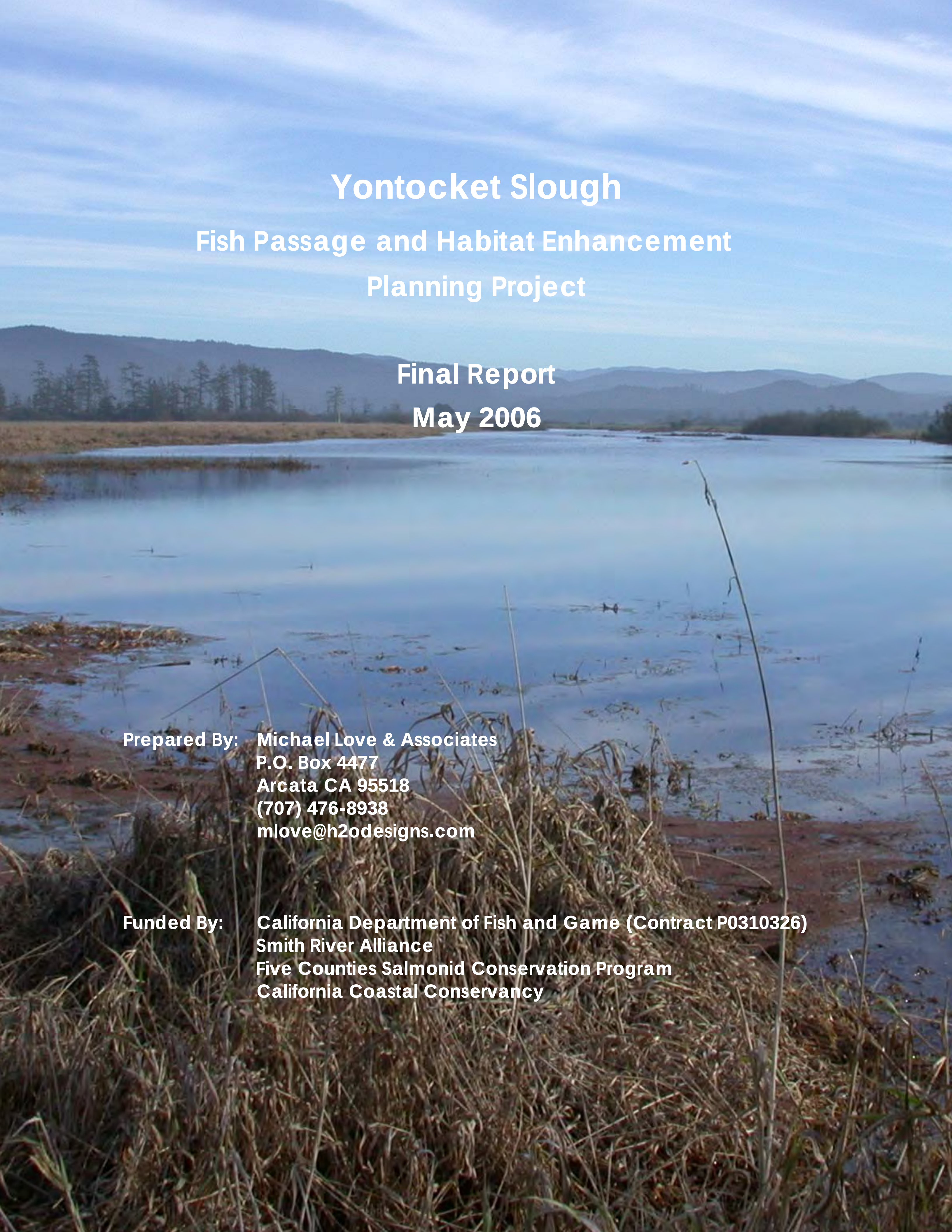

Yontocket Slough

Fish Passage and Habitat Enhancement Planning Project

Final Report
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Prepared By: Michael Love & Associates
P.O. Box 4477
Arcata CA 95518
(707) 476-8938
mlove@h2odesigns.com

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Smith River Alliance
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California Coastal Conservancy

Yontocket Slough Fish Passage and Habitat Enhancement Planning Project

Executive Summary

Project Location

Yontocket Slough is a remnant river channel adjacent to the Smith River estuary, located in Northwest California. The lower half of the slough is owned and managed by State of California, Department of Parks and Recreation (DPR) and is part of the Tolowa Dunes State Park. The remaining portions of the slough are privately owned. Waterfowl hunting is permitted within the State managed portion of the slough. Most of the areas around the slough, including portions of the State Park, are managed pasture for cattle grazing. The State managed pasture adjacent to Pala Road, which is gated, crosses the lower portion of the slough and is used by both hikers and horseback riders to access the Tolowa Dunes and the Yontocket Memorial Indian Village.

Project Need

Fish production within Yontocket Slough is severely limited by blocked access and degraded habitat. Culverts at Pala Road, as it crosses the lower portion of Yontocket Slough, block access to salmon, steelhead, and cutthroat trout and have led to sedimentation of the slough. This sedimentation has degraded the slough habitat and facilitated the spread of invasive reed canary grass (RCG), *Phalaris arundinacea*, which chokes the channel, degrades water quality, and prevents native riparian growth.

Several earlier studies and reports, including The Smith River Anadromous Fish Action Plan (2002) and the California Coho Strategy Recovery Plan (2004), identified Yontocket Slough as potentially valuable habitat for both adult and rearing juvenile salmon, steelhead, and cutthroat trout. The reports all recommend that the slough receive further evaluation to develop a restoration action plan.

Project Partners and Funding

In Spring 2004, the California Department of Fish and Game (CDFG) Fisheries Grants Program awarded Michael Love & Associates a contract (Contract No. P0310326) for creating a planning document to identify habitat restoration opportunities and develop restoration alternatives for the portions of Yontocket Slough and Tryon Creek that lie within properties managed by the State of California, Department of Parks and Recreation (DPR). Additional funding for topographic and vegetation mapping and sedimentation investigations was subsequently obtained from the Smith River Alliance and the California Coastal Conservancy through the Five Counties Salmonid Conservation Program.

To aid in guiding the project, a stakeholder advisory group held three meetings during the planning process. Additionally, the Smith River Watershed Coordinator, Smith River Alliance, Smith River Advisory Council, Smith River Rancheria, Alexandre EcoDairy, and Tedsen and Son Ranch all actively supported development of this planning document.

Project Goals and Objectives

The project objective was to develop a planning document that provided alternatives to meet the following objectives:

1. Provide salmonids unrestricted access to Yontocket Slough and lower Tryon Creek, which extends from the Smith River to Lower Lake Road.
2. Restore fish passage at the Pala Road crossing
3. Eliminate obstructions to fish movement caused by dense growth of canary grass within the waters of Yontocket Slough and lower Tryon Creek.
4. Improve overall fisheries habitat within Yontocket Slough and lower Tryon Creek.

Waterfowl Usage

Yontocket Slough is currently managed for waterfowl and the adjacent pastures on State property east of the slough are managed for Aleutian Geese. During fall and winter months a diverse range of waterfowl, including Puddle Ducks and Ringneck Ducks, can be found at the slough. Duck hunting within the slough is overseen by California Department of Fish and Game, and the site is popular during hunting season. By spring, monotypic stands of RCG have emerged throughout most of the slough. This vegetation type is believed to provide very little foraging habitat and eliminates nearly all open water. The only open water and foraging habitat remaining is within the deepest portions of the slough where RCG can not tolerate the water depths.

One of the driving constraints of this project was to minimize or avoid negatively impacting waterfowl habitat, with the opportunity to improve the quality and possibly increase the amount of available habitat.

Project Activities

Field activities performed as part of this project included (1) monitoring water levels and water quality within Yontocket Slough and Tryon Creek, (2) mapping the topography of the entire project area, (2) mapping occurrences of RCG and other plant communities, and (3) collecting sediment core samples as part of a sedimentation investigation.

Findings

Hydrology

Although the Smith River below the outlet of the slough is tidal, tidal influence does not extend into Yontocket Slough due to its topography. Overbank flows from the Smith River inundating Yontocket Slough appear to be an important hydrologic component. These overbank flows, which occur nearly every three out of four years, rapidly fill the slough. Yontocket Slough receives inflow for much of the year from Tryon Creek. However, during spring through early fall Tryon Creek dries-up and by mid-summer little to no standing water remains within the slough.

The road fill and stand pipes associated with Pala Road control water levels, causing the *upper slough* (upstream of Pala Road) to drain slower than the *lower slough* (downstream of Pala Road). The field observations of water levels show that from December 15, 2004 through April 30, 2005 water levels within the upper slough averaged 0.5 feet higher than the lower slough. Therefore, the removal of all water control structures at Pala Road would have caused the upper slough to be 0.5 feet lower during this period, which equates to an average decrease in inundated area of 10 acres, from 74 acres down to 64 acres. However, during late spring into early summer the water levels within the lower slough quickly recede, and were on average 1 foot lower than the upper slough.

Water Quality

Water temperatures within the slough and Tryon Creek remained below 18º C all year, well within the accepted range for salmonids.

Salinity greater than 2 ppt was detected on two occasions at the confluence of Tryon Creek with the Smith River. Both detections occurred during low summer flows in the Smith River, indicating that tidal effects bring brackish water upriver to at least the mouth of Tryon Creek during periods of low river flows.

Dissolved oxygen (DO) levels in Yontocket Slough were quite low from when sampling began in August 2005 through the beginning of January 2006; often less than 2.0 ppm, which is below the lethal limit for juvenile salmonids. DO levels remained dangerously low for salmonids even after the slough had refilled in late fall. The low DO is believed to be primarily caused by the large amount of decaying organic matter within the slough associated with the annual die-off of reed canary grass.

Vegetation Mapping

Vegetation was mapped by Tamara Gedik of Gedik BioLOGICAL. The entire mapped area was 119 acres, with approximately 95 acres located directly within the slough. Within the surveyed area, reed canary grass covered about 64 acres and much of the grass exceeded 4 feet in height. Reed canary grass is well established in the immediate area surrounding Yontocket Slough and has encroached and stabilized within much of the slough channel.

With exceptions of floating mats that are likely a result of fluctuating water levels during early spring, reed canary grass was not found within the upper slough below elevation 4.8 feet. Instead, these areas are colonized by native yellow pond-lily. As documented in the Biological Report, inundation of reed canary grass by standing water at least 18 to 24 inches deep throughout the growing season (typically through June in the Pacific Northwest) prevents the growth and establishment of reed canary grass.

Sedimentation Investigation

Based on anecdotal evidence of historic aggradation (post 1860's) within the slough, members of the project advisory group expressed interest in conducting a reconnaissance level stratigraphic investigation. Information gained from this investigation would aid in determining the historic conditions within the slough, the feasibility of excavating portions of the slough to improve habitat, and the depth of excavation that may be appropriate given the likelihood of tribal cultural deposits located within sediments deposited prior to the 1860's.

Geologists from Pacific Watershed Associates conducted the sedimentation investigation, using hand-driven gouge cores to obtain sediment samples. Corings were collected throughout the slough and portions of Tryon Creek. Four distinct sedimentary units were identified from the corings: (1) pebbly to gravely-sand at the bottom overlain by (2) mud to peaty-mud averaging 36 inches thick, abruptly followed by (3) gray clay mud averaging 12 inches thick overlain by modern peat averaging 7 inches thick.

Although some uncertainty remains, the clay layer is believed to have been deposited by the 1964 flood event. Assuming that the clay layer formed after 1860, there is between 12 and 18 inches of deposition within Yontocket Slough since European settlement began. If excavation within the slough is considered for enhancing slough habitat, the depth of this excavation should be constrained to between 12 and 18 inches to avoid disturbing pre-1860 deposits. Additionally, a geologist, working in front of any excavation, should perform corings to determine the appropriate excavation depth and cultural monitors or an archaeologist should be on site during any excavation.

Options for Controlling Reed Canary Grass

Numerous tools have been used for eradication and control of reed canary grass (RCG) in similar conditions, review of these methods shows an integrated approach utilizing multiple control methods is most effective.

The methods for reed canary grass management assessed for the Yontocket Slough project are:

- Mowing and grazing
- Disking (Tillage)
- Scraping
- Burning and Flaming
- Herbicide application
- Biological control
- Inundation (depth of 18-24 inches)
- Tarping and Mulching
- Soil amendments
- Revegetation

The Biological Report provides a detailed description of each method.

Inundation with water depths of at least 18 inches through the growing season appears to be the most effective method for inhibiting growth of reed canary grass. In areas where sufficient inundation in not practical, an integrated approach will be required. Small scale pilot projects should be used to determine the most effective methods for controlling reed canary grass at the site.

Restoration Components for Developing Project Alternatives

To develop alternatives for providing fish passage and enhancing habitat within Yontocket Slough, a set of restoration components were developed. The components are divided into three categories: Water Control, Pala Road, and Vegetation Management.

Restoration Component 1. Water Control

Several options were developed for controlling water levels within the slough. The objective was to maintain elevated water levels to control reed canary grass. Reed canary grass is expected to be eliminated in all areas that are inundated with at least 18 to 24 inches of standing water through spring.

Any proposed water control structure would also be required to provide passage for adult and juvenile salmonids. Options considered were roughened channels and traditional pool-and-weir fish ladders. A roughened channel is an oversteepened channel (5% slope or less) constructed of rock and designed to simulate the form and function of a naturally steep channel. Roughened channels require minimal maintenance and provide for passage of most fish and other aquatic species. A fish ladder would contain a series of pools and weirs. To provide for juvenile passage, maximum drop over weirs is 6 inches. Fish ladders are easily adjustable to changing water conditions but have a tendency of collecting debris, requiring routine inspection and maintenance.

Two locations for the water control structures were considered: (1) the slough outlet, and (2) Pala Road.

Restoration Component 2. Pala Road
Three options for Pala Road were considered.

1. Remove the existing road and relocate the public access point to Silva Road.
2. Replace the existing culverts with two 6' x 6' precast concrete box culverts and raise the elevation of the road.
3. Raise the roadbed elevation and install a wet-crossing designed to allow water to flow across the road and into a roughened channel/water control structure.

Restoration Component 3. Vegetation Management
Methods for managing vegetation, and specifically for controlling the growth and distribution of reed canary grass, were divided into two categories:

1. Control through inundation, and
2. Integrated vegetation management approach for areas where inundation is impractical.

<u>Inundation Strategies</u>
A water control structure can help maintain elevated water levels through the reed canary grass growing season, thereby expanding the area of slough inundation sufficiently to inhibit growth. These areas that currently contain reed canary grass should be burned prior to installing the water control structure. Burning will reduce the standing biomass, reducing the amount of decomposing organics and leading to increased levels of dissolved oxygen. However, burning should not be used in areas that will not be sufficiently inundated since it can stimulate growth in reed canary grass, resulting in higher densities after burning.

Excavation of deposited sediments can be used to enlarge the area where inundation is effective. A preferred maximum excavation depth of 18 inches is recommended, based on results of the sedimentation study.

Inundation has not been specifically used along the North Coast to control RCG and there remain uncertainties surrounding available water supply from Tryon Creek during late spring to maintain desired inundation levels. A staged implementation approach could allow for installing a temporary water control structure at Pala Road and monitoring its effectives prior to constructing a relatively expensive and permanent water control structure. This would likely involve raising the road level, plugging the two smaller culverts under the road and replacing the existing standpipes with new ones. The disadvantage of this option is that fish passage would not be provided by the temporary water control structure.

Integrated Vegetation Management Strategies
For areas where inundation is impractical, an integrated vegetation management strategy can be used. The objective is to create a complex canopy of native vegetation that ultimately shades-out the reed canary grass. The recommended strategy employs scraping the ground surface to a depth of 5 to 8 inches and stockpiling removed plant material at a near-by location to be composted or burned.

Following scraping, the area is tilled to break up the soil and then planted with seed and live plantings. Heavy mulch can be used strategically to give the new live plantings a competitive advantage. For at least the first two to three years follow-up treatments will be required to remove any resprouting reed canary grass. This can be accomplished using torching, hand removal, and herbicides.

The actual amount of time that follow-up treatments will be required is dependent on many factors that are impossible to gauge at this point. Smaller scale pilot projects to manage reed canary grass are planned to begin during Summer 2006 within Lower Tryon Creek on Alexandre Dairy, as well as on a similar stream channel near Orick, CA. These projects plan to apply the techniques described in this report. Results from these smaller projects, as well as any pilot projects initiated in Yontocket Slough, will provide invaluable insight into the effectiveness and cost of different vegetation management strategies and the amount of follow-up treatment required.

Developed Alternatives

The restoration components described above were combined to create four comprehensive project alternatives.

Alternative 1 – No Water Control Structure

Alternative 1 is the "minimal alternative" and consists of replacing the existing culverts with new precast concrete box culverts to improve the hydrologic connectivity between the upper and lower slough. In addition, the road level would be slightly raised to reduce overtopping.

This alternative would eliminate the fish barrier at Pala Road but would result in lower water levels within the upper slough during spring, allowing reed canary grass to colonize lower elevation areas of the slough. The expected spread of reed canary grass into an additional 18 acres of the lower slough would lead to further degradation of the slough habitat for both fish and waterfowl, and promote a further decline in water quality.

Estimated Cost:
Design and Environmental Documentation…………………. $31,000
Implementation…………………………………………..........$99,000

Alternative 2 – Fish Ladder at Pala Road (No Excavation of Slough)
Alternative 2 uses a fish ladder constructed of sheet pile walls and wooden weirs located at the upstream end of one of two new concrete precast box culverts at Pala Road. The other box culvert would serve as additional outflow capacity during high flows to avoid increasing the duration of flooding on adjacent pastures. Due to the increased water levels within the upper slough, the fence line would be moved 100 feet back. Within this area between the existing and new fence line (7.6 acres) revegetation efforts would be employed to establish native aquatic species and a riparian buffer along the slough margins. The only ground disturbance associated with this alternative occurs with replacing the culverts at Pala Road and installing the sheet pile associated with the fish ladder.

This option is expected to create an additional 24 acres of deep open-water habitat, free from reed canary grass. However, reed canary grass would remain within much of the shallower portions of the slough. Uncertainties associated with this alternative are whether there will be sufficient flow to maintain the desired water level through spring and if the reduction in the areal extent of reed canary grass is sufficient to decrease nutrient loading to improve dissolved oxygen levels.

<u>Estimated Cost</u>:
Design and Environmental Documentation………………….. $90,000
Implementation………………………………………..…...... $347,000

Alternative 3- Roughened Channel at Pala Road (with Excavation of Slough)
Alternative 3 uses a roughened rock channel located on the downstream side of Pala Road as a water control structure. Water stored in the upper slough would flow across a wet crossing on Pala Road and then down the roughened channel into the lower slough. To provide a migration corridor clear of reed canary grass between the slough outlet and Pala Road, a "fish migration channel" would be excavated.

Portions of the upper slough within the State Park would be excavated (no more than 18 inches deep) to deepen the slough. This will create more deep water habitat and expand the area that reed canary grass is controlled through inundation. The proposed area for excavation (12.3 acres) would generate approximately 20,000 cubic yards of material that would need to be disposed of off-site.

Due to the increased water levels within the upper slough, the fence line would be moved 100 feet back, decreasing the existing pasture by 7.6 acres. Integrated vegetation management strategies, including scraping, would be utilized within both the upper and lower slough (total area of 17.4 acres). Follow-up vegetation treatment will be needed for a number of years to control growth of reed canary grass and ensure successful revegetation with native species. To identify the most effective strategies for controlling reed canary grass and establishing both aquatic and riparian native vegetation, a series of vegetation management pilot projects should be established. Pilot projects will also provide an improved understanding of the level of follow-up efforts required to achieve a successful project.

This alternative is expected to create an additional 38 acres of deep open-water habitat, free from reed canary grass. Uncertainties associated with this alternative are whether there will be sufficient flow to maintain the desired water level through spring and the effectiveness and associated cost of controlling reed canary grass.

Estimated Cost:
Design and Environmental Documentation……………….….… $200,000
Implementation……………………………………….…....... $2,280,000

Alternative 4 – Roughened Channel at Slough Outlet (with Excavation)
Alternative 4 uses a roughened rock channel located within the Yontocket Slough outlet channel. Additionally, two new large culverts would be installed at Pala Road and the road level would be raised to improve drainage and connectivity between the lower and upper slough.

Portions of the lower and upper slough within the State Park would be excavated (no more than 18 inches deep) to further deepen the slough. This will create more deep water habitat, thereby expanding the area that reed canary grass is eliminated through inundation. The proposed area for excavation (15.7 acres) would generate approximately 26,000 cubic yards of material that would need to be disposed of off-site.

