

FINAL ENVIRONMENTAL ASSESSMENT

Restoring the hydrology of the Williamson River and adjacent wetlands on
Klamath Marsh National Wildlife Refuge

National Environmental Policy Act

U.S. Fish and Wildlife Service
Klamath Marsh National Wildlife Refuge
Chiloquin, OR 97624

January 26, 2014

Section I: PURPOSE AND NEED FOR ACTION

Background

The 41,230 acre Klamath Marsh National Wildlife Refuge (KMNWR) is one of 6 refuges of the Klamath Basin National Wildlife Refuge Complex located in south central Oregon and northern California (Fig. 1). KMNWR is located on the eastern slope of the Cascades, approximately 50 miles north of Klamath Falls and is bordered by the Winema-Fremont National Forest and privately owned agricultural grasslands. KMNWR was established in 1958 when approximately 16,400 acres were purchased with Federal Duck Stamp Funds. Additional lands were acquired in subsequent years bringing the refuge to its current acreage and configuration. Originally designated as *Klamath Forest National Wildlife Refuge*, the Refuge was recently renamed, as virtually all of the historic Klamath Marsh now lies within Refuge boundaries.

Similar to many western valleys, early farmers and ranchers at Klamath Marsh drained marsh lands to facilitate haying and livestock grazing. In the early 1900s, the Williamson River (within the Refuge boundary) was diverted into multiple ditches and levee systems. These canals and levee systems have lowered the local water surface elevations of the Williamson River and associated groundwater tables, thus reducing marsh water storage and the extent of areas that are seasonally and permanently flooded. These alterations have likely affected many native species, including redband trout, Klamath largescale sucker, Miller Lake lamprey, and wetland/riparian dependent bird and amphibian species. Water control structures and ditch diversions have directly affected aquatic organisms such as trout by blocking migration pathways, altering natural river flows, and modifying the river channel morphology.

Current marsh habitat provides important nesting, feeding, and resting habitat for waterfowl, while the surrounding meadowlands are attractive nesting and feeding areas for sandhill crane, yellow rail, and various shorebirds and raptors. The adjacent pine forests also support diverse wildlife including great gray owls and Rocky Mountain elk. KMNWR protects one of the largest and most pristine high elevation marshes in the Intermountain West, comprising a contiguous block of 35,000 wetland acres. The remote and diverse habitat provides important habitat for over 250 species of resident wildlife and migratory birds on the Pacific Flyway. Situated in the headwaters of the Upper Klamath Watershed, KMNWR wetlands also play a key role in affecting the water quality and quantity of the Upper Klamath Basin by attenuating water flows and modifying water chemistry.

Under the National Wildlife Refuge System Improvement Act (NWRISA) of 1997, a Comprehensive Conservation Plan (CCP) was finalized for KMNWR in 2010. The CCP emphasized the need to preserve, restore, and enhance the natural hydrology and biological integrity of Klamath Marsh and the associated uplands as habitat for migratory birds and other indigenous wildlife. More specifically, Goal 2 (Riverine and Spring Riparian Habitats) of the CCP seeks to, *Restore the historic form and function of riverine and riparian systems to benefit native fish and wildlife, including redband trout, Oregon spotted frog, and migratory birds.* The CCP also directs that an environmental assessment and alternatives be developed for restoring

the Williamson River and associated floodplain riparian, wetland, and sedge meadow areas. This Environmental Assessment (EA) provides an analysis of potential impacts of the proposed Williamson River Restoration Project on resources on and surrounding KMNWR.

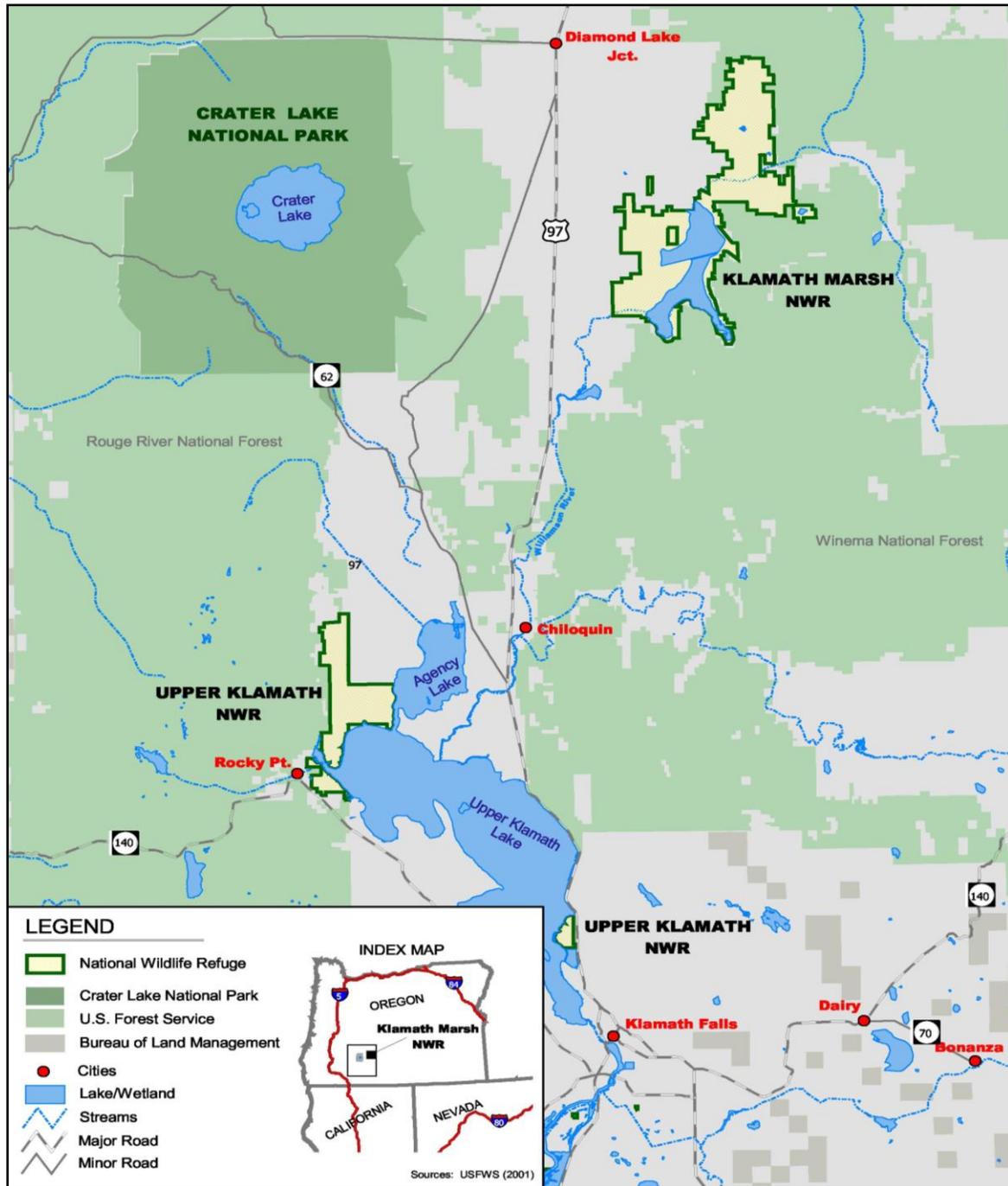


Fig.1. Location of Klamath Marsh National Wildlife Refuge.

A. Why is action being considered?

The Williamson River enters KMNWR at the east central portion of the Refuge near milepost 17 on the Silver Lake Road (See Fig. 2). Prior to refuge establishment, the Williamson River on the Refuge was channelized and diverted for the irrigation of lands for livestock grazing and hay production. Construction of levees, ditches and water control structures allowed for the draining of vast marshes and the redirection of the waters of the Williamson River to bypass the floodplain via canals. As needed for irrigation, waters within this canal system were blocked to allow diversion of irrigation water to specific fields. Since the refuge acquired these lands in 1987, the land has been managed using the existing infrastructure of ditches and water control structures to provide water for wetlands in leveed tracts and low lying areas.

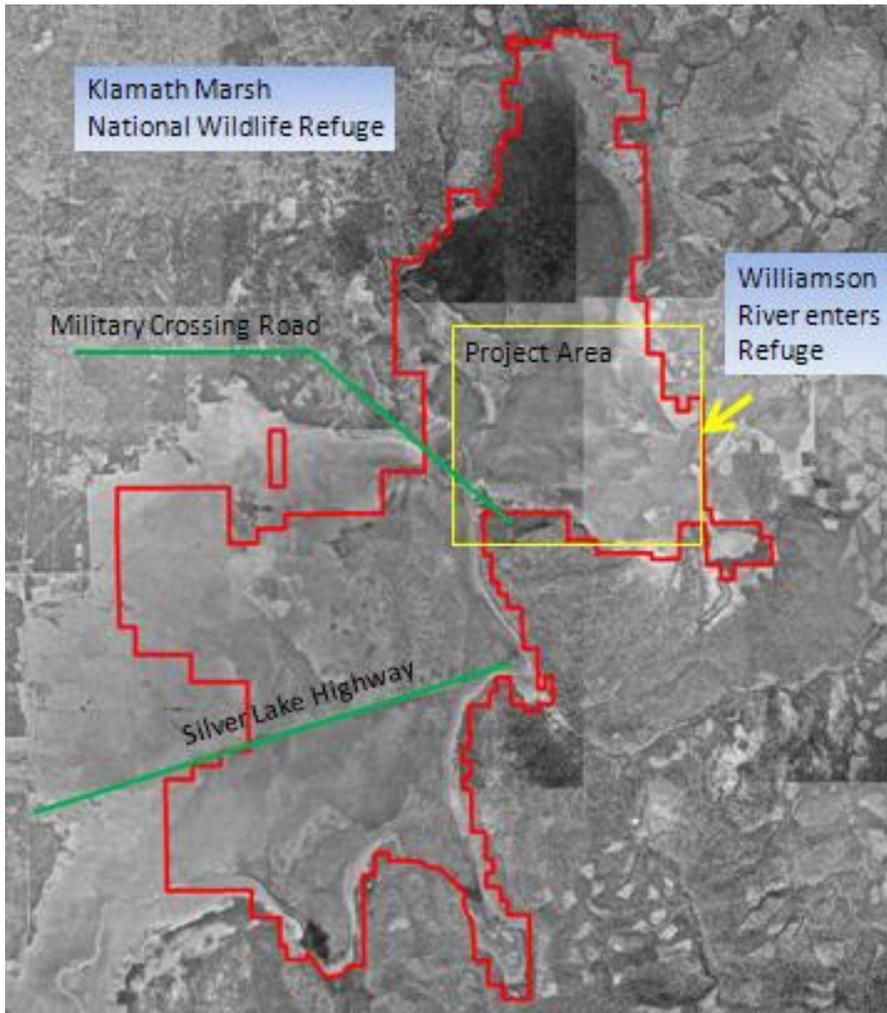


Fig. 2. Klamath Marsh NWR showing project area.

The USFWS proposes to restore the hydrology of the Williamson River and reconnect this hydrology to adjacent wetlands and riparian habitats in the project area depicted in Fig. 2. Specifically, the existing canals and water control structures block fish passage between Klamath Marsh and the Upper Williamson River at 11 locations and likely divert fish into fields during periods of irrigation. In addition, the natural overflow and subsurface water movement are compromised by existing infrastructure. Currently, artificial diversion of water is required to maintain wetland habitats, and because of the depth and straightness of the ditches, water tends to move downstream much faster than historically occurred, effecting thousands of acres of wetland habitats. Marsh hydrology is controlled through the management of water control structures, incised drains, and split flows. Overbank flow during flood events is prevented by 20 miles of levees, thus eliminating nutrients from upstream being distributed over the floodplain. The linear 1 to 5 mile long drains prevent natural processes of sediment deposition that occur in natural meandering channels. The existing irrigation infrastructure limits the hydrology of the floodplain from functioning to support vegetation communities which benefit fish and wildlife.

The proposed restoration actions on Klamath Marsh are focused on sustainable solutions based on the current hydrology and hydrologic trends in the watershed. Numerous studies on the hydrology of the marsh and surrounding watershed have been described in reports by Cummings and Melady 2002, Mayer and Naman 2011, and U.S. Fish and Wildlife Service 2010. The project is designed to restore 10,000 acres of a unique river and marsh ecosystem that is one of the largest and most pristine high-elevation marshes in the Intermountain west.

