Cooperative Restoration of Tribal Trust Fish and Wildlife Habitat in Lower Klamath River Tributaries

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Table of Contents

Table of Contents

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Figures

List of Tables

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Wiley assisting with field surveys at the mouth of Blue Creek, Lower Klamath River.

SCOTT CHARLES GIBSON 1978 – 2008

This report is dedicated to Scott Charles Gibson, who passed away unexpectedly in 2008. Scott worked for the Yurok Tribal Fisheries Program for nearly a decade. He was very passionate about his culture, the Klamath River, and the fish and wildlife of the area. He grew up in Mynot Creek near the Klamath River estuary and explored every inch of the lower river. Scott always shared his passion for the river and his knowledge of the area to anyone interested. It was such a pleasure and honor to be his field partner! Scott shared so much about his life on the river, he never got you lost, he always figured a way to rig the jet boat after breaking down upriver, and his smile was contagious. We miss him dearly and we'll carry him in our hearts always! AHOOO – Captain Scotty G!!

Introduction

Yurok People inhabiting the Klamath River have relied on the resources of the area for their subsistence, cultural, and economic livelihood since time immemorial. The Yurok Tribe is the largest aboriginal tribe in California with over 5,000 enrolled members. The Yurok Tribe's Territory consists of ~320,000 acres of Ancestral Lands including the ~63,000 acre Yurok Indian Reservation (YIR). The YIR, created by federal actions between 1853 and 1891, comprises an area one mile wide on each side of the Klamath River, from just upstream of the confluence with the Trinity River at Weitchpec, California; to the confluence with the Pacific Ocean (Figure 1). A majority of the YIR and Lower Klamath River Sub-basin (LKRSB) is owned by Green Diamond Resource Company (GDRC) and managed for industrial timber harvest. The remainder of the LKRSB is owned by private individuals, the state and federal government, and tribal entities (Figure 1).

Central to the Yurok People is subsistence harvest of Klamath River fish populations. Anthropogenic activities in combination with large flood events occurring over the last 150 years has drastically impaired aquatic and riparian habitats and altered natural flow regimes resulting in substantial declines to Klamath Basin fish runs. In the Klamath River, all runs of chinook salmon, green sturgeon, and Pacific lamprey are on the decline and coho salmon are listed as "threatened" under the Endangered Species Act. Given the sacred connection of the Yurok People with the fisheries resources of the basin, the Yurok Tribal Fisheries Program (YTFP) was established to restore LKRSB habitats to levels that support viable, self-sustaining, native fish populations.

To address this long-term objective, YTFP works with restoration partners, including other Tribal Departments, state and federal resource agencies, small-scale agricultural producers, and private landowners, to assess, identify, and treat factors limiting anadromous fish in the LKRSB. Initial restoration planning efforts included developing the Lower Klamath Sub-Basin Watershed Restoration Plan that prioritized upslope restoration and identified tributary specific restoration objectives for each LKRSB tributary (Gale and Randolph 2000). LKRSB restoration objectives included: 1) reducing sediment inputs from upslope sources by treating high priority watershed roads; 2) restoring native, conifer-dominated riparian forests; and 3) enhancing freshwater aquatic habitats. Since 2000, YTFP and the Yurok Tribe Watershed Restoration Program (YTWRP) have been working cooperatively with our restoration partners to implement the LKRSB restoration plan and meet program objectives.

The LKRSB restoration plan took a top-down approach, where upslope sediment sources were prioritized and treatment of these sources is on-going. Recently, YTFP has focused on improving LKRSB tributary valley conditions and the Klamath River estuary. Many small-scale ranchers and farmers operating in these biologically important areas have experienced loss of lands and infrastructure due to excessive channel aggradation, channel widening, and bank erosion related to land management activities and large flood events. YTFP has been establishing working partnerships with a few local producers to protect their lands while enhancing aquatic and terrestrial habitats for Tribal Trust fish and wildlife populations. Relationships such as these are critical to the long-term restoration of the LKRSB.

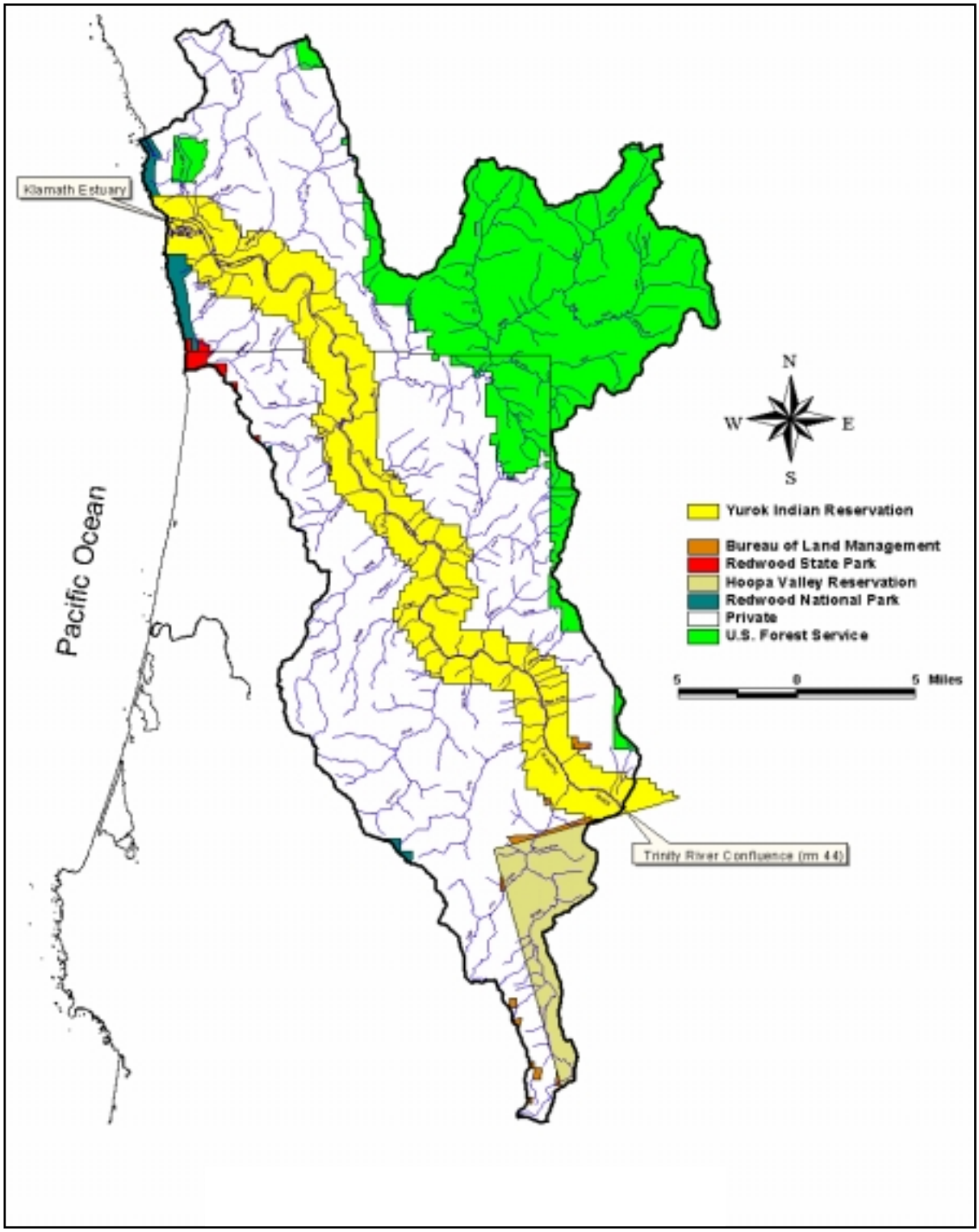


Figure 1. Map depicting landownership in the Lower Klamath River Sub-basin, California.