Due to the increased water levels, the fence line within the upper slough would be moved 100 feet back along upper slough and about 300 feet back along the lower slough. This would decrease the existing pasture by 12.7 acres. Integrated vegetation management strategies, including scraping, would be utilized within the upper and lower slough (total area of 18.8 acres). Follow-up vegetation treatment will be needed for a number of years to control growth of reed canary grass and ensure successful revegetation with native species. To identify the most effective strategies for controlling reed canary grass and establishing both aquatic and riparian native vegetation, a series of vegetation management pilot projects should be established. Pilot projects will also provide an improved understanding of the level of follow-up efforts required to achieve a successful project

This option is expected to create an additional 44 acres of deep open-water habitat, free from reed canary grass. Uncertainties associated with this alternative are whether there will be sufficient flow to maintain the desired water level through spring, the susceptibility of the roughened channel to high velocities from the Smith River during flooding, longevity of the roughened channel due to the rate of lateral migration of the river towards the slough, and the effectiveness and associated cost of controlling reed canary grass.

Estimated Cost:
Design and Environmental Documentation……………….….…. $213,000
Implementation……………………………………….….........$2,810,000

Impacts to Other Wildlife

Aleutian Geese
Alternative 1 would not affect the pastures currently used for foraging by wintering Aleutian Geese. However, the further lowering of Yontocket Slough and resulting spread of RCG would likely reduce the amount of open water habitat available to the geese. Alternatives 2-4 would result in loss of varying acreages of pasture currently used by foraging Aleutian Geese (7.6 acres

for Alt. 2 and 3; 12.7 acres for Alt. 4). However, there would be a large increase in the amount of high quality wetlands and open water habitat associated with alternatives 2-4, likely providing a mix of habitats suitable for the geese.

Waterfowl

Alternative 1 will substantially decrease waterfowl habitat quality by allowing the further spread of RCG into the deeper portions of the slough. This alternative will also reduce the duration that the habitat is suitable for waterfowl usage since water levels within the slough will recede more rapidly than under current conditions.

Alternative 2-4 will substantially improve habitat quality for waterfowl by increasing the area of the slough containing both open water and native aquatic plants (such as yellow pond lily). Since the water control structure in each of these alternatives will maintain higher water levels for a longer duration, the amount of potential waterfowl habitat will increase. Alternatives 3 and 4 have the additional benefit of reestablishing native aquatic vegetation along the slough margins. This could greatly benefit waterfowl by increasing the availability of foraging plants.

With Alternatives 2-4, efforts include attempting to reestablish riparian species along the margins of the slough. Depending on the planting design, this may have an impact on accessibility to portions of the slough for hunting.

Recommendations

Based on the evaluation of the cost and effectiveness of each of the alternatives, we consider the preferred option to be Alternative 3: *Roughened Channel at Pala Road with Excavation of the Upper Slough*. This alternative, or a modified version of it, would provide a large amount of suitable salmonid and waterfowl habitat and requires low maintenance once native vegetation becomes established. A less ambitious vegetation management strategy combined with excavation and a roughened channel at Pala Road may also have similar benefits for substantially less cost. These types of changes could be examined during the final design phase.

We also strongly recommend attempting some small scale pilot projects for testing various reed canary grass control methods. This is best accomplished using a staged implementation approach. Additionally, efforts should be made to carefully monitor and learn from other reed canary grass control projects that are expected to begin during the Summer of 2006. As with any habitat enhancement project dealing with invasive species control and altered hydrology, an adaptive management approach is required to be successful. This project will involve learning from direct experience and require changing implementation and management strategies based on results from previous activities. Lessons learned and techniques refined as part of this project will have direct application to numerous future projects addressing degraded fisheries and waterfowl habitat within coastal northern California.

Phasing and Next Steps

Successful implementation of any of these alternatives will require an involved and long term process. The process can be broken down into four phases.

Phase 1 – Planning Phase
Development and evaluation of alternatives (this document) and selection of a preferred alternative (primarily responsibility of State Parks and Department of Fish and Game working cooperatively).

Phase 2 – Final Design and Environmental Documentation
Develop final engineering designs for Pala Road and the water control structure, design pilot projects for vegetation management, and prepare environmental documents.

Phase 3 – Staged Implementation
Final permitting for each stage of implementation.

Stage 1 - Construction of new water control structures and conducting controlled burns, followed by initiation of several separate pilot projects to test the various techniques (i.e. excavation, scraping, sod disposal, replanting) and evaluate effectiveness.

Stage 2 - Once preferred techniques are identified, begin second stage involving large scale implementation of vegetation management.

Stage 3 – Multiyear follow-up vegetation management and monitoring.

Phase 4 – Vegetation Management
Develop and implement larger scale vegetation management project based on results from Phase 3 pilot projects. Conduct follow-up treatment for control of reed canary grass, monitor effectiveness of project and adapt management of slough as needed.

Conclusion

Estuaries, backwater sloughs, and other types of off-channel habitat have been identified by many as being the habitat type most lacking for salmonids. Within the lower Smith River this type of habitat was once plentiful, but much of it has been severely altered or destroyed. Although restoring access and habitat within Yontocket Slough will require a large amount of effort, when completed the project is anticipated to provide significant benefits for salmonid populations within the entire Smith River Watershed.

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1 Background

1.1 Summary

Fish production within Yontocket Slough, part of the Smith River estuary, is severely limited by blocked access and degraded habitat. Culverts near the mouth of Yontocket Slough block fish access and have led to sedimentation of the estuarine habitat. This sedimentation has degraded the estuary and facilitated the spread of invasive reed canary grass which chokes the channel, degrades water quality, and prevents native riparian growth. This project consists of developing a range of alternatives for improving fish passage and estuarine habitat to guide restoration efforts in Yontocket Slough and Tryon Creek.

1.2 Location

The project area is located in Del Norte County, the northernmost county on the coast of California. Yontocket Slough lies within the coastal plain along the southern bank of the Smith River (Figure 1.1). The slough drains into the Smith River approximately 2.5 miles from the river's mouth. The project area can be found on the Smith River California USGS 7.5 minute quadrangle, Township, Range and Section: T18N, R1W, S32.

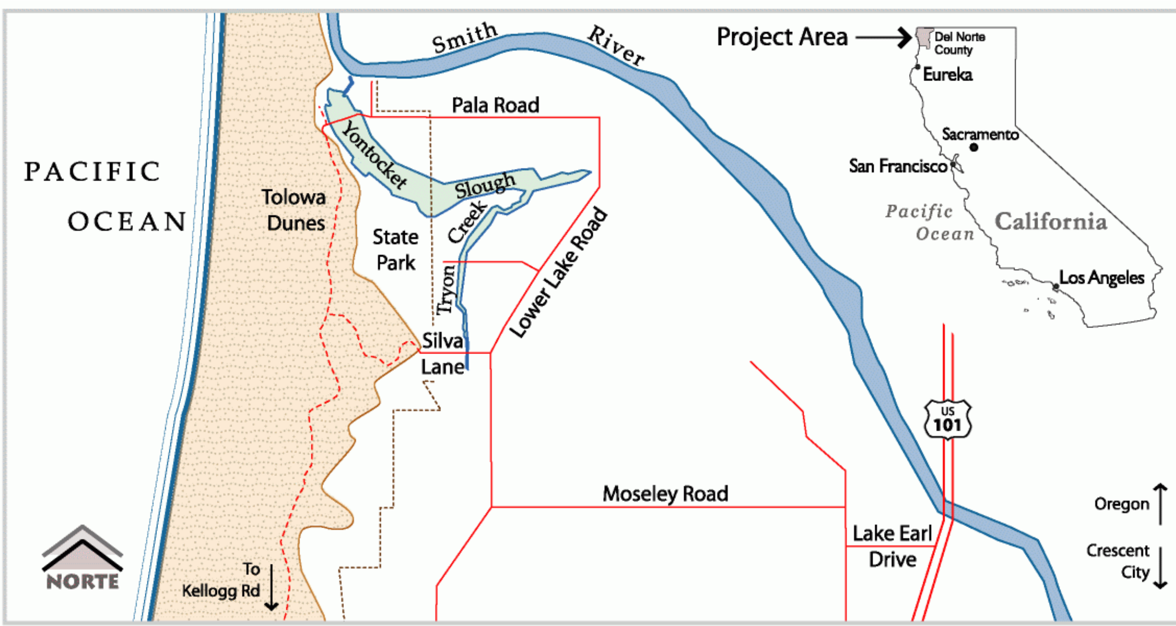


Figure 1.1 - General site map of Yontocket Slough, Smith River, and nearby roads.

1.2.1 Project Impetus

The Yontocket Slough and Tryon Creek Assessment for Improvement of Anadromy, (Scriven, 1999), The Smith River Anadromous Fish Action Plan (Smith River Advisory Council, 2002), and the California Coho Strategy Recovery Plan (CDFG, 2004) identified the existing access and habitat conditions within Yontocket Slough as a limiting factor for anadromous salmonids within

Tryon Creek and the Smith River as a whole. All three reports recommended that the slough receive further evaluation to develop a restoration action plan.

Additionally, the Smith River Watershed Coordinator, Smith River Alliance, Smith River Advisory Council, Alexandre EcoDairy, and Tedsen & Son Ranch all actively supported development of a planning document for implementing fish passage and habitat enhancement projects within Yontocket Slough.

In Spring 2004, the California Department of Fish and Game (CDFG) Fisheries Grants Program awarded Michael Love & Associates a contract for creating a planning document to identify habitat restoration opportunities and develop restoration alternatives for the portions of Yontocket Slough and Tryon Creek that lie within properties managed by the State of California, Department of Parks and Recreation (DPR).

1.2.2 Importance of Estuarine Habitat in Anadromous Salmonid Life History

Yontocket Slough is an abandoned oxbow channel that was historically part of the tidal estuary of the Smith River and likely functioned as a rearing area for salmonids prior to them entering the ocean. Chinook salmon in the Smith River system rear in the estuary from May to December, coho salmon use the estuary for rearing from March to July and steelhead rear in the estuary for the entire year (Bartson, 1997). Quinones and Mulligan (2005) found that juvenile salmonids primarily reside in the middle and upper portions of the Smith River estuary. They also found that chinook salmon were most often found residing among the riparian vegetation within the estuary, likely due to the shelter it provides. Yontocket Slough drains into the Smith River within the middle reach of the estuary and the outlet channel connecting the slough the the river is dense with riparian vegetation. It is reasonable to assume that rearing salmonids utilize this area as well. However, Yontocket Slough upstream of the Pala Road crossing is inaccessible under most flow conditions to these salmonid species that are rearing in the Smith River.

Recent studies have shown that the lack of an estuarine environment is a limiting factor in the success and survival of out-migrating smolts, and plays an important role in the life history of many rearing young of the year (yoy) coho salmon. Extended use of the brackish estuary and low gradient freshwater habitat by smolts has been found to increase their size and strength before entering the ocean, which in-turn improves their survivability chances for returning as adults (Miller and Sadro 2003).

One of the most comprehensive research studies on estuary use by salmonids to date was performed by Miller and Sadro (2000). They investigated juvenile coho usage of the estuarine portion of Winchester Creek, a tributary to South Slough, Coos Bay, Oregon. During a 16-month period they found at least three different life-stages of juvenile coho used the estuary: age-0 fry entering in spring, pre-smolts entering in fall and winter, and age-1 smolts entering in spring.

In all cases growth rates within estuarine habitat was significantly greater than that measured upstream. Age-0 fry in the upper estuarine habitat had growth rates almost double of the fish sampled in the upper watershed. The highest growth rates were found in a tidal marsh adjacent to the main channel and in an off-channel brackish beaver pond. No spawning habitat existed upstream of the pond, indicating that the juveniles had migrated through the tidal estuary and into the pond.

Dye marked age-0 coho were found to utilize the estuarine habitat for more than three months during spring. Results suggest that the age-0 fry may have reentered the upper portions of the stream as summer water temperatures and salinity increased within the upper estuary. During summer months no salmonids were found rearing in the estuary.

Restoring the complexity typically associated with the estuarine environment is thought to be a key to the recovery of threatened coho salmon stocks. Results from ongoing research projects into use of estuaries by salmonids continuously confirms this. A large portion of the Smith River estuary has been has been lost through diking and draining. Restoring the fisheries habitat values of Yontocket Slough and providing fish access to the slough is a critical piece in the salmon recovery efforts of the Smith River watershed.

1.3 Overall Goal

The overarching project goal is to restore fish access into Yontocket Slough and enhance fisheries habitat with the slough and adjacent Tryon Creek. This planning project is aimed at developing a range of alternatives for improving fish passage and habitat to guide restoration efforts in Yontocket Slough and Tryon Creek.

1.4 Project Structure

1.4.1 Project Team

The project team consists of:

Michael Love & Associates (MLA) managed the project and was responsible for hydrologic and water quality monitoring, analysis of collected data, development of fish passage alternatives, and writing and compiling the final report.

Smith River Watershed Coordinator with the Smith River Advisory Council, Zack Larson, arranged and facilitated meetings with the project's advisory group, drafted meeting notes, coordinated access with local landowners, and collected project background information.

Gedik BioLOGICAL Associates (GBA) conducted a biological assessment that included vegetation mapping throughout the project area and development of alternatives for control of invasive reed canary grass and reestablishment of native riparian and aquatic plant species.

Pacific Watershed Associates (PWA) performed a geologic investigation of the sediment stratigraphy within the slough channel.

Graham Matthews & Associates (GMA) mapped the topography of the project area and created the project base map.

1.4.2 Project Funding

Funding for the Yontocket Slough Access and Habitat Improvement Planning Project was provided by the California Department of Fish and Game (CDFG) Fisheries Grants Program. Additional funding to conduct topographic and vegetation surveys was provided by the Smith River Alliance. The Five Counties Salmonid Conservation Program in conjunction with the California Coastal Conservancy provided additional funds to conduct the geological investigation of the slough. Additional funds for onsite archeological monitoring during geological investigations were provided by the Smith River Rancheria. Funding for the Smith River Watershed Coordinator position was provided by CDFG and the Smith River Alliance.

1.4.3 Project Advisory Group

The Project Advisory Group is made up of the following stakeholders, including regulatory agencies, tribal representatives and local landowners.

- California Department of Fish and Game (CDFG)
- California Department of Parks and Recreation (DPR)
- National Marine Fisheries Service (NOAA Fisheries)
- Army Corps of Engineers (ACOE)
- Natural Resource Conservation Service (NRCS)
- Smith River Rancheria
- Smith River Alliance
- Tedsen & Son Dairy
- Alexandre EcoDairy
- Del Norte County Planning Department
- Pacific Coast Fish, Wildlife and Wetland Restoration Association (PCFWWRA)

The advisory group met three times throughout the project development to provide input, and review fish passage and habitat enhancement alternatives. Coordination of the advisory group meetings was facilitated by Zack Larson, Watershed Coordinator. Meeting notes are assembled in Appendix A.

1.4.4 Planning Project Timelines

• Project layout and planning	June 2004
• Advisory Group Meeting No.1	October 20, 2004
• Field work/Data Collection	December 2004 through February 2006
• Smith River Rancheria Cultural Commission meeting	December 6, 2004
• Advisory Group Meeting No. 2	May 16, 2005
• Advisory Group Meeting No. 3	December 13, 2005
• Draft Report	March 2006
• Final Report	May 2006

2 Project Setting

2.1 Project Area

Lower Lake Road borders the project area to the east and the Tolowa Dunes Complex borders the area to the west (Figure 2.1). The Pacific Ocean is immediately west of the Tolowa Dunes and Highway 101 runs about 3 miles east of Lower Lake Road. The Smith River forms the northern terminus of the northwestern portion of the project area. Adjacent land ownership includes: private agricultural lands north, south, and east of the project area, and; Tolowa Indian sacred site and California State Parks managed lands to the west.

2.2 Description of Tryon Creek Watershed and Yontocket Slough

The Yontocket Slough and Tryon Creek system has a drainage area of 3.4 square miles and is 5.5 miles in length. The upper two miles of Tryon Creek contain the best salmonid spawning habitat and the lower 3.5 miles is a migration corridor for adult fish and contains quality juvenile salmonid rearing habitat. The stream and slough drain into the Smith River estuary, approximately 2.5 miles upstream from the river's mouth. Yontocket Slough was once the main channel of the Smith River. At some point the river abandoned the channel, leaving it as an off channel slough.

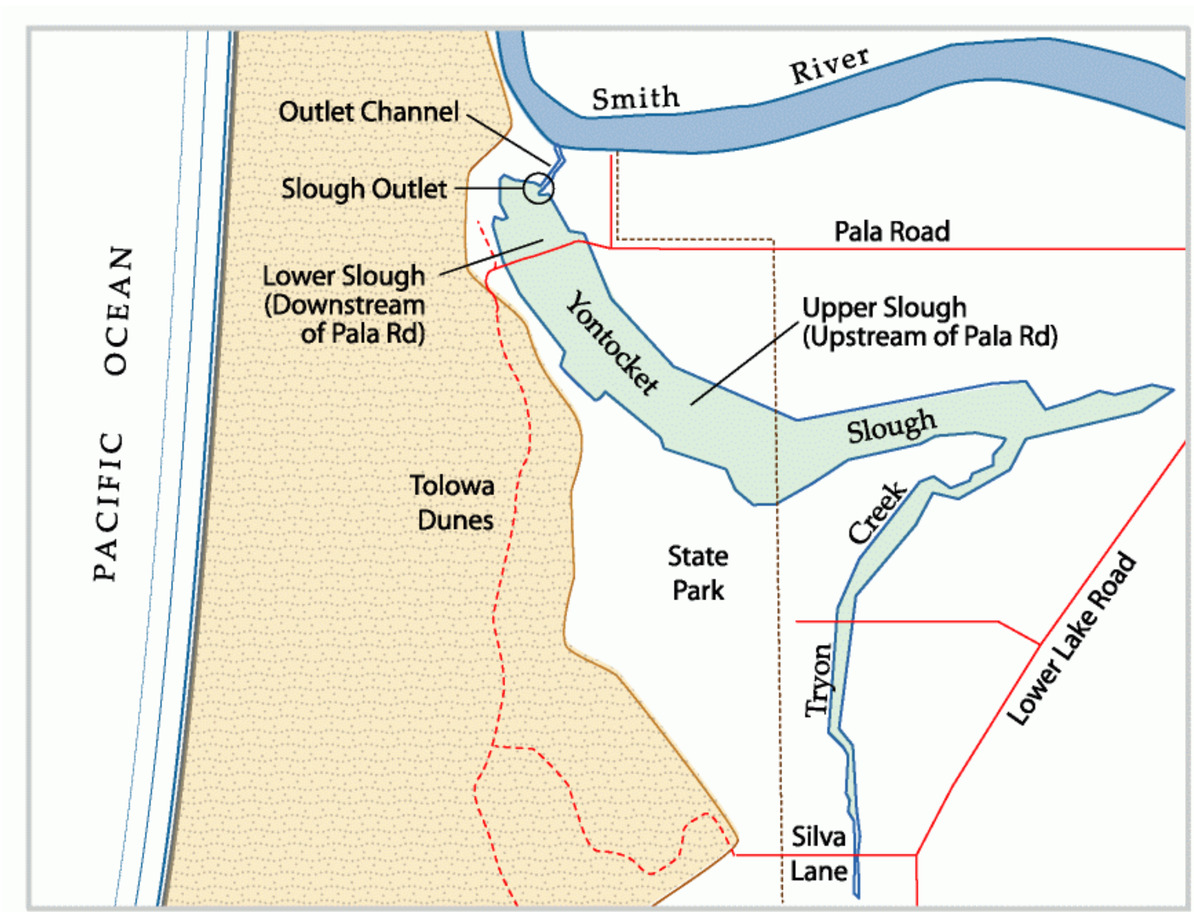


Figure 2.1 - Project site map showing locations of lower and upper Tryon Creek, lower and upper Yontocket Slough, the slough outlet, the Smith River, the State Park Property Boundary, and local roads.

Tryon Creek is a low gradient (<2% slope), predominately silt bottom stream that originates in privately owned second growth forest east of Highway 101 and meanders through irrigated pasture before meeting Yontocket Slough. Summer flows are typically less than one cubic feet per second (cfs) with areas of subsurface flow, while winter flows can be greater than 100 cfs.

2.2.1 Historic Slough Conditions

At one time Yontocket Slough was a bend in the main channel of the Smith River. Approximately 900 years ago (PWA, 2005), the Smith River abandoned the channel, creating an abandoned oxbow or relic channel.

Yontocket Slough is believed to have been historically connected to Lake Earl, a large coastal lagoon, through a series of ponds and flood overflow from Lake Earl. The Tolowa people describe a waterway that connected Indian villages along the edge of the dunes (Brad Cass Advisory Group Meeting No.1, 2004). Since then, dunes are believed to have moved inland covering portions of the historic slough. The existing ponds within the Tolowa Dunes are possibly remnants of slough channels that connected Yontocket Slough to Lake Earl.