B. How does the action relate to Service objectives?

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and restoration of the fish, wildlife, and plant resources and their habitats within the U.S. for the benefit of present and future generations of Americans" (NWRSA of 1997).

The National Wildlife Refuge System goals include the following:

- a. Conserve a diversity of fish, wildlife, and plants and their habitats including species that are endangered, or threatened with becoming endangered.
- b. Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that are strategically distributed and managed to meet important life history needs of these species across their ranges.
- c. Conserve those ecosystems; plant communities; wetlands of national or international significance; and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- d. Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation)
- e. Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats

C. What is the action supposed to accomplish?

Alternatives to address restoration of the Williamson River have been proposed and evaluated by numerous groups since 1999, and described in various documents including, among others, the Klamath Marsh National Wildlife Refuge Wildlife and Habitat Review (2004), the Upper Williamson River Watershed Assessment (2005), and the Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment (CCP) (2010). The above documents all provided the following restoration recommendations for Klamath Marsh: 1) restore connectivity of the stream channel and floodplains, 2) restore effective geomorphic processes in the stream channel, and 3) restore migratory pathways for native fish.

Implementation of the Williamson River Restoration Project is designed to meet the following goals:

- a. Restore the hydrology of KMNWR to increase both the frequency and duration of floodplain inundation from bankfull overflow thereby reconnecting riverine, wetland, and riparian habitat complexes with the floodplain.
- b. Improve habitats for resident fish and wildlife and migratory species with an emphasis on sensitive species such as yellow rails, Oregon spotted frog, redband trout, and sandhill cranes.
- c. Remove barriers to fish passage.

D. Identify issues not discussed in A, B, or C).

- a. **Rights of the Klamath Tribes:** In the State of Oregon's Final Order of Determination for water rights in the Upper Klamath Basin, the Klamath Tribes were determined to have a water right to maintain minimum water levels in Klamath Marsh. The purpose of this water right is to establish and maintain a healthy and productive habitat to preserve and protect the tribe's hunting, fishing, trapping and gathering rights on former reservation lands, of which KMNWR is a part. With a "time immemorial" priority date, the Klamath Tribes have the senior water right on KMNWR. Coordination and consultation with the Klamath Tribes will be required to ensure that the proposed project does not infringe on these water rights.

In addition to water rights, the Klamath Tribes also have subsistence rights to hunt, fish, trap, and gather on the Klamath Marsh. Again, coordination with the Tribes will be necessary to ensure that implementation of the proposed project does not infringe on these rights.

- b. **Environmental and other compliance issues:** Klamath Marsh represents a portion of the Klamath Tribe's ancestral homeland. As such, it contains significant cultural resource sites. Areas on KMNWR where soil disturbing activities are

planned will be surveyed for cultural resources. The areas known to exist with cultural resources will be excluded from earth disturbing activities. The USFWS Cultural Resources Division will work the Klamath Tribes Cultural Resource Department to review cultural resource concerns.

The Oregon spotted frog is currently under consideration for listing under the Endangered Species Act and is thus considered a candidate species. Under Service policy, Refuge staff must assess the potential impacts to the Oregon spotted frog to ensure that this species is not harmed as part of the proposed action. There are no other species known to exist on KMNWR that are currently listed.

Because of the large amounts of material potentially moved under the proposed action, in a largely wetland and riverine setting, the Refuge will need to obtain permits under the Clean Water Act through the U.S. Army Corp of Engineers. A permit for blasting will also be needed from Oregon Department of Fish and Wildlife.

- c. **Private water rights:** Currently a private landowner on the northern edge of the project area has a water right and specified diversion point on the Williamson River. The Service will work with this landowner to ensure that this water right is protected during and after project completion.
- d. **Blasting as an excavation technique:** All action alternatives, B, C, and D, in this EA anticipate the use of explosives to excavate channels and wetlands, particularly in areas either unsuitable or uneconomical to use traditional earth moving equipment. Only trained and certified individuals will be associated with this activity. The public as well as uncertified Service employees will not be allowed in blasting areas.
- e. **Relocation of powerline:** A five mile long powerline exists on the east-west levee along the Kirk Ditch, which bisects the project area. The levee supporting the powerline and adjacent drain interfere with the natural marsh hydrology. To restore marsh and riverine hydrology, removal or modification of the levee may be required. Discussions with Midstate Electric Power Company indicate that this powerline could be relocated, either above or below ground as part of the proposed project.
- f. **Alteration of the current refuge haying program:** Currently portions of the proposed project area are hayed to produce short stature vegetation for spring migrant and resident waterbird species. In addition to providing benefits to wildlife, haying is also profitable to local ranchers. The extent and/or location of this activity will likely be modified under the proposed action consistent with the Service's Compatibility Policy (603 FW 2).

- g. **Sedimentation/erosion:** Although sediment input from upstream is extremely low, the potential for movement of sediments in newly constructed channels and wetlands is likely for several years until vegetation can become established on newly exposed soils.

E. Identify the decision to be made by the responsible official.

The Klamath Basin National Wildlife Refuge Complex Project Leader will decide, after evaluating potential impacts of the alternatives, consultation with the Klamath Tribes, and public comment, which alternative will best achieve the goals of the proposed action. The Project Leader will also determine based on the analysis herein and public comment, whether implementation of the preferred alternative will result in significant impacts to the human and natural environment, thereby, requiring preparation of an Environmental Impact Statement.

Section II: DESCRIPTION OF ALTERNATIVES

At issue for this project is the specific channel type to be designed for restoration of the Williamson River and its associated flood plain wetlands. Channel type considerations and options for Klamath Marsh include a combination of channel types defined according to the Rosgen classification key for rivers (Rosgen, 1996). These include a single-thread C4/5c or E4/5 channel, an anastomosed DA4/5 channel, or a combination of the two types. The gradient of the floodplain from Silver Lake Road to Military Crossing for the first 8,000 feet is 0.002, a drop of 12 feet, and the latter 17,000 feet has a gradient of 0.0001, a drop of only 3 feet. The first 8,000 feet, a water losing reach, lies on a delta plain, while the flatter 17,000 feet acts as a sink, a water gaining reach. Sediment loads contributed from the upstream Williamson River are extremely low. This system is low risk relative to catastrophic flooding or failure making all the above channel types feasible options. However, there are additional considerations including specific reach limitations, adjacent land ownership, and upstream limitations.

There are four alternatives evaluated as part of this draft environmental assessment including:

Alternative A: No Action – continue water management of the refuge with existing infrastructure.

Alternative B: 3 mile single-thread channel merging into anastomose (branched) channels with wetland enhancement (preferred alternative)

Alternative C: 10 mile single-thread channel with wetland enhancement

Alternative D: Anastomose (branched) channel with wetland enhancement

Activities/issues common to all alternatives (except the No Action Alternative)

Construction methods: For all earth moving activities, a combination of traditional excavation with low pressure equipment and blasting with explosives would be used for the creation of channels and ponds/wetlands. The technique of blasting has been used for numerous restoration projects throughout the country due to lower costs, time savings, and efficiency. In the KMNWR project area, there are challenges using heavy equipment in the boggy conditions, or where the groundwater lies at or near the surface, even under frozen conditions. In areas of unconsolidated wet soils, blasting is the only effective construction method available. Although amphibious machines can access most sites, the loose materials cannot be removed efficiently through excavation.

To test the utility of blasting on KMNWR, a series of small pilot projects were completed between 2010 and 2012. Ideal blast sites were determined to be areas where groundwater lies at or near the surface. The technique was found to be a very efficient method of creating open water while matching specified design dimensions for both channels and wetlands. (Fig.3 and 4). Soils were projected up to a distance of 300 feet across the

floodplain from the blast site, eliminating the need to haul. The edge of the blast area typically has a loose berm of soil which can be compacted with an amphibious tracked machine. Blasting would only be used in remote areas distant from boundary areas with homes and would not be used near areas of cultural concern or open water with aquatic wildlife.



Fig. 3. A blasted channel segment shown 10 months after blast.

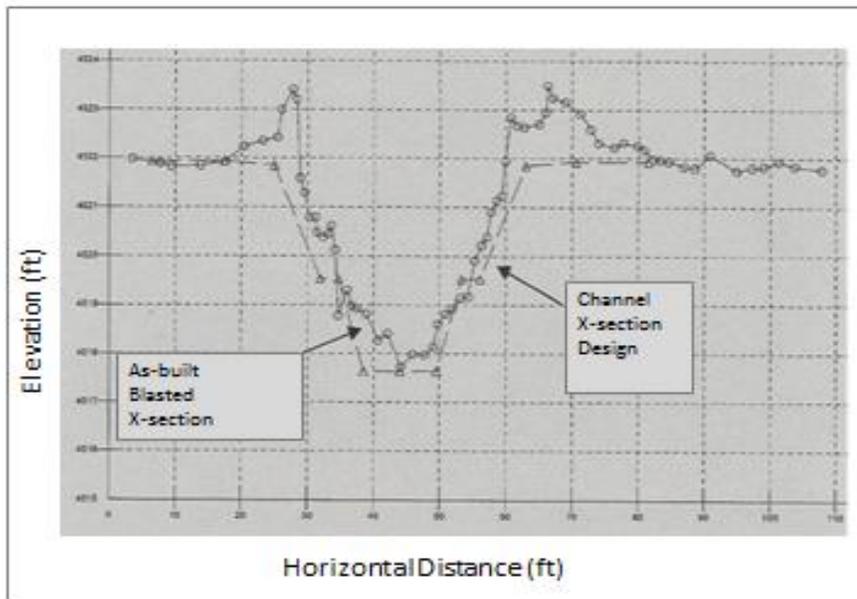


Fig. 4. As-built cross-section of a blasted channel compared to the designed cross-section during constructability trials at KMNWR in 2012.

Removal of Fish Barriers: All action alternatives, B-D, will result in the removal of eleven water control structures which act as fish barriers to the habitat upstream in the Williamson River, Fig. 5.



Fig. 5. Two of eleven water control structures that would be removed in Alternatives B-D that are currently creating fish barriers.

Conversion of existing canals to wetlands and removal of levees: All action alternatives will convert the existing canals to constructed wetlands and remove the levees, except for a short segment of the Williamson River from Silver Lake Road to the beginning of the new channel. Existing canals and ditches will be converted to shallow wetland complexes using soils from existing levees to plug ditches. Shallow excavation adjacent to plugged ditches will occur to create depth diversity. Wetland complexes will connect with floodplain topography and enable water to inundate the surrounding marsh. Depths will range from 0.5 to 5.0 feet, (deep areas located in the old canals), and widths ranging from 5 to 350 feet. Specifically designed wetland ponds with varied design dimensions will be constructed to enable the opportunity to evaluate the re-colonization of Oregon spotted frogs associated with the river and floodplain restoration.



Fig. 6. Existing canals and ditches will be converted to shallow wetland complexes, levees will be removed and the powerline relocated.

Cholo branch maintained: Upstream of the refuge, the Cholo Branch of the Williamson River is diverted south and enters the Refuge approximately ½ mile south of the Williamson River. Under all alternatives, this branch would be maintained and enhanced with a series of wetlands constructed to benefit aquatic species, specifically the Oregon spotted frog. These wetlands would be designed to allow for fish passage while providing for the needs of wetland dependent wildlife species. Water in the Cholo branch would

also subirrigate adjacent hay meadows.

Existing floodplain swales: All action alternatives will maintain the existing shallow swales that are located throughout the surface of the project area. Dimensions of these interconnected features are typical of the topography of large floodplains in snowmelt dominated systems. Dimensions of these swales range from 30 - 40 feet by 2 feet maximum depth (Fig. 7).

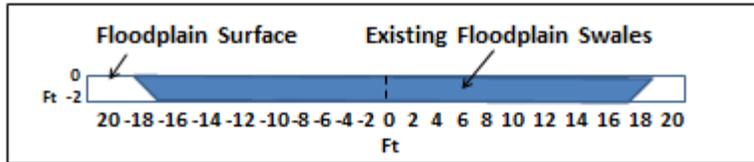


Fig. 7. (a) Typical cross-section of existing floodplain swales.

Private irrigation diversion: One private irrigation diversion from the Williamson River is located in the project area. All alternatives will provide for continuation of this diversion. The Service will provide a fish screen for the diversion to prevent the entrainment of fish.

