 2012), farmland within Klamath, Modoc, and Siskiyou is approximately 1,900,000 acres. This farmland acreage comprises crops as well as livestock. With the exception of Bear Valley refuge, crops and/or grazing are used as habitat management tools on all refuges within the Refuge Complex. Potential adverse impacts to soils from cropping and/or grazing are related to erosion.

Cumulative Impact Conclusion

The continued use of cropping and/or grazing as habitat management tools on refuges within the Refuge Complex would not result in a significant cumulative effect on soil erosion. Cropping and grazing within the Klamath Basin refuges represents a very small percentage of the overall farmland use within the three counties. In 2012, approximately 19,000 acres of crops were planted on the Tule Lake and Lower Klamath refuges. Additional acreage would be subject to grazing on Lower Klamath, Clear Lake, and Upper Klamath refuges. This acreage represents about 1% of the cumulative contribution of soil erosion within the counties. The continued and future expansion of walking wetlands (flood/fallow practices) within both Tule Lake and Lower Klamath refuges serves to minimize soil erosion. In addition, BMPs (Appendix L) are included as part of each alternative to minimize soil erosion from cropping or grazing practices.

6.7.3 Hydrology

Lower Klamath Refuge

The geographic setting for past, present and reasonably foreseeable future cumulative impacts to hydrology at Lower Klamath Lake includes the watershed of the Upper Klamath Basin.

Before European settlement, Lower Klamath Lake was a mosaic of different types of wetlands and open water. Inflow was from the overflow of the Klamath River draining Upper Klamath Lake over a basaltic rock barrier through a bulrush wetland adjacent to it. In spring, water flowed from the river through the Klamath Straits into the lake. The shallower parts of the wetland were vegetated with marsh species which reached as much as 6 feet in the deepest parts. Even 2 or 3 miles from shore, water was no deeper for most of the lake. The lake covered an area of about 32,400 acres, with the adjoining wetlands covering about 40,000 acres (Weddell et al. 1998). Floating islands of marsh vegetation formed mats of up to a few acres in open water. The greatest expanse of open water was in the southern portion of the lake. Elevation of the lake ranged from 4,083 feet in dry years or during the summer to 4,085 feet in more typical years (Service and Reclamation 2006; Weddell et al. 1998). At the turn of the century, steamers were able to navigate Lower Klamath Lake.

With the beginning of reclamation for occupation and farming in 1905, construction of water control measures including a railroad dike east of the river to cut off all flow except through the Klamath Strait and the 1917 closure of the strait itself. These effectively drained all open water and wetland areas of Lower Klamath Lake. Only water needed to irrigate farmed lands flowed

through the Strait. By 1922, all that remained of Lower Klamath Lake and wetlands was a 365-acre sump at the south end of the lake bed. Weeds fueled fires, including long-lasting peat fires, and created bare areas of alkaline soils. This condition lasted for more than two decades, and was reported in 1939 by the refuge manager to have created 34,000 acres of sand dunes and peat beds (Weddell et al. 1998).

As noted above, part of the lake was re-flooded with water from the Tule Lake sump in 1942. The amount of surplus water that remained in Tule Sump at this time following irrigation was about 35,000 acre-feet, and enough water to support 17,000 acres was designated for return to Lower Klamath Lake. Biologists estimated the water would create about 8,000 acres of open water and 9,000 acres of seasonal wetland at Lower Klamath Refuge.

By the mid-1950s, Lower Klamath Refuge was separated by dikes into 13 units; some were dewatered periodically to stimulate production of aquatic food plants for waterfowl. By the 1960s, a comprehensive water delivery system was in place; with the Ady Canal delivering water from the Klamath River and the P Canal system delivering used irrigation water from Tule sump to Lower Klamath Lake. Water from Ady Canal was used to maintain permanently flooded and open submergent habitats during the summer. Water from the P Canal generally became available during the fall when Tule sump was lowered for flood storage.

Reliable data for both water sources are available from 1981 to the present and are shown in Figure 5.5. Deliveries of direct project diversions through the Ady Canal to the refuge were fairly stable through the 1980s and 1990s. Water was used from these sources until recently to mimic to the extent possible given the dual purposes of the refuge and the hydrology that historically occurred at Lower Klamath Lake, when water levels reached annual lows in September and left approximately 50-60% of the lake bed dry (Appendix M). Historically the main water issue on Lower Klamath Refuge was limited drainage capacity and too much water rather than too little (Service 1960–1973). In the 6 drought years in the first half of the record, 1981-1997, the refuge received an average of 28,000 acre-feet of direct project diversions from the Ady Canal. Even after the federal ESA listings of the 1980s and 1990s put limitations on the availability of project water supply, in drought years 1992 and 1994, Lower Klamath Refuge still received 21,000 acre-feet and 42,000 acre-feet, respectively, of direct project diversions. The main effect of the federal ESA listings on the refuge water supply during drought years was on the D Plant return flows, which decreased substantially in 1992 and 1994.

More recent drought years associated with limited project water availability have seen substantial reductions in Ady Canal deliveries to Lower Klamath Refuge (red line on Figure 5.5), mainly due to unresolved questions about within-project priority. Compounding the water supply problems at the refuge is the fact that D Plant pumping of project return flows from Tule Lake Refuge to Lower Klamath Refuge also has declined significantly in recent years, following the expiration of a 50-year old contract in 2006 that supplied low cost power to the project irrigators (DOI and California Oregon Power Company 1956). In contrast to the 1980s and 1990s, in the 6 drought years in the last half of the record (1998-2015), the refuge has been nearly dry, only receiving an average of 13,000 acre-feet from the Ady Canal, as contrasted with refuge water needs and historical deliveries, of over 100,000 acre-feet annually. In 2014, there were zero Ady Canal deliveries to Lower Klamath Refuge and in 2015, 19,000 acre-feet (through November 2015). In comparison, the irrigated lands on Tule Lake Refuge have received full deliveries in recent years (data not shown). The urgency of water issues at the refuge has been raised since the refuge is now essentially dry, a condition not observed since the 1930s.

Clear Lake Refuge

Neither alternative evaluated for Clear Lake Refuge would affect hydrology. Therefore, there would not be any cumulative effects.

Tule Lake Refuge

Tule Lake occupied a space of about 20 by 25 miles before reclamation began in 1908 (Weddell et al. 1998). During high water years, the lake covered about 110,000 acres and water depths reached 46 feet. In drier years, water covered 55,000 acres and reached depths of 7 feet. Tule Lake was fed by water from Clear Lake via the Lost River which flowed for 60 miles to the north end of the lake. Tule Lake depended on this water, and the entire drainage of the river flowed to Tule Lake. In 1912, with the damming of Lost River, the flow stopped and by 1923 Tule Lake was reported to be gradually drying up. A primary source of water at Tule became return irrigation water from farming at what is now both Tule Lake Refuge and Lower Klamath Refuge. This and precipitation at the site created a shallow, open water area of up to 40,000 acres called Tule sump. During the winter of 1929-30, dikes were constructed on parts of Tule Lake to contain sump water. By 1938 the continued accumulation of water in the diked area had become a problem and flooding of farmlands became a concern. The sump became deep enough that little marsh or wetland habitat was supported. The proposal described above in the Introduction section to move water from Tule sump to Lower Klamath lakebed was designed not only to create habitat there, but also to reduce the elevation of the sump itself and re-create seasonal wetlands (Weddell et al. 1998). The proposal was implemented in 1942 and although 9,000 acres of marshland did return, water at Tule rose progressively for several years until the mid-1950s when it stabilized. The rising water covered and reduced the size of marshlands at Tule to about 3,000 acres. The passing of the Kuchel Act in 1964 declared that Tule sump could not be reduced to less than the existing 13,000 acres. Because of this, water levels today remain at or near the same elevations they did when the Kuchel Act was passed.

6.7.4 Climate Change

Water availability and lake levels are also limited by factors other than those described above, as Lower Klamath and Tule Lake are part of a 4-year drought affecting much of the Pacific Northwest. Three global climate models project an increase in annual average temperature of between 2.1° and 3.6° F by 2050. This is predicted to worsen to 4.6° and 7.2° by 2100 (Barr et al. 2010). Projections for annual average precipitation range from an overall reduction of 11% to an increase of 24%. All three models predict summer warming will be greater than warming during other seasons and that summers are likely to be somewhat drier (3 to 37%) than past summers. If modeling proves to be accurate, the cumulative effect on hydrology at Lower Klamath Refuge of increased evaporation of water, evapotranspiration from vegetation and less available water during the growing season could be substantial and adverse.