Historic maps (1856) depict Yontocket Slough as a tidally connected oxbow tributary channel to the Smith River (Figure 2.2) and shows Tryon Creek flowing into Lake Earl, rather than Yontocket Slough. More recent aerial photos (1942) show the slough more isolated from tidal inundation than in the 1856 map (Figure 2.4). Sand dune migration during the period of 1856 (Figure 2.2) to 1921 (Figure 2.3) may have contributed to cutting-off the connection between the slough and the river. A road that was installed before 1942 (Pala Road) also likely contributed to hydrologic and sedimentologic changes in Yontocket Slough.

Discharge from Tryon Creek combined with Smith River overbank flows that fill the slough may have provided sufficient outflow to generate headwardly migrating channels, thereby maintaining a connection to the river. There are features in the 1942 aerial photo that appear to be channels connecting Yontocket Slough to the Smith River (Figure 1942). Since the depth of the channels in 1942 is unknown and mapping surveys were likely conducted during the low water season, it is not possible to evaluate the extent of historic tidal inundation of Yontocket Slough.

More recent mapping and observations show the Smith River has moved laterally in the direction of the south bank. Between 1942 and 2003, the Smith River at the confluence of lower Tryon Creek had migrated more than 250 feet towards the south. The river continues to migrate rapidly south, causing erosion of the left bank and loss of the floodplain. After the 1964 flood, a levee was constructed along the north side of the river, just upriver from the confluence of lower Tryon Creek, possibly further accelerating the lateral migration of the river to the south.

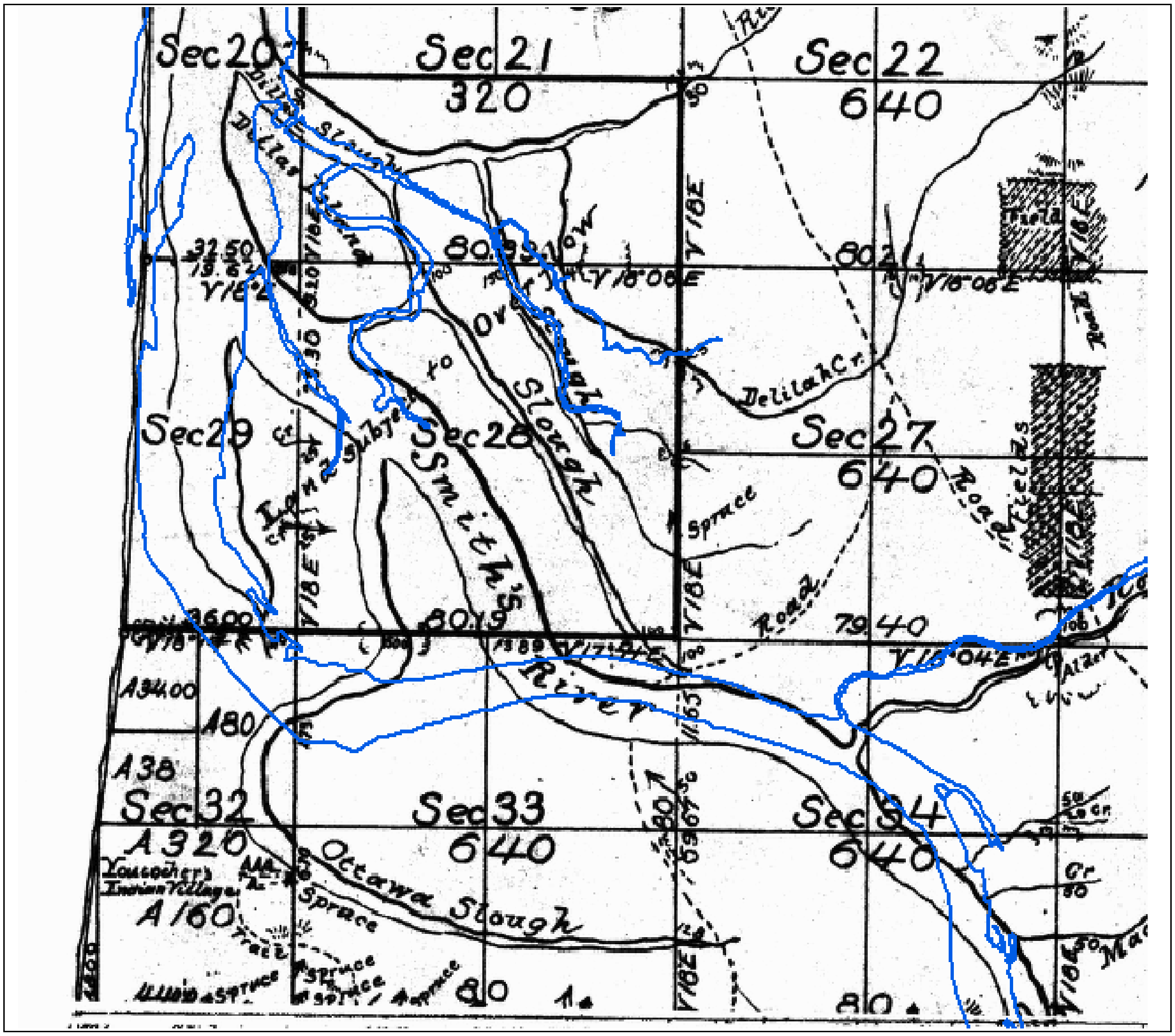


Figure 2.2 – Township plot map from 1856 showing the Smith River estuary and Yontocket Slough, then named Ottawa Slough. The blue line represents the edge of the active channel in 2003, taken from Laird (2004). Note the open connection shown between the slough and the Smith River, suggesting that the slough was tidally influenced in 1856.

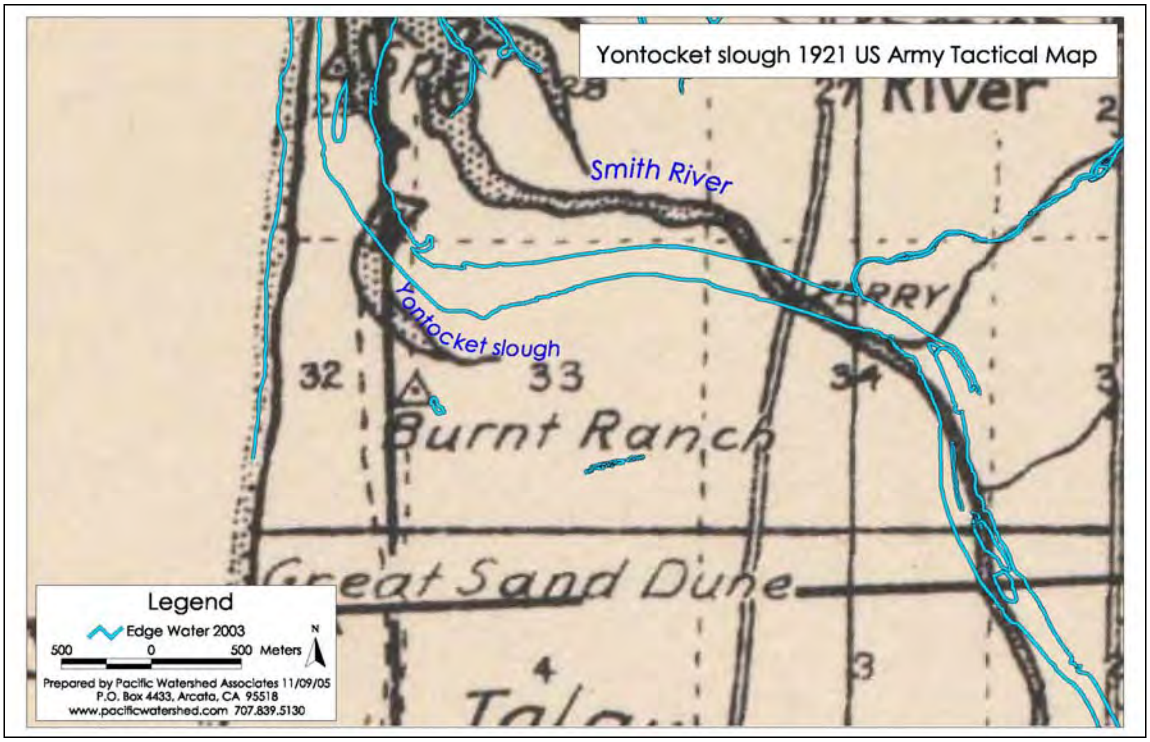


Figure 2.3 – US Army Tactical Map from 1921 showing the Smith River estuary and Yontocket Slough. The blue line represents the edge of the active channel in 2003, taken from Laird (2004).

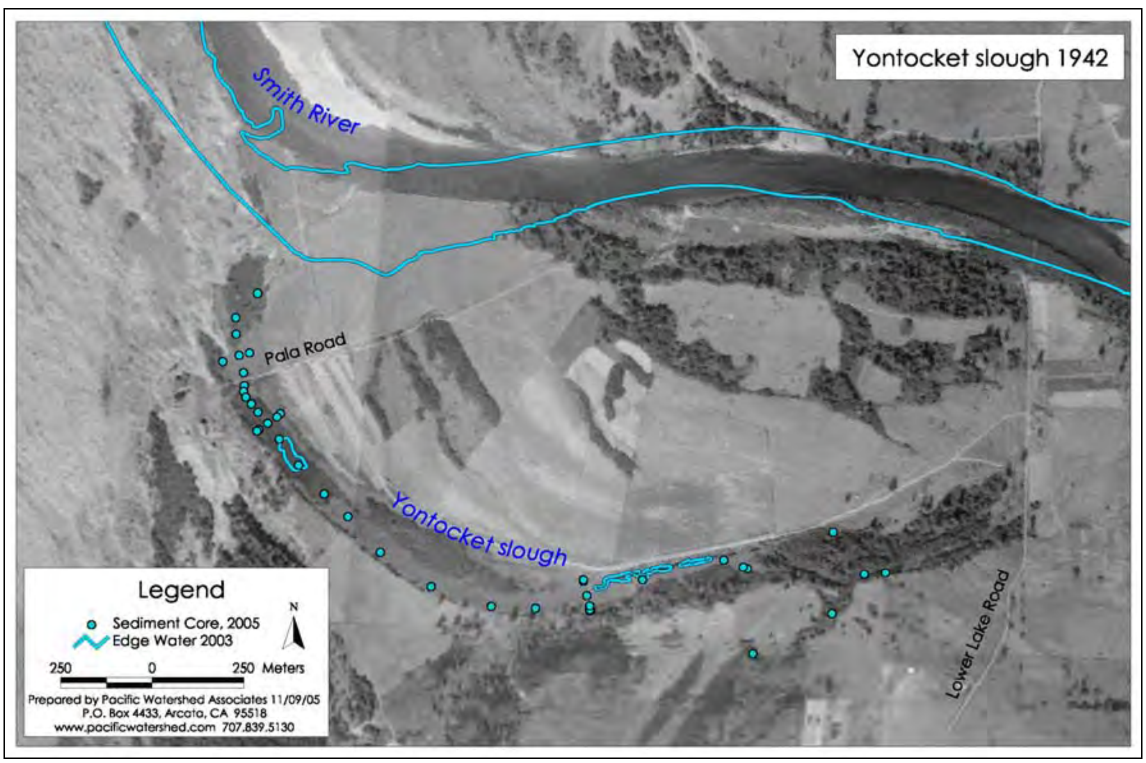


Figure 2.4 – Aerial photograph from 1942 showing the Smith River estuary and Yontocket Slough. The blue line represents the edge of the active channel in 2003, taken from Laird (2004). By 1942 the tidal connection between the river and slough had been eliminated.

2.2.2 Fisheries Usage

The Smith River system supports four principal species of anadromous salmonids: fall-run chinook salmon, coho salmon, winter-run steelhead trout and coastal cutthroat trout. Spring-run chinook and summer run steelhead occur in the system, but in smaller numbers. Other anadromous species present in the Smith River include chum salmon, green and white sturgeon, Pacific and brook lamprey and American shad. (SRAC 2002). Tidewater goby, listed as a Federally Endangered Species, has also been identified as present within the Smith River estuary, and Tillas Slough in particular.

By all accounts, historic salmon runs were very abundant throughout the Pacific Northwest, including the Smith River. Salmon runs in the Smith River supported native people's food needs and in the late 19th and early 20th centuries sustained a cannery operation at the mouth of the river.

Early accounts describe the abundance of salmon:

"Near [the mouth of the Smith River] are a number of sloughs, branching out from right and left, and during the fishing season these waters are literally alive with salmon."
(Bledsoe, 1881 in Bartson, 1997)

"The average catch of fish is from 100 to 1,000 at a haul and as many as 1,500 have been caught in one haul of the seine. …The fish caught weigh from five to sixty pounds"
(Bledsoe, 1881 in Bartson, 1997)

Commercial harvest of salmon in the Smith River was already underway in the 1860s as noted in an account of the 1861 flood, "Near the mouth of the river, a fishery owned by W. H. Woodbury was washed away together with four hundred barrels of salmon" (Bledsoe 1881 in Bartson 1997). More extensive records of salmon harvests are available from a cannery operated at the mouth of the Smith River from 1878 to the 1930s. Although the cannery records may be incomplete, they indicate annual harvests in excess of 50 tons in the 1890s. Fish populations declined until operation of weirs and nets in the river was no longer commercially viable. During the 1930s, California's rivers were closed to commercial fishing by the California Assembly (Bartson, 1997).

Fish assemblages and estuary use

The Smith River fisheries are classified as part of the Klamath-Rogue Ichthyo-province. Salmonids are the dominant fishes throughout the Smith River watershed with the exception of the estuary. The fish assemblage in the estuary is very diverse and includes many marine species and almost all freshwater fish species of the Smith River. The species composition in the estuary varies daily, diurnally, and seasonally due to changing tides, river discharge, and other factors. Although the Smith River estuary has not been well studied, research in other estuaries suggests that many marine and riverine species depend on estuary habitat for part of their life cycle. Several species of marine invertebrates are also found in the estuary. (Bartson, 1997)

Estuary habitats include flooded salt marshes, mudflats, and tidal channels. Patterns of estuary residence vary greatly between species, fish size, tidal stage, and time of year (Healey 1982, Levings et al. 1986, Macdonald et al. 1987, Nicholas and Hankin 1989 in Bartson 1997). The length of time that a juvenile salmonid resides in the estuary depends on size at entry, availability of preferred prey, river discharge, and estuarine topography. Despite variability in estuary use, it is generally agreed that estuarine habitats are important to juvenile salmonids for feeding, physiological adaptation from fresh to salt water, and protection from predation allowing juvenile salmonids to increase in size before entering the ocean.

Listing status of the four principle salmonids in the Smith River Watershed

The following are the listing status of Smith River salmonids under the Federal Endangered Species Act (ESA): (NOAA Fisheries at http://www.nmfs.noaa.gov/pr/species/fish/)

- Chinook salmon: ESA listing "Not Warranted" at this time
- Coho salmon: Threatened
- Steelhead trout: ESA listing "Species of Concern"

In 2004 the California Fish & Game Commission officially listed coho salmon populations from San Francisco to the Oregon border under the California Endangered Species Act (CESA).

Limiting Factors to Fish Production in Yontocket Slough and Tryon Creek

Currently several factors severely limit fish production within the Tryon Creek Watershed:

Fish passage barrier at the Pala Road Crossing located within the lower end of Yontocket Slough blocks upstream migrating adult and juvenile salmonids at almost all flows. The barrier consists of two culverts with standpipes, located on a road currently managed by California State Parks. The standpipes, which were installed over 20 years ago, raise the water level of the slough to enlarge existing waterfowl habitat. However, they also block fish access to upstream habitat and increase the deposition of fine sediments within the slough. There are two other at-grade 24 inch circular culverts under Pala Road that had been blocked by flashboards until recently. However, these culverts are frequently clogged with vegetation, preventing fish passage. Under most conditions fish can only access the slough and Tryon Creek when floodwaters within the Smith River overtop Pala Road allowing them to swim over the road.

Invasive non-native reed canary grass has colonized much of the slough, stream channel and riparian areas. Reed canary grass prohibits riparian growth, chokes the stream channel, inhibits the mobility of fish at lower flows, increases sedimentation, and produces dangerously low levels of dissolved oxygen resulting from decomposition of biomass.

Sediment contributions to the stream channel remain a concern. Local ranchers reported that the slough and stream channel filled will large quantities of fine sediments during the 1964 flood event (Advisory Group Meeting No. 1 and 2). After the flood the slough size and depth is believed to have decreased and the plant community changed. Additionally, pools within Tryon Creek became much smaller and less frequent. Since then, previously funded CDFG and Coastal Conservancy projects on the Moseley and Tryon Ranches, upstream of Yontocket Slough, have led to the installation of livestock exclusion fencing and riparian re-vegetation throughout much of the stream corridor. It is believed that these projects have greatly reduced sediment inputs and are promoting healthy riparian habitat.

Water withdrawals from Tryon Creek for agricultural uses also likely limit fish production. It has been reported that summer water withdrawals from Moseley Ranch cause portions of the stream channel to stop flowing, and even flow backwards (Richard Tryon of Tryon Ranch at Advisory Group Meeting No. 1).

2.3 Cultural Setting

2.3.1 Native American History

Humans probably arrived in this area between 10,000 and 5,000 years ago. Historic Tolowa territory, which included Yontocket Slough, comprised over six hundred square miles within northwestern California and extended slightly into Oregon, roughly coinciding with modern day Del Norte County. The Tolowa population probably numbered between 1,000 and 2,400 (Gould, 1978, Thorton, 1984). There were three distinct Tolowa communities in the region: the He-nag-gi, living along the lower Smith River; the Tolí-o-wa, living around Lake Earl; and the Ta-ta-ten, living in the Crescent City area along Pebble Beach and Point St. George. The Tolowa villages were usually located in coastal areas with sites at the mouth of Peacock Creek, the mouth of the Smith River, on the south bank of the Smith River, Point St. George, and the peninsula between Lake Earl and Lake Tolowa (Funderburk 1979 in Bartson 1997). An important Tolowa winter village was located in the dunes above modern day Yontocket Slough in a village known as Hawunkwut.

The Tolowa hunted seals and sea-lions using redwood dugouts, going out as far as Seal Rocks, about 6 miles offshore. Seal meat was primarily a trade item. Other food sources included smelt caught and dried in the late summer and salmon and eel captured in weirs or nets in the Smith River. From the beach the Tolowa fished for perch and cod and gathered shellfish. They also hunted deer and elk but relied primarily on the supply of food that the rivers and sea provided (Bartson, 1997).

In the early 1800s, the first European explorers arrived at the villages of the native Tolowa. Their first contact with Euro-American settlers occurred in 1828 with the overland explorations of Jebediah Smith, followed by intensive Euro-American settlement of the region after 1850. The Tolowa probably numbered more than 1,000 in pre-contact times; however, the census of 1910 listed only 121 people, a result of epidemics of cholera, measles, diphtheria (and perhaps smallpox) and numerous attacks by settlers (Encyclopedia of North American Indians).

In 1853, as supposed retaliation for the deaths of several early prospectors, the settlers ambushed the members of the Yontocket village during a religious ceremony and celebration. The village was set on fire and people were shot and stabbed as they fled the burning houses. Many people were killed and bodies were thrown into the slough. After the massacre, the area became known as Burnt Ranch and later the Pala Place, and is known today as the Yontocket Memorial Village (Gould, 1984).

Between 1852 and 1855, the Tolowas were removed to a reservation on the Klamath River, to the south of their territory. In 1860, they were relocated to the Siletz Reservation in western Oregon after aiding other Coast-Rouge Indians in the resistance movement. For a time the Tolowa people were relocated to the island off of the mouth of the Smith River (Encyclopedia of North American Indians).

Today the Tolowa people manage the Smith River Rancheria (Smith River) and the Elk Valley Rancheria (Crescent City). The Yontocket Village site is now part of Tolowa Dunes State Park and is still actively used by members of the Smith River Rancheria as a cemetery and memorial village site. Additionally, the site is currently used by the tribe as an active cemetery.

2.3.2 Early Economic Activities

Lumber was exported from Crescent City as early as 1859 (California Resources Agency 1965). In 1872, large-scale logging began in coastal areas. The Timber and Stone Act of 1878 allowed timber interests to acquire large tracts of productive forests in the Smith River area and throughout the Pacific Northwest. In 1889, 11.5 million board feet of lumber were exported from Crescent City. A railroad was built to carry lumber from Smith River to the wharves of Crescent City (Bartson 1997).

In addition to logging, other activities also influenced the lower Smith River and surrounding areas. In the 1860s, a cannery was established near the mouth of the Smith River. Many areas were cleared for agriculture and, by 1880, dairy farming was the primary agricultural activity in the area. Levees were constructed throughout the area, although the dates of construction have not been determined.

2.3.3 Current Land Uses

The California Department of Parks and Recreation (CDPR) acquired the lower 2,500 feet of Yontocket Slough as part of the purchase of the Bliss Ranch in the 1970s (Figure 2.6). Funds were provided through a State bond and acquisition was a collaborative effort between CDFG and CA State Parks. The area remained undeeded and unclassified until 1990's and is currently managed by State Parks.