While treatment of site level problems such as eroding pastures and protecting associated infrastructure has been worthwhile; more comprehensive watershed restoration plans needed to be developed for priority LKRSB tributaries. Therefore, YTFP coordinated funding from the Natural Resources Conservation Service (NRCS), the Bureau of Reclamation (BOR), and the CDFG's Fisheries Restoration Grant Program to continue collecting critical hydrologic and geomorphic information in four priority LKRSB tributaries: Salt Creek, Hunter Creek, Terwer Creek, and Blue Creek (Figure 2); and develop potential restoration strategies.

Assessment and planning efforts were conducted from July 2006 – March 2008 and primarily focused on the lower valley reaches of the four LKRSB watersheds. We collected historic information and baseline data to 1) characterize conditions currently limiting fisheries and riparian habitats; and 2) develop watershed enhancement recommendations and strategies aimed at providing long-term geomorphic solutions for identified limiting factors. Another primary objective was increasing Tribal capacity for engaging restoration partners, small-scale producers, and local landowners in LKRSB assessment and planning activities. This project also provided quality employment opportunities and technical training to Yurok Tribal staff including geomorphic mapping, total station surveying, and surface water and groundwater monitoring experience. Additionally, the data collected serves as critical baseline information and provides a quantitative means to document changes to these habitats over time and assess the effectiveness of future restoration in these watersheds.

Partner and Stakeholder Meetings

A major component of this project was to coordinate our watershed assessment and restoration planning activities with landowners, small-scale producers, and stakeholders. YTFP has been building restoration partnerships in the LKRSB for over a decade. In 1995, the Yurok Tribe helped form the Lower Klamath Watershed Restoration Partnership with GDRC, California State Coastal Conservancy, and the Northern California Indian Development Council to address state and federal mandates by developing innovative solutions to resource management issues. This partnership has allowed YTFP and other Tribal Departments to conduct physical and biological monitoring and assessments, watershed improvement projects, and road decommissioning activities on GDRC lands.

GDRC owns property in all four of the LKRSB watersheds we assessed and therefore we coordinated with their resource staff on a fairly regular basis during this project. Several small-scale producers live and raise cattle in the valley reaches of Salt Creek, Hunter Creek, and Terwer Creek. Therefore, YTFP focused a great deal of energy coordinating with priority producers in these watersheds. A majority of the area assessed in Blue Creek is owned by GDRC; therefore, we concentrated our outreach efforts on GDRC resource staff. YTFP began engaging pertinent landowners and producers in the Salt Creek and Hunter Creek watersheds in summer 2001. Following initial watershed investigations, YTFP re-initiated landowner outreach activities in these watersheds in 2005 – 2006. YTFP organized several scoping meetings with these landowners to introduce project objectives; discuss assessment methods and potential restoration strategies and benefits; and to obtain their input. Increased flooding (i.e. duration and magnitude) was a priority concern of landowners

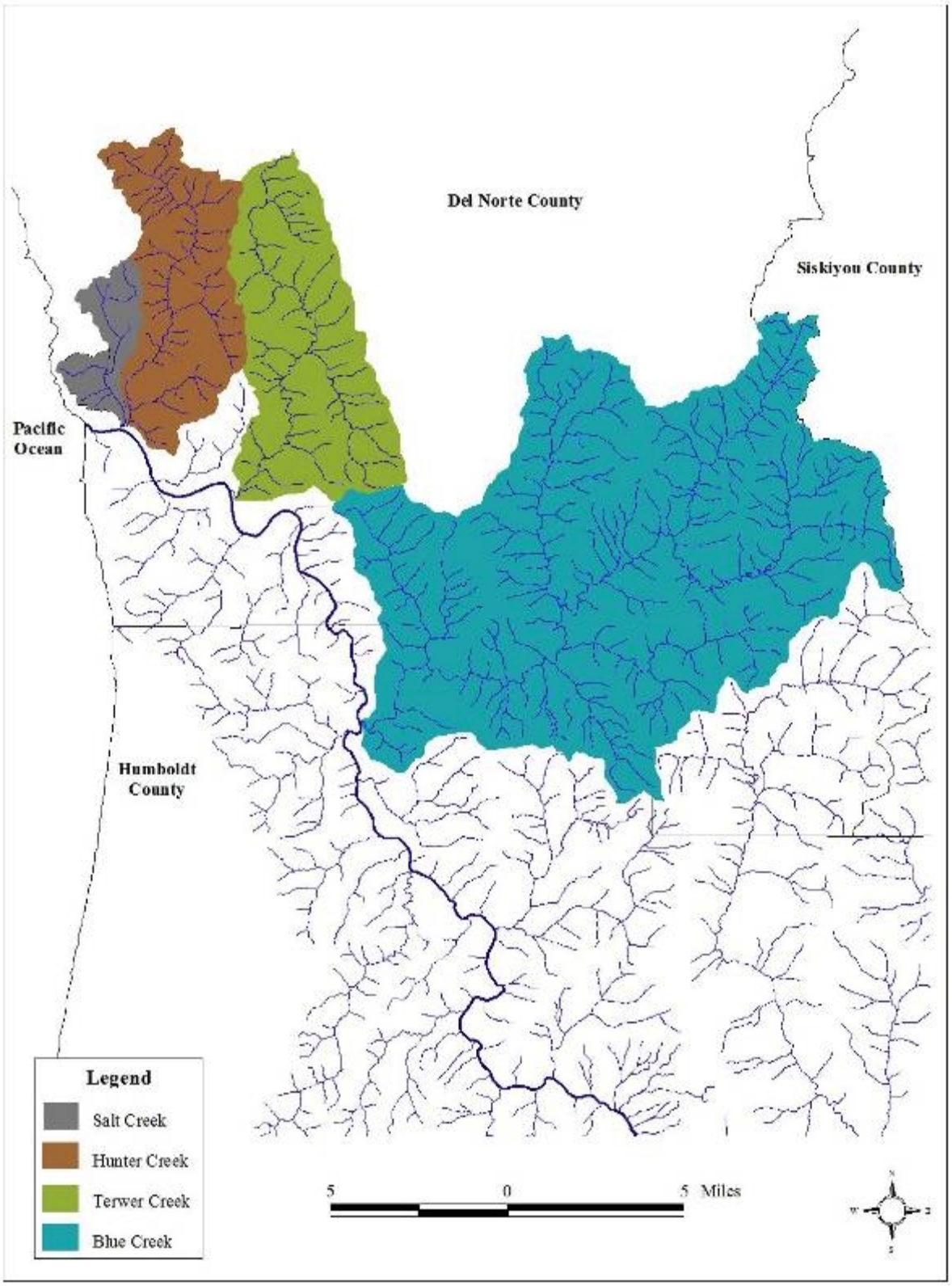


Figure 2. Map depicting four priority watersheds assessed by the Yurok Tribal Fisheries Program in 2006 - 2008, Lower Klamath River Sub-basin, California.

living in High Prairie Creek. These landowners were concerned that aggradation occurring in lower High Prairie Creek was resulting in increased flooding of their lands. Therefore, YTFP specifically addressed this concern and developed conceptual restoration alternatives that would result in increased water and sediment storage in the vicinity of the High Prairie Creek confluence with the intention of reducing flooding impacts to local residents and property.

California Department of Transportation (Caltrans) plans to elevate the grade of U.S. Highway 101 and replace multiple stream crossings along a portion of the highway located near the Klamath River estuary. The project, known as the Klamath Grade Raise (KGR), currently remains in the planning and scoping phase. The Klamath River estuary and its associated habitats are of great cultural and economic value to the Yurok People and critical to the survival of Klamath Basin salmonids and lamprey. Therefore, YTFP has been coordinating closely with CalTrans to provide spatial and temporal fish distribution information for their project area; discuss the potential impacts to Tribal Trust fish populations and their habitats; promote construction strategies that limit impacts to fish and wildlife; and develop strong wetland mitigation projects in the vicinity of the estuary to further reduce impacts related to the KGR.