Upper Klamath Refuge

Neither alternative evaluated for Upper Klamath Refuge would affect hydrology. Therefore, there would not be any cumulative effects.

Bear Valley Refuge

Neither alternative evaluated for Bear Valley Refuge would affect hydrology. Therefore, there would not be any cumulative effects.

Cumulative Impact Conclusions

Although continuing farming and refuge management practices over the 15-year life of the CCP do not adversely affect hydrology compared to current baseline conditions, most of both refuges are diked, and irrigated and no longer represent a natural hydrologic system. In combination with actions related to an inadequate water supply to meet all needs in the Klamath Basin, such as managed water diversion, historic drying, re-flooding, low priority of wildlife needs at the refuges and climate change, cumulative impacts to hydrology have been widespread and adverse. These are somewhat offset by the beneficial effects of current and proposed refuge management, including by maintaining or creating wetlands by flooding in the fall and winter, maintaining permanent open water habitat, and through other measures described in the alternatives such as increasing walking wetlands.

6.7.5 Water Quality

The geographic boundary of the cumulative impacts to water quality includes the watershed of the Upper Klamath Basin.

Historic (i.e., Past) Actions

The relatively low relief, volcanic terrain of the Upper Klamath Basin supported large, shallow natural lakes (including Upper Klamath Lake, Tule Lake and Lower Klamath Lake) and wetlands. Lower Klamath Lake and Tule Lake have been altered over time as noted above under Hydrology. These alterations, as well as human activities in the upper basin such as wetland draining, agriculture, ranching, logging, and water diversions have altered seasonal stream flows and water temperatures, increased concentrations of nutrients (nitrogen and phosphorus), suspended sediment in watercourses, and degraded other water quality parameters such as pH and dissolved oxygen concentrations. In addition to these land use activities in the Upper Klamath Basin, soils and groundwater are naturally high in phosphorus and other nutrients. In combination, they have been linked to increased nutrient loading, subsequent changes in trophic status, and associated degradation of water quality that continues today (DOI 2012). As the area around Upper Klamath Lake has been progressively reclaimed and used for human purposes described above, conditions have worsened.

Upper Klamath Lake was the original source of water to Lower Klamath Lake. While Upper Klamath Lake was large enough to act as a settling basin for sediment and provided water described as “comparatively clear” in the early 1900s (Weddell et al. 1998), it was high in organic material from the decay of marsh vegetation. Because of its high surface to volume ratio and high nutrient input from groundwater and surrounding volcanic soils, Upper Klamath Lake was rich in dissolved nutrients like phosphorus, even in this early time. The combination of shallow water and high nutrient levels resulted in seasonal algae blooms, which in turn resulted in fluctuating dissolved oxygen and pH levels (ibid).

As noted above in the Hydrology Section, flows to Lower Klamath stopped in 1917 as a result of diverting the flow from Lost River, leaving only a few small wet areas and uncovering alkali

lakebed soils. Dewatering allowed substantial farming to begin at the site, an action that changed soils, introduced pesticides and altered hydrology such that the only water brought to the land was that needed for irrigation. Beginning in 1942, used irrigation water from Tule Lake sump was pumped through the P Canal system to help in re-flooding areas that had formerly been wetlands at Lower Klamath Refuge. Because this source water had run through Upper Klamath Lake, its quality was eutrophic and contained fertilizers (nutrients) and pesticides as described above. This continues to be the case.

Increased power rates for Klamath Project irrigators has also prompted increased irrigation efficiencies and decreased agricultural return water in recent years. Kaffka and Danosky (2002) concluded that wetlands and farming practices in the southern portion of the Klamath Project result in net removal of nutrients diverted for irrigation on a yearly basis, and that recycling of agricultural runoff water for irrigation may further reduce the amount of nutrients returned to the river more effectively than implementing a TMDL program. Therefore, if current water use efficiencies continue, nutrient load reductions to the Klamath River would also likely continue (see also Section 5.2.1, Hydrology).

Although water entering Tule Lake was originally low in sediments, sediments in irrigation water return flow have also reduced depth in Tule sump by as much as 14 inches or 30% (Service 2002b). This has left Tule sump itself prone to eutrophication, algae blooms, as well as high concentrations of dissolved salts, ammonia, and pesticides.

Available Water

As noted above, the climate changes predicted for the Klamath Basin area include increased summer temperatures and lower precipitation. All three climate models predict summer warming will be greater than warming during other seasons and that summers are likely to be somewhat drier (3 to 37%) than past summers (Barr et al. 2010). In addition, the 2013 BiOp for coho salmon and two species of suckers has created another higher priority use for scarce water in the basin. These factors can reasonably be expected to worsen in the future to concentrate existing pollutants and nutrients in the remaining water delivered to the refuges, making the effects on dissolved oxygen, pH, and overall quality more noticeable. Water temperatures may also increase as climate warms. Specific changes that may occur include:

- Changes in the balance of inflows and evaporation, e.g., increase or decreases in flows will affect wetlands by altering nutrient loadings and other inputs.
- Threatened stability of wetlands by increasing decomposition rates due to higher temperatures and lowering of water tables.
- Increase carrying capacity for primary producers, especially phytoplankton, thus mimicking eutrophication.
- Changes in the species composition, seasonality and production of planktonic communities (e.g., increases in toxic blue-green algal blooms) and their food web interactions resulting in changes in water quality.
- Water quality and pollution buffering decreased with decreasing wetlands (Bates et al. 2008; IPCC 2007; Kusler 2006).

Cumulative Impact Conclusions

Compared to current baseline conditions, the actions described in any of the alternatives analyzed in the EIS are not expected to change activities that contribute to adverse water quality

conditions at the refuge or have more than minor adverse impacts. Although the effects of past, present and reasonably foreseeable future actions described above have and would continue to substantially alter the water quality at both refuges, implementing the CCP is not likely to result in noticeable additional adverse or offsetting beneficial impacts.

6.7.6 Air Quality

The geographic area of consideration is the Klamath Air Basin. Within the Klamath Air Basin each of the alternatives evaluated could result in a short-term increase of air pollutant emissions from various land management and public use activities. The refuges that make up the Refuge Complex occur in a region that has been classified as an attainment area for all National Ambient Air Quality Standards (NAAQS) criteria pollutants (USEPA 2008), therefore, the minor amounts of air pollutant emissions would not result in cumulative impacts to air quality in the Basin.

6.7.7 Vegetation and Habitat

The geographic region for the analysis of vegetation and habitat is regional, and includes the California Central Valley as well as the Klamath Basin.

Lower Klamath and Tule Lake

In the early 1900s, wetland vegetation and open water at Lower Klamath Lake covered an area of about 70,000 acres. The eastern shore was lined with dense tules that extended into the lake as much as 5 or 6 miles, but the southern shore was deeper and did not support marsh vegetation. On the western edge, small streams entered the lake and supported extensive riparian marshes (Weddell et al. 1998). Seasonal wetland, characterized by a gradual decline in water levels throughout spring and summer was abundant. The refuge also had an abundance of permanent wetland, which is flooded year-round and is characterized by bulrush, cattail, and a submergent plant community dominated by sago pondweed. Other habitats included wet meadow and open water (ibid).

As noted in other sections, by 1917 water except as needed for irrigation of crops was shut off to the lakebed and by 1919 much of the former lake bottom was dry and covered with weeds. Serious peat fires, some of them quite deep and long lasting, persisted. By 1925, Lower Klamath was described as “a great desert waste of dry peat and alkali.” When the area was reflooded with used irrigation water from Tule sump in the early 1940s, it was enough to create about 12,000 wet acres. These were diked and managed on a rotating basis to maintain seasonal wetland and a more natural drying cycle to help in producing aquatic food plants for waterfowl.