Cattle grazing on State Park land was halted following the acquisition until the mid-1990s when grazing was reintroduced as a management tool for the provision of forage habitat for the federally protected Aleutian goose. A management system was adopted that allowed the California Department of Fish and Game to manage nearby wetlands on CDPR property, including Yontocket Slough, during waterfowl hunting season.

A land exchange, including the Pala Unit (Yontocket Slough), between the CDFG and CDPR is currently under review and presumably will be finalized in the next few years.

Pala Road

Local residents report that Pala Road is typically impassable due to flooding for two to three weeks of the year. Pala Road forms a loop to Silva Road through the Tolowa Dunes State Park. Silva Road provides access to the dunes complex and can be used when Pala Road is closed. The Pala Road crossing is currently managed for access to the CDPR property and the Yontocket Memorial Village and Cemetery. A locked gate currently prevents unauthorized vehicle traffic from using Pala Road west of the parking lot.

Figure 2.5 - Bliss Ranch (foreground) and Yontocket Slough during the winter of 1972. Photograph from the California Coastal Project. Note the vegetation within the slough is believed to be yellow pond lily.

When Yontocket Slough was part of Bliss Ranch, Pala Road as it crossed the slough contained two 24 inch and two 36 inch diameter corrugated metal culverts. All four culverts were at-grade. Shortly after acquisition two standpipes were attached to the 36 inch culvert inlets to raise the water level of the slough in order to enlarge habitat for waterfowl. The other two culvert inlets were blocked with flashboards. Some time within the last few years the flashboards were removed by vandals and have not been replaced, allowing water to flow freely through the two at-grade culverts. However, these at-grade culverts are often partially plugged with detritus, preventing fish from moving through them.

Indian Cemetery

The Smith River Rancheria maintains a historical burial ground and currently uses the area adjacent to the slough as an active cemetery. In 2004, the Rancheria received permission to create 50 new burial plots, located near the historical burial area just west of the slough. The Rancheria is concerned with recent illegal digging in burial grounds and has asked State Parks to increase patrol of the area (Advisory Group Meetings). They have concerns regarding allowing easy public access by foot and horse via Pala Road. At the third advisory group meeting Brock Richards of the Smith River Rancheria expressed the Tribe's desire to have the Yontocket Slough crossing removed and Pala Road closed. The cemetery and Memorial Village can currently be accessed via Pala Road, Kellogg Road and Silva Lane.

Grazing

Dairy farming and beef cattle ranching are historic industries on the Smith River plane. The State Park land adjacent to the east side of the slough is managed for grazing by dairy cows as a tool for the provision of forage habitat for the federally protected Aleutian goose. Currently this land is grazed by cows from Alexandre Dairy, an organic dairy. The Tedsen Ranch, a conventional dairy farm, borders the eastern portion of the State Park property. The slough upstream of the

State Park boundary is owned by Tedsen Ranch along the northeastern bank and Alexandre Dairy along the southwestern bank.

The potential impacts to fisheries from grazing occur from unrestricted livestock encroachment on stream banks, which can increase erosion, decrease riparian habitat, and reduce water quality and fisheries habitat. If untreated, waste streams from cattle excrement and fertilization application can have serious impacts to water quality. Water quality problems are further impacted by water withdrawals for irrigation of grass fields.

Vegetation

Yontocket Slough, within the State Park boundary, is mostly devoid of riparian vegetation. Invasive reed canary grass has colonized much of the slough and adjacent lands. In the deeper portions of the slough yellow pond lily is present. In the uplands along the western side of the slough are patches of willow and Sitka spruce. Within lower Tryon Creek near the Smith River there are areas of dense willow. European beach grass has colonized much of the dunes.

Reed canary grass is also prevalent within the slough upstream of the State Park boundary. However, this portion of the slough has much more riparian vegetation. Both banks have large Sitka spruce mixed with hooker willow and salmonberry scrub.

Upper Tryon Creek, upstream of the slough, is choked with reed canary grass. The lower portion of the creek has a dense willow riparian area but the ground and channel bed are still covered with reed canary grass. Further upstream on the Alexandre Dairy the channel is currently devoid of riparian vegetation and dominated by reed canary grass.

Water Withdrawals

The Westbrook off-channel 200 hp turbine pump was installed on Moseley Ranch in the early half of 1970's for irrigation purposes; at that time, the operation of the pump caused ¾ mile of stream to be dewatered throughout the irrigation season. Later, mitigation measures were put in place, including recharge of the stream with cold pumped water. However, the pump is still in operation and is believed to still have substantial impacts on the rate of flow within Tryon Creek during the irrigation season.

Public Access

Currently the lower Yontocket Slough and Tolowa Dunes State Park are used as recreation areas with public access via Pala Road and Kellogg Road. The main public uses of the area are hiking, horse riding, watching and hunting of waterfowl, coastal access, and fishing along the south bank of the Smith River near the mouth of Tryon Creek. Legal and illegal off road vehicle use is common in the park area, around the slough, and around the Lake Earl Wildlife Area.

Waterfowl

A variety of resident and migrating waterfowl utilize the slough and the adjacent grasslands for feeding. Redheads are found primarily in Lake Earl and use slough areas for foraging. Puddle Ducks and Ringneck Ducks are found widely throughout the slough and Canvas Back Ducks have occasionally been observed in the slough. Seasonal duck hunting by the public is permitted within the State managed portion of the slough.

Aleutian Geese utilize the area annually during migration as a stopover along the Pacific Flyway. Geese feed on grasses in the adjacent pastures, preferring areas with short grasses that do not provide cover for predators. During their stopover, 30 to 35 Aleutian gees eat as much grass as one cow, thus competing with local ranchers for cattle feed. In the summer, Alexandre Dairy grazes and irrigates approximately 300 acres of State Park property adjacent to the slough to create suitable public land for Aleutian geese to help relieve pressures on adjacent private lands.

2.4 Previous and Current Habitat Restoration

In 1985 Tryon Ranch received California Coastal Conservancy grant funds for stream restoration that included removing wood and dredging silt that was deposited during the 1964 flood. The dredging was done with a drag line and dredged materials were spread across the adjacent land. Dredging deepened pools for fish habitat and eliminated reed canary grass within the channel. The project also included fencing the riparian areas and planting riparian spruce, alder, and willow.

In 2002, the Smith River Advisory Council (SRAC) and Alexandre Dairy developed and implemented a cattle exclusion and riparian enhancement project (funded by CDFG Fisheries Restoration Grants Program). The project area included approximately one mile of Tryon Creek upstream of the 1985 project site on the Tryon property. Post project observations confirmed adult cutthroat trout utilizing the project area.

Alexandre Dairy in coordination with the Smith River Watershed Coordinator fenced and re-vegetated about one mile (approximately 3 acres) of Tryon Creek on their Moseley Ranch Property. The project was partially funded through CDFG Fisheries Grants Program. During February 2006, volunteers planted an additional 500 native trees along Tryon Creek on the Moseley Ranch.

Reed canary grass has invaded Tryon Creek, rendering much of the habitat unsuitable for anadromous fish migration, spawning or rearing. Alexandre Dairy, funded by CDFG and the USFWS Partners Program, is pursuing control of the invasive plant within a 2,500-foot reach of Tryon Creek. Various reed canary grass control techniques, including those recommended by Gedik BioLOGICAL Associates, will be employed to identify effective treatment methods. Herbicides will not be used as part of this effort. In general, heavy equipment and manual labor will be used to remove reed canary grass and excavated material will be transported to an offsite location to be burned and composted. The project also includes replacement of a failing ranch road culvert on Tryon Creek, exclusionary fence along the creek, and planting of native riparian tree species. Permits are pending and work is anticipated to begin in August 2006.

The California Conservation Corps was recently awarded funding from CDFG Fisheries Grants Program to enhance more than one half mile of riparian habitat along the banks of Yontocket Slough on the Tedsen Ranch by constructing 3,000 feet of cattle exclusion fence and planting 1,500 native trees. The planting of these 1,000 Sitka spruce and red alder trees, as well as 500 willows sprigs will restore two acres of riparian forest, and benefit populations of anadromous fish. Work should begin on implementing this project in the Summer of 2006.

2.5 Existing Habitat Values to Waterfowl

Yontocket Slough provides open water habitat to waterfowl during late fall and early winter. Standpipes were placed on the inlet of culverts at Pala Road a number of years ago to assist in maintaining high water levels within the upper slough to increase waterfowl habitat. However, during early spring, monotypic stands of reed canary grass (RCG) cover a large portion of the slough, thus eliminating open water habitat. Additionally, RCG is believed to provide very little foraging habitat, and grows so dense that waterfowl can not use the habitat. Therefore, due to the presence of RCG, habitat is only suitable for waterfowl from the onset of winter rains through the filling of the slough in late winter.

Fish passage and habitat enhancement alternatives that address the presence of reed canary grass will likely benefit waterfowl by opening up more suitable habitat. Additionally, rearing coho thrive on marshy habitat, such as beaver ponds and old mill ponds (Sadro and Miller 2000). This is the likely the type of habitat Yontocket Slough historically provided. Therefore, alternatives for Yontocket Slough that have the most benefit in terms of coho rearing habitat will almost undoubtedly also improve habitat conditions for waterfowl.

3 Activities and Findings

The Yontocket Slough Fisheries Access and Habitat Improvement Project involved the following field activities:

- Topographic mapping of the entire project area
- Monitoring water levels within Yontocket Slough and Tryon Creek
- Water quality monitoring within Yontocket Slough and Tryon Creek
- Mapping vegetation throughout the project area

3.1 Topography

3.1.1 Topographic Mapping Activities

Keith Barnard from Graham Mathews and Associates, with field assistance from Michael Love & Associates staff, mapped the topography of the project area. The mapped area was approximately 95 acres and encompassed the entire slough, from Lower Lake Drive northwest to the slough outlet downstream of Pala Road (Figure 3.1). The mapping also included the Tryon Creek channel from Silva Road downstream to where it enters Yontocket Slough and the stream channel from the slough outlet to the confluence with the Smith River.

A survey control network was established using Global Positioning System (GPS) survey equipment to provide horizontal and vertical control within the project area. The network was based on benchmarks maintained by the National Geodetic Survey. Final survey elevations are based on the North American Vertical Datum of 1988 (NAVD88) in feet, which is 0.39 feet above the Mean Lower Low Water (MLLW) tidal datum established for Crescent City. Horizontal coordinates are based on the North American Datum 1983 (NAD83) California State Plane, Zone 1, in feet.

The mapping was performed during December 2004 and January 2005. During this period the slough was fully inundated due to high flows occurring in November 2004. This required using several different survey techniques, dependent on the specific terrain conditions. Real-Time Kinematic GPS (RTK) was used to map areas that were dry or inundated by less than three feet of water. In these areas effort was made to ensure that the survey elevation was taken on top of the soil, and not on vegetative clumps associated the pervasive reed canary grass.

In inundated areas, bathymetry was mapped using sonar in combination with RTK. An inflatable cataraft with an electric motor was utilized to map the slough's bathymetry. The sonar provided readings that corresponded to the top of the reed canary grass clumps, where present. To remove the vegetation from the bathymetry, the bottom was probed at locations throughout the slough using a stadia rod to determine the actual depth to native soil. These measurements were utilized in the data processing phase to correct the elevations recorded by the sonar.

In addition to mapping topography, the location and elevation of various staff plates used for hydrologic monitoring were surveyed. This allowed for converting observed stage readings at locations thought the project area into water surface elevations based on a common vertical datum (NAVD88).

All survey points were accumulated in AutoCAD LDD3 software to build a digital terrain model (DTM) from which contour lines were generated. The final DTM was built from approximately 20,000 points, 17,000 of which were corrected and filtered bathymetry points collected using sonar.

Figure 3.1 - Aerial photo showing area of mapped topography, which included (1) Yontocket Slough, (2) the Tryon Creek channel from Silva Road to the slough, and (3) the channel from the slough outlet to the Smith River. Elevations of contours are in NAVD88 datum.

3.1.2 Description of Topography

The topography within and adjacent to the slough varied from about elevation -1.0 feet (NAVD88) in the deepest locations to roughly elevation 16 feet on some of the higher terraces (Figures 3.2 and 3.3). Tall sand dunes, reaching over 60 feet high in places, border the west side of the lower slough. Characteristic of an abandoned channel meander, the banks on the outside portion of the bend (southern bank) are relatively steep, at nearly 2H:1V slope. Along the inside portion of the bend (northern bank) the steepness of the banks are more variable. In addition, steep banks occur throughout most of the private owned portion of the slough, but are more gradually sloping throughout the State Parks' portion of the slough.

The profile in Figure 3.2, which runs along the thalweg (deepest locations) of the slough and Tryon Creek, shows that the channel bed at the confluence with the river is approximately 0.5 feet elevation. From the confluence the channel climbs in elevation until it reaches the outlet of the slough. Near the outlet the channel becomes confined and the channel bed elevation is controlled by a naturally occurring hard spot, or "knick point", which prevents the slough from completely draining. At river levels above roughly elevation 7 feet the Smith River will backwater the lower slough up to Pala Road. Once the river level exceeds elevation 10 feet it will overtop Pala Road and the standpipes, causing the backwater affect to extend upstream into the upper slough.

3.1.3 Culvert Configuration at Pala Road

The inlet and outlet bottoms for each of the four culverts under Pala Road at Yontocket Slough were surveyed, along with the top of the stand pipes (Figure 3.4). At the crossing the road surface ranges between 10.1 and 11.5 feet. Near the locked gate and parking lot on Pala Road the road surface is about elevation 11.5 feet.

3.1.4 Stage-Area and Stage-Volume Relationships

Using the collected topographic information, we developed relationships between stage (water surface elevation) within the slough and the corresponding area of inundation (Figure 3.5) and volume of water stored within the slough (Figure 3.6). These relationships were developed for both upstream and downstream of Pala Road (upper and lower slough).

The rating curves show that when water levels begin to overtop Pala Road the slough has a total water surface area of approximately 100 acres and contains nearly 350 acre-feet of water.
Also, the stage-area curve clearly shows that nearly all of the slough is above elevation 4 feet.

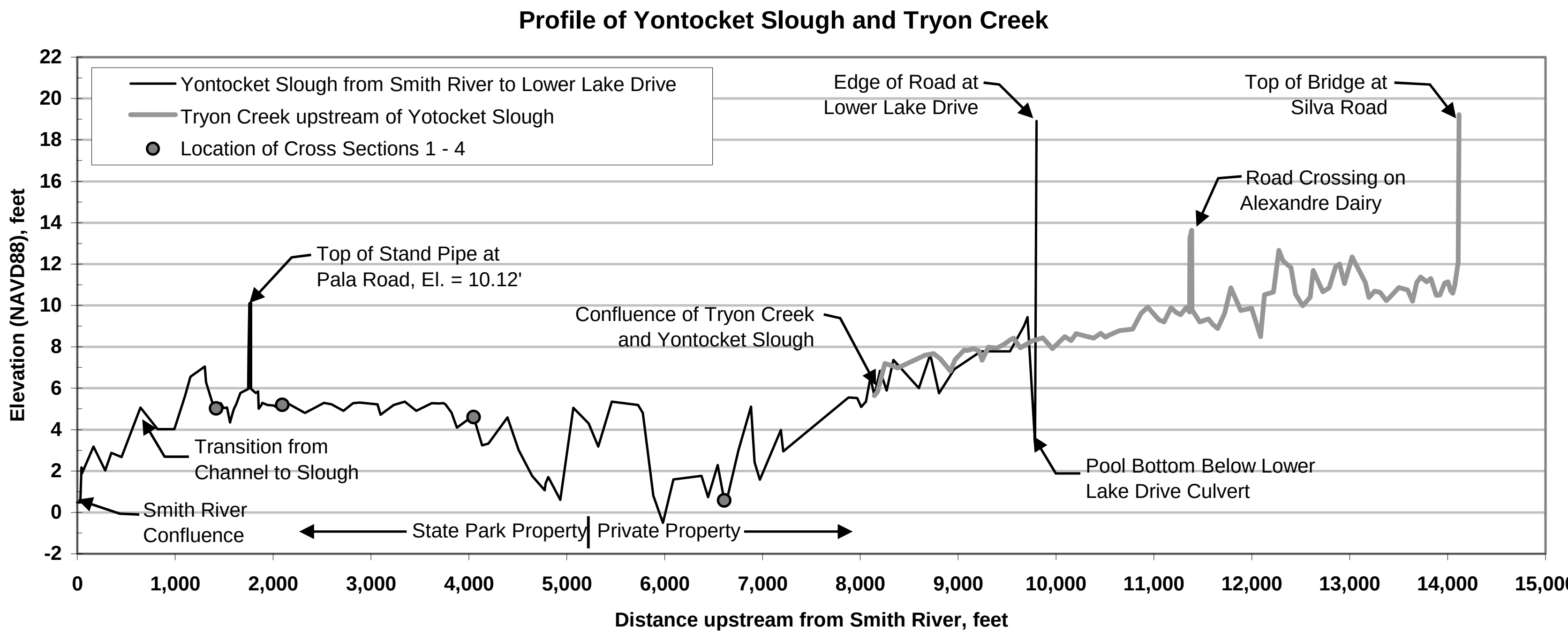


Figure 3.2 - Profile of Yontocket Slough and Tryon Creek. Profile begins at the Smith River confluence and proceeds to the end of the slough at Lower Lake Drive. The profile of Tryon Creek from its confluence with Yontocket Slough proceeding upstream to the Silva Road Bridge is also plotted.

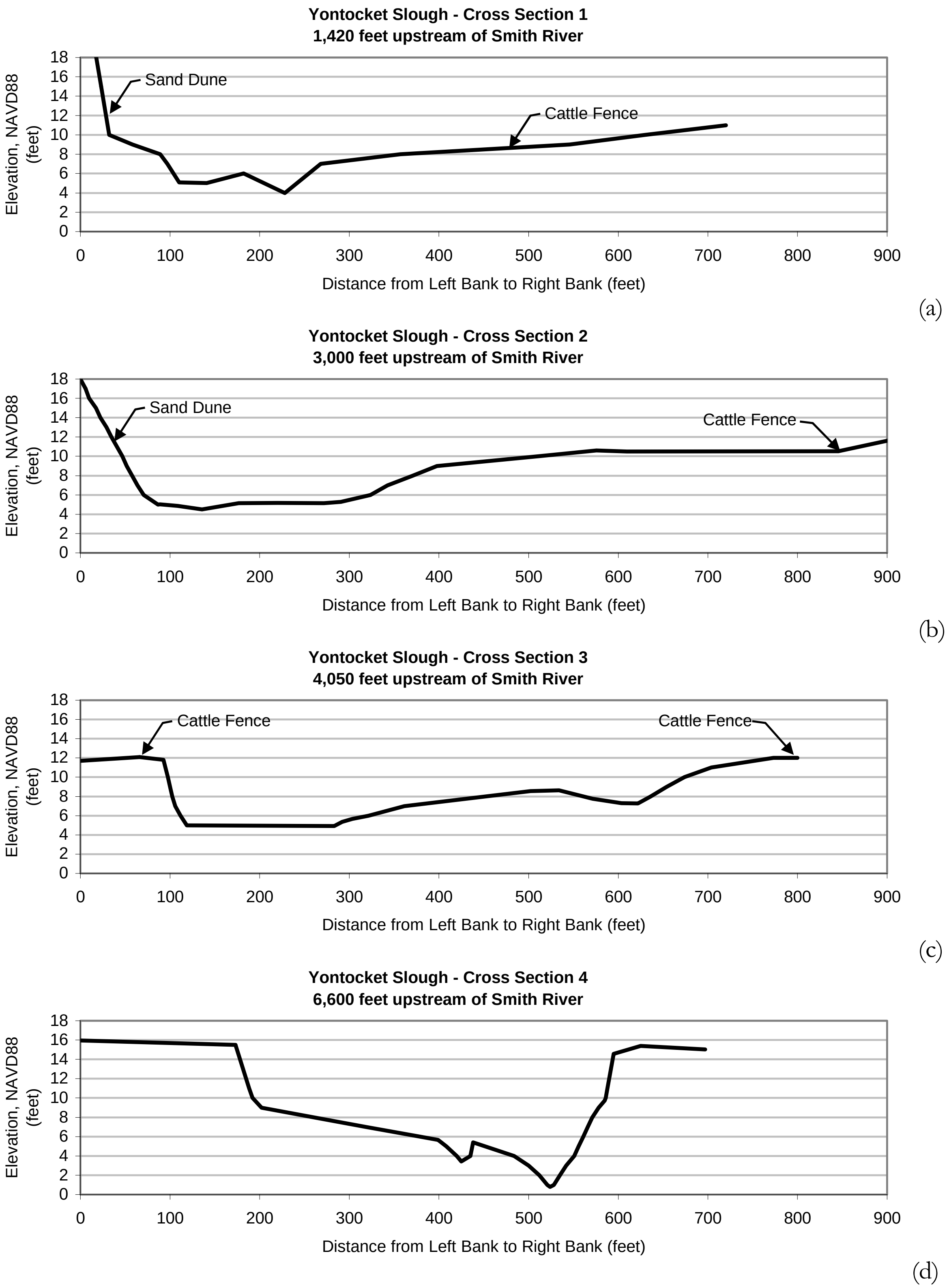


Figure 3.3 - Section view of the slough (a) 1,420 feet downstream of Pala Road and (b) 3,000 feet, (c) 4,050 feet and (c) 6,600 feet upstream of Pala Road.