Effectiveness monitoring: Monitoring of pre and post project conditions will occur under whichever action alternative is ultimately selected. Monitoring will include ground and surface water hydrology and native fish and wildlife surveys. A population of the Oregon spotted frog, a candidate for federal listing under the ESA, inhabits the KMNWR project area. Research to study the re-colonization of new wetlands by this species will be conducted by the U.S. Geological Survey (USGS).

Removal of Kirk Ditch powerline: Under all action alternatives, the six mile long Kirk Ditch powerline would be relocated to an underground location on the south edge of Klamath Marsh, or provisions made to enable the movement of water through the powerline access levee.

Haying: Haying in the project area would continue subject to the Service's Compatibility Policy (603 FW 2). One of the benefits of the project is to demonstrate that traditional sedge meadow haying sites can be sub-irrigated using the natural hydrology of properly functioning adjacent streams rather than the traditional methods of blocking streams and diverting surface water. Because of the expense and difficulties of keeping livestock out of the newly constructed channels and associated riparian areas, it is unlikely that livestock will be grazed in the project area.

Alternative A. No Action – continue wetland management using existing infrastructure

Under the No Action Alternative, Refuge staff would continue to utilize the existing infrastructure of canals, drains, and water control structures to divert water to irrigate wetlands

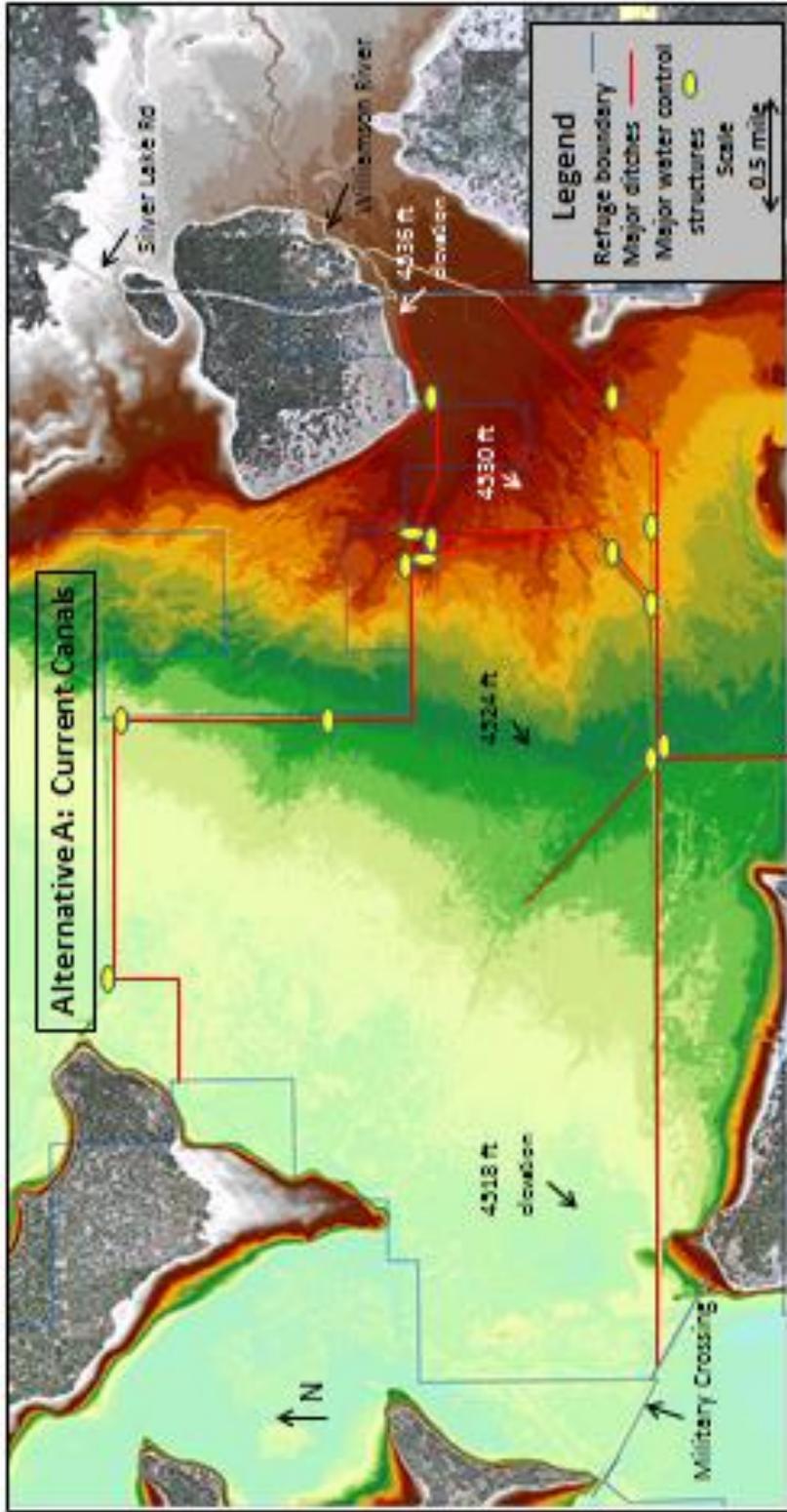


Fig. 8. Alternative A. Location of existing major canals and water control structures in the project area displayed on LIDAR imagery. Colors represent 1 foot elevations. (Darker shades blend).

for hay production and native marsh habitats (9,000 total acres) (Figs. 5, 6, and 8). The Refuge would continue to expend funding and manpower to maintain this infrastructure. Significant additional funds would be required in the future to upgrade diversion structures to allow for fish passage. In addition, screening will be required in the future to prevent fish from being diverted from canals during irrigation periods. The Kirk Ditch powerline would be maintained. No riparian vegetation would be planted along canals as debris from brush and trees tends to plug water control structures. A more detailed description of how water is managed via the current water control infrastructure can be found in the KMNWR CCP (U.S. Fish and Wildlife Service 2010).

Alternative B (Preferred) - Combination single-thread channel and anastomose channel

Beginning where the Williamson River enters the Refuge, a sinuous channel would be constructed (Fig. 10) that extends 3.0 miles westward to the end of the delta plain and merges into a series of constructed anastomosing (branched) channels flowing into the lower saturated elevations. (Refer to Section III, p. 25). The gradient of the floodplain from Silver Lake Road to the end of the single channel (8,000 linear feet) has a slope of 0.002, a drop of 12 feet, and transitions into the anastomosed channel as the slope decreases to 0.0001 feet, a drop of 3 feet, extending 17,000 feet to Military Crossing Road. This transition occurs where the losing reach and gaining reach intersect. The single thread 3.0 mile channel would be constructed using a combination of excavators and blasting (Fig. 4). The constructed stream channel would be a Stream Type C4/5 and Type E4/5 (Rosgen 1996), with a width range of 34-38 feet and depth range of 2.0 – 5.7 feet.

Backwater channels (Fig.9) would be constructed to provide an additional habitat type for fish and wildlife, as well as more access to the floodplain during high water events. Backwater channels would have an average width of 2.0 feet and from 2.0 to 2.5 feet in depth and vary in length from 0.25 to 0.5 miles.

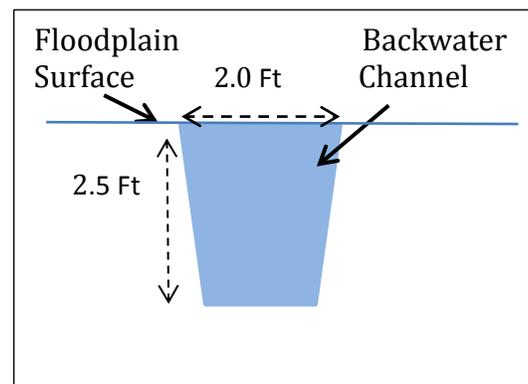
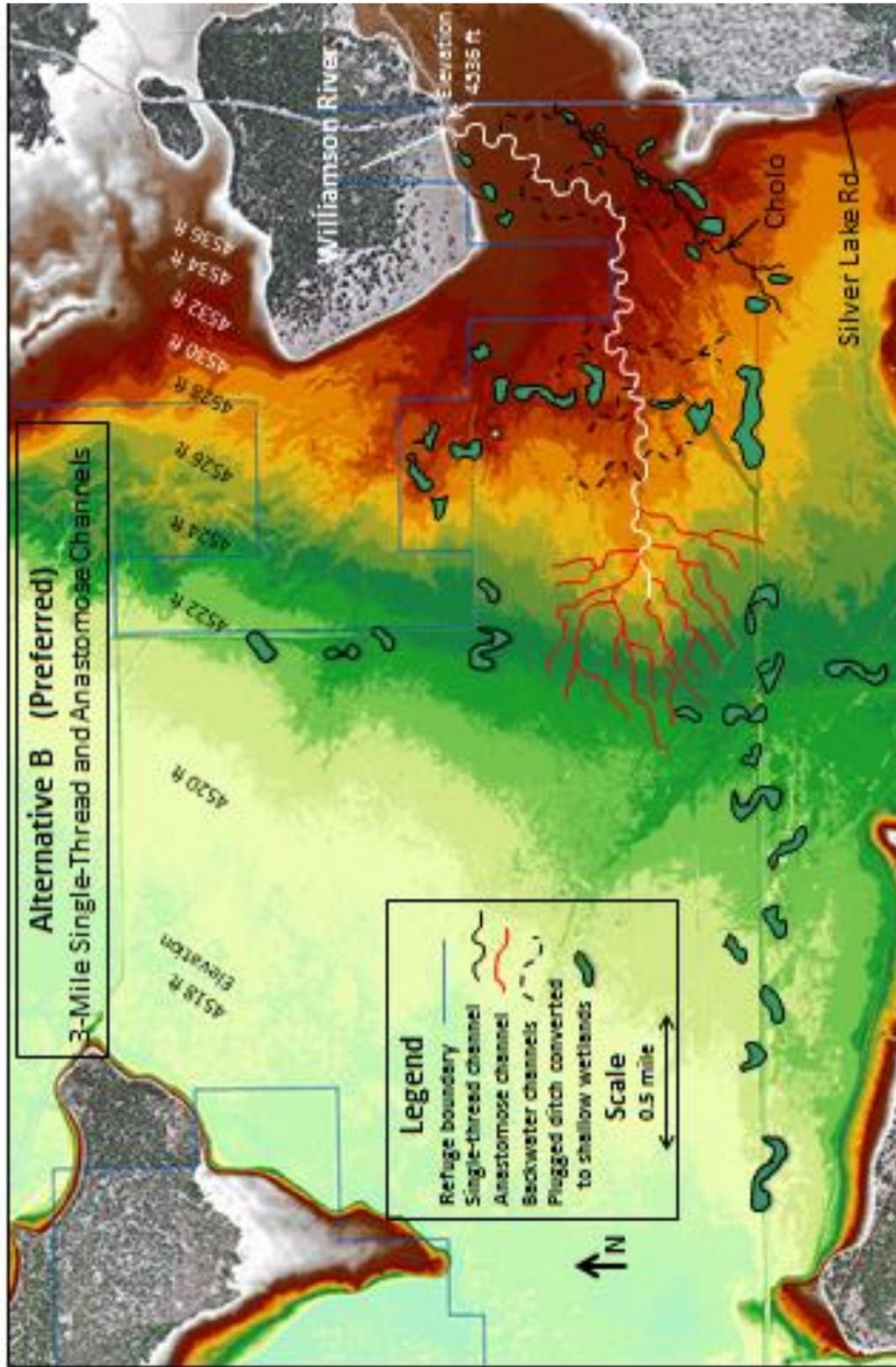


Fig.9. Photo and cross-section of a proposed backwater channel.

Fig. 10. Alternative B (Preferred). Combination single-thread and anastomose channels, backwater channels and converted wetlands conceptual design superimposed on LIDAR imagery.



In-stream wood toe structures and logs would be placed in the 3.0 mile channel to provide cover, shade, and structure used by otters, beavers, waterbirds, snakes, fish and a diversity of macro-invertebrate species. Although the majority of the instream cover and shade provided in this system is from overhanging and instream sedge vegetation and undercut banks, the unique areas of woody structure provides additional diversity.