Before reclamation, Tule Lake was surrounded by lava beds and generally lacked shoreline vegetation. However, a zone of emergent marsh vegetation about 1 mile wide grew around the north side with a fringe down the west side fanning out toward Canby Bay. In the early 1920s, diversion of water from Lost River led to gradual drying of Tule Lake such that the entire water area in drought years was less than 2,000 acres. Normally, water from irrigation return flow kept water levels higher, covering up to 40,000 acres in wetter years. By 1938 after the return flow sump area was diked, water in it became quite deep. As water depth increased, portions of the sump became too deep to support emergent vegetation and the marsh began to recede. Remaining stands of emergent vegetation became very dense. Since the 1960s, siltation and stabilization of

water levels pursuant to the Kuchel Act greatly reduced the aquatic productivity of Tule sump, including of wetland vegetation.

In the 1970s, management emphasis at the refuges shifted efforts to simply enhance populations of waterbirds and furbearers to management of biological diversity through the restoration of ecosystem processes. The refuge began to combine remaining natural processes such as flooding, drying, and fire with artificial practices such as farming and selective mechanical control of vegetation to maximize habitat quality for wildlife. A more complex approach where diversity was emphasized and targets set for relative abundance of habitat types (e.g., seasonal, permanent, upland wetlands) was implemented. Vegetation was managed to control plant succession and maintain some relatively open marshland habitat to increase species diversity.

At Tule Lake Refuge, the shift to restoring ecological processes incorporated the knowledge that seasonal wetlands required periodic disturbance to maintain productivity and incorporated wetland/agricultural rotation to mimic natural disturbance (Mauser 1994b in Weddell et al. 1998). This emphasis continues today and currently, seasonal wetlands cover up to one-third or about 15,000 acres of the refuge. Permanently flooded wetlands cover up to 10,000 acres; wet meadow 5,700 acres and uplands which are not flooded another 6,500 acres.

Clear Lake

Clear Lake was a natural lake that existed prior to construction of the Clear Lake Dam, which was constructed between 1908 and 1910 to increase the storage capacity of Clear Lake as part of the Klamath Project. The dam is located at the head of the Lost River, which flows northward from California into Oregon. Clear Lake has a surface area of 25,760 acres and is one of the basin's most important sites for colonial waterbirds. Habitat management at Clear Lake Refuge focuses on wildfire suppression in order to enhance the sage-steppe habitat.

Upper Klamath

Upper Klamath Lake is shallow and has extensive wetlands within and immediately adjacent to the natural lake area. Historically, there were up to 52,000 acres of marshland associated with Upper Klamath Lake and up to 65,000 acres of open water at maximum capacity (Service 2008). Lake levels were controlled by two basalt reefs in the upper part of the Link River above the current location of the dam. Prior to construction of the dam and channelization of the reefs, lake levels varied from about 4,140 to 4,143 feet, with a mean annual variation of about 2 feet (Boyle 1976). Today, Upper Klamath Lake remains the largest and highest lake in the Klamath Basin system. Upper Klamath Lake is large, shallow, and through flowing, so that its water is fresh and has a short residence time. Emergent marsh at Upper Klamath Refuge exist above elevation 4,139.5 and are inundated when Reclamation managed lake elevation exceed this level. Water within refuge wetlands is a mixture of the open waters of Upper Klamath Lake and from a series of large springs on the west side of the marsh.

Bear Valley

The Bear Valley refuge does not provide any wetland habitat. It consists of forested habitat that is managed to provide breeding and wintering habitat for the bald eagle.

Regional framework

Because the Klamath Basin is pivotal in supplying wetland habitat in a mostly dry region, the focus of regional cumulative impacts is on this type of vegetation/habitat.

The Klamath Basin lies along the Pacific Flyway, a bird migration corridor that stretches north and south between Alaska and South America. More specifically, it is part of the southern Oregon, northeastern California region, an area that includes the Central Valley of California. Despite its smaller size, the Klamath Basin historically contained over 350,000 acres of wetlands and supports a significant proportion of the waterfowl use in this area of the Flyway during fall and winter. During spring migration, snow melt and precipitation creates a larger wetland habitat base for waterfowl at the refuges.

Waterfowl are highly mobile and can change their use of habitat over a large landscape if needed. This makes them capable of moving to wintering or migratory habitat as it is available, in this case to the Central Valley when Klamath Lake was dried or Tule sump too deep to support wetland habitat. Conversely, waterfowl have used wetlands at Klamath Basin over the years when agricultural activities in the Central Valley are in full swing, such as during the spring.

In the early 1900s, the Central Valley was an area of four million acres of wetland and supported 20 to 40 million waterfowl annually. During subsequent years, most of this land was reclaimed and developed until agriculture and urban developed reduced wetland acres by over 95%. As in Klamath Basin, water was supplied primarily through managed systems. This left just over 200,000 acres of managed wetlands in the Central Valley, two-thirds in private ownership (CVJV 2006). Bird numbers fell to 6 to 7 million in the 1970s. Similar to the refuges, the long-term availability and affordability of water supplies for remaining wetlands is uncertain (ibid).

After about 1985, growers began increasingly to turn to rice in the Central Valley, a crop that requires fall and winter flooding. Acreage in rice increased from 62,000 acres in 1985 to 152,000 acres in 1995 to an average of about 384,000 acres in 2006. This change was deliberately aimed at restoring waterfowl habitat and has again made the Central Valley an attractive wintering area for waterfowl (Appendix M). In addition, a Joint Venture of agency, NGO and other partners have pursued preservation of existing wetlands and other measures to help in restoring waterfowl to the Central Valley.

As wintering habitat became increasingly available in the Central Valley in the 1990s, fewer overwintering waterfowl used habitat in the Klamath Basin. This is also true of fall migrants, whose numbers decreased at Klamath Basin in response at least in part to flooding of rice in the Central Valley in the fall. Springs counts in Klamath Basin have remained the same.

Cumulative Impact Conclusions

The ability of waterfowl to choose habitat from such a large geographic area and the combined efforts of Central Valley and Klamath Basin land managers to continue to provide diverse wetland habitat likely offsets some of the significant loss of wetland habitat the entire area has experienced since reclamation began. This direct loss of migratory, wintering and nesting habitat—up to 95% in the Central Valley—has undoubtedly been the major source of losses in waterfowl and waterbird populations since the early 1900s. Reclamation and continuing agricultural production in the Klamath Basin, particularly of crops that do not support waterfowl in some way (e.g., non-grains) as well as scarce water supplies and low priority for receiving

diverted water in both the Central Valley and Klamath Basin have and continue to have widespread and adverse impacts on the availability of critical wetland habitat. Climate change, as described above would likely continue to result in fewer acres of wet habitat and/or degrade the quality of existing wetlands, particularly in the summer months.

As with other resources, the changes to wetland habitat in the alternatives described in this CCP/EIS are unlikely to change the availability or quality of wetland habitat to a great degree over the 15-year life of the plan compared to current baseline conditions. The availability of wetland habitat regionally is also unlikely to change greatly, although efforts by agencies, the Central Valley Join Venture and others to protect existing wetlands and use tools like converting to crops that lend themselves to seasonal flooding and provide waste grain have noticeable beneficial and offsetting impacts for wetland habitat.

6.7.8 Fish, Wildlife and Listed Species

Prior to reclamation efforts in 1908, the area that is now covered by Lower Klamath and Tule Lake Refuges was characterized as "perhaps the greatest feeding and breeding ground for water fowl on the Pacific coast" as well as "the great breeding ground (for inland waterbirds) of that whole region" (Finley 1905 in Weddell et al. 1998). Between 4,000 and 9,000 white pelicans returned to the area each spring to breed. They were fed by abundant fish, with reports of lake trout and other species "commonly 8-10 inches" consumed by these birds. The islands of Lower Klamath Lake supported abundant gulls, cormorants, and terns, including colonies of Caspian terns (a species of conservation concern today) as large as 500 individuals. Seventeen native fish species were reported; eight of these occurred on in Klamath Lake Basin.

The early abundance of birds continued into the mid-1900s with the establishment of the Klamath Lake Reservation, with large colonies of great blue herons and cormorants. Mallards were common nesters, as were western grebes, white pelicans, green-winged teal and pintail ducks. Waterbirds including white-faced glossy ibis, Wilson's phalarope, snipe, and avocets were also present.