YTFP organized a field tour of lower High Prairie Creek and Salt Creek on September 12, 2006 with the following project partners: Rocco Fiori, Fiori GeoSciences (FGS); Kevin McKernan, Yurok Tribe Environmental Program (YTEP); and Jack Miller, (Caltrans). YTFP presented an overview of the environmental issues of concern and discussed potential restoration options for the confluence reach of High Prairie Creek and Salt Creek. Top priorities were to obtain input regarding wetland protection and management and to discuss how best to protect existing infrastructure (i.e. U.S. Highway 101 and private property) while improving conditions for fish and wildlife.

On September 27, 2006, YTFP, Rocco Fiori (FGS), and Monica Hiner (YTEP) attended a meeting with the KGR Project Development Team (Caltrans) and other resource agency staff to discuss the following issues: 1) design alternatives for the proposed water crossings; 2) how best to minimize impacts to fish, wildlife, and wetland habitats; and 3) project mitigation. Mitigation for this project will include a combination of constructing new wetland habitats and enhancing existing wetlands. One option discussed was allowing the Yurok Tribe to use mitigation funds to purchase lands and be responsible for the prescribed wetland creation and/or enhancement. YTFP continues to work closely with CalTrans environmental and mitigation specialists to develop KGR mitigation strategies in priority areas (i.e. close proximity and hydrologic connectivity to the estuary). This report will be extremely useful for developing potential wetland mitigation strategies for the KGR.

YTFP and Rocco Fiori (FGS) met with U.S. Fish and Wildlife staff (USFWS) for a field visit of lower High Prairie Creek and Salt Creek on January 16, 2007. YTFP presented an overview of the area and the proposed restoration alternatives and strategies. USFWS provided critical insight regarding the environmental setting and the potential benefits and risks associated with proposed restoration alternatives. We also discussed potential restoration funding options. In March 2007, YTFP and FGS finished a preliminary report detailing assessment and monitoring efforts in the Salt Creek watershed and presented

several restoration alternatives for the confluence reach of High Prairie Creek and Salt Creek. YTFP and Rocco Fiori (FGS) met with CDFG staff to discuss the results of the geomorphic assessment of Salt Creek and introduce the proposed restoration alternatives. CDFG provided valuable input regarding potential funding sources and regulatory compliance. YTFP also distributed the watershed report to other Tribal Departments, landowners, several federal and state resource agencies, and CalTrans. The report was finalized in May 2007 after receiving feedback from multiple resource partners (Beesley and Fiori 2007a).

In May 2007, YTFP also re-initiated discussions with a local Hunter-Salt valley producer to share the results of the recent Salt Creek and High Prairie Creek assessment; and to discuss the potential of constructing off-channel habitats on his property. We met numerous times with this producer and continue to work towards finding mutually beneficial salmonid restoration opportunities in this critically important area. Creating off-estuary rearing habitats for Klamath Basin salmonids is a top priority for YTFP; therefore we focused a great deal of attention towards the Hunter-Salt valley during this project. YTFP will continue expanding public outreach efforts in the Hunter-Salt valley to ensure assessment and restoration planning activities meet long-term resource and stakeholder objectives.

YTFP has been coordinating with GDRC and small-scale producers in Terwer Creek to implement bank stabilization and riparian enhancement projects since 2004. The objectives include developing and implementing mutually agreed upon strategies that result in benefits for willing participants and provide improved conditions for wildlife and aquatic dependent species. This study allowed YTFP to continue and expand our landowner outreach and effectiveness monitoring activities in this priority LKRSB watershed. During this project, YTFP conducted several scoping meetings with a local producer, CDFG, USFWS, and National Oceanic and Atmospheric Administration (NOAA) regarding on-going and future restoration implementation and effectiveness monitoring activities in Terwer Creek. We also held several informal meetings with another Terwer Creek producer operating a ranch downstream of our current work sites in Terwer Creek. We will work with this producer over the next year to try and develop mutually beneficial projects to enhance their existing operation and provide improved conditions for Tribal Trust fish and wildlife. YTFP has been successfully implementing these types of cooperative projects in Terwer Creek since 2004.

Salt Creek

Salt Creek is the lower-most anadromous tributary to the Klamath River, entering the estuary less than one mile upstream of the Pacific Ocean (Figure 3). The watershed is comprised of a diverse range of habitats including the deep ponds and shallow marshes of Salt Creek (Figure 4) and the alluvial reaches of High Prairie Creek (Salt Creek's major tributary) (Figure 5). Salt Creek provided a unique opportunity to examine conditions affecting salmonid habitats in an off-estuary watershed affected by beaver activity, wetland expansion, agricultural use, and upslope land use activities that result in excessive sediment yield. YTFP has produced

Figure 3. The Salt Creek watershed, Lower Klamath River Sub-basin, California (Base image: portions of the 2005 NAIP imagery, 1 meter resolution).

Figure 4. Photographs of the channel and marsh habitats of Salt Creek, Lower Klamath River Sub-basin, California (2002 - 2003).

Figure 5. Photographs of a large wood accumulation in High Prairie Creek, Lower Klamath River Sub-basin, California (2004).

two comprehensive assessment and restoration planning studies for the Salt Creek watershed (Beesley and Fiori 2004; Beesley and Fiori 2007a). Therefore, this section will focus on the restoration recommendations developed from past and on-going studies and stakeholder input. For this report, we are only presenting conceptual restoration recommendations and alternatives. YTFP continues to coordinate with stakeholders in this watershed to develop and implement mutually beneficial restoration designs.

Salt Creek Recommendations

High Prairie Creek

A priority restoration objective for High Prairie Creek is to reduce impacts associated with upslope sediment sources and channel stored sediment. Future restorative efforts need to focus on reducing sediment production and delivery to the critically important wetlands located in Salt Creek. A watershed level road assessment should be conducted in High Prairie Creek to document existing and potential road related impacts to stream habitats and prioritize road decommissioning. Road removal projects conducted in this watershed should employ full recontouring techniques where slope stability allows. This method provides both sediment reduction and hydrologic recovery of the groundwater system while other less intensive treatments only provide sediment reduction. Road removal projects that improve groundwater recovery would likely result in increased summer base flows and improved rearing conditions for juvenile coho salmon and other aquatic dependent species. Decreasing the hydrologic linkages between roads and the surface-groundwater system in coastal watersheds has become increasingly more important due to the effects related to global climate change (i.e. increased air temperatures, reduced annual snow accumulation, and decreased summer snow melt runoff events).

Another priority restorative action for High Prairie Creek includes protecting and enhancing large wood accumulations in the fluvial corridor of this drainage (Figures 5 – 6). These large wood accumulations retain significant amounts of channel stored sediment, meter sediment delivery to downstream habitats, and facilitate the formation of complex stream and riparian habitats. Although many of the large wood accumulations identified by Beesley and Fiori (2004) hindered fish passage at low flows, the benefits provided by these structures is essential to the existence and maintenance of the anadromous habitats in High Prairie Creek and the wetlands located in Salt Creek. Protecting and enhancing large wood accumulations within the fluvial corridor and addressing road related impacts in this drainage should alter sediment delivery and storage dynamics and facilitate the long-term success of future stream and wetland restoration programs.

The Yurok Redwood Experimental Forest (YREF) is a 1.46 square mile U.S. Forest Service research area located in High Prairie Creek. The YREF was established in 1940 to conduct silvicultural research on coastal redwoods (Figure 7) (USFS 1990). Approximately 45 percent of the experimental forest was clearcut between 1956 and 1985. However, a research and natural area was established in the YREF that comprises 16 percent of the total forest area. Ecological survey data for the research and natural area is presented in Taylor (1982).