Two types of woody structures are planned for instream fish habitat for the first 3 miles of the Williamson River single channel. The first, toe wood structure is a bank treatment that incorporates limbs, logs and branches into the outside meander bend of the lateral scour pools of the Williamson River. This treatment focuses on the lower one-third of the meander bend and replicates the roots of an established tree or other woody vegetation. These are built to be undercut and produce excellent fish habitat, as well as bank protection valuable for newly constructed streams during the first few years of revegetation. This treatment would be limited to every 6th outer meander (totaling 7) with a focus on the tightest design radius of curvatures. Structures will be covered with sod mats from the site. The woody debris will be installed to be over 90% below the low flow water surface elevation, to insure that the wood will stay submerged and not decay at an accelerated rate due to cycling of aerobic and anaerobic conditions. The second type of woody structure, logs, will be strategically placed along the streambank, 3/4 submerged at angles beneficial to the conditions at that specific site within the stream.

Where streambank elevations are suitable, willows and other riparian species would be planted. Additional activities include the installation of a fish screen to prevent entrainment of fish in a private irrigation diversion on the north side of the project, and the relocation of the powerline or provisions made to enable the movement of water through the powerline access levee.

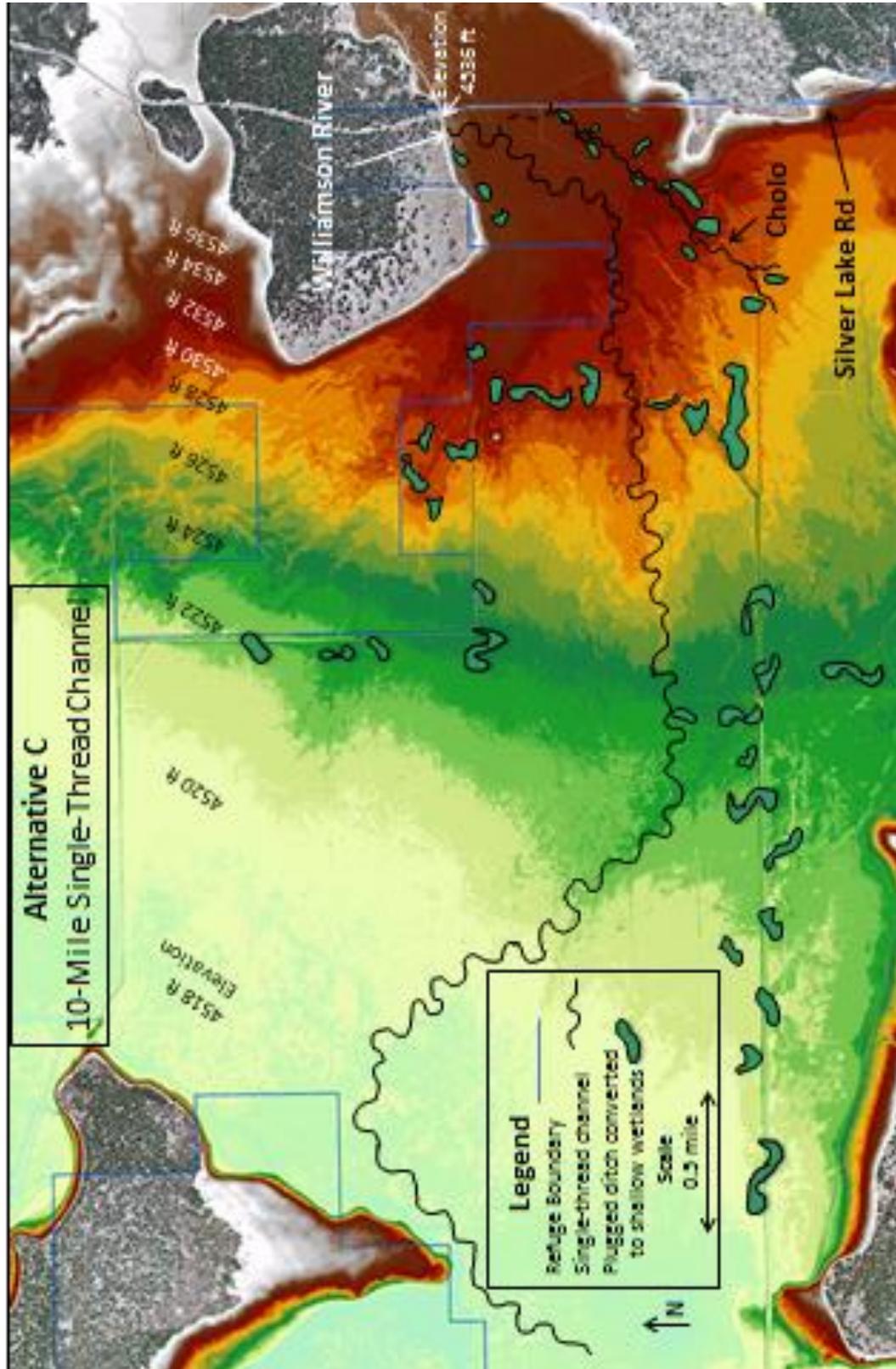
Existing drains and levees would be converted into complexes of depressional wetlands and ponds (Refer to Sect. II, p. 12). Eleven water control structures acting as fish barriers would be removed allowing native fish passage upstream to spawning reaches of the Williamson River. The private inholders in the path of the proposed channel have the option for the new channel to either bisect the southern end their property or bypass their property to the south.

Alternative C – Single -Thread Channel Only

Beginning where the Williamson River enters the Refuge, a 10 mile sinuous channel would be constructed that would extend toward Military Crossing Road (Fig. 11). The dimensions for this channel would be identical to Alternative B (Fig. 4), except for the length. The constructed stream channel would be a Stream Type C4/5 and Type E4/5 (Rosgen 1996), with a width range of 34-38 feet and depth range of 2.0 – 5.7 feet.

Riparian plantings and in-stream wood toe structures and logs would only be placed in the first 3 miles of the 10 mile channel. Two types of woody structures are planned for instream fish habitat

Fig. 11. Alternative C. Ten mile single-thread channel and converted wetlands conceptual design superimposed on LIDAR imagery.



for the first 3 miles of the Williamson River single channel. The first, toe wood structure is a bank treatment that incorporates limbs, logs and branches into the outside meander bend of the lateral scour pools of the Williamson River. This treatment focuses on the lower one-third of the meander bend and replicates the roots of an established tree or other woody vegetation. These are built to be undercut and produce excellent fish habitat, as well as bank protection valuable for newly constructed streams during the first few years of revegetation. This treatment would be limited to every 6th outer meander (totaling 7) with a focus on the tightest design radius of curvatures. Structures will be covered with sod mats from the site. The woody debris will be installed to be over 90% below the low flow water surface elevation, to insure that the wood will stay submerged and not decay at an accelerated rate due to cycling of aerobic and anaerobic conditions. The second type of woody structure, logs, will be strategically placed along the streambank, 3/4 submerged at angles beneficial to the conditions at that specific site within the stream. Where streambank elevations are suitable, willows and other riparian species would be planted

No anastomose or backwater channels would be constructed as in alternative B. The fish screen installation, the powerline relocation or provisions, the conversion of existing drains and levees to depressional wetlands (Refer to Section II, p. 12), and the removal of fish barriers would also occur. As in Alternative B, the private inholders who lie in the vicinity of the path of the proposed channel have the option for the new channel to either bisect the southern end their property or bypass their property to the south.

Alternative D – Anastomose Channel Only

Beginning where the Williamson River enters the Refuge, an anastomose (branched) channel made up of 10-15 individual channels would be constructed that would extend several miles westward. (Fig.12). The channels would correspond to Rosgen (1996) type DA 4/5 channels having a maximum depth of 2.0 feet and widths of 2.0-15 feet. Existing ditches and levees would be converted into complexes of depressional wetlands and ponds (Refer to Section II, p. 12) and eleven fish barriers would be removed allowing native fish passage upstream to spawning reaches of the Williamson River. Additional activities include the installation of a fish screen for a diversion from the Williamson River to a private irrigator, and relocating a 6-mile long powerline that currently bisects the marsh to the south part of the project area, or providing provisions to enable the movement of water through the powerline access levee.

Fig. 12. Alternative D showing a proposed anastomose channel and ditch converted wetlands conceptual design superimposed on LIDAR imagery.