Deeper water at Tule Lake meant less emergent or shoreline vegetation habitat, Nonetheless, early reports of wildlife at Tule Lake included a very large (estimated at 500 individuals and 500 nests) colony of ospreys, large western grebe rookeries and abundant fish. Early in the 20th century, hunting for sport and plumage took thousands of grebes and terns for the millinery market and additional thousands of ducks for shipment to nearby urban areas for food. After inflow from the Lost River was stopped in 1917, planted grain at the northern and eastern ends of the lake continued to attract geese and goose hunters in the fall. Overall, the population of waterfowl at Tule declined, hunting increased and by the mid-1920s remaining game birds were "under almost constant fire from sunrise to sunset" (Steele 1927 in Weddell et al. 1998).

As Lower Klamath Lake dried, aquatic or semi-aquatic species including terrapins (western pond turtle) and Lost River suckers disappeared. In addition to the species themselves, suckers had been a major food source for fish-eating birds such as osprey or pelicans.

While Lower Klamath Lake was drained to a "desert," diking of the sump area of Tule Lake later led to too much water in the diked areas. As open water took over, marsh began to recede by about 1938. Earlier in the decade, Tule Lake was praised as a source of abundant geese, swans, and a few pelicans and great blue herons. The combination of open water, marsh habitat and

nearby grain attracted large numbers of migrating waterfowl; with biologists commenting on the importance of the lake in autumn and its significance in supporting ducks and geese on the Pacific Flyway as the California Central Valley was developed (Weddell et al. 1998). Nonetheless, the lake was not managed primarily for wildlife during this period, and flooding of nests from rising water levels in the spring and diseases of waterfowl resulting from inadequate summer water were common (ibid). Tule Lake Refuge recorded its highest waterfowl abundance in fall of the 1950s, with an average of 1.1 million birds per day (bpd) and a maximum of 4.2 million. Waterfowl concentrations began to decrease in the late 1950s, a trend that continued until the early 1980s when populations stabilized (Gilmer et al. 2004). In addition to a decline in numbers, the 1970s saw fewer species, with colonial nesting birds relatively absent, especially compared to those at Lower Klamath Refuge. The nesting colony of ospreys had disappeared.

The clear importance of Tule Lake in supporting Pacific Flyway populations of waterfowl in the 1930s was at least partially the reason the recommendations of re-flooding Lower Klamath lakebed with some Tule sump water were implemented in 1942 as managers expected similar success. By the mid-1950s, Lower Klamath Refuge contained 12,000 acres of marsh that were dewatered on a rotational basis to boost uncovered shoreline plant and invertebrate life. Tule Lake was also able to provide higher quality wetland as the sump was diverted in part to Lower Klamath and additional marsh vegetation re-appeared. Waterfowl responded and the average peak population for 1952 and 1953 on both lakes exceeded 5 million birds. In 1955, there were 7 million on the refuges at one time (Service 1956 in Weddell et al. 1998). More recently, as noted above under the habitat discussion, the Lower Klamath Refuge has applied more finely divided definitions of types of wetlands and has managed its lands to produce the best combination of these types. Habitat is managed to provide abundant high quality food sources, particularly seeds and invertebrates that support waterfowl. The refuge continues to have concentrations of ducks and geese numbering in the hundreds of thousands during fall migration and is an important waterfowl breeding ground.

The numbers of the five most common waterfowl breeding species at Lower Klamath Refuge in particular have remained in the same general range since the 1950s, except for gadwell, which has gone from 1700 in the 1950s and 1960s to over 11,000 in the 1990s. Ruddy ducks have experienced a decline, falling from well over 2,000 in the 1970s to 648 in the 1990s (Appendix M). The use of the refuge by geese has increased in the spring since the 1970s.

Waterfowl use has also shifted from Tule Lake to concentrate at Lower Klamath since the 1980s and remains there currently. As a result, numbers at Tule Lake Refuge have shifted. For example, dabbler ducks (including mallard, pintail, etc.) and geese numbers have substantially declined from the 1970s to 1990s. These guilds both make use of waste grains and biologists speculate that it may be greater harvest efficiencies and changed cropping patterns at Tule that have influenced their use. Diving ducks (such as redhead, ruddy, and canvasback) are also significantly less concentrated at Tule than in the 1950s to 1970s, a fact attributed at least in part to the replacement of seasonal wetlands with permanent wetlands and sedimentation (Appendix M and Weddell et al. 1998).

Clear Lake refuge continues to provide habitat for the largest colony of American white pelicans in California and the Klamath Basin's main colony of Caspian terns (Shuford et al. 2004). White pelicans are attracted to the refuge because of the availability of secure isolated nesting islands. Each island or series of islands is optimized for nesting under different lake levels.

Upper Klamath refuge also provides habitat for American pelicans and the emergent marshes on the refuge are the principal nesting area for Canada geese in the Upper Klamath Basin. The refuge is especially important in the Klamath Basin as a breeding area for canvasback, redhead, and ringneck ducks.

Bear Valley provides breeding and wintering habitat for the bald eagle.

Regional Framework

The reduced use of Tule Lake Refuge is also believed to be a function of the increased attractiveness of Central Valley agriculture for waterfowl, primarily from increased acreage flooded in the early fall. As noted above, waterfowl are highly mobile and are attracted to the best habitat over a large area including the Central Valley and Klamath Basin during all seasons. The refuges experienced their highest fall waterfowl populations during the 1950s and 1960s when the Central Valley wetlands and agriculture provided little habitat. As noted above under the habitat discussion, while the Central Valley originally contained more than four million acres of wetlands, agriculture and urban development reduced this habitat by over 95% (CVJV 2006). While an estimated 20-40 million birds used Central Valley wetland habitat in the 1800s, by 1970 numbers decreased to between 6 and 7 million (ibid). Between 1985 and 2003, the Central Valley Joint Venture was able to add to existing wetlands such that just over 200,000 acres of wetlands remained and nearly 400,000 acres of agricultural lands were enhanced, primarily by planting and flooding rice to offer fall and winter waterfowl nesting habitat. These remnant wetlands and rice fields now support an average of 5.5 million waterfowl annually. Development and scarce water make the Central Valley the most threatened farming region in the country (ibid).

Changes to protect and enhance wetlands and particularly the switch to rice and fall/winter flooding appears to have led to a relatively greater use of the Central Valley and lesser use of Klamath Basin habitat in these seasons. The autumn abundance of waterfowl at both refuges in the Klamath Basin, which averaged 1.4 million birds per day in the period between 1953 and 1976 fell to an average of 620,000 birds per day from 1977-2001 (Gilmer et al. 2004). Over this same time period, spring abundance at Klamath Refuge fluctuated, but then sharply increased in the 1990s.

Federal Listed Species

Of the 13 federal listed species in the area, seven may have habitat at the refuges. Of these seven, only shortnose sucker and Lost River sucker have been documented at the refuges, although others may occur. The Service has determined that adverse effects to the other 11 federal listed species are not likely.

Cumulative effects to both species of sucker are enumerated in the biological opinion for these and three other species that do not exist on Lower Klamath or Tule Lake refuges (NMFS and Service 2013). Of the few populations of these suckers that remain, most are very restricted in distribution and generally lack the ability to successfully reproduce. This condition was caused by several factors, including habitat loss, construction of barriers, overharvesting of adults, and entrainment of young individuals. Suitable habitat was drastically reduced in extent and functionality due to the historical conversion of wetlands to agricultural use and construction of irrigation and hydroelectric facilities, which drained lakes and wetlands and created barriers to spawning habitat. Although one dam that blocked access to approximately 95% of potential river spawning habitat for Upper Klamath Lake populations of the suckers was removed in 2008, many other

significant physical barriers persist throughout the range of these species, limiting the ability of populations including those in Tule Lake to reproduce or disperse. Overharvesting potentially contributed to declining population levels in Upper Klamath Lake, and entrainment of larval and juvenile suckers into irrigation and hydroelectric structures was also cited as a threat at listing. In addition, competition and predation from non-native fish and algae blooms in Upper Klamath Lake have cumulative and adverse effects.

Additional future impacts are expected from ongoing warming and drought predicated to continue to worsen in summer months, and from additional threats related to predation, competition, disease and parasites from non-native fish and other wildlife.