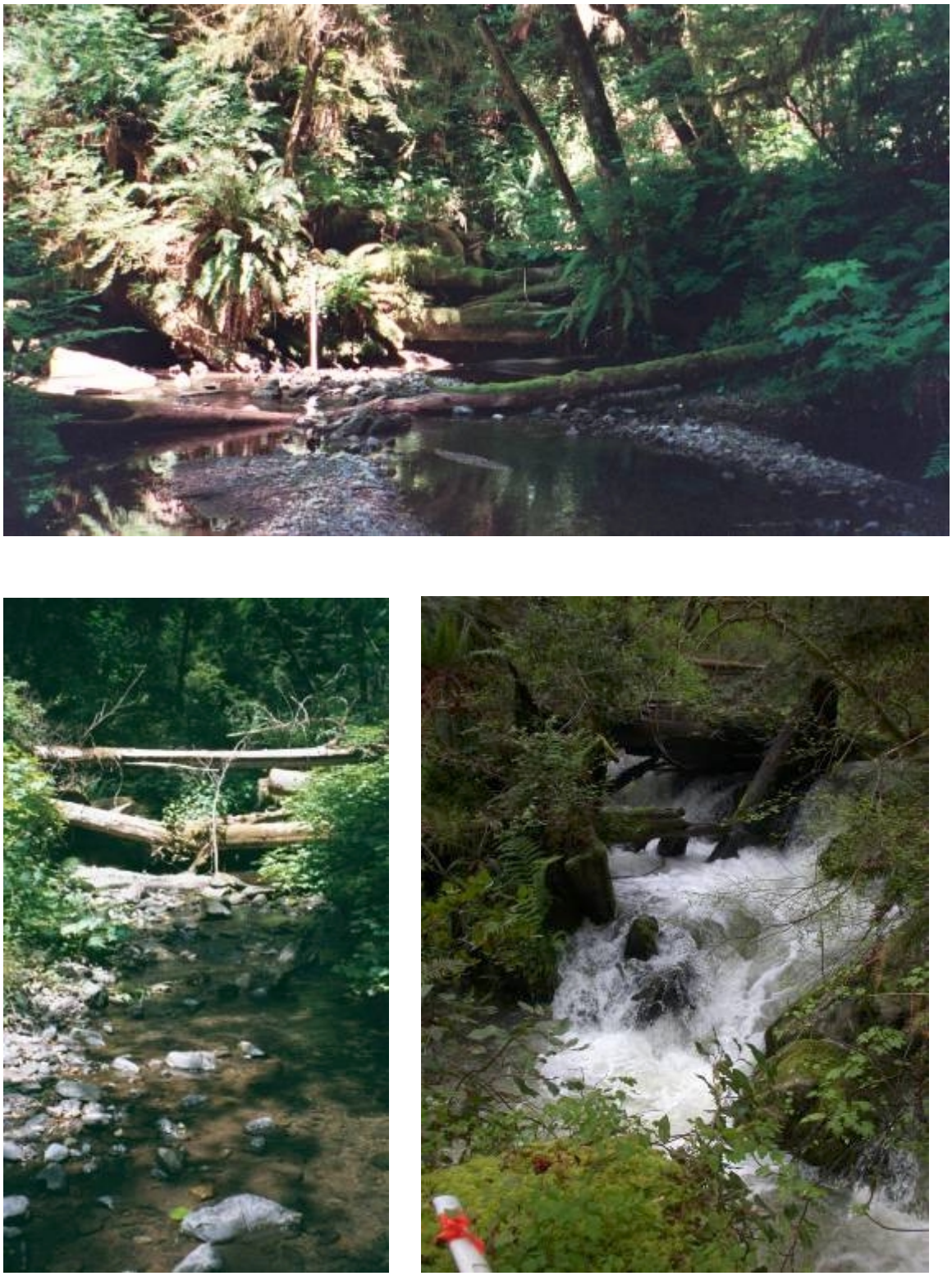


Figure 6. Examples of large wood accumulations located in High Prairie Creek, Lower Klamath River Sub-basin, California (2002 – 2003).

Figure 7. Mature conifer stands of the Yurok Redwood Experimental Forest located in High Prairie Creek, Lower Klamath River Sub-basin, California (2004).

This natural area should remain protected and the YREF should continue providing watershed research and aquatic and terrestrial enhancement opportunities.

High Prairie Creek and Salt Creek Confluence

Beesley and Fiori (2007a) presented treatment alternatives for the confluence of High Prairie Creek and Salt Creek that ranged from taking no action to implementing large-scale stream and wetland enhancement (Figure 8). The wide range of alternatives continues to allow YTFP to account for multiple factors including existing infrastructure, landowner concerns, and permitting requirements; and to consider potential outcomes versus cost effectiveness. During this project, YTFP developed strong partnerships with several resource agencies and gained valuable feedback and support for Alternatives III and IV (Figure 9). A primary concern for implementing either alternative was the existence of a defunct wastewater treatment facility (WTF) in the project area (Figure 8) and the potential of exposing and releasing any contaminants from this site.

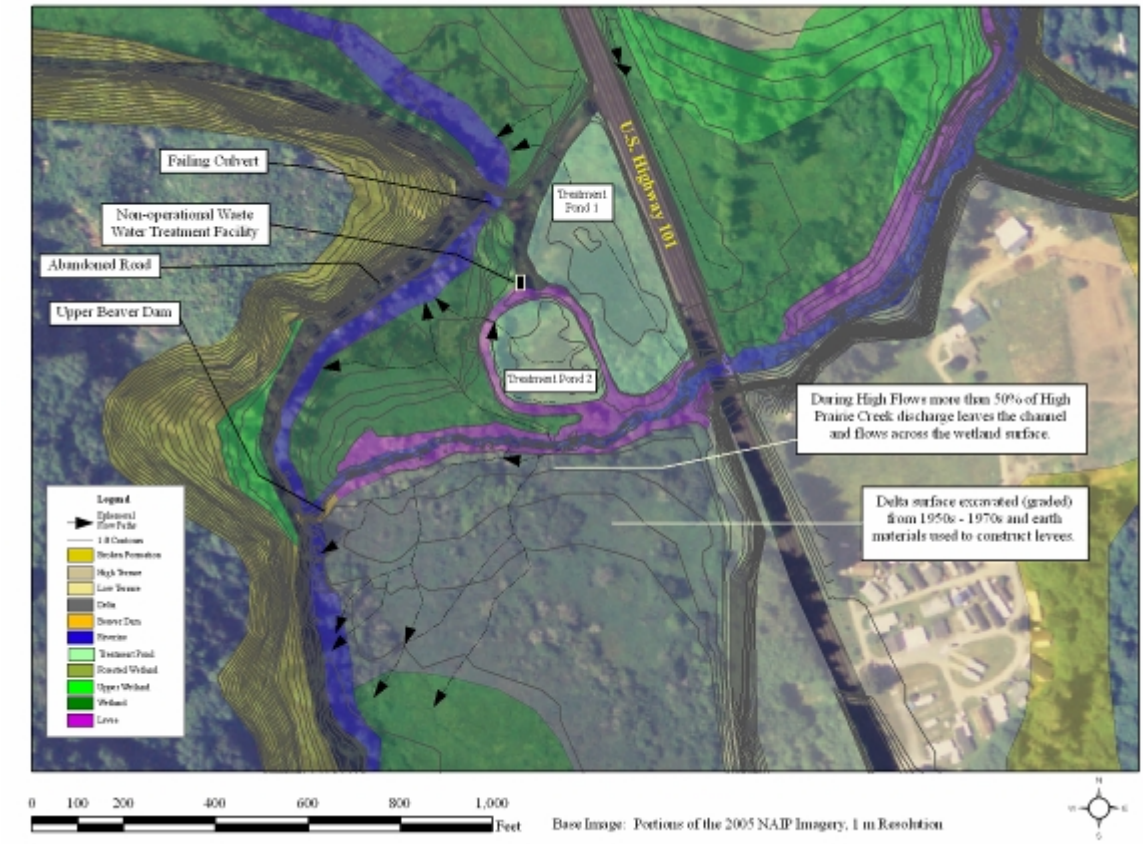
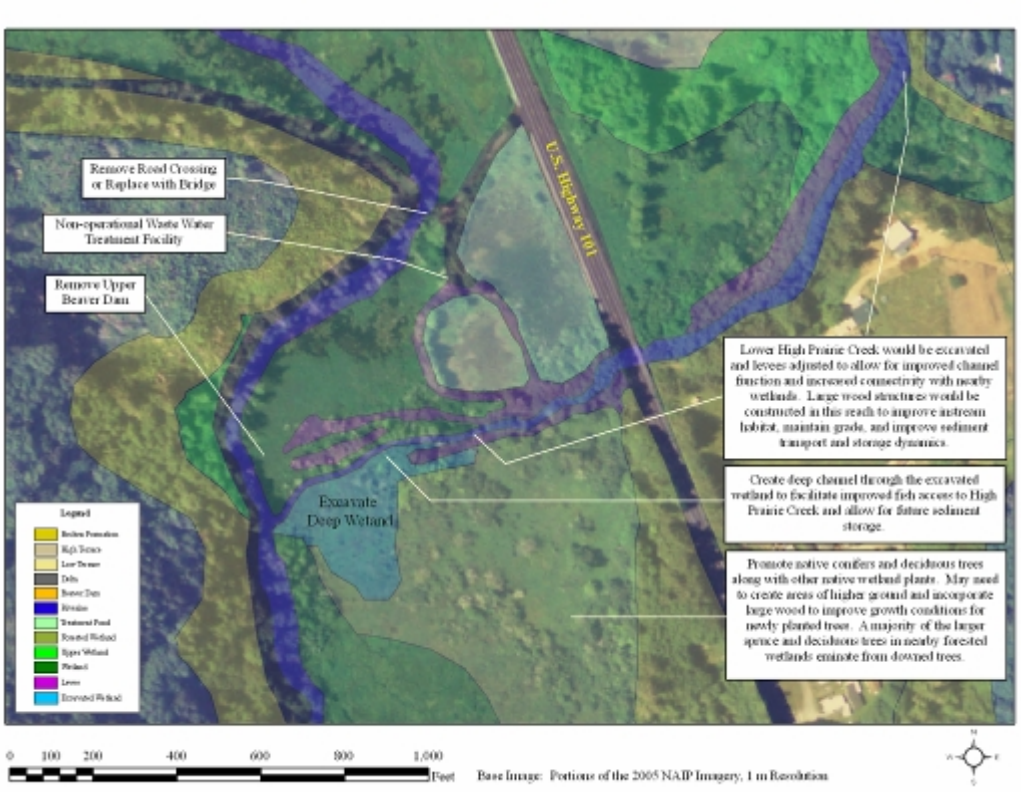