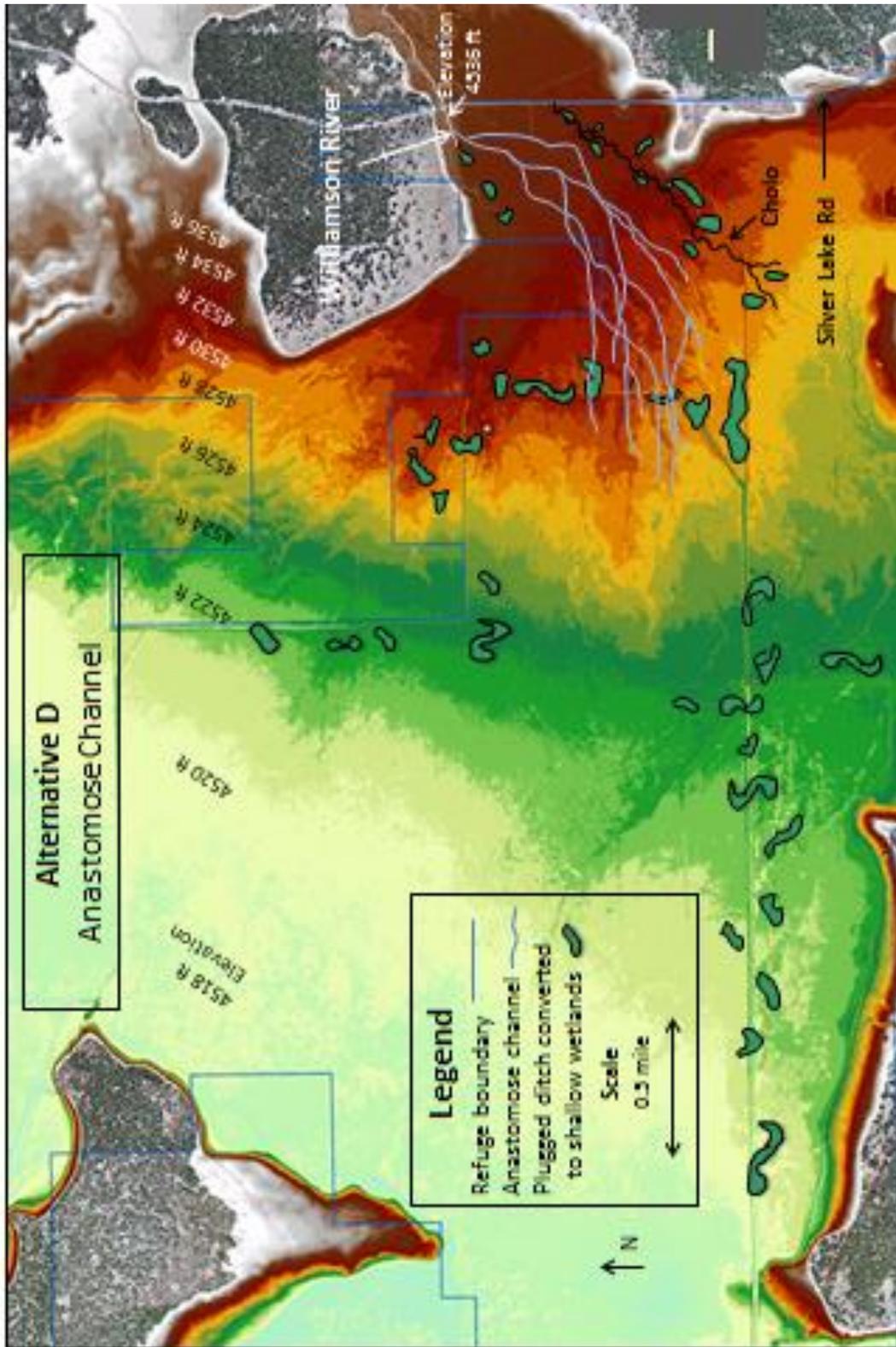


Table 1. Alternatives/effects matrix

Decision making criteria	<u>Alternative A</u> No Action	<u>Alternative B</u> Single channel and anastomose channel (Preferred)	<u>Alternative C</u> Single channel only	<u>Alternative D</u> Anastomose channel only
<p>Principal Environmental (Biophysical) effects</p> <p>Restore natural hydrology</p>	<p>Hydrology constrained within existing infrastructure of canals, drains, and water control structures</p>	<p>Hydrology restored within single 3-mile meandering natural channel, anastomose and backwater channels and the reconnected floodplain wetlands and riparian habitats.</p>	<p>Hydrology restored within single 10-mile meandering natural channel, existing anastomose channels and the reconnected floodplain wetlands and riparian habitats.</p>	<p>Hydrology restored in anastomose channel reconnected to floodplain wetlands.</p>
<p>Provide diverse riverine, wetland, and riparian habitats driven by the natural hydrology of the Williamson River</p>	<p>No natural riverine or riparian habitats provided. Wetlands subject to flooding through artificial canals and water control structures. Overall habitat complexity low. Lack of riparian shading results in high water temps in canals for fish.</p>	<p>The creation of naturally functioning riverine, wetland and riparian habitats, with bankfull overflow, increased water table and greater connectivity of features will result in greater diversity and complexity of habitats than in Alternative A. Greater riparian vegetation shades water in summer for cooler temps.</p>	<p>Same as B except complexity of anastomose channels and backwater channels mostly lacking. Summer water temps same as Alternative B.</p>	<p>Same as B, except lacking larger instream features and woody riparian habitats. Lacking instream features and habitat structure for native fish and wildlife compared to Alternative B or C. Lacking backwater channels.</p>
<p>Provide for native fish and wildlife and migratory birds with an emphasis on migratory birds and sensitive species.</p>	<p>Hydrology of refuge habitats largely man-made, which at times may not be consistent with life history needs of refuge fish and wildlife.</p> <p>No functioning riverine systems lead to poor habitat conditions for redband trout.</p>	<p>Reconnected river and floodplain wetlands will result in an increased water table and enhance the productivity of wetland vegetation in riverine and wetland habitats.</p> <p>Restored wetlands will increase diversity and abundance of native and migratory wildlife.</p>	<p>Same as B, except lacking backwater channels.</p>	<p>Same as B except without large channel riverine habitat. Reduced diversity. Fewer channel types and no wood structure would reduce habitat used by otters, snakes, fish cover and macro-invertebrate substrate.</p>

	No restoration of riverine or wetland habitats leads to suboptimal conditions for Oregon spotted frogs, yellow rails, sandhill cranes and migratory birds.	<p>Functioning river channel, backwater channels and associated riparian habitats will provide improved habitat for redband trout and other native fish species.</p> <p>Sensitive species such as yellow rails, spotted frogs, redband trout, and sandhill cranes all expected to benefit by increased diversity of water levels resulting from the increased water table.</p>	<p>Same as B but lacking backwaters channels.</p> <p>Same as B.</p>	<p>Same as B, but lacking backwater channels.</p> <p>Same as B.</p>
Fish passage	Fish passage blocked at 11 points on Refuge	All fish passage barriers removed	Same as B	Same as B
Sedimentation/ erosion	Since the current canal system has been in existence for decades, vegetation is well developed and sedimentation and erosion potential slight.	Sedimentation and erosion potential in first few years after construction. Movement and redeposition of sediment in constructed channel a positive effect as it creates diverse habitat features	Same as B	Same as B
Degree of Public Controversy	<p>Potential for controversy high as No Action counters recommendations of stakeholders to restore natural hydrology and riverine systems on the Refuge.</p> <p>No impact to private irrigation diversion.</p>	<p>Potential for controversy low as proposed action consistent with recommendations from stakeholders to improve the Williamson River through the Refuge.</p> <p>Medium potential for controversy to inholding irrigator.</p>	<p>Same as B</p> <p>Same as B</p>	<p>Potential controversy high from stakeholders seeking single channel stream habitat as prescribed in the CCP.</p> <p>Potential negative effect to inholding irrigator as the anastomose channels fork from the main channel</p>

		Change in water management may create some uncertainty with Refuge hay permittees.	Same as B	where it enters the refuge. Same as B
Principal Socio/Economic Impacts	<p>No potential for recreational fishery in natural stream channel</p> <p>Current hay program likely to continue in similar areas as the past.</p> <p>Water diversion of private landowner maintained</p> <p>No large expenditure of funds on restoration work leads to lack of opportunity for Klamath County economy. Fish screens may be a future cost for the refuge.</p>	<p>Potential for recreational fishery in 3 mile single channel</p> <p>Some uncertainty relative to the extent or area for hay cutting by adjacent ranchers</p> <p>Water diversion of private landowner improved with fish screens</p> <p>Expenditures of restoration funding beneficial to Klamath County economy</p>	<p>Maximum potential for recreational fishery in 10 mile single channel</p> <p>Same as B</p> <p>Same as B</p> <p>Expenditures of restoration funds beneficial to Klamath County economy</p>	<p>No potential for recreational fishery in anastomose channel</p> <p>Same as B</p> <p>Same as B</p> <p>Expenditures of restoration funding minimal for benefits to Klamath County economy.</p>

Section III: AFFECTED ENVIRONMENT

Wildlife

Over 250 species of wildlife reside, migrate through, nest, forage, hunt or loaf in Klamath Marsh. A diversity of mammals include mule deer, Rocky Mountain elk, antelope, coyotes, river otters, beaver, muskrats, and numerous small mammals. Pacific flyway bird migrations through the marsh include ducks, geese, swans, cranes, shorebirds and numerous other waterbirds. The diverse communities of native fish, wildlife and plants include a species proposed for listing as federally threatened, the Oregon Spotted Frog (*Rana pretiosa*), the fisher (*Martes pennati*), and numerous species of concern, including the redband trout (*Oncorhynchus mykiss gibbsi*), the Miller Lake lamprey (*Lampetra minima*), as well as the largest population of yellow rails (*Coturnicops noveboracensis*) west of the Rocky Mountains. Other federal species of concern on Klamath Marsh are the Lewis's woodpecker (*Melanerpes lewis*) and the white-headed woodpecker (*Picoides albolarvatus*). Several of the State of the Oregon sensitive species include the bufflehead (*Bucephala albeola*), the great grey owl (*Strix nebulosa*), the greater sandhill crane (*Grus canadensis Canadensis*) and the western toad (*Bufo boreas*). A more detailed description of habitats and wildlife on KMNWR can be found in the 2010 Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment (CCP).

Vegetation/Hydrology

Historic conditions regarding vegetation and hydrology were described in the 2010 Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment (CCP) briefly as follows....

*The vegetation and hydrology of Klamath Marsh has changed considerably since first described by Abbot in 1855 surveys. Henry L. Abbot described Klamath Marsh as "a strip of half submerged land about 12 miles long and 7 miles wide covered with clumps of tule and other aquatic plants separated by small sheets of water". Later in 1904, Coville described Klamath Marsh containing 10,000 acres of the great water lily, *Wocus*. A BIA report in 1913 described an area 15 miles long and 3 miles wide on Klamath Marsh engulfed in water and covered with tule, American slough grass and *wocus*. In 1955, the area was recorded to consist of 9,900 acres of shallow marsh and 15,000 acres of deep marsh. (USDI and USFWS). By 1963, the area was said to include 920 acres of open water; 8,966 acres of marsh; and 4,345 acres of wet meadow, consisting of *carex*, *deschampsia* and *Scirpus*, etc. and 995 acres of grassland and forests (Oneil 1965), a ratio of emergent vegetation to open water of nearly 10 to 1. The annual Refuge narrative in 1975 indicated the vegetation was dominated by dense stands of hardstem bulrush while open water –vegetation was virtually non-existent with an estimated 10 % of the marsh consisting of open water...*

Over time, the percentage of open water to vegetation has declined. The historical information indicates that although the same types of plant communities have persisted over time, (open water with *wocus*, bulrush, sedge, rush, willow, grasses, and ponderosa pine), the extent and

distribution of these community types have changed dramatically since the turn of the century. Two reports examined climatologic and hydrologic information for the marsh and Upper Klamath Basin. Mayer et.al (2007) showed that hydrographs of both the inflow and outflow at the marsh are strongly correlated with the 5 to 7 year wet/dry cycles in precipitation. The cycles are superimposed over a long-term declining trend extending for several decades. Inflow and outflow at the marsh are lower now than at any time during the period of record. Similar trends have been determined regionally (Mayer and Naman 2011) and weather induced declines in inflows will have a profound effect on the marsh as well as the larger Klamath Basin.

Soils/Hydrology

Historic landform data indicates that the first 3 miles of the proposed channel location lie on a broad, low grade, poorly drained delta plain. The gradient of the floodplain from Silver Lake Road to Military Crossing for the first 8,000 feet is 0.002, a drop of 12 feet, and the remaining 17,000 feet has a gradient of 0.0001, a drop of 3 feet. Sediment loads contributed from the upstream Williamson River are extremely low. The combination of these variables enable channels of appropriate dimensions (depth, width, sinuosity, etc.) to be created without risk of filling in and will maintain a water table elevation in the floodplain at the water level of the river channel. Lateral movement within these soils has been demonstrated where floodplain water levels match channel water levels measured by water level loggers installed on the refuge, as well as in non-leveed depressional features.

Soil profiling in the project area was conducted by the National Resource Conservation Service in October, 2013, (Gebauer 2013) and was described:

"alternating layers of silts and sands in the delta plain, in addition to the complex, undulating surface relief, influences the surface hydrology. The majority of the soils on the delta plain are poorly drained. Piezometer data from around the marsh indicate that in the upper 200 cm of the soil profile, water tables throughout the refuge begin to rise in the late fall, prior to significant inputs of precipitation, peaking in spring, and dropping in mid to late summer. Water coming into the delta plain area from the Williamson River overflow would be in addition to, and likely later than, the rise in ground water. The diatomaceous silts in the soil profile have a very slow saturated hydraulic conductivity, and act as an aquatard."

In the wetter soils to the west, beyond the delta plain, there is a layer of organic and diatomaceous silts over the top of coarse, pumaceous sands. The coarse sands have a very high saturated hydraulic conductivity, so that water moves through them very quickly. The water in the subsurface sands is typically artesian, held under pressure beneath the surface silt layers under shallow, standing water.

Far up-stream in the Williamson River valley (private lands to the east of Silver Lake Road), the soils also differ from the complex, stratified soils seen on the delta plain, further highlighting the uniqueness of the soils found in the delta plain area. Immediately upstream of the delta plain, the valley broadens out, and the soils have less stratification of silts and sands,

indicating either that the “repeated overflow of the Williamson River” was not as common or as widespread upstream as on the delta plain, or that the energy was more quickly dissipated over the broader, less confined valley.

Finally, the alternating layers of silts and sands in the delta plain, in addition to the complex, undulating surface relief seen on the delta plain, likely influence the surface hydrology. The majority of the soils are poorly drained. In the delta plain, the alternating layer of sands and diatomaceous silts may result in a horizontal flow of water through the sandier layers, resulting in a patchwork of ponding depths during wet periods.”

Section IV: ENVIRONMENTAL CONSEQUENCES

Alternative A – No Action

Description: Under the No Action Alternative, Refuge staff would continue to utilize the existing infrastructure of canals, drains, and water control structures to divert water to irrigate wetlands for hay production and native marsh habitats (9,000 total acres). The refuge would continue to expend funding and manpower to maintain this infrastructure. Significant additional funds would be required in the future to upgrade diversion structures to allow for fish passage. In addition, screening will be required in the future to prevent fish from being diverted from canals during irrigation periods. The Kirk Ditch powerline would likely be maintained, and limited, if any riparian vegetation would be planted along canals as debris from brush and trees tends to plug water control structures.

- 1. *Restoration of natural hydrology:*** The natural hydrology of the Williamson River would continue to be controlled by the present water control system. Although this infrastructure could be used to mimic the natural hydrology of the river, it is doubtful that this water management could duplicate the short-term (yearly) and long-term (decades) natural hydrologic cycles.
- 2. *Provide diverse riverine, wetland, and riparian habitats driven by the natural hydrology of the Williamson River:*** Natural hydrology relative to channel and floodplain wetland interaction would remain disconnected. Limited and poor quality habitat for native fish and wildlife species would continue, particularly along canals, drains, and levees. Restoration of riparian habitat would not occur as brush and trees along canals tend to produce debris that plugs water control structures. In addition, restoration of streamside wetlands would not occur which would limit the diversity of wetlands on the Refuge.
- 3. *Provide habitats for native fish and wildlife and migratory birds with an emphasis on “sensitive” species:*** The limited habitat potential of this alternative depicted in item 2 above, limits expansion of fish and wildlife use in the project area. While key sensitive species such as yellow rails, spotted frogs, redband trout, and greater sandhill cranes exist in the project area, their density and numbers are far below the potential for the site.
- 4. *Fish passage:*** Fish passage barriers and the potential of entrainment of fish at diversion points would continue. Ultimately, fish passage may be an additional monetary cost of the present system.
- 5. *Sedimentation/erosion:*** Since the current canal system with instream vegetation has been in existence for decades, erosion potential is slight. The canals receive extremely low sediment loads from upstream, and have rarely needed maintenance to remove sediment in at least 60 years.