Both species were already endangered at the time of the biological opinion, and NOAA Fisheries and Service determined continuing operations would result in a high risk of extinction.

Changes to water deliveries and equipment to improve water quality, increase quantity and reduce entrainment as well as habitat improvement measures were proposed to support sucker reproduction, as well as larval and juvenile stages of both species. With these measures in place, the agencies concluded continued operation of the Klamath Reclamation Project (responsible for providing all diverted water to the Lower Klamath and Tule Lake Refuges) could continue with jeopardizing the continued existing of this population of suckers.

As noted in Section 6.7.5, Water Quality, Lower Klamath Lake and Tule Lake have been altered over time. These alterations, as well as human activities in the upper basin such as wetland draining, agriculture, ranching, logging, and water diversions have altered seasonal stream flows and water temperatures, increased concentrations of nutrients (nitrogen and phosphorus), suspended sediment in watercourses, and degraded other water quality parameters such as pH and dissolved oxygen concentrations. Elevated nutrients on the refuge are a reasonable future impact in limiting the geographic range of salmon. The effects of the Klamath Project on listed salmon are covered in the Joint Biological Opinion on the Effects of Proposed Klamath Project Operations from May 31, 2013 through March 31, 2023, on Five Federally Listed Threatened and Endangered Species (NMFS and Service 2013).

Cumulative Impact Conclusions

Since European settlement, the combination of urban development, agriculture and the diversion and degradation of available water have so reduced waterfowl wetland habitat in the region of the California and Oregon portion of the Pacific Flyway that numbers of birds has dramatically fallen. Despite efforts in the Central Valley to preserve existing wetlands and encourage fall and winter flooding of crops, and Service management of the Klamath Basin refuges to create the best habitat balance possible given their dual purposes of conservation and agricultural productivity, populations of waterfowl are unlikely to increase to levels historic habitat supported. This adverse impact is somewhat tempered by the ability of waterfowl to select migratory, wintering or nesting habitat from a wide geographic area. Also, within limits imposed by its purposes, the Service manages the refuges to maximize the extent and quality of wetland habitat, and all alternatives in the CCP would continue to provide offsetting and beneficial influences these substantial adverse impacts of cumulative actions in the region. While changes to water delivery to support endangered suckers is predicted to improve reproduction and offset extinction of these

populations, it has also further reduced water available for the refuges and is likely to result in fewer waterfowl and other wetland-dependent wildlife in the Klamath Basin.

6.7.9 Cultural Resources

The alternatives described for each refuge can involve ground disturbing activities that could result in adverse impacts on known and unknown cultural resources at each refuge. Increased visitation also increased the potential for theft, vandalism, and other adverse impacts on cultural resources. These impacts could be cumulatively significant because the cultural resources in the Refuge Complex provide important information on the history and prehistory of the Klamath Basin. All proposed ground disturbing activities would include measures to identify and avoid important resources, especially eligible resources, and protect known resources from adverse visitor impacts.

6.7.10 Visitor Services

Waterfowl Hunting Programs

Waterfowl – Local Analysis

The areas open to waterfowl hunting, the numbers of hunters, and the harvests of ducks and geese on Klamath Basin refuges in recent years are displayed below in Table 6.10. The size and shape of the hunt zone area has remained relatively constant for many years. However, the numbers of hunters and numbers of waterfowl harvested has varied widely depending on, among other factors, whether adequate water was available to flood up refuge habitats (both hunt and sanctuary areas) and when the wetlands froze.

Waterfowl – Regional Analysis

Statewide, in recent years, the total annual duck harvest in Oregon has ranged from 256,802 to 684,200 birds and the total annual goose harvest has ranged from 45,374 to 105,400 birds (Olson 2014). Across California, in recent years, the total annual duck harvest has ranged from 1,062,362 to 1,738,441 birds and the total annual goose harvest has ranged from 130,100 to 244,500 birds (Olson 2014).

Table 6.10. Waterfowl Hunting Statistics.

Refuge[1]	*Hunt Area*[2]	*Hunters*[3]	*Waterfowl Harvested*[3]	
			Ducks	*Geese*
Clear Lake	10,726 (44%)	50 - 200	Unk	Unk
Lower Klamath	24,380 (48%)	1,500 – 2,600	3,557 – 14, 341	1,631 – 7,576
Tule Lake	14,500 (37%)	2,700 – 2,800	6,361 – 11,314	1,528 – 4,446
Upper Klamath	<9,100 (39%)	240 - 500	502 – 750[4]	223 – 333[4]

[1] Bear Valley Refuge is not included because waterfowl hunting is not allowed on the refuge.
[2] Hunt area in acres and approximate percent of total acreage under Service management jurisdiction (in parenthesis).
[3] Number of hunters and waterfowl harvested in recent years. These harvest figures include harvest by sport hunters with and without guides. The figures displayed represent the worst-case scenario and include 100% fatality among animals shot, but not retrieved (aka the crippling loss rate). See earlier text. "Unk" means that the Service does not collect data for this element on this refuge.
[4] The Service does not collect data on the number of waterfowl harvested at Upper Klamath Refuge. The harvest data displayed are estimates.

Duck harvests on the Klamath Basin refuges in recent years represent 0.78% to 1.09% of the sum of the Oregon and California harvests, and goose harvests represent 1.9% to 3.5% of the sum of the states' harvests (no harvest numbers were added for Clear Lake) (Olson 2014).

Waterfowl – Flyway Analysis

Wetlands on refuges and other lands in the Klamath Basin provide important waterfowl breeding habitat. However, the greatest values of these areas is to serve the migratory and wintering needs of millions of Pacific Flyway waterfowl that breed much further north. In recent years, populations of ducks have been estimated to total 4.7-5.9 million and goose populations have been estimated to be 1.1–1.8 million during mid-winter counts in the Pacific Flyway (Olson 2014). Annual duck and goose harvests on the Klamath Basin refuges (less than 30,000 and less than 15,000, respectively) affect a very small percentage of the birds that pass through or winter in this area.

In 2014, total duck harvest in the Pacific Flyway was 2,338,797 and total goose harvest was 467,785. Duck harvests on the Klamath Basin refuges in recent years represent 0.43% to 0.72% of the Pacific Flyway harvests and goose harvests represent 0.86% to 2.3% of the Pacific Flyway harvests (no harvest numbers were added for Clear Lake) (Olson 2014).

Analysis of Impacts to Waterfowl

As described in more detail earlier, the Service, and California and Oregon fish and wildlife agencies carefully manage all the game species discussed herein. The agencies gather a substantial amount of data about wildlife populations, harvests by hunters, habitat carrying capacity, public recreation (including hunting, and wildlife observation and photography), and depredation. These efforts are continuous and are especially significant regarding waterfowl and other migratory birds (Service 2016b). These data are used to establish wildlife population objectives and management plans designed to ensure the long-term survival of all these game species at healthy, sustainable population levels. These data are also used to make key management decisions on at least an annual basis. The Service establishes framework regulations for the harvest of migratory birds across the nation and the states work with the four flyway councils to establish state-specific migratory bird harvest regulations consistent with the national framework regulations.

In consultation with the states and flyway councils, refuges also evaluate their local situation, including the compatibility of waterfowl and other hunting programs, and determine whether additional refuge-specific regulations should be adopted. These could be different season dates or bag limits, but they would always be more restrictive than those established by the states.

As a result of the data gathering and analyses, and careful consideration of multiple factors in establishing annual hunting regulations, the game species discussed herein have generally had healthy populations for many years. This is supported by data from the most recent (2014) U.S. continental waterfowl population and habitat surveys which estimated total duck populations at 49 million birds; which is 8% greater than the 2013 figure and 43% higher than the long-term average (Olson 2014). The estimate of total pond acreage across the country was approximately 7.2 million acres; similar to the 2013 acreage, but 40% above the long-term average. Goose production estimates were variable, with abundance indices up for 9 populations and down for 11 populations (Service 2014).

The state and federal wildlife agencies are likely to pursue the same general processes for management of waterfowl into the foreseeable future. This includes regular surveys and data analyses, special studies, and application of the principles of adaptive management (i.e., reducing uncertainty over time through use of monitoring and course corrections to increase the likelihood of achieving management objectives). In light of the foregoing, continuation of regulated hunting on the Klamath Basin refuges would not be expected to have significant cumulative impacts on local, regional, or flyway waterfowl populations.