Figure 8. Existing conditions for the confluence reach of High Prairie Creek and Salt Creek, Lower Klamath River Sub-basin, California (Beesley and Fiori 2007a).



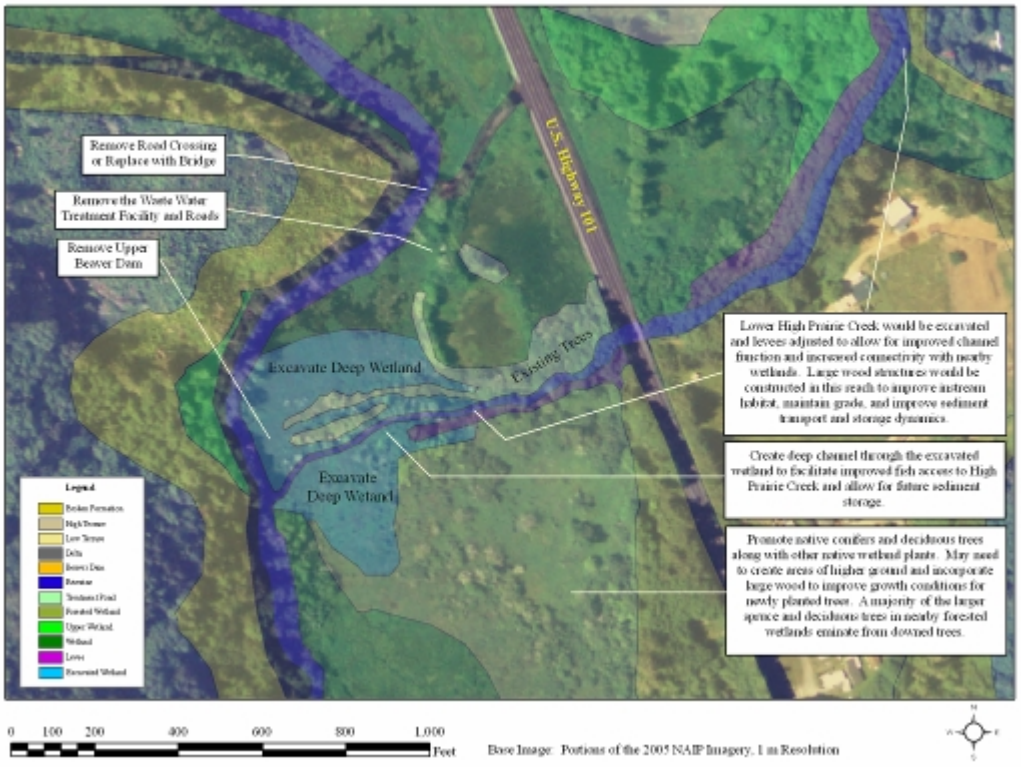


Figure 9. Restoration Alternatives III (top image) and IV (bottom image) for the confluence reach of High Prairie Creek and Salt Creek, Lower Klamath River Sub-basin, California.

YTEP is currently expanding their wetland program and working with YTFP to coordinate wetland assessment and restoration planning efforts in the lower eight miles of the Klamath River. YTEP recently obtained permission from the local Community Service District to collect soil and water samples from the WTF. YTFP and YTEP are currently pursuing the funding necessary to 1) continue to coordinate with pertinent landowners and gain support of the proposed alternatives; 2) conduct more detailed wetland assessments; and 3) collect and analyze soil and water samples from priority areas at the WTF. Results of these efforts would allow YTFP to develop a comprehensive regulatory compliance strategy, pursue the funding required to obtain the necessary permits, and implement the preferred alternative. Alternatives III and IV developed by Beesley and Fiori (2007) are presented below.

Alternative III: Deepen High Prairie Creek Delta

Alternative III would include excavating sediments from the lower reaches and the delta of High Prairie Creek in a manner that would result in substantial wetland enhancement, improved juvenile and adult salmonid access, and increased habitat quality, especially for juvenile coho salmon (Figure 9). Other advantages include increased storage for sediment emanating from High Prairie Creek and water. Increased water storage at this site may help attenuate downstream flood peaks and reduce flood impacts to local producers and landowners. YTFP would work with qualified wetland vegetation specialists to develop a comprehensive revegetation component for this type of treatment option. Primary revegetation objectives include reducing the presence of invasive species (i.e. reed canary grass); promoting native wetland and riparian species (i.e. skunk cabbage, sitka spruce, and willow); and improving wetland function. Revegetation efforts will likely be quite expensive given the fairly large area to address and the cost of wetland plants. YTFP currently operates a small-scale native plant nursery. We continue seeking the funding to expand the nursery to increase our ability to enhance riparian and wetland habitats located throughout the LKRSB.

Alternative III calls for a fairly large restoration footprint on existing vegetation, soils, and private land and therefore would require substantial landowner consent. Project success will likely depend on the ability to provide affected landowners with beneficial conservation easement strategies. Obtaining the required permits for implementing this alternative will be a fairly intensive process given existing infrastructure (i.e. U.S. Highway 101 and the WTF) and the environmental setting. Specialized excavation techniques would be required due to the saturated soil conditions and the presence of reed canary grass. Disposal of the extracted material would require careful planning with the pertinent permitting agencies. The estimated design life of Alternative III would be 20 – 40 years with only minimal maintenance required during that time.