6. **Public controversy:** Recommendations to restore the hydrology and habitat of KMNWR were published in the KMNWR Final CCP and EA, 2010, the Upper Williamson Watershed Assessment, 2005, and the KMNWR Wildlife and Habitat Review, 2004, as well as other documents. These three documents represent the views of scientists and managers from local and regional federal and state agencies, the local watershed group, local landowners, The Klamath Tribes, The Nature Conservancy, Audubon, Oregon Wild and others. To continue the present management practices despite the identified problems listed in several forums would be controversial.
7. **Socio/Economic impacts:** Under the No Action Alternative, the present location of haying activities would likely continue which provides benefits to local ranchers and does increase the visibility of wildlife to the visiting public, particularly along Silver Lake Highway. In addition, the potential to open the project area for recreational fishing would remain very low as there are few fish to catch and the value of the outdoor experience would be limited to fishing in canals and drains.

Ongoing maintenance and operation of the current water control system results in significant expenditure in manpower and funds. Upgrades to the system to allow for fish passage at 11 barriers, likely in the future, will require additional funding needs, and will be costly to maintain and operate. This alternative ensures the ongoing yearly need for maintenance funding, plus unknown future funding for fish passage.

Alternative B – Single thread and anastomose channels (preferred alternative)

Beginning where the Williamson River enters the Refuge, a 3.0 mile sinuous channel would be constructed that would merge into a series of constructed anastomose channels. Backwater channels would be constructed off the single channel for fish and wildlife habitat. Woody structure would be added to the newly constructed single channel to improve channel complexity.

Existing drains and levees would be converted into complexes of depressional wetlands and ponds. Eleven water control structures, acting as fish barriers, would be removed allowing native fish passage upstream to spawning reaches of the Williamson River. In-stream habitat, wood toe structures and logs, would be placed in the 3.0 mile channel to provide cover, shade, and macro-invertebrate habitat. Willows and other riparian species would be planted on streambanks. Additional activities include the installation of a fish screen to prevent entrainment of fish in a private irrigation diversion on the north side of the project, and relocating the Kirk Ditch powerline that currently bisects the marsh to the forest boundary south of the project area.

1. **Restoration of natural hydrology:** This alternative will restore the riverine system and reconnect it to the historic floodplain, increasing the water table and seasonal surface water hydrology that supports diverse wetland vegetation communities. Wetland water levels will vary in water depth as well as length of inundation. Movement of water through the marsh to Military Crossing will be slow with water dispersed throughout the

floodplain rather than through a linear drainage system.

- 2. Provide diverse riverine, wetland, and riparian habitats driven by the natural hydrology of the Williamson River:** Habitat types include emergent marsh, sedge meadows, grasslands, wet meadows, riverine, riparian and open water. This diverse combination of habitats will meet the life history needs of all stages of resident wildlife and the seasonal requirements of migratory species. The project design targets wetland complexes that are large; blocks of several thousand acres of seasonally flooded sedge/rush, to small, <200 acre wetland complexes or isolated shallow ponds off-stream or connected to the new river system. The replacement of ditches, levees, and water control structures with a free flowing river system and functioning riparian habitat will enable native fish to access upstream Williamson River reaches and move within Klamath Marsh channels, wetlands, and backwaters according to their seasonal needs.

With removal of water control infrastructure, the Kirk Ditch powerline and associated access roads would be removed as well. This reduction in vehicle access will reduce the potential for the spread of noxious weeds, many species of which would threaten native habitats.

- 3. Provide habitats for native fish and wildlife and migratory birds with an emphasis on “sensitive” species:** The diversity of habitats provided under this alternative will be tied to the natural hydrology of the Williamson River; a hydrologic cycle that species native to KMNWR are adapted. The reconstruction of the Williamson River channel and removal of fish barriers will provide an additional three miles of natural channel which will be reconnected to the upper river. In addition to fish moving upstream from the Refuge, fish from the upper watershed will have access downstream to the seasonal food and habitat resources within KMNWR. Redband trout in particular will benefit from this aspect.

Construction of backwater channels adjacent to the single channel and the reactivation and construction of anastomose channels will further increase the diverse habitats available to fish and wildlife. Instream wood structure adds additional diversity for reptiles, amphibians, otters, and fish. The form of the waterways would be attractive to beavers, responding to the interaction of the open water and floodplain without levees and constraints to prevent overflow. Particularly during high flow periods, water movement throughout the floodplain would create maximum diversity in habitats thus increasing habitat provided for more species.

The increased inundation of the floodplain through greater connection of the river will buffer drought year impacts on wetland water levels. The water table will be increased, resulting in more diverse topography that will enable greater likelihood of all water levels being available for specific nesting needs. For example, the yellow rail, a species of concern, will benefit from increased expanses of sedge meadow with 3 inches of standing water early in the nesting season with nearby deeper water as the season progresses.

Restored streamside wetlands will be particularly beneficial to the Oregon spotted frog which presently occupies the project area at low densities and only in specific areas. The diversity of vegetation, hydrology and wetland depths will provide for the species needs throughout the year. Elimination of water control infrastructure and associated access roads would reduce the amount of disturbance to wildlife near the present road system.

4. ***Fish passage:*** Fish passage barriers will be eliminated as part of the project allowing full access for fish moving upstream and downstream.
5. ***Sedimentation/erosion:*** Minimal sedimentation and erosion are expected in the first few years after construction from soils disturbed within the project area. However, movement and redeposition of sediment in the constructed channel will result in the creation of natural stream features. Sediment delivery from the upstream Williamson River is extremely low due to 1) the lack of suspended material and 2) the presence of a depositional bowl feature on the property upstream of the Refuge. Evidence of low sediment delivery from upstream is illustrated in the canals on the refuge which have required no removal of sediment in at least the last 60 years.
6. ***Public controversy:*** A low degree of public controversy is expected from implementation of this alternative as it agrees with the recommendations from stakeholders over the last decade to restore/ improve the Williamson River through the Refuge. No impacts are anticipated relative to diversion of water for private lands. There may be some uncertainty as to how much haying will be allowed under this alternative.
7. ***Socio/Economic impacts:*** This alternative will allow for the continuation of the haying program which provides important habitat for spring migrating waterbirds as well as economic resources to local ranches. The exact extent and acreage of haying allowed will be subject to the Service's Compatibility Policy (603 FW 2) as well as where and how sedge meadow habitats respond to the project. In addition, restoration of the Williamson River channel could allow for a public recreational fishing opportunity which does not currently exist. Access for this fishery will also allow for additional public use areas on the refuge potentially increasing tourism dollars to Klamath County. The project will create 2-3 years of varied work on the project, including stockpiling wood, heavy equipment operation, blasting, planting, tree growing, monitoring, research and surveys. Much of this work would be contracted to businesses in Klamath County.

Elimination of the current water management infrastructure would allow the costs currently consumed with maintenance of this system to be diverted to other conservation oriented activities on the Refuge.

Alternative C – Single channel only

Beginning where the Williamson River enters the Refuge, a 10 mile sinuous channel would be

constructed that would extend to Military Crossing Road. Large woody debris would be added to the first 3.0 miles to provide habitat complexity in the restored river. Existing drains and levees would be converted into complexes of depressional wetlands and ponds. Eleven fish barriers would be removed allowing native fish passage upstream to spawning reaches of the Williamson River. Riparian areas would be planted with willows and other riparian species. Additional activities include the installation of a fish screen for a diversion from the Williamson River to a private irrigator, and relocating the Kirk Ditch powerline that currently bisects the marsh to the forest boundary south of the project area.

1. ***Restoration of natural hydrology:*** The lower five miles of the river channel, west of the single channel in Alternative B leading to Military Crossing, would be well below marsh water elevations through most of the season and would exist within the “gaining reach” of the floodplain. The period of this inundation would be greater to the west and especially significant near Military Crossing. Thus, during most of the year much of the water in this western reach would likely not flow in the constructed channel but would move as overland flow through the marsh.

The restored riverine system and natural hydrology will be reconnected to the historic floodplain, sustaining a water table and hydrology that supports diverse wetland and riparian vegetation communities. Thus, impacts to habitats and species are similar to Alternative B, except there may be additional open water river channel exposed, particularly late in the summer or in dry years when marsh levels are reduced.

2. ***Provide diverse riverine, wetland, and riparian habitats driven by the natural hydrology of the Williamson River:*** Alternative C will provide a longer single channel compared to Alternative B, especially late in the summer or in dry years. Because anastomose channels are not constructed with this Alternative, there may be slightly less habitat diversity due to fewer of these habitat features. It is also possible that these habitat features may form naturally on the floodplain from the seasonal overflow of the stream bank. In terms of wetlands, Alternative C will provide some additional wetlands in the westward part of the project area, potentially adding more diversity to wetland habitats.
3. ***Provide habitats for native fish and wildlife and migratory birds with an emphasis on “sensitive” species:*** This alternative will provide a greater amount of single channel habitat for native fish including redband trout, particularly late in summer or in dry years when the river channel is extended further west by a reduced marsh water level. Anastomose channels will not be reactivated or constructed under this alternative resulting in less potential habitat for spotted frogs, although it is possible that anastomose channels may form naturally from overflow of the constructed stream bank. It is expected that wetland and riparian dependent wildlife species will benefit similarly as to Alternative B.
4. ***Fish passage:*** All 11 fish passage barriers would be removed under this alternative.

5. ***Sedimentation/erosion:*** Sedimentation and/or erosion is expected to be greater in the first several years following construction because the length of the constructed river channel is 10 miles long compared to 3 miles under the preferred Alternative B. However, movement and redeposition of sediment in the constructed channel will result in the creation of natural stream features. Sediment delivery from the upstream Williamson River is extremely low due to 1) the lack of suspended material and 2) the presence of a depositional bowl feature on the property upstream of the refuge. Evidence of low sediment delivery from upstream is illustrated in the canals on the refuge which have required no removal of sediment in at least the last 60 years.
6. ***Public controversy:*** This alternative would be consistent with the recommendations from stakeholders relative to restoration of the Williamson River; however, some individuals and local landowners may question the costs/benefits of this alternative. No impacts are anticipated relative to diversion of water for private lands. There may be some uncertainty as to how much haying will be allowed under this alternative.
7. ***Socio/Economic impacts:*** Construction of the additional seven miles of channel westward of the three miles proposed in Alternative B (preferred) would be expensive and of questionable value (see item 1 above). This alternative would create 2-3 years of varied work on the project, including stockpiling wood, heavy equipment operation, blasting, planting, tree growing, monitoring, research and surveys much of which would be contracted potentially providing additional money to the Klamath County economy. The additional funds required for alternative C would be greater than for the preferred alternative. In addition, this alternative would provide potentially more stream miles to a public recreational fishery. While this alternative will provide additional funding and recreational opportunity, its cost would come at an expense to conservation work that could be done elsewhere on the Refuge.

Alternative D – Anastomose channel only

Beginning where the Williamson River enters the Refuge, an anastomose channel would be constructed that would extend 1 to 2 miles. Existing drains and levees would be converted into complexes of depressional wetlands and ponds. Eleven fish barriers would be removed. Conversion of ditches and drains and levees into wetlands would be constructed to not impede surface water flow. This alternative would allow water during high flow events to flow at random across the floodplain toward Military crossing. There would be no riparian plantings under this alternative due to the likely movement of shallow channels during high flows. Additional activities include the installation of a fish screen for a diversion from the Williamson River to a private irrigator, and relocating a 6-mile long powerline that currently bisects the marsh to south part of the project area.