Pheasant Hunting Programs

Ring-necked Pheasant – Local Analysis

Pheasant populations on Lower Klamath and Tule Lake Refuges have declined in the past decade. This is especially the case on Tule Lake Refuge where the decline is likely due to poor habitat quality (inadequate cover) and perhaps secondarily due to suppression of insect populations by agricultural insecticides (Grove et al. 1998; Grove et al. 2001). Because they are not a native species and are not actively managed on the refuges, the Service does not collect data on pheasants harvested on these refuges. However, county-specific numbers are tracked and included in Table 6.11 below.

Ring-necked Pheasant – Regional Analysis

According to the ODFW 2012 and 2014 Oregon Bird Hunting Forecasts, pheasant numbers in Klamath and Lake Counties remain very low (ODFW 2012b and ODFW 2016c). Pheasant harvests in Oregon have declined significantly in the past few decades when compared with the harvests in the 1970s and 1980s. More recent hunter and harvest data for Klamath and Lake Counties and statewide are presented in Table 6.11.

Across California, over the past 12 years or so, the number of pheasant hunters and the number of pheasants harvested has generally declined. Table 6.12 below displays the number of pheasant hunters and their harvests statewide and in California's two northernmost counties that include Lower Klamath and Tule Lake Refuges.

Table 6.11. Pheasant Hunting Participation and Harvest Summary for Klamath and Lake Counties and Statewide (Oregon)

Year[1]	*Klamath and Lake Counties*[2]		*Statewide*	
	Hunters	*Harvest*	*Hunters*	*Harvest*
2005-2006[3]	799	1,469	14,947	61,276
2006[4]	1,134	1,715	13,267	40,795
2007[4]	1,046	2,080	8,999	25,179
2008[4]	784	1,805	9,703	33,722
2009-2010[4]	716	1,552	6,857	33,720
2010-2011[4]	572	680	8,199	34,081
2011-2012[4]	278	971	7,779	30,351
2012-2013[4]	450	2,274	6,753	30,340
2013-2014[4]	180	328	4,402	19,930

[1]Harvest data are not available for 2004-2005 season.
[2]Data for Upland Game Bird Harvest Unit - Area 6 (ODFW 2016b).
[3]Data from ODFW 2006.
[4]Data from http://www.dfw.state.or.us/resources/hunting/upland_bird/harvest/index.asp#Statistics (ODFW 2016d).

Table 6.12. Pheasant Hunting Participation and Harvest Summary for Modoc and Siskiyou Counties and Statewide (Oregon)[1]

Year[2]	*Modoc County*		*Siskiyou County*		*Statewide*	
	Hunters	*Harvest*	*Hunters*	*Harvest*	*Hunters*	*Harvest*
2000	508	604	1,239	1,557	48,814	152,352
2001	261	603	946	1,892	45,906	145,383
2002	365	822	852	4,138	43,058	137,420
2003	429	2,605	490	2,452	42,143	148,835
2004	403	906	1,309	4,767	39,107	132,998
2005	1,033	1,711	1,324	5,168	38,700	136,225
2006	223	644	1,190	2,355	30,064	98,023
2007	233	367	867	3,833	32,133	103,364
2008	319	1,012	1,092	3,381	22,657	64,802
2010	479	1,038	1,384	3,807	27,689	78,832

[1]Data from California Department of Fish and Game 2011. Data are for hunters and their harvest, not including licensed game bird clubs.
[2]Data are for the years 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2010 (no reports are available for 2009, 2011, 2012, 2013, or 2014).

Analysis of Ring-Necked Pheasant Impacts

Unlike waterfowl, mule deer, and pronghorn antelope, ring-necked pheasants are not a native species and thus are not actively managed on refuges (see Biological Integrity, Diversity, and Environmental Health policy at 601 FW 3). Regardless, the presence of these birds supports sport hunting and other wildlife-dependent public uses, such as wildlife observation and photography, and the birds do not conflict with accomplishing refuge purposes.

The mixture of habitats and ongoing management programs, primarily on Lower Klamath Refuge, provide for the survival of naturally self-sustaining populations of pheasants. However, pheasant populations on the more-intensively farmed areas of Tule Lake Refuge and in many other areas of the Klamath Basin and elsewhere in California and Oregon are doing relatively poorly (Grove et al. 2001; also see CDFW 2015b).

The number of individuals hunting pheasants on the refuges has been low, but relatively stable in recent years. As long as refuge habitat management programs continue in a manner similar to how they have been conducted in the past, pheasant populations on Lower Klamath Refuge would continue to survive and the birds would likely continue to hang on near the sumps on Tule Lake Refuge. Pheasants are polygynous and many fewer roosters (males) compared with hens (females) are needed for breeding and to sustain healthy populations. Because only roosters are hunted, continued hunting on these refuges, as described herein, would not be expected to have a significant impact on local, regional, or statewide populations of ring-necked pheasants.

Mule Deer Hunting Program

Mule Deer – Local Analysis

As noted earlier, the Service does not collect harvest data for deer hunted at Bear Valley Refuge and it is unknown how many deer occur on the refuge. The State of Oregon manages deer in this area as part of the Keno game management unit (#31), of which the refuge is only a small part.

The state also collects harvest data for the entirety of the unit. In recent years, total harvests have ranged from 223 to 495 deer annually for this unit (ODFW 2012a). As noted earlier, because the refuge is only a small part of the unit and has a shorter season than the unit as a whole, it is expected that the number of deer harvested there is a small percentage of the total number harvested in the unit.

Mule Deer – Regional Analysis

The sum of deer harvested in the Rogue (#30), Keno (#31), and Klamath Falls (#32) game management units in Oregon in recent years ranged from 1,957 to 2,852 (ODFW 2016e and ODFW 2012a). In California, the sum of deer harvested in the C1, X1, and X2 game management units ranged from 704 to 971 in recent years (CDFW 2016b).

Statewide, in recent years, the total harvest of mule (including black-tailed) deer in Oregon has ranged from 40,239 to 51,210 and, across California, has ranged from 26,425 to 32,954 (ODFW 2016e and CDFW 2016b). Oregon's estimated statewide deer population in 2008 was 229,037 animals (ODFW 2009).

Analysis of Mule Deer Impacts

Consistent with trends throughout the western U.S., estimated deer populations in recent years in Oregon, including in the Klamath Basin, have been lower than in years past (ODFW 2009). The reasons are not completely understood, but may be due to severe weather, ongoing conversion of wild lands to less-valuable habitats, predation, disease, and/or other factors. The numbers of deer hunters and harvest numbers have also been down in recent years, and harvest is not disproportionate to the deer populations. Population indices (w/deer-per-mile counts) have been low in recent years, although buck-to-doe ratios and spring fawn survival and fawn-to-adult ratios remain stable (ODFW 2011a; ODFW 2016e).

Among other considerations, deer populations are managed to stay within their habitat carrying capacity, for human recreation (including hunting, observation, photography, and nature study), and to address depredation concerns. Sport hunting of deer can be used as a wildlife management tool to help meet population objectives, and it provides recreation and food for hunters.

The states develops annual deer hunting regulations based on data generated by population and harvest surveys, and in consideration of habitat carrying capacity and depredation concerns. In general, the annual production of fawns would be expected to replace individuals lost through hunting. The success of this management strategy over the decades strongly suggests that continued hunting of deer through the state's regulated programs, including allocation of deer hunting tags, would not be expected to have a significant impact on healthy and sustainable deer populations.

<u>Pronghorn Antelope Hunting Program</u>

Pronghorn – Local Analysis

As noted earlier, the Service does not collect harvest data for pronghorn hunted at Clear Lake Refuge (on the "U") and it is unknown how many pronghorn occur on the refuge. The State of California manages pronghorn in this area as part of the Clear Lake game management unit (#2), of which the refuge is only a small part. Although harvest data are not available for the refuge, a

maximum of six permits are issued for pronghorn hunting each year. Therefore, including crippling loss (see earlier discussion), pronghorn harvest on the refuge totals an average of seven or fewer each year. In recent years, there have been only 10 to 15 rifle tags and one archery tag offered each season for the entire Clear Lake Unit, and total annual harvests have ranged from 8 to 12 pronghorns (CDFW 2016a). In the past, surplus pronghorn numbers in the Clear Lake Unit have allowed the state to remove some animals for translocation to other areas within their historic range (CDFG 2004).