Alternative IV: Large-scale Wetland and Channel Improvement

Alternative IV would expand on the objectives of Alternative III by 1) excavating sediments from lower High Prairie Creek and from critical areas in Salt Creek; 2) removing or modifying existing levees and infrastructure to improve channel and wetland function; 3) providing juvenile and adult salmonid access; and 4) increasing the quality and quantity of salmonid rearing habitat (Figure 9). This alternative would also greatly improve the

aesthetics of the area by naturalizing defunct infrastructure associated with the WTF. The estimated design life for Alternative IV would be 40 – 60 years with only minimal maintenance required (i.e. invasive plant removal and promotion of native riparian species).

Implementing Alternative IV requires landowners to consent to using a greater portion of their lands for conservation purposes. YTFP will need to continue building strong landowner partnerships and develop long-term beneficial conservation easement strategies for pertinent landowners to consider this alternative further. Permitting for this alternative would be intensive given the larger footprint and waste disposal associated with this option. Additional studies will likely be required to develop the environmental documentation required to permit such an effort. A revegetation plan would also need to be developed to ensure restorative measures promoted native wetland and riparian vegetation assemblages. Long-term objectives include implementing process-based strategies that would be adaptive in nature to allow for modifications based on comprehensive effectiveness monitoring.

Salt Creek Downstream of High Prairie Creek

For this report, we designated three distinct restoration planning reaches within lower Salt Creek: Middle Salt Creek, Lower Salt Creek_2, and Lower Salt Creek_1 (Figure 10). Salt Creek was historically an extensive backwater feature of the Klamath River estuary and interconnected with Hunter Creek and its lower-most tributaries: Panther Creek, Mynot Creek, and Spruce Creek (Figures 11 – 12). Agricultural development and other land management activities conducted in the early 1900s resulted in substantial wetland conversion and loss of channel and riparian complexity (Figure 13) (Beesley and Fiori 2004). New channels were constructed for Salt Creek and Hunter Creek that resulted in significant loss of aquatic and terrestrial habitat quality and quantity. Land use activities in Salt Creek continue to result in loss of fisheries and riparian habitat and hydrologic alterations.

Middle Salt Creek

The Middle Salt Creek reach, located downstream of the High Prairie Creek confluence, consists of ~ 70 acres of open water and emergent wetlands (Figure 10). Priority recommendations for this reach include wetland protection and enhancement. A first step would be to work with pertinent landowners to develop desirable conservation easement strategies or other innovative approaches that would result in long-term protection and enhancement of these critically important wetlands. These wetlands provide extremely valuable off-estuary rearing and staging habitats for numerous natal and non-natal salmonid populations; and reduce localized flooding impacts by providing substantial water and sediment storage capacity (Beesley and Fiori 2007a).

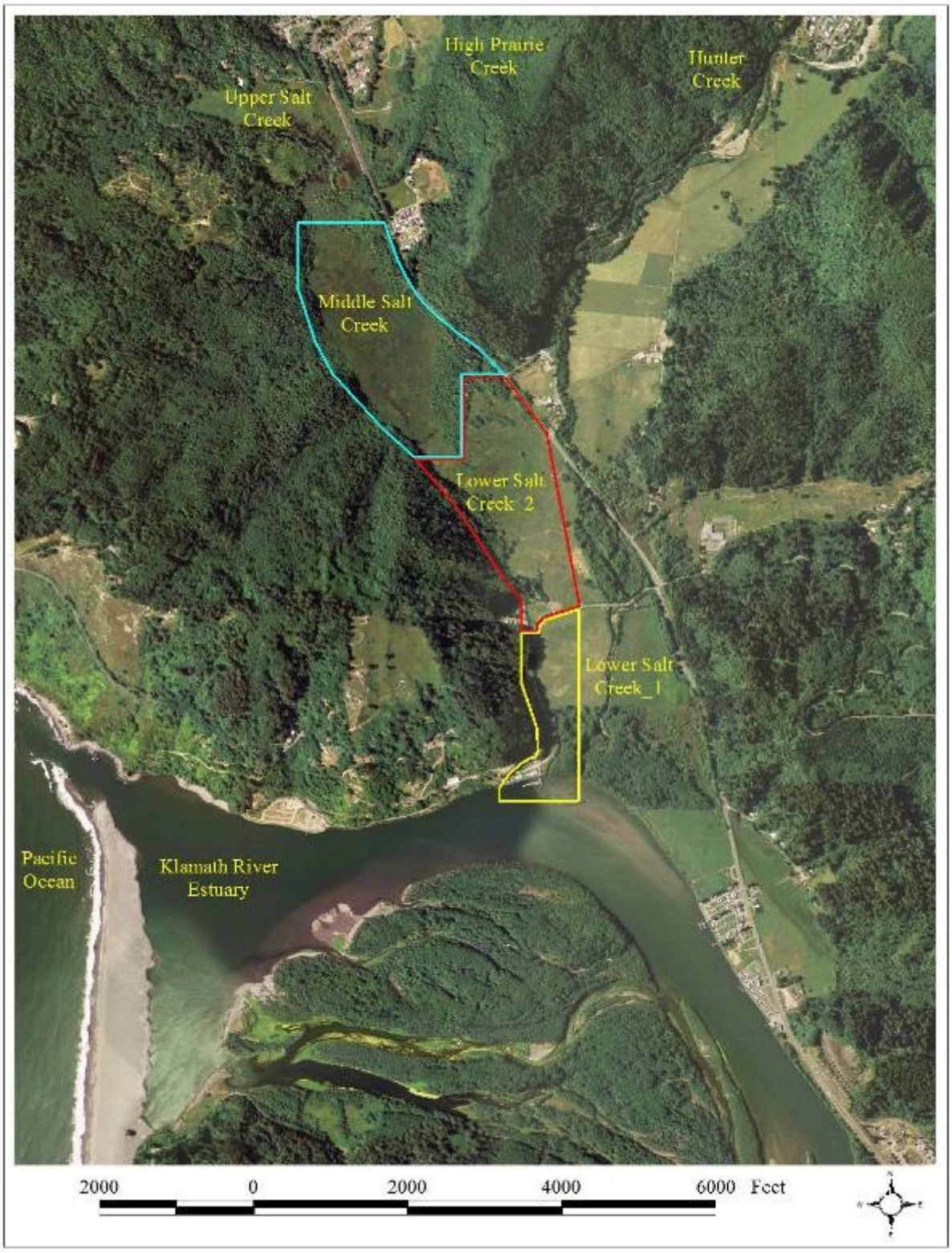


Figure 10. Map of lower Salt Creek, Lower Klamath River Sub-basin, California (Base image: portions of the 2005 NAIP imagery, 1 meter resolution).