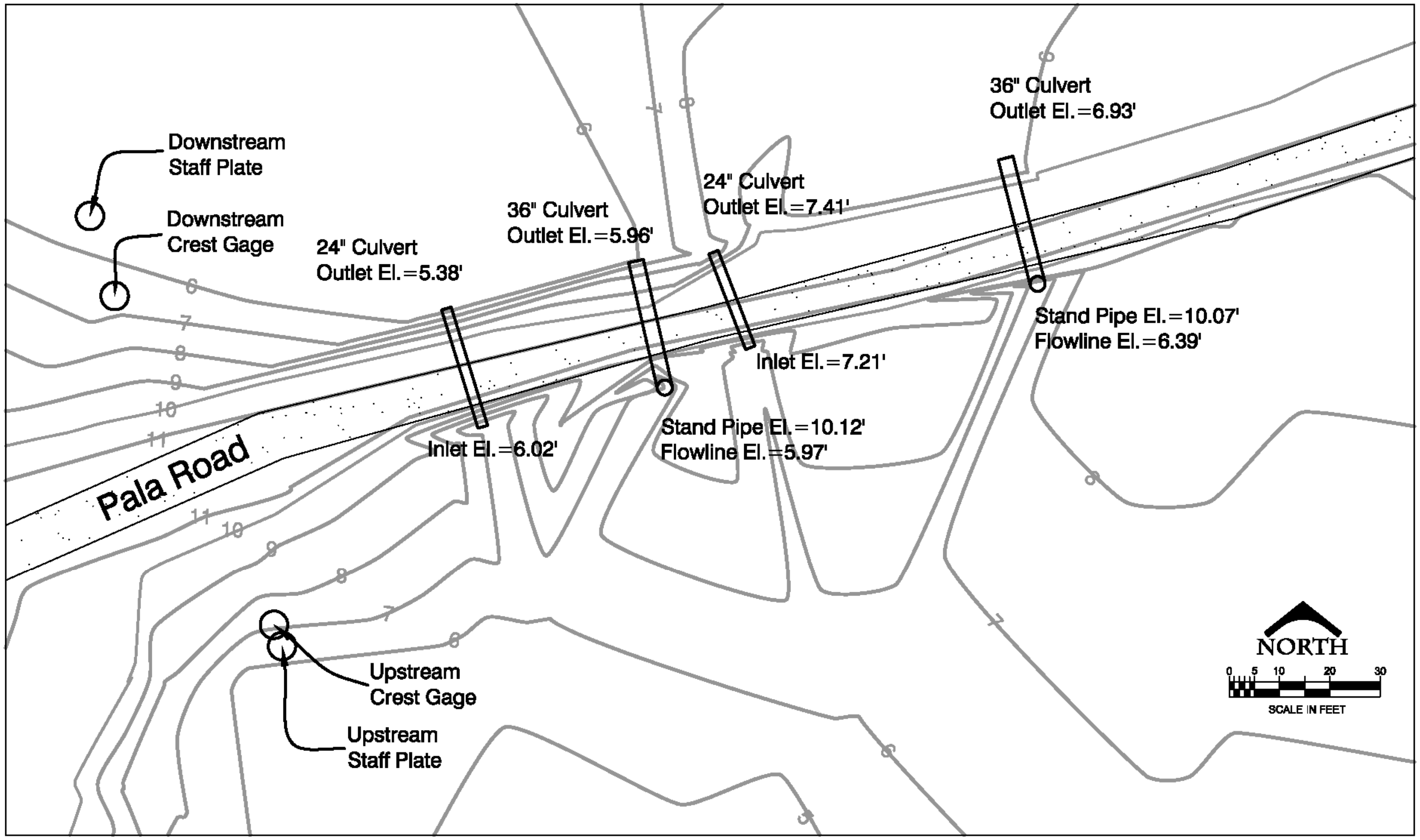


Figure 3.4 - Plan view of Pala Road crossing Yontocket Slough, showing location and elevations of the two 24 inch free flowing culverts and the two 36 inch culverts with stand pipes. Also shown are the location of the staff and crest gages adjacent to Pala Road. All elevations are in NAVD88 datum.

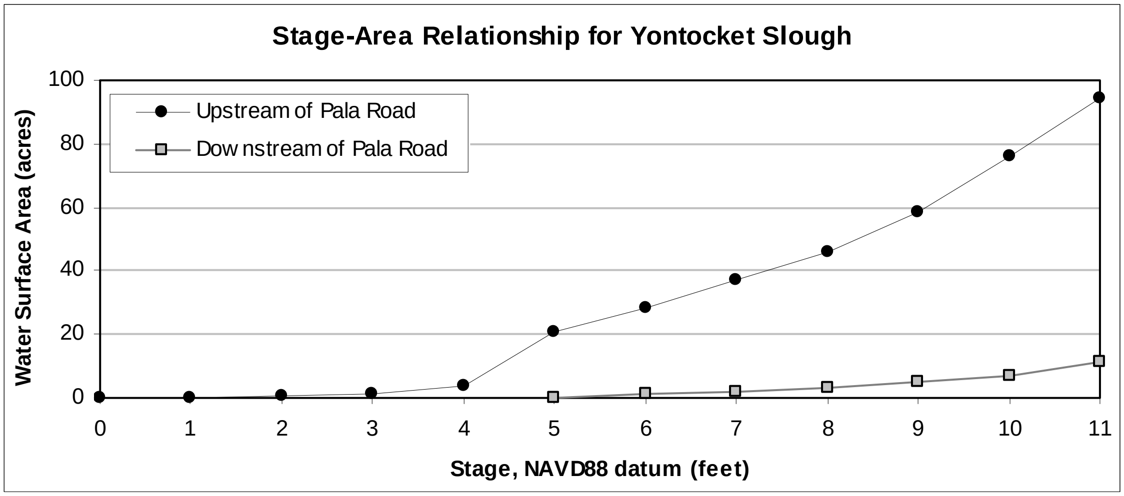


Figure 3.5 – Relationship between the stage (water surface elevation) upstream and downstream of Pala Road and the water surface area of Yontocket Slough.

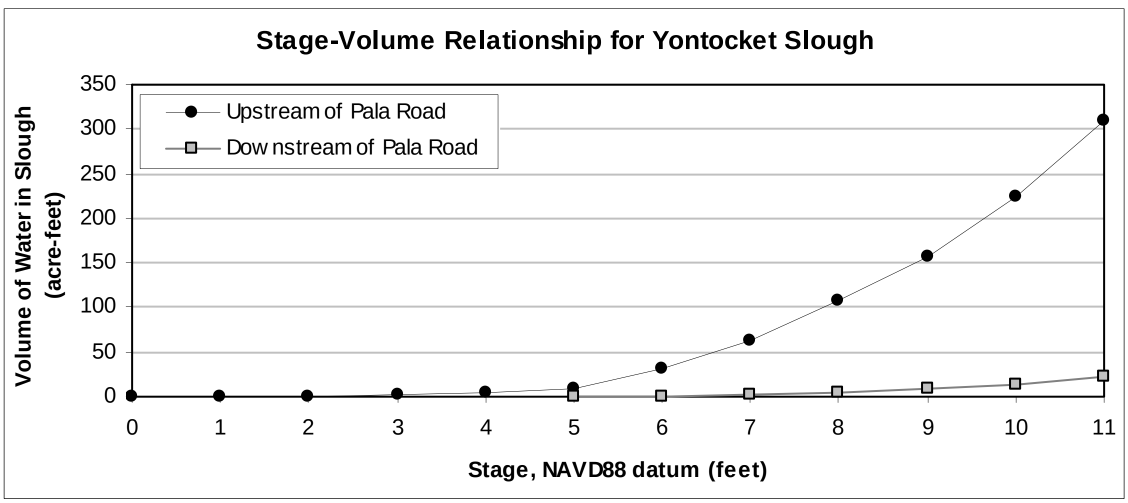


Figure 3.6 - Relationship between the stage (water surface elevation) upstream and downstream of Pala Road and the volume of water stored within Yontocket Slough.

3.2 Hydrologic Characteristics

Understanding the hydrologic characteristics and processes occurring within and adjacent to Yontocket Slough was a key objective of this planning project. Field investigations and analysis of collected data were intended to improve our understanding of:

- Extent and timing of hydrologic connectivity between Yontocket Slough and the Smith River,
- Seasonal flow contributions of Tryon Creek to Yontocket Slough,
- Affect of Pala Road as a control structure on the water levels in the slough, and
- Depth, timing, and duration of inundation and its effect on the growth of reed canary grass.

3.2.1 Hydrologic Monitoring Activities

To monitor the water levels during the project planning period, four stage plates and three crest gages were installed in December 2004. Stage plates were installed at four monitoring sites:

1. Confluence with the Smith River,
2. The lower slough immediately downstream of Pala Road,
3. The upper slough immediately upstream of Pala Road, and
4. Tryon Creek at the Silva Road Bridge.

Crest gages were also installed at the two Pala Road sites and the Silva Road site. Crest gages were constructed following the U.S. Geological Survey guidelines and are designed to record the peak stage.

Field observations were made on a frequent basis. Observations included reading the current water level at all four sites and noting the peak water level recorded by the crest gages, followed by resetting the crest gages. During Winter and Spring of 2005 observations were generally made immediately before and after rain events. Beginning in April 2005 water level observations were conducted weekly. Observations were concluded in February 2006.

During Summer and early Fall of 2005 the slough downstream of Pala Road and the channel at Silva Road became dry. However, these sites were still visited weekly to identify timing of resurfacing water. In August 2005 it became apparent that the standing water at the staff plate upstream of Pala Road was disconnected from the standing water in the deeper potions of the upper slough. To monitor water levels within the deeper section of the slough an additional "dry season" staff plate was installed mid-slough, near the State Parks property boundary. Water levels were monitored at this fifth site until the end of October, when water levels began to rapidly rise, making the site inaccessible.

All water level observation and water quality data are provided in Appendix B.

3.2.2 Observed Water Levels

Observed water levels were converted to a common vertical datum (NAVD88) and plotted (Figure 3.7). To relate changes in water levels within Tryon Creek and Yontocket Slough to precipitation events and changes in river levels, we obtained river stage and rainfall records collected at the Smith River at Dr Fine Bridge station from the California Department of Water Resources. The Dr Fine Bridge station is located at the US101 Bridge approximately 4.2 miles upriver from the confluence with lower Tryon Creek. Dr Fine Bridge station likely experiences similar rainfall patterns as the project area, and river levels are generally not tidally influenced at this location.

Smith River at Tryon Creek

Tryon Creek enters the Smith River about 2.5 miles upstream of the river's opening to the Pacific Ocean, and is tidally influenced. However, collected water surface and topographic data indicates that tidal affects do not extend into the slough. As shown in the ground surface profile extending through Yontocket Slough and Tryon Creek (Figure 3.2), water levels within the Smith River need to exceed elevation 7 feet before backwatering into the lower portion of the slough, and exceed 10.1 feet before overtopping Pala Road. During the monitoring period, the river level exceeded 7 feet only during high flow events.

Observed river levels at the confluence with Tryon Creek (Figure 3.7b) show that during summer low-flow the tidal influence is somewhat muted, with river levels only changing one or two feet with changes in the tide. The highest observed water level during summer and early fall was 4.5 feet (4.9 feet MLLW datum). Water levels at the river remained relatively consistent at low-tide, maintaining at about 2.4 feet (2.8 feet MLLW datum). This minimal tidal flux is likely due to the relatively small and shallow opening and associated sand bars located at the river's mouth during summer months.

During winter and spring Smith River water levels at the lower Tryon Creek confluence are influenced primarily by the river's flow rate and secondarily by tidal conditions. During large flow events the river level can become high enough to backwater into Yontocket Slough. Backwatering from the Smith River causes water to flow up Tryon Creek and into the slough. Between November 2004 and February 2006 water from the Smith River overtopped Pala Road on at least four occasions. On each of these occasions, overtopping of Pala Road coincided with the river level rising above monitoring stage at the Dr Fine Bridge gaging station.

Therefore, Yontocket Slough is not currently connected to the Smith River's tidal estuary due to the topography of the slough and the limited tidal influence occurring at the mouth of Tryon Creek. However, during winter high flow events the Smith River can become high enough to backwater into the slough, allowing water and fish to easily enter the slough from the river.

Yontocket Slough

Water levels changes within Yontocket Slough coincide with rainfall events. In both December 2004 and December 2005 the level of the Smith River was sufficient to backwater into the Slough and overtop Pala Road, causing water levels to rapidly rise. A relatively dry period in January and February 2005 resulted in a substantial draw-down in water levels, until the return of heavy rains in March. In March and April flow inputs from Tryon Creek combined with some backwatering from the Smith River caused water levels in the slough to rise, overtopping Pala Road.

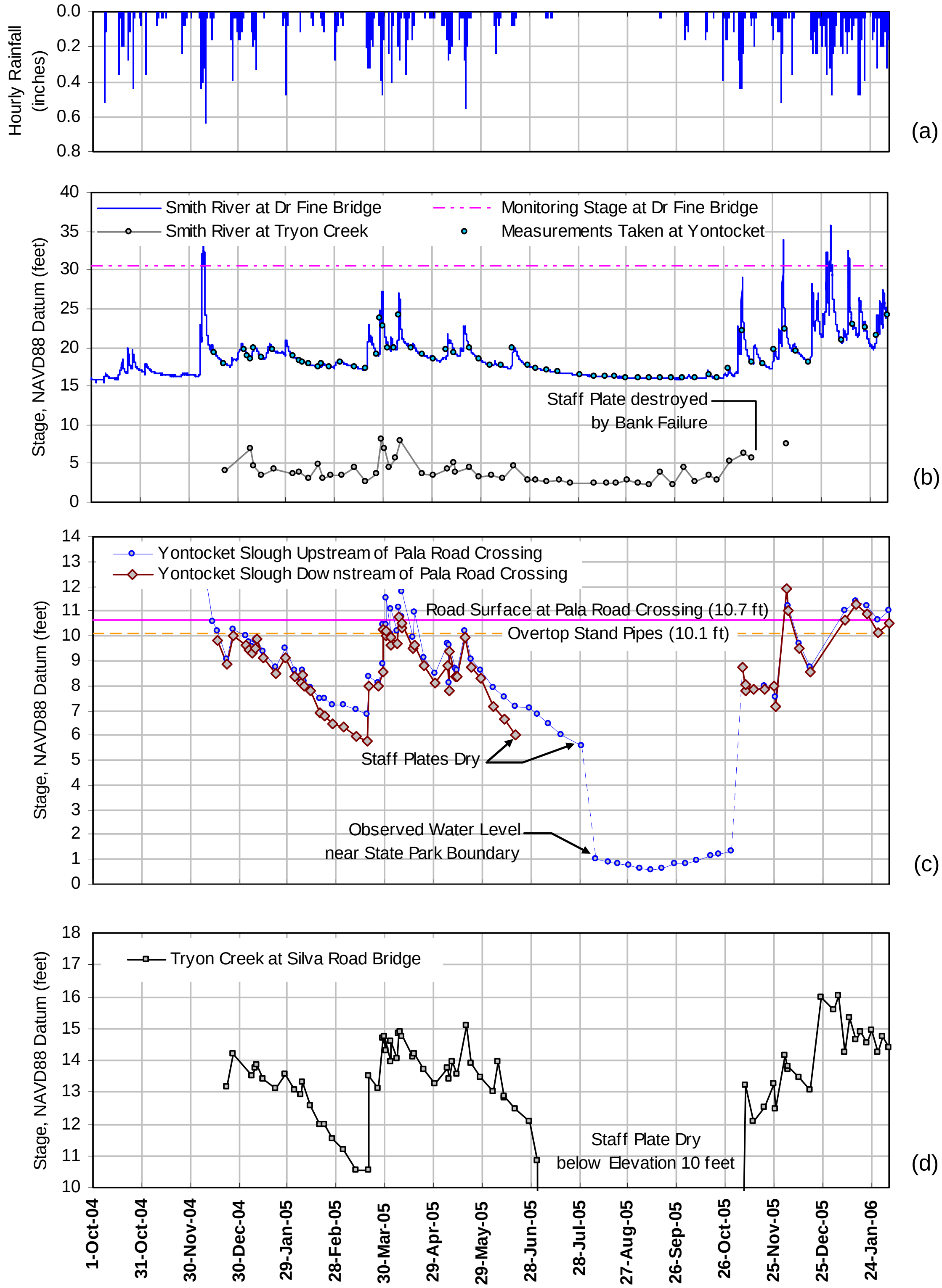


Figure 3.7 – Recorded (a) rainfall and (b) river levels at the Fine Bridge gaging station (DWR Station Name: DRF), combined with observed water levels at lower Tryon Creek confluence with Smith River, (c) water levels downstream and upstream of Pala Road, and (d) water levels at Tryon Creek at Silva Road Bridge.

During much of the winter and spring, water levels on both sides of Pala Road remain at a similar elevation. When the water level upstream of Pala Road rose above 7.5 feet, the level downstream of the road was on average only 0.36 feet lower. As the water level drops below 7.5 feet, water no longer drains through the two open culverts and is stored behind the Pala Road fill prism. During this time the downstream water level drops much more rapidly than upstream.

The lowest water levels were observed in September at the mid slough "dry season" staff plate. At this location the slough bottom is near elevation 0.4 feet and the lowest observed water level was in early September, at elevation 0.55 feet.

Tryon Creek at Silva Road

Observations of Tryon Creek water levels at Silva Road Bridge indicate that this portion of the stream is not directly influenced by the level of the slough. Water levels at Silva Road Bridge were generally 3 to 4 feet higher than those observed in the slough.

Except during large rainfall events water currents were typically slow to non-existent within this section of Tryon Creek. This section of stream has characteristics of a slough channel, with deep, slow moving water due to its low gradient, downstream depositional areas that create backwaters, and flow resistance associated with thick patches of reed canary grass within the channel.

During the extended dry period in February and March of 2005 the channel was nearly dry. In late spring, at the end of the rainy season, the stream channel went dry, and remained dry until the return of rains in early November 2005. Flow within Tryon Creek is believed to be strongly influenced by direct pumping of water from the upstream channel during the growing season.

3.2.3 Historical Frequency of Inundation by Smith River

In addition to flow from Tryon Creek into Yontocket Slough, inundation by over-bank flows from the Smith River appears to be an extremely important mechanism for rapid filling of the slough. These over-bank flows occur most frequently in late fall and early winter when water levels in the slough are still relatively low. The floodwaters from the river provide sufficient inflow to fill the slough over the course of a few hours. They also provide a direct connection to the river, allowing both adult and juvenile salmon and trout to move freely into the slough. Extensive over-bank flow and flooding by the Smith River into Yontocket Slough occurred on at least four occasions from November 2004 to February 2006. During all of these events the river reached monitoring stage at the Dr Fine Bridge gaging station.

Conversations with Bob Tedsen, a long-time resident of the adjacent Tedsen Ranch, confirmed that extensive inundation of the slough by the Smith River occurs when the river at Dr Fine Bridge is at or above monitoring stage. Extensive inundation is believed to occur at slightly lower stages during high tide events, although it is not possible to determine exactly when this occurs without more data.

The stage data from Dr Fine Bridge shows that the river level has risen above monitoring stage on 34 separate occasions since 1983 (Figure 3.8). Each of these events likely caused inundation of Yontocket Slough by the river's over-bank flows. In any given year there is roughly a 75% chance that the river will surpass monitoring stage, leading to inundation of the slough. During those years that the river level remains low, the slough is believed to receive most of its flow inputs from Tryon Creek alone.