Pronghorn – Regional Analysis

In recent years, the annual harvest of pronghorn in Oregon's Klamath Falls (#32) and Interstate (#75) game management units has ranged from 73 to 114 animals (see ODFW 2012a). Statewide, in recent years, the total pronghorn harvest in Oregon has ranged from 1,086 to 1,487 animals (ODFW 2011b).

In California, all pronghorn hunting occurs in six game management units in the northeastern corner of the state. It is estimated that the population of pronghorn in this area during the past decade or so has ranged from approximately 3,000 to 4,000 animals (Institute for Wildlife Studies 2016). Annual harvest in recent years in all six units has ranged from 154 to 214 animals (see CDFW 2016a).

Analysis of Pronghorn Impacts

The population of pronghorn in California increased in the 1970s, 1980s, and early 1990s, eventually totaling approximately 8,000 animals. However, a hard winter in 1992-1993 reduced their numbers by almost half and the population (estimated to be more than 3,973 animals in 2003) has been relatively stable since that time (CDFG 2004; CDFG 2012). The long-term pronghorn population objective for northeastern California is 5,600 to 7,000 animals with a post-hunt season ratio of 24 bucks to 100 does (CDFG 2004).

In recent years, statewide population indices (w/pronghorn-per-mile counts) for Oregon have been relatively stable, as have buck-to-doe ratios and fawn-to-doe ratios. In addition, the number of hunters and total harvest of pronghorns statewide have remained relatively stable (ODFW 2012a).

Among other considerations, pronghorn populations are managed to stay within their habitat carrying capacity, for human recreation (including hunting, observation, photography, and nature study), and to address depredation concerns. Sport hunting of pronghorns can be used as a wildlife management tool to help meet population objectives, and it provides recreation and food for hunters.

Pronghorns are polygynous and many fewer bucks compared with does are needed for breeding and to sustain healthy populations. Properly regulated buck-only hunts, the most common in California and Oregon, would not be expected to have any population-level effects. Sometimes the states offer either-sex hunts when populations have outgrown the habitat's carrying capacity or there are high degrees of depredation.

In the final environmental document on pronghorn hunting in California (CDFG 2004), CDFG stated that, "Long-term data indicate that production and survival of young animals can replace the animals removed by hunting" and "…removal of pronghorn antelope from a population, whether by natural- or human-caused factors, results in high fawn production in following years to

compensate for animals removed, provided the level of hunting is below the potential to replace." They further stated that, "Pronghorn antelope hunting will not be proposed if the Department determines that pronghorn antelope numbers have declined to a level which may not sustain a healthy and viable population." Continued hunting of pronghorn through the states' regulated programs would not be expected to have a significant impact on healthy and sustainable pronghorn populations.

Effects of Hunting on Non-Hunted Fish and Wildlife

As described in more detail above, hunting could have a variety of effects on species of fish and wildlife that are not hunted. For example, the potential exists that a stray shot from a hunter could cause injury or death to a non-target species of wildlife, that avian predators or scavengers could experience secondary poisoning through ingestion of spent lead ammunition in unretrieved game animals or gut piles, or that gallinaceous and other ground-feeding birds could experience lead poisoning when they picked up fragments of lead ammunition when searching for grit. Disturbance from hunting and hunting-related activities may have the broadest range of potential effects on non-game species. Loud noises, fast-moving vehicles (including boats), and dogs all can disturb wildlife causing a range of potential actions and associated effects. For example, affected animals could experience stress; expend energy; flee; and/or reduce time spent feeding, avoiding predators, breeding, nesting, and taking care of young. If these several effects occurred repeatedly, especially during very cold weather, they could reduce an individual animal's fitness and/or reduce a population's long-term survival. Hunting and related activities could also alter fish and wildlife habitat, indirectly affecting non-game species. For example, hunters and their vehicles can compact soils, create erosion, crush vegetation, and carry invasive species to and within a refuge; and motorboats used in hunting could cut submergent and emergent vegetation, and reduce the quality of fisheries habitat by increasing water turbidity and the discharge of petroleum products.

Although the actual magnitude of all these potential effects is unknown, anecdotal observations indicate diversity and abundance of non-game wildlife at the refuges remains high and impacts on hunting has been minimal. This includes fish and other aquatic biota. These species would not be affected by terrestrial hunting programs (for pheasant, deer, and pronghorn) and would be unlikely to be adversely affected by waterfowl hunting. This is because the number of motorboats used by hunters and the turbidity and petroleum discharges they could create are relatively small when compared to the large sizes of Upper Klamath Lake and the sumps at Tule Lake Refuge. Boats are not allowed on the reservoir at Clear Lake Refuge, so waterfowl hunting would have no effects there on fish or other aquatic biota.

The many existing mitigative measures described earlier reduce the likelihood that these effects materialize or they minimize their actual impacts. Examples of such measures include requiring the use of non-lead ammunition for waterfowl and pheasant hunting, designation and management of sanctuary areas, reducing the length of the deer-hunting season at Bear Valley Refuge, and requiring that owners/handlers keep hunting dogs under control. Mitigative measures included in Alternatives B, C, and D would further avoid or minimize effects of hunting on non-target species. These measures include a 10-miles-per-hour speed limit for boats; phasing in requirements to use non-lead ammunition for hunting of deer and pronghorn, and requirements for motorboats to have 4-stroke (4-cycle) motors; and partnering with California, Oregon, and the U.S. Forest Service to develop and operate invasive species decontamination stations on/near the refuges.

Other Past, Present, and Reasonably Foreseeable Hunts and Anticipated Impacts

Past

Sport hunting in the Klamath Basin, including on private properties, on state wildlife areas, on public lands managed by the U.S. Forest Service and BLM, and on the refuges has been ongoing for decades with relatively minor changes over time. Hunts are conducted under the umbrellas of annual California and Oregon waterfowl, upland game, and big game regulations. The state upland game and big game regulations are based on population surveys and harvest data. Their waterfowl hunting regulations are developed consistent with federal migratory bird hunting framework regulations that establish the maximum season length, earliest beginning and latest ending dates for seasons, and maximum bag limits per species or species group. These framework regulations are based on the results of annual population and habitat surveys, banding programs, and harvest surveys; utilize principles of adaptive management; are established in partnership with the states, four flyway councils, Canada and Mexico, and others; and help ensure hunting opportunities and healthy, sustainable migratory bird populations into the future. The effects of past refuge hunting programs on fish, wildlife, plants, and their habitats; and other wildlife-dependent public uses would generally be the same as described elsewhere herein associated with Alternative A (No Action Alternative).

Present

At present, sport hunting in the Klamath Basin continues relatively unchanged from the past several decades. Hunts continue to be conducted under the umbrellas of annual state regulations, the migratory bird portions of which are developed consistent with federal framework regulations that continue to be based on a large and comprehensive data-gathering and analysis program. The effects of present refuge hunting programs on fish, wildlife, plants, and their habitats; and other wildlife-dependent public uses are as described elsewhere.

Reasonably Foreseeable Future

It is expected that sport hunting programs in the Klamath Basin, including on the refuges would continue into the foreseeable future with perhaps a handful of changes from the present. One change would be the requirement for all hunters to use non-lead ammunition; including for upland game and big game species (both California and Oregon are moving in this direction). As discussed elsewhere herein, this would be expected to reduce the lead toxicity risk to wildlife posed by animals (such as dove, quail, pheasant, and turkey) directly feeding on ammunition fragments; and the secondary poisoning of avian predators and scavengers (such as condors, hawks, eagles, falcons, owls, and vultures) feeding on gut piles and on game species that were shot, but not retrieved.