1. ***Restoration of natural hydrology:*** The natural hydrology of the refuge would be restored as water entering the refuge would be conveyed through a web of anastomose channels. The river and floodplain would be reconnected to sustain a water table and

hydrology that supports diverse wetland vegetation communities. These effects are similar to Alternatives B and C.

2. ***Provide diverse riverine, wetland, and riparian habitats driven by the natural hydrology of the Williamson River:*** Effects to wetlands on the floodplain will be similar to Alternatives B and C, at least in the west part of the project area. This alternative will result in less large channel riverine and associated riparian habitats compared to Alternatives B and C.
3. ***Provide habitats for native fish and wildlife and migratory birds with an emphasis on “sensitive” species:*** The diversity of habitat types for fish, particularly redband trout, would be less without a single threaded channel and constructed fish habitat (woody debris). Fish from the upper watershed may have less access to the refuge during low flows and higher temperatures. Other aquatic species, i.e., river otters, that use larger channels may not occupy the refuge area at all without deeper riverine habitat. During high flows in spring, the anastomose channels may provide additional habitat that could be beneficial to Oregon spotted frogs. However, after high flows, areas may dry out where egg masses are deposited, which would be detrimental to the species. The degree of this benefit will depend on the period of inundation of these channels which will be unpredictable due to water year dependence.
4. ***Fish passage:*** All 11 fish barriers would be removed under this alternative.
5. ***Sedimentation/erosion:*** Some sedimentation/erosion can be expected under this alternative resulting from construction and channel readjustment. However, as in B and C, the low gradient and soils are not expected to produce excessive movement of soil. The amount of erosion and sedimentation would be expected to be greater than B and less than C depending on the number of anastomose channels constructed and the number which form naturally.
6. ***Public controversy:*** In general, there is a low degree of controversy regarding river and wetlands restoration on KMNWR because it agrees with the recommendations from stakeholders over the last decade to do actions to improve the Williamson River reach flowing through the Refuge. Some individuals may question the lack of a single channel in this alternative and the reduced diversity of habitats for some species. This alternative has a potential to negatively affect the inholding of the adjacent landowners. Although his legal point of diversion on the Williamson River is maintained, uncontrolled flows from the anastomose channels may enter their property. In addition, this alternative would allow for little, if any, recreational fishing opportunities as contemplated in the KMNWR CCP.
7. ***Socio/Economic impacts:*** This alternative would create 1-2 years of varied work on the project, including heavy equipment operation, blasting, monitoring, research and surveys much of which would be contracted potentially providing additional money to the

Klamath County economy. The funds required would be less with alternative than alternative B or C. This alternative would provide little if any potential for a public recreational fishery in the project area, thereby minimizing the potential for additional recreational or wildlife observation activities. This alternative may impact the private landowner whose land would lie in the path of the natural anastomose channel formation by flooding of his pasturelands at potentially inappropriate times for agricultural use.

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Section V: COMPLIANCE, CONSULTATION AND COORDINATION WITH OTHERS

Compliance: Cultural Resource, Clean Water Act, Endangered Species, and Blasting Permit compliance are in the initial stages of discussion with the appropriate agencies/individuals.

Coordination:

Coordination with the Klamath Tribes is important because of their water, subsistence, and cultural resource rights on Klamath Marsh NWR. Coordination initiated by the Service with the Klamath Tribes prior and during development of the Environmental Assessment (EA) is as follows:

Klamath Marsh NWR personnel met with the Tribes in November 2012 at the Klamath Tribal Office to discuss the potential river project on Klamath Marsh NWR prior to the development of the EA. Attending were Will Hatcher, Kris Fischer, Tony LaGreca, Larry Dunsmoor of the Klamath Tribes, and Mike Johnson and Faye Weekley of Klamath Marsh NWR. A draft of this EA was provided to the Klamath Tribes on April 29, 2013 prior to the release to the general public on June 12, 2013. To solicit input from the Klamath Tribes, Refuge personnel held a field meeting at Klamath Marsh NWR on May 2, 2013. In attendance were Kris Fischer, Tony LaGreca of the Klamath Tribes, and Refuge personnel included Mike Johnson, Dave Mauser and Faye Weekley. Written responses to the draft EA were received from the Klamath Tribes on July 15, 2013.

Additional coordination through meetings, presentations, tours, site visits, consultations, phone calls and emails were made to the following individuals, agencies, and/or organizations:

Dave Rosgen, Wildland Hydrology, design consultation and review
Dr. Tim Mayer, U.S. Fish and Wildlife Service, Division of Engineering
David Bidelsbach, Stantec, Inc., Engineering Division
Anan Raymond, U.S. Fish and Wildlife Service, Cultural Resources Division
Carol Franson, U.S. Army Corps of Engineers
Bethany Harrington, Oregon Department of State Lands
Bill Tinniswood, Oregon Department of Fish and Wildlife
Chris Pearl, U.S. Geological Service
Sean Murphy, U.S. Geological Service
Eric Janey, U.S. Geological Service
Michael Edwards, U.S. Fish and Wildlife Service,
Michelle McDowell, U.S. Fish and Wildlife Service, Division of Migratory Birds
Chris Gabauer, Natural Resource Conservation Service, MLRA Soil Survey
Michael Harrington, Oregon Department of Fish and Wildlife
Steve Hayner, Bureau of Land Management
Mike Green, U.S. Fish and Wildlife Service, Division of Migratory Birds
Ken Popper, The Nature Conservancy
Jerry Cordova, U.S. Fish and Wildlife Service, Bend Field Office

Josh Murphy, Klamath Soil and Water Conservation District
Matt Barry, U.S. Fish and Wildlife Service, Division of Habitat Conservation
Kenny Knight, landowner adjacent to Klamath Marsh NWR
Scott White, Oregon Department of Water Resources, Watermaster
Jennifer O'Reilly, U.S. Fish and Wildlife Service, Bend Field Office
Carol Damberg, U.S. Fish and Wildlife Service, Sacramento Regional Office
TPC Ranch, adjacent landowner to Klamath Marsh NWR
Bruce and Penny Emory, adjacent landowners to Klamath Marsh NWR
Dave Mosby, landowner adjacent to Klamath Marsh NWR
Dan Blake, Klamath Falls Fish and Wildlife Office
Scott Shuey and family, adjacent landowners to Klamath Marsh NWR
John Hyde, landowner upstream of Klamath Marsh NWR
Hoda Sandosi, Klamath Falls Fish and Wildlife Office
Malcolm and Kae Doolan, adjacent landowners to Klamath Marsh NWR
Wendell Wood , Oregon Wild
Kris Fischer, The Klamath Tribes
Larry Duns Moor , The Klamath Tribes
Will Hatcher, The Klamath Tribes
Donnie Ratcliff, U.S. Fish and Wildlife Service, National Fish Passage Program
Dana Hicks, Oregon Department of State Lands
U.S Navy. Explosives Operation Division
Mike Lattig, Clearwater Native Plants
Tia Adams, Klamath Falls Fish and Wildlife Office
Frank Issacs, Oregon Eagle Foundation
Dr. John Ritter, Oregon Institute of Technology, Department of Geomatics
Kevin Rhode, Midstate Electric Cooperative
Jeff Rose, U.S. Fish and Wildlife Service, Division of Engineering
Dana Ross, entomology taxonomy
Bruce Taylor, Intermountain West Joint Venture/Defenders of Wildlife
Chris Gabauer, Natural Resource Conservation Service, MLRA Soil Survey
Gary Ivey, International Crane Foundation
Kyle Gorman, Oregon Water Resources Department

**U.S. Department of the Interior
Fish and Wildlife Service
Klamath Basin National Wildlife Refuge Complex**

FINDING OF NO SIGNIFICANT IMPACT

**Environmental Assessment for Restoring the hydrology of the Williamson River
and adjacent wetlands on Klamath Marsh National Wildlife Refuge**

The U.S. Fish and Wildlife Refuge proposes to restore the hydrology of the Williamson River and reconnect this hydrology to adjacent wetlands and riparian habitats on Klamath Marsh National Wildlife Refuge. The project is designed to restore 10,000 acres of a unique river and marsh ecosystem that is one of the largest and most pristine high-elevation marshes in the Intermountain west by creating a river channel using natural channel design and converting an existing irrigation system to floodplain wetlands. The restored hydrology will increase both frequency and duration of floodplain inundation from bankfull overflow thereby connecting riverine, wetland and riparian habitat complexes with the floodplain. Habitats will be restored for resident fish and wildlife and migratory species with an emphasis on sensitive species such as yellow rails, Oregon spotted frogs and sandhill cranes. The current marsh hydrology is controlled by structures, incised drains, levees and split flows. Artificial diversion of water required to maintain wetland habitats is delivered through a 5-mile linear drain and 5 additional miles of multidirectional leveed drains that compromise subsurface flow and wetland interconnectedness. Current wetland hydrology is further impacted by accelerated movement of water through the marsh via the drains, overbank flow prevented by 20 miles of levees, and reduced flows available for seasonal wetland cycles. Additional tasks proposed involve the removal of 11 barriers that prevent the passage of fish and aquatic life from moving upstream, and the relocation of 6 miles of powerline that bisect the refuge. The existing irrigation infrastructure limits the hydrology of the floodplain from functioning to support vegetation communities which benefit fish and wildlife.

Decision

Following review and analysis, the USFWS selected alternative 3 as the proposed action for implementation because it is the alternative that best achieves the purpose and need.

Alternatives Considered

Alternative A: No Action

Under Alternative A, the No Action Alternative, we would not take any action and continue water management of the refuge with the existing infrastructure.

Alternative B: Construct a 3-mile single thread channel merging into anastomose channels (preferred alternative)

Under Alternative B, a 3-mile single thread channel merging into anastomose channels with wetland enhancement (preferred alternative).

Alternative C: Construct a 10-mile single thread channel

Under Alternative C, a 10-mile single thread channel would be constructed with wetland enhancement.

Alternative D: Construct and anastomose channel

Under Alternative D, an anastomose channel would be constructed with wetland enhancement.

Selection of the Proposed Action, Alternative B

Alternative B was selected over the other alternatives because it provides the combination of optimum hydrologic restoration and the greatest diversity of fish and wildlife habitats for native and migratory species. This alternative includes high quality large channel habitat, instream wood, backwaters, and provides the greatest opportunities to evaluate re-colonization of Oregon spotted frogs (petitioned for listing as threatened) after hydrologic restoration.

Implementation of the preferred alternative would be expected to result in the following environmental and socioeconomic effect:

Environmental

Hydrology is restored within single 3-mile meandering natural channel, anastomose and backwater channels and the reconnected floodplain wetlands and riparian habitats. The creation of naturally functioning meandering river channel will provide benefits to aquatic fish and wildlife, including lower temperatures in summer, increasing aquatic and riparian vegetation for cover, varied depths and increased macro-invertebrates. Overbank flow, increased water table, increased diversity in depths, decreased fluctuations in water levels from diverting flows and connectivity with floodplain wetlands are beneficial to vegetation communities and wildlife communities. Wood toe structure and log placement in the river channel will provide cover and habitat for redband trout and other native fish, otters, and reptiles. The functional riparian zone in the restored river and wetland habitats will benefit aquatic, terrestrial, native and migratory species, including waterfowl, shorebirds, rails, cranes, otters, beavers, frogs, snakes, and native fish. Greater diversity in wetland habitat levels will benefit seasonal wetland vegetation response and benefit nesting species such as yellow rails and sandhill cranes to provide varied elevations throughout the nesting season to accommodate different water year levels. Opportunities to evaluate the Oregon spotted frog re-colonization of diverse habitats after restoration will benefit future habitat planning for other restoration projects in areas with habitat for Oregon spotted frogs. An increase in migratory bird stopovers should result from an increased and more diverse wetland habitat in spring. Moving the powerline will reduce the potential for bald eagle loss as well as enable a more natural functioning hydrology. Removal of fish barriers will enable

upstream movement of native fish. Installation of a fish screen will reduce the entrainment of fish in the fields of the private irrigator.

Socioeconomic

The increase in use by migratory birds and improved fish habitat will benefit public use for bird watching and the Williamson River fisheries. Improved fish habitat will be beneficial to the Williamson River fishing interests. Expenditures of restoration funding will be beneficial to the Klamath County economy. Some uncertainty will occur relative to the extent or area for hay cutting by adjacent ranchers.