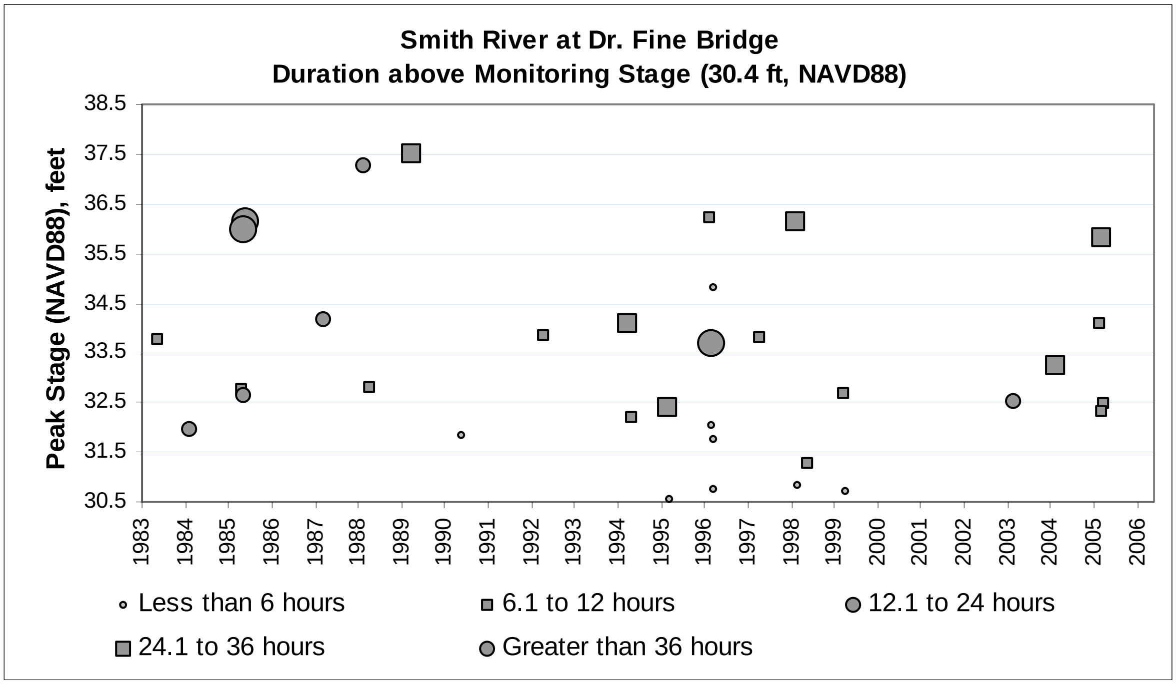


Figure 3.8 – Occurrences since 1983 of the Smith River water levels peaking above monitoring stage at Dr Fine Bridge. These events are assumed to cause inundation of Yontocket Slough by over-bank flows originating from the river. The different symbols indicate the duration that the river remained above monitoring stage.

3.3 Water Quality Sampling

As part of this project, water quality sampling was conducted from August 2005 to February 2006. The following parameters were sampled:

1. Water Temperature
2. Dissolved Oxygen
3. Salinity

Water temperature and dissolved oxygen were sampled using a YSI EcoSense DO200 with an accuracy of +/-2% of the reading. Salinity was measured using an Oakton hand-held SALT 6 salinity meter, which reads salinity between 1.0 to 50.0 ppt with an accuracy of +/- 1% of the reading. Both were calibrated before each use. In-situ measurements were taken during weekly staff plate readings. Sample locations were (1) the confluence of Tryon Creek with the Smith River, (2) near the staff plate downstream of Pala Road, (3) near the staff plate upstream of Pala Road, (4) near the midpoint of the slough at the State Park property boundary, and (5) Tryon Creek at the Silva Road Bridge.

3.3.1 Water Temperature

Water temperatures remained below 18ºC from November 2005 through the end of the monitoring period (February 2006). The warmest water temperatures were recorded during August. During this period the deeper waters of the slough near the State Park boundary and at the confluence of Tryon Creek with the Smith River averaged 15.6ºC and 14.6ºC, respectively. These temperatures are well suited for summer rearing of juvenile salmonids. (McCullough, 1999).

3.3.2 Salinity

Salinity greater than 1.0 ppt was detected at the Tryon Creek confluence with the Smith River on two separate occasions. Both detections occurred during low summer flows in the Smith River, indicating that tidal effects bring brackish water upriver to at least the mouth of Tryon Creek during periods of low river flows. Salinity was not detected at any of the other monitoring sites.

3.3.3 Dissolved Oxygen

Dissolved oxygen levels in Yontocket Slough were quite low through the beginning of January, often less than 2.0 ppm (Figure 3.9). Dissolved oxygen levels began to rise only after prolonged flooding of the slough. Levels below 2 ppm are considered lethal for juvenile salmonids (Water Quality Assessments, 1996)

Even after the slough had filled in late fall, dissolved oxygen levels remained dangerously low for salmonids; this is likely caused by the large amount of decaying organic matter within the slough associated with the annual die-off of reed canary grass. Additional factors that may be reducing dissolved oxygen include runoff into the slough containing nutrient-rich cattle waste as well as water withdrawals from Tryon Creek that reduces the amount of inflow. Further water quality study could assist in determining the sources and amount of the nutrient loading.

3.4 Biological Assessment

Early in the project reed canary grass (*Phalaris arundinacea* L.), an invasive and aggressive semi-aquatic grass, was identified as having major detrimental effects on fisheries and waterfowl habitat within Yontocket Slough. The grass was first introduced to the project area by the University of California Agricultural Extension Service in approximately 1962 (Bicknell, 1991). Since then it has colonized much of Yontocket Slough and the Tryon Creek stream channel, forming a monocrop of the grass by out-competing native plant species.

Detrimental effects of reed canary grass on habitat within Yontocket Slough include:

1. Likely hinders fish movement within the slough during spring through fall due to its density and a lack of open water,
2. Leads to extremely low dissolved oxygen levels, lethal to fish, through late fall as a result of large quantities of decomposing plant material,
3. Prevents native wetland plant species from growing and providing suitable food sources for waterfowl and other animals, and
4. Prevents the reestablishment of riparian vegetation along the margins of the slough and creek.

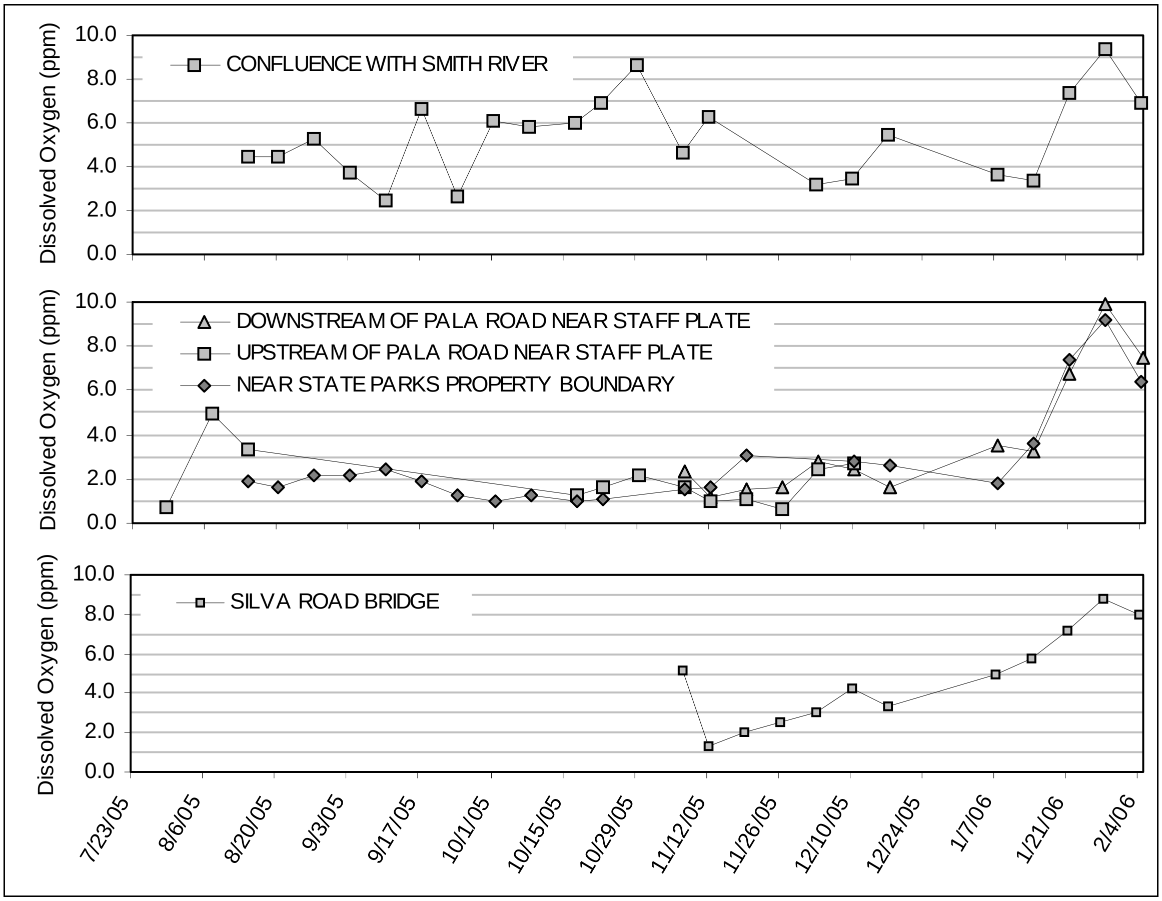


Figure 3.9 – Measured dissolved oxygen at five locations within the project area. In the upper slough levels were lethal (<2ppm) for salmonids through November.

To aid in developing alternatives for controlling reed canary grass and improving habitat within the slough, Tamara Gedik of Gedik BioLOGICAL was contracted as project biologist. Her tasks included mapping vegetation throughout the project area and developing a set of preferred vegetation control options. During field mapping, the project biologist also identified and recorded any *special status* plant species found within the project area. Additionally, sensitive wildlife species observed during the field mapping were noted. The full Biological Report for the project is provided in Appendix E. The following briefly summarizes the methods and findings.

3.4.1 Overview of Vegetation Mapping Methods

Field mapping of reed canary grass was conducted in August through October 2005 using a Trimble GeoExplorer 3 hand-held GPS unit in combination with a real-time differential correction unit. Data was recorded using NAD 83 horizontal projection and California State Plane, Zone 1 coordinates measured in U.S. survey feet, consistent with the project topographic base map created by Graham Matthews and Associates. Reed canary grass occurrences were demarcated in the field by differences in average height (Figure 3.10). Observations of plant cover, associated species, general phenology, and plant height were collected. No formal plot or transect data was collected due to time constraints.

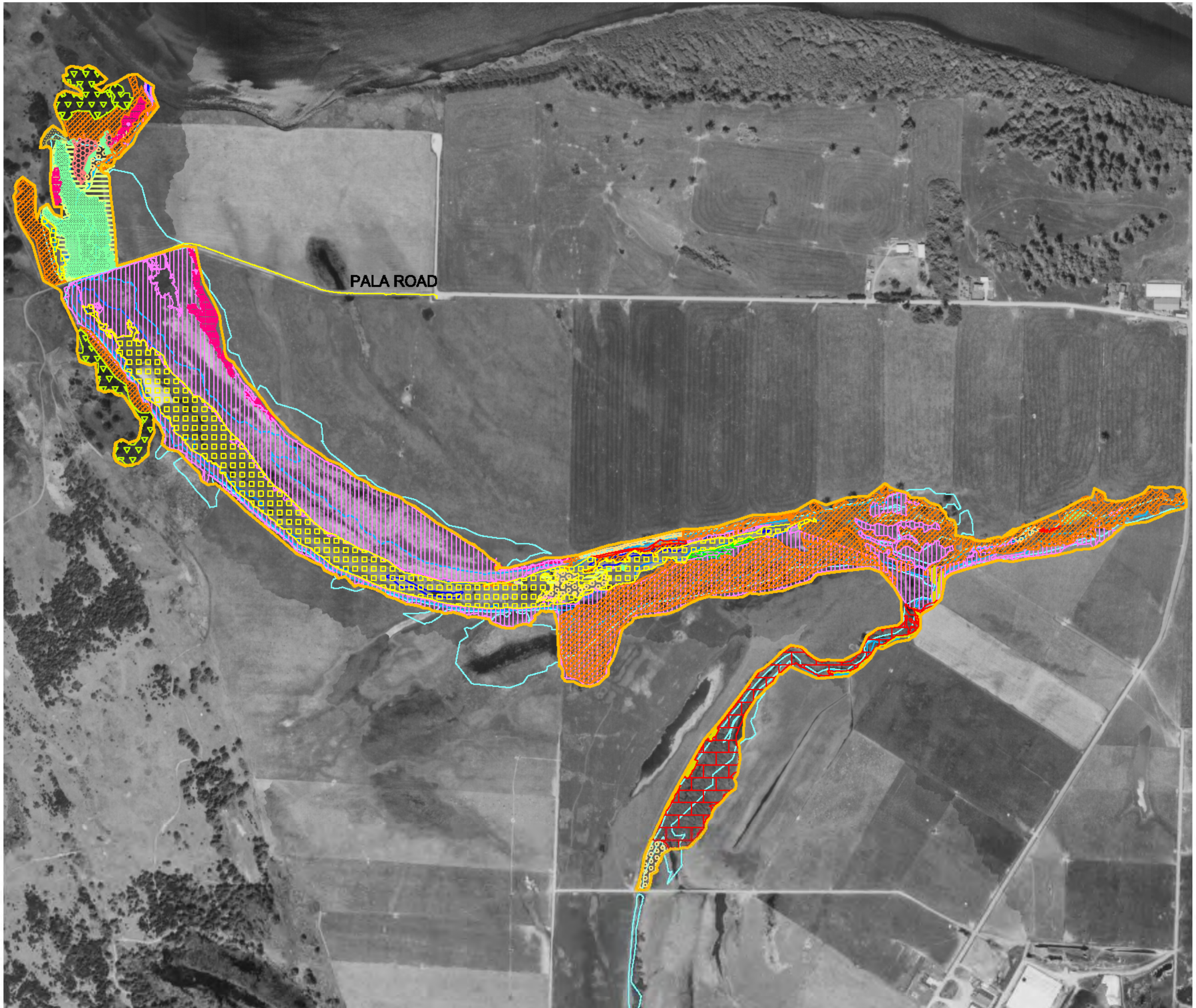


Figure 3.10 - Vegetation map showing the distribution and size classes of reed canary grass within the project area, along with the location of other surrounding vegetation communities

VEGETATION TYPES

AT YONTOCKET SLOUGH
Del Norte County, CA

Legend:

- SURVEY AREA
- SITKA SPRUCE
- SITKA SPRUCE-SALMONBERRY SCRUB
- HOOKER WILLOW
- INTRODUCED PERENNIAL GRASSLAND
- EUROPEAN BEACHGRASS
- PACIFIC REEDGRASS
- YELLOW POND-LILY
- LESS THAN 3' REED CANARY GRASS
- 3-4' AVG. HEIGHT REED CANARY GRASS
- 4-5' AVG. HEIGHT REED CANARY GRASS
- 5+' AVG. HEIGHT REED CANARY GRASS
- MIXED HEIGHTS REED CANARY GRASS

Approximate scale: 1 inch= 640 feet

0 320 640 1280

Map created by Tamara Gedik in December, 2005 using base map and aerial photo provided by Michael Love and Associates

GEDIK BioLOGICAL ASSOCIATES

A few occurrences of reed canary grass could not be mapped with GPS due to inaccessibility associated with standing water. These areas were photographed and mapped by hand in AutoCAD using aerial photos. Mapping efforts focused on slough channel and immediate surrounding area. Agricultural lands adjacent to Yontocket Slough and Tyron Creek were not mapped.

Surrounding vegetation communities, with the exception of reed canary grass, were mapped in AutoCAD at a coarse scale (minimum mapping unit of 0.5 acre) using primarily photographs and aerial imagery.

3.4.2 Overview of Findings

Reed canary grass is well established in the immediate area surrounding Yontocket Slough and has encroached and stabilized within much of the slough channel. Much of the agricultural land surrounding Yontocket Slough is also dominated by reed canary grass. However, these areas were not addressed during the vegetation mapping.

The entire mapped area was 119 acres, with approximately 95 acres located directly within the slough. The remaining acreage was within Tryon Creek, some of the riparian areas adjacent to the slough, and in the sand dunes adjacent to the slough and lower Tryon Creek. Within the surveyed area, reed canary grass covered about 64 acres. Reed canary grass was grouped into five height categories within the project area: less than 3 feet height (1.8 acres) occurring primarily in areas grazed by cattle; 3-4 foot average height is most prevalent throughout the project area (48 acres); 4-5 foot height (1.7 acres) occurs sporadically in the project area; greater than 5 foot height (4.8 acres) is predominant north of Pala Road; and lastly a mixed-height classification (7.8 acres) is common in the area surrounding Upper Tryon Creek, where reed canary grass grows at varying heights throughout woody riparian vegetation. Appendix C provides photo documentation of the established reed canary grass within various locations throughout the project area.

The long-term establishment of reed canary grass in the area is evident by the prevalence of an uneven hummocky topography. This has been created by the growth of many previous years' vegetation toppling over, with new growth emerging laterally atop old mounds. Thus, in many areas a fluctuation of 2-3 feet in height can be achieved with each step. Reed canary grass has also developed floating mats of vegetation, likely a result of fluctuating water levels within the slough during spring.

With exceptions of floating mats, reed canary grass was not found growing at locations within the upper slough below roughly elevation 4.8 feet. Instead, these areas are colonized by native yellow pond-lily. As documented in the Biological Report, inundation of reed canary grass by standing water at least 18 to 24 inches deep throughout the growing season (typically through June in the Pacific Northwest) can prevent the growth and establishment of reed canary grass. This likely explains the lack of reed canary grass in the deeper portions of the slough. In 2005 water levels in the upper slough remained above 6.5 feet through the end of June (Figure 3.7). This would be sufficient to prevent growth of reed canary grass within portions of the upper slough that have bottom elevations below elevation 5 feet.

3.4.3 Identification of Sensitive Species

No sensitive plant species were identified within the project area. Five individual plants of Pacific gilia (*Gilia capitata* ssp. *pacifica*), a small annual that has special status, were observed in sandy soils approximately 10 feet from a hiking trail northwest of Pala Road. This location is outside of the project area and is not anticipated to be within the area of disturbance for any of the proposed project alternatives.

Sensitive wildlife species observed while conducting the field vegetation mapping were yellow-legged frog (*Rana boylii*) and northern red-legged frog (*Rana aurora aurora*). Additionally, black-crowned night herons (*Nycticorax nycticorax*) and great egrets (*Casmerodius alba*) were observed occupying willow thickets at the site. The presence of rookery sites in this area is unknown.

Salmonids are likely present within the slough and Tryon Creek during certain periods of the year. Additionally, the lower tidally influenced portion of Tryon Creek may provide suitable habitat for tidewater goby (*Eucyclogobius newberryi*). Consultation with a fisheries biologist may be required to assess habitat conditions and determine presence/absence status of tidewater goby if the preferred alternative involves impacting this portion of Tryon Creek.

3.5 Implications of Restoring Hydrologic Connectivity at Pala Road

The collected water surface elevations upstream and downstream of Pala Road were used to assess the effects of the road and associated culverts on (1) water levels, (2) areal extent of inundation, and (3) distribution of water depths within the slough. An elevated ground surface at the outlet of the slough, downstream of Pala Road, controls the water surface elevation of the lower slough. The water level within the upper slough is controlled by a combination of the culverts under Pala Road, the road prism, and the water surface within the lower slough. We can use the collected stage data along with the stage-inundation area curves (Figure 3.6) to evaluate the results of fully connecting the lower and upper slough through either removing the road or installing large drainage structures (i.e. large culverts or a bridge) at Pala Road.

Fully opening the hydrologic connection of the slough at Pala Road and removing all water control structures will result in only a minimal decrease in inundation during late fall through early spring. Examining the period from December 15, 2004 through April 30, 2005, water levels within the upper slough averaged 0.5 feet higher than the lower slough (9.3 ft versus 8.8 ft). Therefore, the removal of all water control structures at Pala Road would have caused the upper slough to be 0.5 feet lower during this period, which equates to an average decrease in inundated area of 10 acres, from 74 acres down to 64 acres.

3.5.1 Impacts on Distribution of Reed Canary Grass

Currently in late spring, and during extended dry periods in the winter, water levels in the lower slough drop at a faster rate than the upper slough, upstream of Pala Road. Restoring the hydrologic connection of the slough at Pala Road will likely cause the upper slough's water level to drop more rapidly during late spring, as well as increase the magnitude of draw-down events during dry periods in the winter and early spring. This has implications on the growth and spread of reed canary grass.

As discussed in Section 3.4.2 and in the Biological Report (Appendix E), an area must remain inundated with standing water between 18 and 24 inches deep through June to suppress growth of reed canary grass. In June 2005, after a wetter than average spring, the slough downstream of Pala Road was on average one foot lower than upstream of the road. With opening up the hydrologic connection of the slough we anticipate lower water levels upstream of the Pala Road during late spring, likely leading to the spread of reed canary grass into the lower elevations of the slough. Currently reed canary grass grows above elevation 4.8 feet. If the upper slough's water levels in late spring become roughly 1 foot lower than current levels, we would expect to see reed canary grass begin to grow at elevation 4.0 feet or lower. This could result in reed canary grass becoming established in another 16 acres of the slough, leaving less than 4 acres of the slough free from this invasive species. Additionally, an increase in frequency and magnitude of draw-downs during extended dry periods in the winter may promote an increase in the occurrence of floating mats of reed canary grass during early spring, which could allow the grass to colonize the remaining 4 acres.