Data supporting the Service's annual framework regulations for migratory bird hunting reveal a total duck population estimate for 2014 of 49.2 million birds in the traditional survey area (Alaska, north-central United States, and south-central and northern Canada) (Service 2014). This figure represents an 8% increase over the 2013 estimate and is more than 40% greater than the long-term average (1955-2013). Production estimates for geese were variable, with abundance indices up for 9 populations and down for 11 populations. These data support more liberal duck hunting regulations and relatively stable regulations for geese for the 2015–2016 hunting season. However, wildlife populations can fluctuate in response to a variety of factors, including weather, predation,

disease, and the quality and quantity of habitats on breeding, migratory, and wintering grounds. Changes in bag limits and length of season would be made in future years, as necessary, to sustain healthy populations of ducks, geese, and other migratory birds.

The effects of three other possible changes are worthy of note. In recent years, substantial effort has been made by a broad range of interests to address significant environmental and economic issues in the Klamath Basin. These efforts have resulted in signing of the KBRA, KHSA, and Upper Klamath Basin Comprehensive Agreement. Among other things, these agreements seek to restore wetlands, riparian corridors, and other habitats, reduce water quality degradation in Upper Klamath Lake, and help restore populations of endangered suckers; remove four hydroelectric dams on the Lower Klamath River; increase in-stream flows and re-establish anadromous fish runs throughout the Klamath Basin; provide reliable water and power supplies to agriculture, towns/cities, and refuges; support continuation of flood-fallow operations; and support sustainable human communities. These agreements are awaiting Congressional approval. If these agreements are legislated and implemented, the potential exists for Klamath Basin refuges (especially Lower Klamath and Tule Lake Refuges) to receive more reliable water supplies. This would increase the quality and quantity of refuge wetland and other habitats, and increase the capacity of these refuges to support native wildlife species, including waterfowl and other game species. This would likely result in enhanced hunting opportunities and hunter success on these refuges.

Secondly, gray wolves (*Canis lupus*) have recently returned to the Klamath Basin area of southern Oregon and northern California. This includes a new pack in the southern Cascade Mountains that has established a territory in the eastern Rogue and western Keno game management units (ODFW 2015). These animals are freely roaming and breeding and, as their packs grow, predation and competition with other native predators (e.g., cougars and coyotes) would increase. Wolves prey on a variety of wild and domestic animals, including deer, elk, cattle, and sheep (ODFW 2010). Research has recently been initiated to better understand relationships among these mammalian carnivores and various prey species, including those that are hunted by humans. It is too early to tell whether wolves would displace some cougars and/or coyotes and whether predation on big game species would increase, decrease, or remain unchanged as a result. Regardless, this adds a bit more complexity to game management in this area and state hunting regulations (including those affecting deer hunting at Bear Valley Refuge and potentially pronghorn hunting at Clear Lake Refuge) may need to be adjusted to compensate for any changes in big game populations. Alternately, there might be new opportunities to hunt predators.

Finally, there is strong agreement within the world's scientific community that climate change, including global warming, is occurring and that human activities since the industrial revolution and especially since the middle of the 20th century have strongly influenced these changes (IPCC 2014). Among other effects, climate change is likely to result in more extreme weather events, including storms and droughts. In the Klamath Basin, models project that the snow pack will be reduced and it will melt earlier, that summers will be warmer and drier, and that the areas burned by wildfires will increase (Barr et al. 2010). There was not agreement among these models on the effects on annual precipitation in the Basin (it could increase or decrease). This would mean less water in streams and rivers late in the season. Less water combined with higher temperatures during the summer and fall would increase the competition among agriculture, fisheries, wildlife, and urban areas for adequate supplies of clean, fresh water to meet their needs. As discussed elsewhere herein, Lower Klamath and Tule Lake Refuges do not currently have reliable supplies of water adequate to manage the full potential of their wildlife habitats. If, as projected,

temperatures rise and water supplies diminish, the quantity and quality of wetland and other valuable wildlife habitats on the refuges would be reduced and fewer migratory birds and other wildlife species could be accommodated. If similar effects occurred throughout the Pacific Flyway and elsewhere in North America, then populations of waterfowl and other waterbirds would diminish along with associated hunting opportunities. Federal and state hunting regulations would need to reflect these population changes with reduced seasons, bag limits, and/or both. Climate change could also affect terrestrial habitats by, for example, altering the diversity and availability of desirable forage and cover for ungulates. It is unclear what those changes might be, where they would occur, and what effects they might have on big game species like deer and pronghorn. Again, state regulations and associated hunting opportunities would likely be altered if these effects caused changes in game populations. Refer to Sections 5.1.1 and 6.7.4 for more detailed discussions about climate change.

Anticipated Impacts

Continuation of waterfowl, pheasant, deer, and pronghorn hunts on Klamath Basin refuges and other public and private lands in the area would not be expected to result in any new or additional effects beyond those already described. This is because breeding results in annual recruitment of new individuals into these species' populations; these hunting programs are reevaluated annually (in consideration of the results of species production, habitat, and harvest surveys); and regulations are modified, as necessary, on an annual basis to ensure sustainable populations into the future. Continued sport hunting on refuges and other public and private lands in the Klamath Basin would have no long-term effects on populations of these game species.

Continuation of refuge hunting programs would have the same effects on other refuge visitors and associated facilities as earlier described. This will be ensured through completion and implementation of this CCP (including consideration of public review comments); monitoring, evaluation, and regular review of the CCP to ensure its implementation is achieving goals and objectives; revision of the CCP every 15 years or earlier if needed; and development and reevaluation of compatibility determinations on a 10- or 15-year cycle, or earlier if needed.

Continuation of hunting programs on all lands and waters throughout the Klamath Basin would enhance the potential that new invasive species would be introduced and that the range of existing invasive species would increase across these areas. This potential would not be substantially different than that posed by other, non-hunting recreation on these lands and waters, or economic or other uses of these areas. As described earlier, Alternatives B, C, and D would address this threat by partnering with the states of California and Oregon, and the U.S. Forest Service to develop and operate portable decontamination stations. Many more efforts will be needed in association with various other uses to adequately address this serious threat.

6.7.11 Social and Economic Conditions

The cumulative impacts of each alternative for the refuges considered in this CCP would be beneficial to the local economy. All refuges are open for at least one type of wildlife-dependent recreation. Clear Lake and Bear Valley Refuges are currently open only for hunting but additional wildlife-dependent recreation is being considered. Lower Klamath, Tule Lake, and Upper Klamath Refuges are open to a wider range of wildlife-dependent recreation including hunting, wildlife observation and photography, and interpretation. Land management activities (haying, grazing, and farming) are used and would continue to be used on Lower Klamath, Tule

Lake, and Upper Klamath Refuges to enhance and restore habitat. These land management activities would have a cumulative beneficial effect on Socioeconomic Resources.

6.7.12 Unavoidable Adverse Impacts

None of the alternatives considered would be expected to result in unavoidable, long-term adverse impacts on the environment. Where the potential for such effects has been identified, appropriate mitigation measures have been incorporated into the project scope to reduce the effects to below a level of significance. In addition, monitoring of the refuges' resources, as described in the CCP strategies (Appendix F), would be conducted as part of any proposed management action to enable refuge staff to identify and analyze management results and adapt management policies should any unforeseen adverse effects arise.

6.7.13 Irreversible and Irretrievable Commitments of Resources

Most management actions identified in this document would require a commitment of funds that would then be unavailable for use on other Service projects. At some point, commitment of funds to these projects would be irreversible, and once used, these funds would be irretrievable. Non-renewable or non-recyclable resources committed to projects identified in the CCP would also represent irreversible and irretrievable commitments of resources, such as fuel for refuge vehicles, supplies used in management or maintenance activities (e.g., herbicide, fencing, signs), and fuel for construction equipment used to implement habitat enhancement and restoration projects, and visitor services improvements.

6.7.14 Short-term Uses versus Long-term Productivity

An important goal of the Refuge System is to maintain the long-term ecological productivity and integrity of the biological resources on refuges. This system-wide goal is the foundation for the goals presented in the CCP. The implementation of the action alternatives would include increased protection of natural resources to benefit wildlife through a balance of wetland and agricultural habitats, and increased management of wildlife habitats and expansion of visitor service activities and facilities. The resulting long-term productivity would include increased protection and survival of migratory bird species, endangered species, as well as myriad native plant and animal species. The public would also gain through long-term opportunities for wildlife-dependent recreational activities.

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