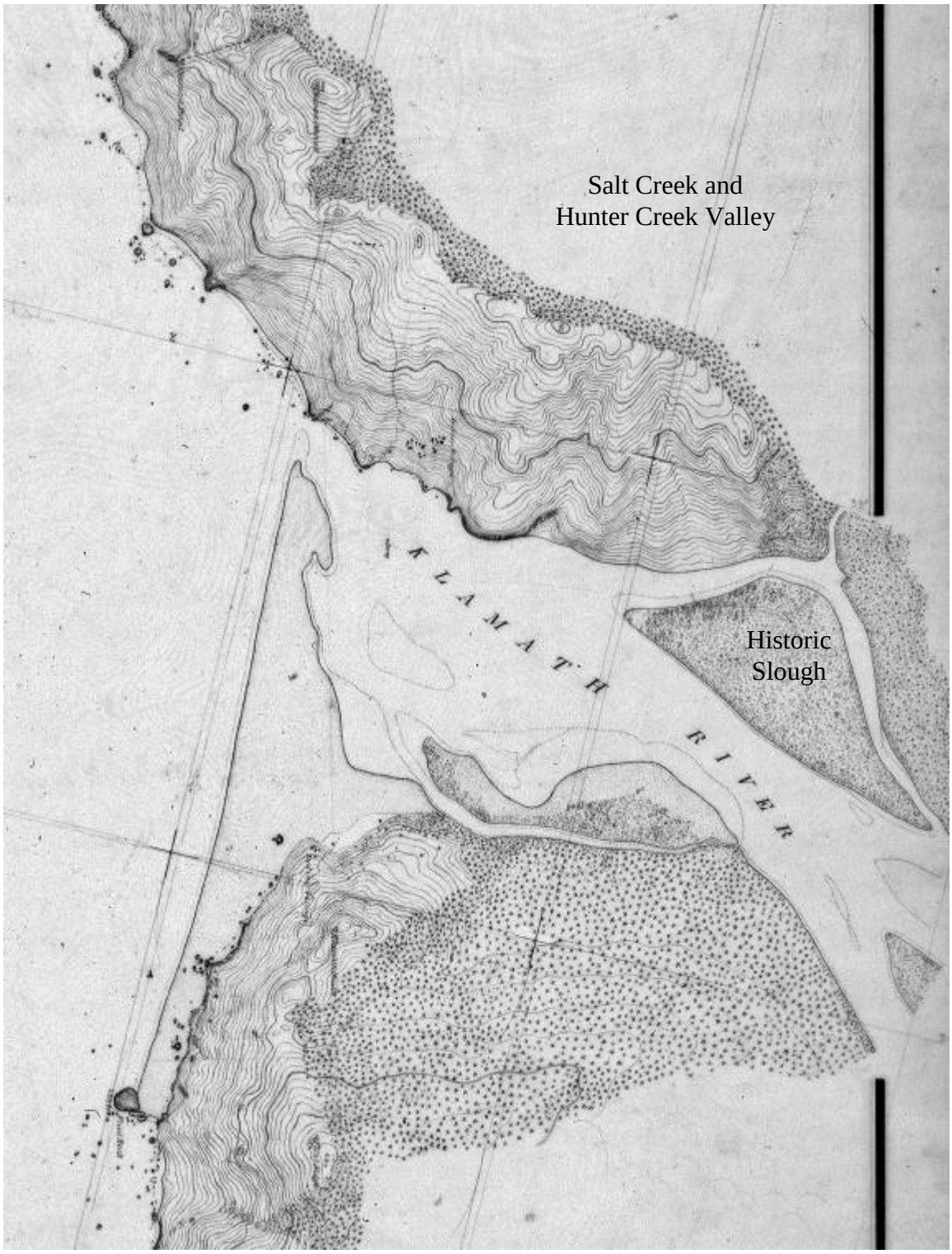


Figure 11. The U.S. Coast and Geodetic Survey 1874 topographic map of the Lower Klamath River (T-1370) (scale 1:10,000) (Laird 2008). Text was added to highlight the former slough that Hunter Creek and Salt Creek watersheds historically occupied.

Figure 12. U.S. Coast and Geodetic Survey, Nautical Chart 5702 1st edition, 1915 U.S. Coast California-Oregon Trinidad Head to Cape Blanco (Scale 1:200,000) (Laird 2008).

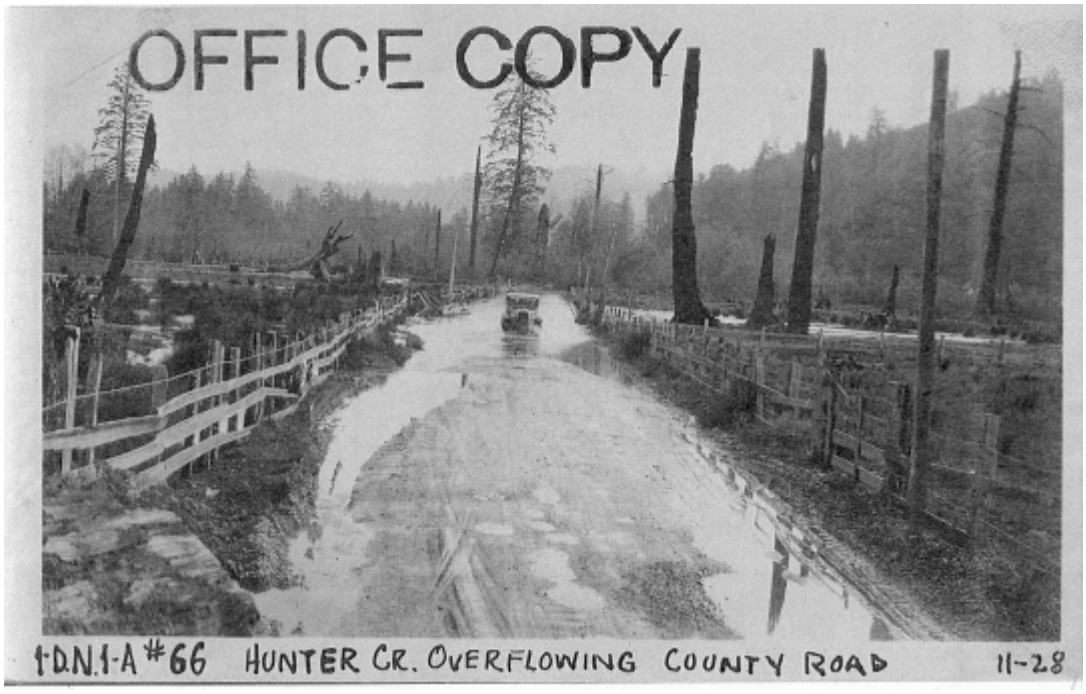


Figure 13. A historic photograph of lower Hunter Creek and Salt Creek in the vicinity of Requa, Lower Klamath Sub-basin, California (Provided by the California Department of Transportation, November 1928).

Habitat enhancement measures recommended for the Middle Salt Creek reach include:

- Conduct wetland investigations to develop innovative strategies that would reduce the presence of invasive plants, improve wetland function, and increase rearing and staging capacity for natal and non-natal salmonids.

- Implement a comprehensive native wetland and riparian plant revegetation program that focuses on promotion of native plant assemblages to facilitate long-term benefits for Tribal Trust fish and wildlife and improved geomorphic and hydrologic function;

- Addition of large wood elements and constructing wood accumulations to increase habitat complexity and promote improved growing conditions for newly planted sitka spruce, willow, coastal redwood, and cottonwood; and

- Develop a comprehensive effectiveness monitoring program to quantify restoration outcomes, learn from past efforts, and apply the knowledge to future off-estuary wetland enhancement projects in the Klamath River or other north coast basins.

Lower Salt Creek_2

Lower Salt Creek_2 (LSC_2) is located upstream of Requa Road and consists of ~50 acres of emergent wetlands with low gradient channels and springs (Figure 12). The priorities for this area include working with local producers to develop projects that would result in 1) benefits to participating landowners; 2) increased rearing and staging capacity for natal and non-natal salmonids; 3) improved hydrologic and geomorphic function; and 4) reduced impacts associated with river and/or tributary flood events. Conceptual designs for LSC_2 ranged from increasing salmonid rearing capacity by constructing off-channel habitats to major wetland enhancement based on project support and funding. A cattle exclusion fence was recently constructed along lower Salt Creek to help protect the stream and adjacent riparian habitats. A minimal treatment design would be to continue concentrating efforts within the existing riparian fences. The California Conservation Corps (CCC) have been planting trees and conducting invasive plant management within these fences for a few years. However, anoxic soils of lower Salt Creek appear to inhibit survival of planted trees.

Organic materials such as small and large wood should be added to riparian soils of lower Salt Creek and elevated planting surfaces should also be constructed. The objectives for employing these techniques include increasing oxygen levels in riparian soils to improve localized growing conditions for native trees; and adding complexity to stream and floodplain habitats for Tribal Trust fish and wildlife. Other treatment options include constructing small off-channel alcoves and backwater pools or channels within the existing fence; and adding large wood to channel and floodplain habitats. Any wood added to this reach should be keyed into existing vegetation or into the banks (Figure 14) to reduce the potential for floating and repositioning during high flow or backwater events. Working within existing fences would require the least amount of land and would be relatively inexpensive given the proximity to access roads and services. However, this approach does not adequately address hydrologic and geomorphic dysfunction and would result in limited benefits to natal and non-natal fish populations for that reason.


a. Using an excavator to insert large wood into the bank.

b. Using an excavator to wedge large wood into existing vegetation.