Measures to mitigate and/or minimize adverse effects have been incorporated into the proposal, including:

Construction Activities

Construction (mechanical) activities will observe proper management of fuels, stockpile areas, minimal road construction, minimal wetland impacts, and the use of specified spoils locations. Construction equipment will be steam cleaned prior to entering the refuge to prevent the import of weeds. Construction (blasting) will observe regulations regarding delivery and storage of explosives, only daytime operations, the use of professional blasters, observe distance from human dwellings, avoid blasting in areas potentially harboring Oregon spotted frogs, only allow certified blasting personnel within the blast zone.

Soil, Water Resources and Vegetation

When working in waterways, silt fences and other measures will be observed to reduce impacts on water quality. Measures will be observed to minimize the number of roads and compacted areas during construction. Spoils from excavation will be placed in predetermined spoils areas. Staging areas for wood will be predetermined to minimize vegetation disturbance. Areas excavated for sod mats will be treated (watering, seeding or protection) to discourage disturbance resulting in weeds. Seeding and planting will occur in areas disturbed from construction.

Wildlife

Construction will be done outside of the nesting season. When working in active waterways, work will occur during the in-stream work period unless a waiver is issued by ODFW. Areas will be searched for wildlife before heavy equipment is mobilized or equipment is operated or before blasting.

Cultural Resources

Prior to all construction, cultural resources in all areas will be identified and avoided. If

unrecorded cultural resources are discovered during construction, all work will stop in the vicinity until a USFWS Archeologist and Klamath Tribal Archeologist surveys and records the location.

The proposal is not expected to have any significant effects on the human environment because:

The project will restore the natural hydrology of the Williamson River and associated wetland and riparian habitats. The restored river and wetland system will benefit the natural diversity and abundance of native fish and wildlife species. The location of the project is primarily within remote wetland habitat remote and not close to homes. No blasting will occur near Silver Lake Road, the only area near human dwellings.

The proposal has been coordinated with all interested and/or affected parties. Parties contacted include:

Neighbors to the Refuge and permittees, the Klamath Tribes, and local agencies, and environmental groups.

Public Availability

The EA was made available for public review and comment from 12 June 2013 through 12 July 2013. The document was posted on the Refuge Complex website and the public was notified of its availability through public notice in local newspapers. Additionally, notices were sent via U.S. mail to local agencies, landowners adjacent to the Refuge, and the Klamath Tribes. 4 comment letters were received. Our responses to the final comments are included in the final EA.

Conclusion

Based on review and evaluation of the information contained in the EA, it is my finding that the proposed action, Alternative B, does not constitute a major federal action significantly affecting the quality of the human environment, within the meaning of section 102(2)(C) of the National Environmental Policy Act of 1969, as amended. As such, an environmental impact statement is not required.

This Finding of No Significant Impact and supporting EA are on file at the U.S. Fish and Wildlife Service, Klamath Basin National Wildlife Refuge Complex, 4001 Hill Road, Tulelake, California 96134. These documents are available to the public and can be found on the Internet at http://www.fws.gov/refuge/Tule_Lake. Interested and affected parties will be notified of this decision through a news release.

COMMENTS

Upon the completion of the draft EA, several tours were led, presentations were given, and it was released to the public for comment June 12, 2013. Below is a summary of comments received from the draft EA and the responses to the comments.

A. Water History, Flow, Levels,

A1. Comment: An interpretive summary would be helpful for the historical section in Section III, Affected Environment, regarding the change in the percentage of open water habitat since 1900.

Response: Comment noted and interpretive summary added on page 20.

A2. Comment: A water user asked if downstream water users would be impacted by changes in flow available downstream during the construction period or after project implementation.

Response: Although water management in the project area may change during construction, the amount of water moving through Military Crossing would remain the same thus not impacting downstream users.

A3. Comment: How would channel inundation and channel processes function?

Response: The historic landform data indicates that the proposed channel location lies on a broad, low grade, poorly drained delta plain. The delta plain extends 8,000 feet west from Silver Lake Road, with a gradient of 0.002, a drop of 12 feet, and the remaining 17,000 feet of floodplain to Military Crossing has a gradient of 0.0001, a drop of 3 feet. Sediment loads contributed from the upstream Williamson River are extremely low. Creating channels with appropriate dimensions and sinuosity without leveed banks will maintain a water table elevation in the floodplain at the water level of the river channel(s). This has been demonstrated in these soils by water level loggers installed on the refuge, as well as in non-leveed depressional features in the entire project area demonstrating lateral movement within the soils.

The soil profiling conducted in the project area by NRCS in October, 2013, (Christopher Gebauer, Soil Scientist, MLRA Leader, preliminary report) described "alternating layers of silts and sands in the delta plain, in addition to the complex, undulating surface relief, influences the surface hydrology. The majority of the soils on the delta plain are poorly drained. Piezometer data from around the marsh indicate that in the upper 200 cm of the soil profile, water tables throughout the refuge begin to rise in the late fall, prior to significant inputs of precipitation, peaking in spring, and dropping in mid to late summer. Water coming into the delta plain area from the Williamson River overflow would be in addition to, and likely later than, the rise in ground water. The diatomaceous silts in the soil profile have a very slow saturated

hydraulic conductivity, and act as an aquatard.

In the wetter soils to the west, beyond the delta plain, there is a layer of organic and diatomaceous silts over the top of coarse, pumaceous sands. The coarse sands have a very high saturated hydraulic conductivity, so that water moves through them very quickly. The water in the subsurface sands is typically artesian, held under pressure beneath the surface silt layers under shallow, standing water.

Up-stream in the Williamson River valley (to the east of Silver Lake Highway, on private lands), the soils also differ from the complex, stratified soils seen on the delta plain, further highlighting the uniqueness of the soils found in the delta plain area. Immediately upstream of the delta plain, the valley broadens out, and the soils have less stratification of silts and sands, indicating either that the “repeated overflow of the Williamson River” was not as common or as wide-spread upstream as on delta plain, or that the energy was more quickly dissipated over the broader, less confined valley.

A4. Comment: Does further topographic alteration of the marsh create a high risk for lowering the local water table?

Response: The current irrigation/leveed channel system acts as a shuttle to transport water to specific areas in the shortest possible timeframe. Removing the levees and allowing the water in channels to laterally move through the delta plain would greatly expand the extent of lateral flow within the floodplain from the current confined flow, and would greatly likewise increase the time the water would be retained in the floodplain. Creating channels with appropriate dimensions and sinuosity and without leveed banks will maintain a water table elevation in the floodplain at the water level of the river channel(s). This has been demonstrated in these soils by water level loggers installed on the refuge in the project area, as well as in non-leveed depressional features in the entire project area demonstrating lateral movement within the soils. Further, when the existing ditches and drains are converted to wetlands with the levees removed, water will not be able to move quickly out of the project area as is the existing system of linear ditches. The local water table will be increased with the removal of levees, conversion of linear drains to wetlands, and adding meanders to created channels.

A5. Comment: At this low gradient, we are concerned the channels will fill in over time?

Response: There are extremely low sediment loads in the Williamson River entering the refuge. The existing waterways on the refuge have never needed maintenance to remove sediment, even with split flows during high flow events. This includes the Williamson River reach below headquarters which is backed up for the diversion dam. For the first 3 miles of alternative B and C, the channel capacity will be less than the current channel capacity of the headquarters reach, which will further reduce potential of sediment loading. For the alternative C in the west part of the project, there may be some sediment

deposited in the years following construction.

- A6. Comment:** In Alternative C, the 10 mile channel, we are concerned that some of the channel would be inundated after drains and levees are converted to wetlands.

Response: During high water years during peak flows, it is likely that channels will be inundated, particularly in the western part of the project area.

B. Blasting and Frogs

- B1. Comment:** We are concerned that blasting may have the potential to harm Oregon Spotted Frogs (OSF).

Response: Blasting activities in the Klamath Marsh soils have been determined to be most efficient when conducted where the soil is saturated to the surface. Areas potentially harboring frogs (OSFs and Pacific Tree frogs) including ditches and ponded or standing water, are not sites where blasting would occur. Additionally, spoils from the blast can be directed to specific areas of the floodplain to avoid contact with watered areas harboring frogs. The Service believes that harm to OSFs is unlikely when blasting under these conditions.

- B2. Comment:** We are concerned that blasting will create only straight-sided ponds that would not be suitable habitat for Oregon spotted frogs (OSF) without sufficient depth and variability on the fringe for breeding and rearing as in Fig. 3 and 4.

Response: Fig. 4 showed typical "channel" riffle design dimensions compared to actual blasted dimensions. This would not represent typical "pond or wetland" dimensions that would be created for OSFs. One of the objectives for holding blasting trials in fall, 2012, was to determine how precise the dimensions could be achieved using blasting excavation techniques in the Klamath Marsh soils. We evaluated the level of precision for width, depth, inner berm, thalweg, fringe shelves, and bank angle, as well as determining the angle and direction for projecting spoils from the blast site and how far.

Dimensions were created within 5 inches of the prescribed channel design (Fig. 4). Note the difference of the vertical and the horizontal scales (1 ft: 10 ft). Trial blasts covered depth ranges from 1 - 8 feet and width ranges of 3 - 35 feet. It was also demonstrated that spoils can be directed to specific areas of the floodplain to enable the creation of tight meander bends to achieve the desired channel form. Wetland/pond design dimensions targeted for OSFs are being developed with Christopher Pearl of the U.S. Geological Survey (USGS), Corvallis, Oregon, based on a decade of research on OSF habitat, including local projects at Jack and Crane creeks.

- B3. Comment:** We are concerned that blasting will create large, deep water areas that would

attract bullfrogs.

Response: As described in Response C2 above, blasters have the ability to blast precise dimensions for wetlands and channels. No large, deep wetlands are planned. The dimensions for the wetland designs that are being developed with Christopher Pearl of USGS will incorporate habitat needs for Oregon spotted frogs, which do **not** include large, deep water areas. Dimensions will include varying depths and topography, shelf width and shelf depth to encourage specific vegetation establishment, various types of wetlands, including flow-through, overflow, off-channel, instream, plus both seasonal and permanent wetlands. Fortunately, Klamath Marsh has had no reports of bullfrogs for several decades.

C. Large Wood

- C1. Comment:** Does large wood naturally occur in the system? It seems like functional cover and complexity could be achieved with vegetation natural to the system rather than the large expenditures that would be required by placing LWD.

Response: Wood has floated into the refuge headquarters channel reach from the Upper Williamson River and lodged in the streambank. This naturally recruited wood provides diverse structural instream habitat used by otters, waterbirds, snakes and as cover for fish. The majority of the instream cover and shade provided in this system is from overhanging and instream sedge vegetation and undercut banks, but those unique areas of woody structure provide additional diversity.

Tree communities upstream on the Williamson River and adjacent floodplain vary in species, age, and distance from the river. Mature stands of ponderosa and lodgepole pine are generally found greater than 20 feet from the riverbank. Windstorms resulting in blowdown create recruitment material for floods, but trees are likely lodged or dropped within a limited number of meander bends due to the narrow and uneven floodplain. Most of the logs in the Refuge Headquarters reach of the Williamson were deposited prior to 2000. Since natural recruitment of wood is unlikely, prescribed wood placement will be necessary.

Two types of woody structures are planned for instream fish habitat for the first 3 miles of the Williamson River single channel, alternatives B and C. The first, toe wood structure is a bank treatment that will include an engineered design to incorporate limbs, logs and branches into the outside meander bend of the lateral scour pools of the Williamson River. This treatment focuses on the lower one-third of the meander bend and replicates the roots of an established tree of other woody vegetation. These are built to be undercut and produce excellent fish habitat, as well as bank protection valuable for newly constructed streams during the first few years of revegetation. This treatment would be limited to every 6th outer meander (totaling 7) with a focus on the tightest design radius of curvatures. Structures will be covered with sod mats from the site. The

woody debris will be installed to be over 90% below the low flow water surface elevation, to insure that the wood will stay submerged and not decay at an accelerated rate due to cycling of aerobic and anaerobic conditions. The second type of woody structure, logs, will be strategically placed along the streambank, 3/4 submerged at angles beneficial to the conditions at that specific site within the stream. All the wood needed for the project is available nearby on the refuge within a mile. Removal of this wood on the refuge is covered in a previous EA, KMNWR Fire Hazard Reduction and Wildlife Habitat Enhancement Project, Final EA, March 21, 2003.