3.6 Stratigraphic Investigation

As shown in early maps (Figure 2.2), the slough was once connected to the Smith River estuary, suggesting that the slough channel may have been tidally influenced, and thus deeper, during this earlier period. Additionally, at several project advisory meetings long-time local residents claimed that the slough filled-in with sediment during the 1964 flooding of the Smith River, resulting in notable changes in water depths and vegetation communities. According to these accounts, shortly after the 1964 flood water lilies began to grow within the slough for the first time, possibly due to shallower water depths. Shortly after 1964, local land owners also report that reed canary grass began colonizing the slough. This invasive plant forms mounds and collects sediment that is believed to have further accelerated aggradation within the slough.

With anecdotal evidence of historic aggradation (post 1860's) within the slough, members of the project advisory group expressed interest in conducting a reconnaissance level stratigraphic investigation. Information gained from this investigation could aid in determining the historic conditions within the slough, the feasibility of excavating portions of the slough to improve habitat, and the depth of excavation that may be appropriate given the likelihood of tribal cultural deposits located within sediments deposited prior to the 1860's.

In October 2005 Pacific Watershed Associates (PWA) was contracted through funds provided by the California Coastal Conservancy and the Five Counties Salmonid Conservation Program to conduct a reconnaissance stratigraphic investigation to determine the thickness of historic (post-1860) aggraded sediment.

It was thought that sediment coring using hand driven "gouge cores" might yield stratigraphic data sufficient to delineate between protohistoric (between 1850 and 1860) and the historic sediment deposits. Sediment from the cores was described in sufficient detail to determine relative thickness of the sedimentary units. The conditions leading to the deposition of these sediments were interpreted based on the physical characteristics of the sediments. This stratigraphic history was then evaluated and correlated to historic floods. This section summarizes the stratigraphic investigation methods and findings. The complete report prepared by PWA is provided in Appendix F.

3.6.1 Coring Methodology

Sediment in Yontocket Slough was cored to determine subsurface stratigraphy and thereby help guide future restoration efforts. Specific sedimentary marker beds identified in the subsurface were correlated through the use of a reconnaissance stratigraphic study using hand driven, three centimeter diameter, gouge cores. The thickness of these stratigraphic units provides estimates of historic sedimentation in the context of geomorphic, hydrologic, biologic, and cultural conditions. Field investigations were conducted in October 2005. To accomplish correlation of these deposits, detailed stratigraphic data were recorded using a selected portion of the USDA soils description protocol. Color, texture, structure, roots, thickness, and other stratigraphic data were recorded for each layer to aid in correlation between cores.

Thirty cores were taken along a transect parallel to flow in Yontocket Slough and Tryon Creek (Figure 3.10). To provide estimates of the lateral variability of the stratigraphy, cross-channel coring transects (cross sections 1, 2, and 3) were conducted. Core spacing was based on: (1) available time; (2) ability to correlate stratigraphic units between adjacent cores; and (3) areas more likely to be included in future restoration planning. The number of cores was determined in the field based on the content (physical characteristics of the sediment strata) of the cores and the ability to correlate stratigraphic sequences between cores. Downstream of Pala Road, where coring was not possible due to sediment coarseness, Yontocket Slough bank exposures were described in order to extend the stratigraphic study downstream to the Smith River.

Core locations were surveyed with a "total-station" to locate the horizontal and vertical positions of the lithostratigraphic contacts found in the sediments. Surveyed locations were tied to the topographic mapping of the slough conducted by Graham Matthews and Associates through use of common horizontal and vertical datums.

3.6.2 Findings and Interpretation of Stratigraphic Investigation

Four distinct sedimentary units were identified from the corings. The bottom unit was pebbly to gravely-sand, and interpreted as the original bed of the Smith River before it abandoned the channel. Abruptly overlying the bottom unit is a massive mud to peaty-mud that grades upwards into a muddy-peat to fibrous peat. This unit, named Peat 1, averaged 36 inches thick between cores. The top of Peat 1 is consistently near mean sea level. Peat 1 is abruptly overlain by a gray clay mud. The gray clay mud grades upwards to a silt-clay, peaty-mud. This unit, named Clay 1, averaged 12 inches thick. The stratigraphic section is capped by the modern peat and vegetation mat, which averaged 7 inches thick between samples. In a few of the corings small layers of clay were found within Peat 1 and small layers of peat were identified in Clay 1.

Peat 1 is believed to have formed over many centuries given its state of decomposition, upward gradation from mud to fibrous peat and thickness. Clay 1 is believed to have been deposited during some large flood event or as a result of some catastrophic sedimentologic change. However, there are not many layers of mud in the coring samples that can be correlated, making it difficult to determine which historic floods are more likely to be represented in the stratigraphy at Yontocket Slough. The historic peak flow data record for the Smith River (USGS Gage 11532500) dates back to 1931. A peak historical hydrograph for the Smith River was prepared by

Laird (2004) using anecdotal references for the pre-gage period of 1850 – 1931. In both the gaged and pre-gaged records the largest historic peak flow, by far, is the 1964 flood. Therefore, it is reasonable to believe that Clay 1 was deposited during the 1964 flood. This hypothesis is supported by anecdotal reports from Bob Tedsen of Tedsen Ranch, which is adjacent to the slough (Advisory Group Meeting Notes, Appendix A).

There are other possible explanations for formation of Clay 1. An alternative hypothesis is that Clay 1 formed during a prehistoric flood. This would mean that there is very little aggradation within the slough from the 1964 flood. Another process that could lead to the formation of Clay 1 is a rapid change in the hydrologic regime of the slough. This type of change might have occurred when the slough became disconnected to the Smith River and the tidally influenced estuary, possibly being cut-off by migrating sand-dunes.

Assuming that Clay 1 formed after 1860, then there is between 12 and 18 inches of deposition since European settlement began. If excavation within the slough is considered for enhancing slough habitat, the depth of this excavation should be constrained to between 12 and 18 inches to avoid disturbing pre-1860 deposits. Additionally, a geologist and archaeologist or cultural monitor working in front of any excavation, should perform corings to determine the depth to Clay 1. This on site coring can help guide the appropriate excavation depth.

The complete report prepared by PWA, including detailed interpretation of findings, is provided in Appendix F.

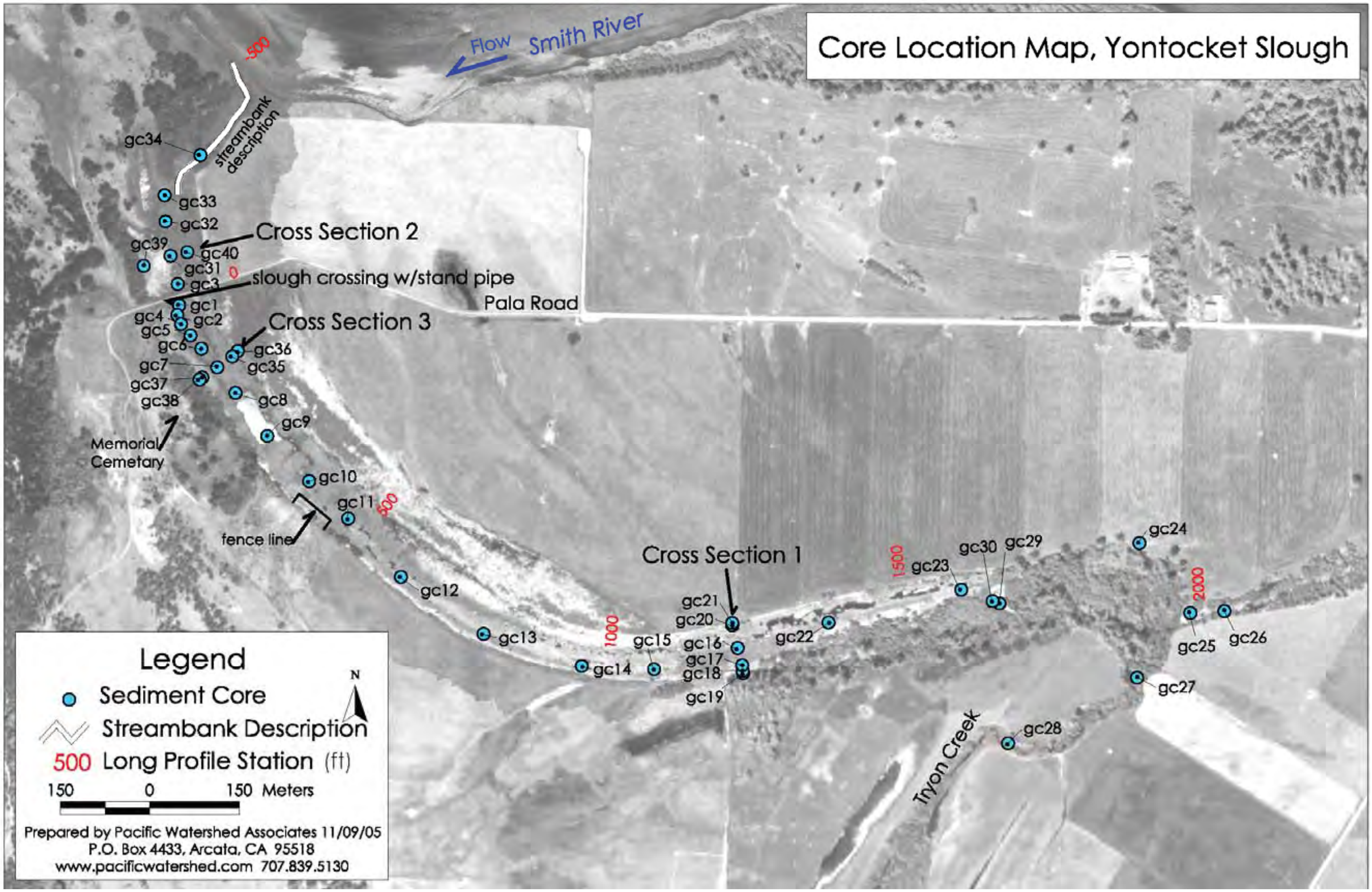


Figure 3.11 – Locations of cores within the Yontocket Slough. Sediment core locations are indicated by light blue dots. The long profile and cross-section transects are labeled in black. Stationing for the long profile transect is in red. Streambank description locations are indicated by the white line in top left corner.

4 Vegetation Control Methods for Reed Canary Grass

Numerous tools have been used for eradication and control of reed canary grass (RCG), and oftentimes an integrated approach utilizing multiple control methods is most effective. The following is an overview of the most common measures for controlling RCG, as reported in the Biological Report prepared for this project by Gedik BioLOGICAL Associates. The entire Biological Report is provided in Appendix E.

The methods for reed canary grass management that were assessed for the Yontocket Slough project are:

- Mowing and grazing
- Disking (Tillage)
- Scraping
- Burning and Flaming
- Herbicide application
- Hand removal
- Biological control
- Inundation
- Tarping and Mulching
- Soil amendments
- Revegetation

With any combination of these approaches the sequence, timing of application and sustained follow up of activities is critical and must be considered in the final design and budget.

4.1 Reed Canary Grass Lifecycle

In the Yontocket Slough area, reed canary grass was introduced by the Agricultural Extension Service of the University of California in approximately 1962 (Agricultural Extension Service 1962 in Bicknell 1991). As indicated in Bicknell (1991), a manuscript prepared by the Agricultural Extension Service states that "…Reed's Canary Grass has been planted and furnishes considerably more feed than the native plants. Canary grass will survive considerable flooding and persists in suitable sites."

Reed canary grass (*Phalaris arundinacea*) is a perennial rhizomatous grass that is coarse, sod forming and thrives in cool climates. It grows vigorously, with creeping rhizomes producing vertical culms (stems) that can reach heights of 6 feet or greater.

Reed canary grass is most often found growing in wetland habitats that receive extended periods of saturation during the growing season. This plant is quite adaptable morphologically and able to tolerate long periods of inundation and drought. It is particularly successful in areas disturbed by grazing and soil movement.

Reed canary grass is recognized as a clonal rhizomatous perennial, which refers to the plant's primary mode of reproduction occurring vegetatively from underground horizontal stem tissue (rhizomes). Rather than probe deeply into the soil, rhizomes creep densely below the soil surface and form thick mats in a sod-like layer. Over time, the layering of rhizomes, leaves, and dead stems can develop the sod layer of reed canary grass to a depth of 1.5 feet (Tu 2004). Reed canary grass rhizomes and seeds are often transported via waterways to areas downstream of existing stands, thereby furthering colonization of nearby areas.

Reed canary grass is recognized as a cool season grass, which begins growth early in the season before warm season plants and grasses begin growth. It has a second period of growth after seed maturation. Rapid early growth is one mechanism by which reed canary grass maintains a competitive advantage over slower growing species (Perry et. al 2004, Budelsky and Galatowitsch 2000), and contributes to its development of monotypic stands.

Reed canary grass cannot thrive in shaded conditions, and has been known to forage for light such that unshaded parent clones can produce tillers that extend into heavy shade and derive energy from the unshaded parent (Maurer and Zedler 2002 in Miller and Zedler 2003). Plants bloom between May and July, and well established populations have high seed bank densities. Therefore, even with marginal germination the species is able to maintain a competitive advantage.

4.2 Mowing and Grazing

Mowing and grazing serve to impede the growth and spread of reed canary grass by removing biomass. Mowing and/or grazing alone will not control reed canary grass, but may serve to prevent further contribution to the seed bank over time. Livestock will only graze on young plants, and therefore older established plants must be mowed or otherwise treated first.

Because the plant propagates primarily vegetatively, mowing or grazing alone will only marginally control plant spread. However, some argue that a sustained impact over time will stress the plant sufficiently to enable a thinning of the vegetation such that native vegetation can germinate and establish (Antieau 2000). This rationale also applies to disking (tilling), excavation, and burning methods, which are described separately below.

It is critical to sustain treatment efforts: if mowing occurs only once or twice per year, it will actually stimulate additional stem production (Tu 2004). Continued mowing five or more times per year, for 5 to 10 years has been reported successful in controlling reed canary grass, but has not been conducted on a large scale in the Pacific Northwest (Tu 2004).

4.3 Disking (Tillage)

Disking and tilling refer to the mechanical turning of the soil and break up of rhizome structure. Disking of reed canary grass can prove effective if used with other treatment measures such as inundation or herbicide application. Disking serves to break apart, aerate, and expose wetland soils dominated by reed canary grass, and brings native seeds up to the soil surface for germination (Paveglio and Kilbride 2000). In a 1994 study, Paveglio and Kilbride (2000) used a 15-ft stubble disk (36 inch blades) during August for the first treatment to reed canary grass to break up rhizomes. Two subsequent diskings were conducted in late August and early September using a cultipacker with a stubble disk to establish a smooth surface for germinating native plants (Paveglio and Kilbride 2000). In areas with special-status species or intact native ecosystems, disking is not a favorable option because it will significantly disrupt the existing habitat (Tu 2004). Disking may also be an expensive option if specialized equipment (48-inch tillage plates and tractor) is not available.

Application of herbicide prior to disking causes rhizomes to deteriorate and reduces post-disking seedling emergence (Lyons 1998). One study found that disking three times late in the season after herbicide application suppressed reed canary grass (Paveglio and Kilbride 1996 in Lyons 1998).

It should be emphasized that tillage alone will not serve to eradicate reed canary grass, but can help to control it particularly if combined with other treatments such as herbicide or tarping (pers. communication Tracey 2005). Use of tillage without other treatment methods may trigger dormant buds to produce new shoots, which would result in even greater density of reed canary grass than if nothing was done in the first place (Reinhardt and Galatowitsch 2004).

Disking has also successfully resulted in control of reed canary grass when combined with a sufficient flooding regime. Tillage should occur as plants are coming into flower (July or August) to maximize aboveground energy allocation. This approach exploits the low underground carbohydrate reserves present at that time (Antieau 2000). Tu (2004) recommends tilling the soil as soon as it is dry enough, and passing over the area several times in order to break up the canary grass sod layer. Allow the exposed stems and rhizomes to dry out, and continue to till all the soil repeatedly to break up all of the clumps. Let fragments dry out until all that remains is broken up clods of soil. Begin flooding the area when the winter storms begin, and keep the area flooded through late spring (May, June) of the following year.

4.4 Scraping

Scraping is the physical removal and disposal of soils containing reed canary grass colonies. Scraping is an effective way to initially remove rhizomes and some seed bank material from reed canary grass infestations. Scraping, or excavation, to a depth of 3-6 inches is sufficient to remove plant material, including seeds and roots (Land and Water, 2006). With a skilled equipment operator, plant material can be scraped and rolled up like sod (pers. communication Taylor 2005). Following scrapping, it may be necessary to disk the area to uncompact the soils. Scraping should be used as a one-time tool because prolonged scraping of soils will damage soil integrity. Scraped areas should be promptly inundated or replanted with native seed and live material to minimize establishment by new seedlings of reed canary grass from the seed bank.

Scraping on a large scale can be costly due to the expense associated with equipment operation and increases with the level of tolerance of final elevations. In addition, an approved haul site must be available and costs to transport material can be significant. Lastly, the risk of transporting invasive exotic material and spreading the plant elsewhere should be considered. If space allows on site, excavated material can be covered and composted, rotating periodically to accelerate decomposition.

4.5 Burning and Flaming

Control or Burning is commonly used in conjunction with other methods for an integrated approach towards reed canary grass control. While burning is successful at removing initial biomass and reduces seed bank density, studies show that burning alone can stimulate growth of reed canary grass, thereby increasing density and biomass. As with other treatment methods, burning is effective for initial site treatment but will not serve as a long-term control measure if used without other treatment methods.

One recent study noted that an initial increase in shoot density occurred immediately after burning (average burn temperatures of 194-266° F), and that 4 weeks after burning shoot density was double that of a control plot. However 12 weeks after burning, biomass was equal to that of a control plot, and plots burned 2 years in a row had similar biomass to control plots (Reinhardt and Galatowitsch 2004).

Prescribed fire may be necessary for 5 or 6 years in order to remove a substantial portion of the seed bank and be successful (Lyons 1998). Timing of the burn is critical: according to Henderson (1991, in Lyons 1998,) and a recent study by Foster and Wetzel (2005), early spring burns can stimulate and accelerate growth of reed canary grass, whereas late spring burns will weaken the plant. Burning plants in early to mid-summer or early to mid-fall may be more effective (WA Noxious Weed Control Board 2005). However, Tu (2004) indicates that burning reed canary grass in the fall does little to control it.

To minimize stimulation of stem production following burns, the fire must burn down through the sod layer to the mineral soil surface. Burning to this extent can sterilize the soil affecting the growth of other plant species. Additionally, burning affects air quality and must be timed for approved burn days.

Flaming is similar to burning; however use of a hand-held device enables focused treatments of burning, and due to the smaller scale of burn does not usually require the same permitting by local jurisdictions as burning does. Flaming or spot burning is more appropriate for small-scale sites or for controlled burning around native plant occurrences. Additionally the effect on air quality is significantly less than that of prescribed burning. To be most effective, growth from the previous year should be removed prior to targeting live material for focused flame treatment.

4.6 Herbicide

Herbicide application is one of the most common tools used to control reed canary grass infestations. Glyphosate is the chemical most often used because it is approved for application in aquatic environments (*Rodeo* is a formulation of glyphosate designed for use in wetlands). Many land managers combine burning with herbicide use to reduce biomass prior to herbicide treatment and reduce regrowth after burning. This approach has mixed results, and timing of both the burn and application of herbicide are critical to the success or failure of treatment.

Glyphosate is a non-selective herbicide used on many food and non-food crops as well as non-crop areas such as roadsides. When applied at lower rates, it serves as a plant growth regulator. The most common uses include control of broadleaf weeds and grasses in: hay/pasture, soybeans, field corn, ornamentals, lawns, turf, forest plantings, greenhouses, and rights-of-way.

Glyphosate is strongly adsorbed to soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade it even under low temperature conditions. It tends to adhere to sediments when released to water. Glyphosate does not tend to accumulate in aquatic life. (EPA Consumer Fact Sheet).

Some researchers have suggested that herbicide (namely Glyphosate) be applied in early spring when reed canary grass is beginning to sprout, and before other native species germinate (Lyons 1998). However, early spring application will only kill above-ground vegetation since the plant is using carbohydrates to produce new shoots. It is therefore best to apply herbicide in the fall, immediately following flowering. Application of herbicide in the fall will maximize the impact to reed canary grass by utilizing this period of translocation to the rhizomes to deliver herbicide to both above-ground and underground biomass.