Figure 14. Examples of large wood placement techniques implemented in West Fork McGarvey Creek during summer 2007, Lower Klamath River Sub-basin, California.

Several springs and historic flow paths currently drain towards Salt Creek's existing channel within LSC_2. However, livestock operations occurring in this valley over the last decade have significantly degraded these features. Off-channel habitats provide critically valuable habitat during large floods by allowing fish to migrate to areas of calm water to conserve energy and take advantage of floodplain derived food. LSC_2 provides some of the best opportunities to enhance and create larger-scale off-channel habitats that would result in substantial flood relief to local residents as well as dramatically improve conditions for Klamath Basin salmonid populations. This type of effort would require a relatively large restoration footprint. Therefore, YTFP continues to work with local producers and restoration partners to find mutually beneficial conservation easement options to ensure long-term enhancement and protection for this extremely valuable off-estuary watershed. Potential off-channel enhancement options for this area are presented in Figure 15. These options are only conceptual designs based on the need to increase the amount of high quality off-estuary habitat available to adult and juvenile salmonids and reduce flooding impacts on the local community.

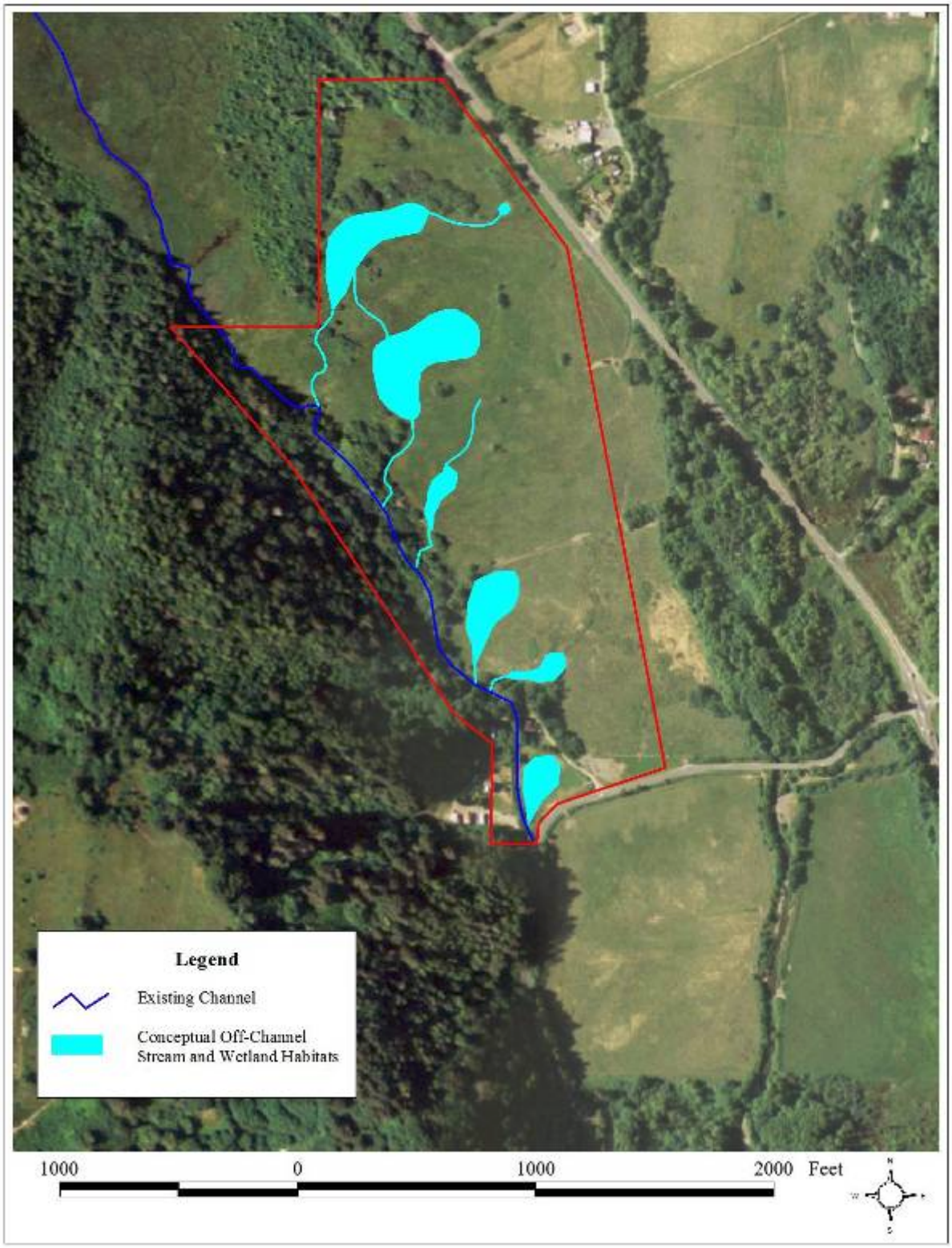


Figure 15. Map depicting conceptual salmonid habitat enhancement options for lower Salt Creek, Lower Klamath River Sub-basin, California (Base image: portions of the 2005 NAIP imagery, 1 meter resolution).

Lower Salt Creek_1

Lower Salt Creek_1 (LSC_1) includes ~25 acres of emergent wetlands and riparian habitats from Requa Road to the confluence of Salt Creek and the Klamath River estuary (Figure 10). The channel in this reach is greatly influenced by mainstem flow conditions and tides emanating from the Pacific Ocean (Hiner and Brown 2004; Beesley and Fiori 2007a). YTFP regards LSC_1 and LSC_2 as the highest priority areas when considering Tribal Trust fish and wildlife, the Yurok People and their culture, the local community, and Public Trust. However, the land is currently privately owned and thus restoration and long-term protection of this area depends on the actions of a few individuals. YTFP is committed to developing and maintaining strong working relationships with the landowners located in the vicinity of the Klamath River estuary. Since this project, we coordinated with other Tribal Departments to secure a planning grant from the Coastal Conservancy that will allow the Yurok Tribe to continue community outreach in the Klamath River estuary.

Cattle exclusion fences were also recently constructed along the pastures located in LSC_1. The CCC has planted trees within these fences and incorporated some log-boulder structures. Unfortunately, the primary landowners of LSC_1 were not currently interested in implementing any large-scale salmonid restoration on these lands. YTFP will continue working with individuals to gain increased support for larger-scale projects that focus on long-term protection. In the meantime, tree survival and growth in this reach would likely be improved by implementing techniques that result in increased amounts of available oxygen in riparian soils. The most stable riparian assemblage for this reach may be one dominated by carex, juncas, and willow species. When undisturbed, these species develop substantial root networks that promote increased soil cohesion and bank stability; and create complex fish habitat at low and high flows (i.e. undercut banks and willow thickets).

A priority restorative measure for lower Salt Creek includes further documenting topographic and hydrologic conditions associated with the Requa Road crossing. This information would greatly assist the development of stream crossing designs that would improve hydrologic and geomorphic function in this reach. The current road and culvert configuration results in substantial channel and flow path constriction. Necessary improvements include 1) installing a bridge or a larger culvert to increase flow conveyance; and 2) incorporating multiple, oversized elliptical culverts in the road bed to improve hydrologic function in the reach and increase floodplain connectivity during periods of moderate to high Klamath River flows. This type of effort would be expensive; however the long-term benefits to public and fisheries resources associated with the project would likely outweigh the expense. Again, this area is extremely vital to the Yurok People (and several other California Tribes located in the Klamath Basin) and the fish and wildlife resources they rely on; as well as to the local community and Public Trust.