As indicated previously, several years of herbicide application and burning are necessary before desired results are observed. Some herbicide treatments have been ineffective when applied too soon after burning, due to excess stress on the plants and a resulting inability to maximize translocation of herbicide into rhizomes (Reinhardt and Galatowitsch 2004). Some studies have noted that even after burning and herbicide application for more than 2 years, reed canary grass populations were not reduced sufficiently to enable native seeds to establish. It has also been noted that efficacy of herbicide applications does not last for more than 2 years before follow-up is required (Reinhardt and Galatowitsch 2004, Foster 2005, WA SNWCB 2005). This is due to resprouts from the seed bank and adjacent stands. After fall herbicide application, a follow-up treatment should occur to target resprouts in late spring.

It has been suggested that management of reed canary grass regrowth during establishment of a dense native canopy is necessary to eliminate the competitive advantage of reed canary grass. Because Glyphosate herbicide is not selective, care must be taken once native plants reestablish to avoid killing surrounding vegetation. Use of a wiper or wick device for follow-up spot treatments can enable greater control of herbicide around native plant occurrences.

4.7 Hand Removal

Physical removal of plants using hand tools is only practical on areas less than one acre in size or for isolated plants. This method requires a significant commitment of time and labor. Hand removal can be successful if efforts are maintained at least 2-3 times per year for five years (Henderson 1987 in Lyons 1998). Care should be taken to remove the entire root mass and all rhizomes, and is easiest to accomplish when soil is moist (Tu 2004). All plant material must be removed and carefully disposed of, because even a small piece of material can resprout into a new plant.

4.8 Biological Control

To date, there are no known biological agents effective at reed canary grass control.

4.9 Inundation

Flooding of areas of reed canary grass can prevent its growth. Where feasible, use of inundation as a control method has proven effective if sufficient water depths are maintained for an extensive period of time. A variety of depths and periods of inundation have been reported successful for eliminating reed canary grass. According to a U.S. Department of Agriculture-Natural Resource Conservation Service study (1996, in Antieau 2000), reed canary grass can only tolerate deep inundation (at least 30 cm of water) for 2 years before it perishes. Stevens and Vanbianchi (1993, in Antieau 2000) reported successful elimination after flooding areas with water deeper than 1.5 m for at least three growing seasons.

Inundation is also effective in areas where tillage has occurred because seedling resprouts cannot survive prolonged inundation. Comes et al (1978, in Lyons 1998) observed that germination rates of some reed canary grass seed remained high for 3-12 months after inundation, but after 48 months of inundation, no seed was viable.

Others have suggested a minimum depth of 18 inches as sufficient (Tu 2004, Messinger pers. communication 2005). If inundation is not maintained at a sufficient depth for an extended period of time, reed canary grass will grow back (Taylor personal comm. 2005). It is important to avoid periods of draw-down during inundation, because a fluctuation in water levels will further stimulate reed canary grass (Miller and Zedler 2003).

Floating mats of reed canary grass should also be removed prior to inundation using a "hydrorake" (LeFor 1987) or similar device designed to remove the rhizome mat, aquatic and above-ground biomass.

Negative effects of inundation include a reduction in dissolved oxygen availability due to plant die-off and demand for oxygen during decomposition. Additionally, mortality of existing vegetation including native species may occur (Miller and Zedler 2003, Morrison and Molofsky 1999, Mommer and Visser 2005). It should be noted that while a short-term effect on dissolved oxygen availability may occur due to inundation, continued growth and die-off of reed canary grass will contribute to long-term reductions in dissolved oxygen availability. Reduction in oxygen demand can be accomplished by burning prior to inundation in order to remove biomass.

Additional considerations of long-term inundation include vector control and mosquito population increases. Coordination should occur with the County Environmental Health Department's Vector Control Officer to adequately address vector control measures associated with standing water.

4.10 Tarping and Mulching

Covering with a tarp, weed fabric or mulch blocks light and kills plants underneath over time (assuming clones are not tapping light source outside of tarp). Another method known as solarizing uses plastic to cover material in place and heating until seed banks are not viable.

Various efforts have been employed using tarps or mulch for weed control and removal. Use of these methods on a large scale may be problematic. An advantage of this approach is the minimal disturbance to surrounding native vegetation and sensitive habitats. While similar in approach, each method is slightly different, and can be used most effectively on small scales to control reed canary grass occurrences.

Solarization utilizes clear or black plastic to essentially bake undesired vegetation. Use of a tarp or weed fabric blocks light and kills plants underneath over time (assuming clones are not tapping light source outside of tarp). Several layers of cardboard covered with 4-6 inches of wood mulch can achieve similar results. Each of these methods can be secured in place using 7-inch gutter spikes, washers and "duck-bill tree anchors" (Tu 2004). Tarps and cardboard mulches must be kept in place for at least 1-2 years, even when used in conjunction with inundation. Initial costs for material may be high ($400 per 12 ft x 350 ft roll per Tu 2004), but does not require as many follow-up visits during treatment as other methods.

Areas covered by mulch or tarps should be mowed or tilled prior to cover. Due to the aggressive growth of reed canary grass by rhizomes and tillers, the risk of plants creeping out along the edges of the tarp is high. Even a small amount of live material growing outside a tarp would be sufficient to support the growth of a clonal mat underneath the tarp. A trench overlapping the edges of the tarp should be dug in order to break the rhizome connection to soil outside the tarp. Tarps should be monitored particularly during storm and high wind events to ensure they do not become loose.

Revegetation with native plants can be achieved by cutting slots in the cover material to plant starts while maintaining the effects of smothering the reed canary grass. Antieau (1998, 2000) suggests using large-diameter circles of mulch material within stands of reed canary grass, and planting the circles densely with appropriate conifers and early successional species after reed canary grass dies. It is believed that these circles of vegetation will then grow outward and increasingly shade surrounding areas of reed canary grass infestation (Antieau 1998).

4.11 Soil Amendments

Some studies indicate that manipulating the availability of certain nutrient resources may limit growth of reed canary grass and provide native species a competitive advantage for establishment. For example, it is well-known that reed canary grass invasion is facilitated by high quantities of nitrogen, which is common in wastewater treatment plants, agricultural areas, and surface runoff from residential developments (Perry et al. 2004, Green and Galatowitsch 2002, Decker et al. 1967 in Antieau 1998). By enhancing soil with carbon in the form of sawdust, nitrogen availability is limited and therefore growth of reed canary grass is slowed, thereby enabling native species to establish (Perry et al. 2004).

Because large quantities of carbon would be necessary to lower nitrogen availability, this approach is not practical on a large scale. Further, maintaining low nitrogen availability over time can be challenging, particularly in agricultural environments where nitrogen inputs from fertilizers and animal waste are consistently high (Perry et al. 2004). In time nitrogen becomes available in carbon enriched areas as carbon is released to the environment through respiration (Perry et al. 2004). To be most effective, carbon enrichment of soils should be combined with measures to reduce nitrogen input, such as minimizing sources of nitrogen in the surrounding area and planting native plant buffers between nitrogen sources and restored areas.

4.12 Revegetation

To out-compete the invasive reed canary grass revegetation with native species is a critical component of any treatment method. It is imperative to establish a complex native canopy as soon as possible to minimize seed bank germination and maximize out-competition of reed canary grass. There are a wide variety of approaches to revegetation methods and timelines.

Reinhardt and Galatowitsch (2004) suggest that clearing efforts should be accompanied by dense reseeding with native species, but emphasize that even without rhizome recolonization, reed canary grass will continue to propagate from a dense seed bank up to two years after clearing and replanting efforts. Their studies indicate that even with an ideal high density planting of native seeds (15,000 seeds m^{-2}), reed canary grass would continue to recolonize cleared areas with a seed bank of only 10 seeds m^{-2}.

Antieau (1998) has suggested that the reed canary grass seed bank should be depleted when possible prior to planting with native plants. He suggests leaving a cleared area devoid of vegetation for at least one, but preferably several growing seasons. Subsequent resprouts of reed canary grass should be treated by disking, flaming, and/or periodic herbicide applications (Antieau 1998). When it is not feasible to leave a cleared area fallow, Antieau (1998) suggests dense plantings of native seed (50-100 lbs. per acre) using competitive grass species. Plants recommended by Antieau (1998) that are appropriate for the Yontocket project site include tufted hairgrass (*Deschampsia cespitosa*), bentgrass (*Agrostis spp.*- native varieties only), and red fescue (*Festuca rubra*). Any woody material should be planted before seeding.

Planting of live material in addition to seeding will enable more rapid establishment of a native plant community, particularly if a complex canopy design is implemented. In other words, by planting species in herbaceous, shrub, and tree forms of varying heights, access to light needed by reed canary grass will be significantly reduced, and will further enable native seedlings to establish. Antieau (1998, 2000) has suggested planting conifers in dense, wide blocks in both wetland and adjoining buffer habitats to minimize side lighting that would assist colonization of reed canary grass. In wetter areas, conifers such as Sitka spruce (*Picea sitchensis*) can be planted in holes carved in downed logs to prevent waterlogging newly establishing roots.

A designed early succession (Antieau 1998) may be implemented at the site by planting fast growing tree species such as red alder (*Alnus rubra*) that can rapidly grow and establish a canopy cover to shade out reed canary grass. These "early colonizer" species may be selectively thinned several years later and replanted with conifers best suited to the site.

5 Project Goals, Objectives, and Additional Considerations

The following is a list of the project's specific goals, objectives, and additional considerations. This list was developed by the project team and reviewed and approved by the advisory group during the second meeting on May 16, 2005. The list was used to help guide the development of project alternatives (Chapter 6) as well as to compare each alternative (Chapter 7).

5.1 Goals

1. Provide salmonids unrestricted access to Yontocket Slough and lower Tryon Creek, which extends from the Smith River to Lower Lake Road
2. Restore fish passage at Pala Road crossing
3. Eliminate obstructions to fish movement caused by dense growth of reed canary grass within the waters of Yontocket Slough and Tryon Creek.
4. Improve overall fisheries habitat within Yontocket Slough and lower Tryon Creek.

5.2 Restoration Objectives

To assess each developed alternative's ability to satisfy the project's restoration objectives, their anticipated impacts were evaluated both qualitatively and quantitatively using evaluation criteria listed below.

1. Provide fish passage at Pala Road crossing

    Evaluation Criteria

    a. Ability to meet DFG and NOAA Fisheries fish passage guidelines for adult and juvenile salmonids.

2. Reduce and control reed canary grass within the slough and stream channels

    Evaluation Criteria

    a. Reduction in areal distribution and growing season of reed canary grass throughout the project area and within identified key locations.

    b. Impact on ability of fish to move freely through the system (density and timing of reed canary grass growth relative to expected salmonid movement patterns).

3. Improve water quality

    Evaluation Criteria

    a. Suitability of summer water temperatures for salmonids.

    b. Effects on dissolved oxygen levels within the slough and stream.

    c. Short and long-term effects on erosion and sedimentation of the slough and stream channels.

4. Increase habitat complexity for fisheries
   Evaluation Criteria
   a. Composition of habitat types (deep open water, undercut banks, riparian cover, large wood cover).

5.3 Additional Considerations

A number of other factors beyond the specific project objectives were considered when developing project alternatives. They include socio-political and site constraints, stakeholders' interests, impacts to the general public, and impacts to wildlife other than fisheries. Below are the various issues considered when developing and evaluating the different project constraints and alternatives.

1. **Cultural Resources**
   Evaluation Criteria
   a. Risk and scale of short-term disturbance resulting from fish passage and habitat restoration activities

   b. Risk of disturbance through changes in public accessibility

2. **Waterfowl and Aleutian Goose Habitat**
   Evaluation Criteria
   a. Effect on total surface area of slough

   b. Changes to distribution of habitat types within slough (shallow waters, deep open waters, vegetation types)

   c. Change in quality and quantity of Aleutian goose foraging habitat

3. **Adjacent landowners**
   Evaluation Criteria
   a. Change in magnitude and frequency of flooding

   b. Change in grazing area available on State and private lands

4. **Safety, accessibility, and operational/maintenance requirements**
   Evaluation Criteria
   a. Conform to existing safety and road standards

   b. Changes to public accessibility

   c. Levels of operation and maintenance required

5. **Cost and time to obtain fisheries benefits**
   Evaluation Criteria
   a. Implementation/capital costs

   b. Recurring costs

   c. Period before benefits are realized

6 Components for Development of Project Alternatives

Within this chapter various restoration components for improving fish access and enhancing fisheries habitat within Yontocket Slough are developed to a concept level. The concept level provides sufficient information to evaluate each restoration component's effectiveness, impacts within and adjacent to the project area, and estimated implementation cost. Many of these components must be carried out in conjunction with other activities to function effectively. To assist in categorizing each of the restoration components and to understand how they fit together, components were divided into four categories:

1. Water Control
2. Crossing at Pala Road
3. Habitat within Lower Slough (downstream of Pala Road)
4. Habitat within Upper Slough (upstream of Pala Road)

Using these four categories, a flowchart was created that shows the potential combination of the different components (Figure 6.1). Each pathway begins with the type and location of water control structure options for Pala Road (if any), and continues through the vegetation management methods for the lower and upper slough areas. A thorough description of each component is provided in this chapter, which can be used to compare and develop alternatives.

Implementation costs are estimated for each restoration component. These costs do not include design, permitting, and overall implementation of the developed restoration alternative. Detailed component cost estimates are provided at the end of Appendix D.

In the next chapter the restoration components were used to develop four overall project alternatives. Total costs for implementation of each developed alternative are in given in Chapter 7 and in Appendix D.

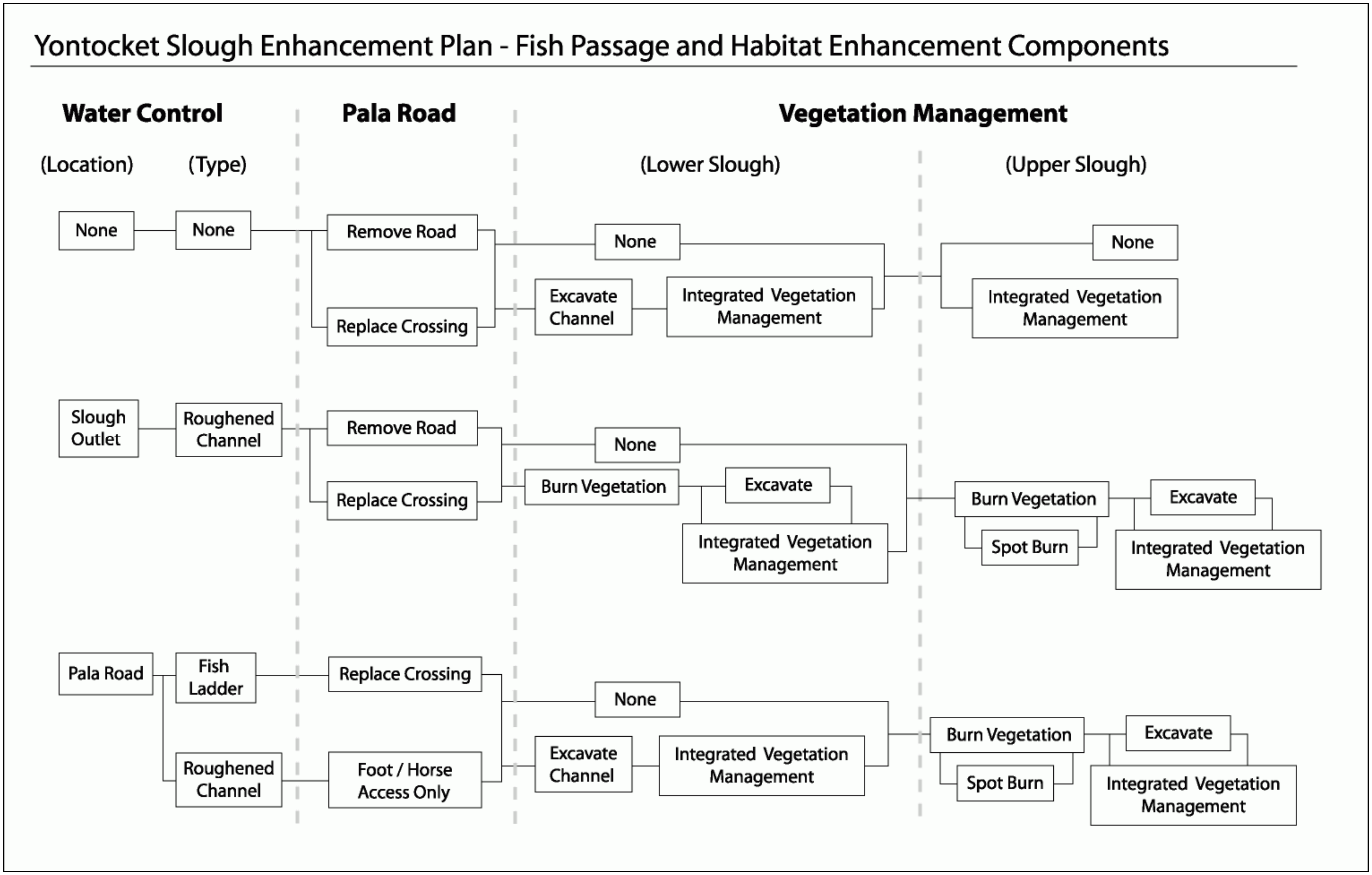


Figure 6.1 - Flow chart illustrating possible combinations of the various restoration components used to develop project alternatives. Components were divided into three categories: Water Control, Pala Road and Vegetation Management.

6.1 Options for Water Control Structures

As discussed in Section 4.9 and in the Biological Report (Appendix E), an area must remain inundated with standing water between 18 and 24 inches deep from late fall through June to suppress growth of reed canary grass (RCG).

Currently water levels within the upper slough remain above an elevation of 6 feet through June (Figure 3.7), leaving the elevations below 4.8 feet free of reed canary grass (Figure 3.10). Above this elevation reed canary grass grows in abundance. Downstream of Pala Road water levels drop sufficiently low in the spring to allow reed canary grass to grow throughout the entire lower slough. To manage the growth of reed canary grass and expand the open water habitat, water control measures can be used to inundate larger portions of the slough for extended periods.

The water control options that were evaluated are:

1. Roughened channel at the slough outlet
2. Roughened channel with wet crossing at Pala Road
3. Fish ladder at Pala Road
4. No control structure

Each of these control options should be designed with water level control features that allow for seasonal adjustment of the water level and draining of the slough.

Minimum Target Water Level

For this project a minimum water elevation of 10 feet was selected for inundation of the slough. The water control structure would be designed to maintain water levels between 10 and 11 feet throughout spring. To minimize flooding of adjacent pastures, the structure would be designed to drain more rapidly (larger outflow capacity) at levels exceeding 11 feet. The water control structure will be designed to avoid increasing the frequency or duration of flooding above 11 feet, with respect to existing conditions.

Maintaining water levels above 10 feet elevation through spring is expected to eliminate reed canary grass within areas of the slough below approximately 8 feet elevation. Based on observations there appears to be sufficient flow into the slough to maintain this water level through spring. Currently, water elevation in the upper slough is largely controlled by the standpipes and culverts located along Pala Road. The top of the standpipes are currently at elevation 10.1 feet and water levels reach 10 to 11 feet for much of the winter. However, because of the two open culverts the slough drains too rapidly in the spring to control reed canary grass growth.

Setting a higher minimum target water level was evaluated and considered infeasible due to a lack of sufficient inflow and because of the elevation of adjacent lands. Water levels above 11 feet are difficult to control due to the elevation of the surrounding land and Pala Road prism. For example, the public parking lot at the Pala Road gate is at about elevation 11.5 feet.

Fish Passage at Water Control Structures

Currently, fish can only access Upper Yontocket Slough and Tryon Creek when floodwaters within the Smith River overtop Pala Road, allowing the fish to swim over the road. With any new water control structure fish passage should be provided. Each alternative evaluated below is designed to retain water at the prescribed levels while still providing improved fish passage conditions. Two possible locations for placement of a water control structure were identified, at Pala Road and at the outlet of the slough (Figure 6.2).

Overview of the Roughened Channel Concept

Two of the water control options involve the use of a "roughened channel". A roughened channel, or "nature-like" fishway, is an oversteepened channel designed to allow for passage of fish and other aquatic organisms in addition to accommodating peak flows and associated debris and sediment. The roughened channel is designed to function similar to a steep, natural stream reach. The primary hydraulic function of a roughened channel is to create conditions suitable for fish passage while dissipating energy within an oversteepened section of channel. Common applications include "fish friendly" grade control within altered channels, dam bypasses, or as water control structures.

The steep sections of a roughened channel contain rock steps and cascades, which increase the channel's overall roughness and dissipate energy. These cascades form complex flow patterns with large variations in water velocities, providing migrating fish numerous pathways to choose from as they swim upstream. Small shifts in rock arrangements typically do not affect the functionality or stability of roughened channels.

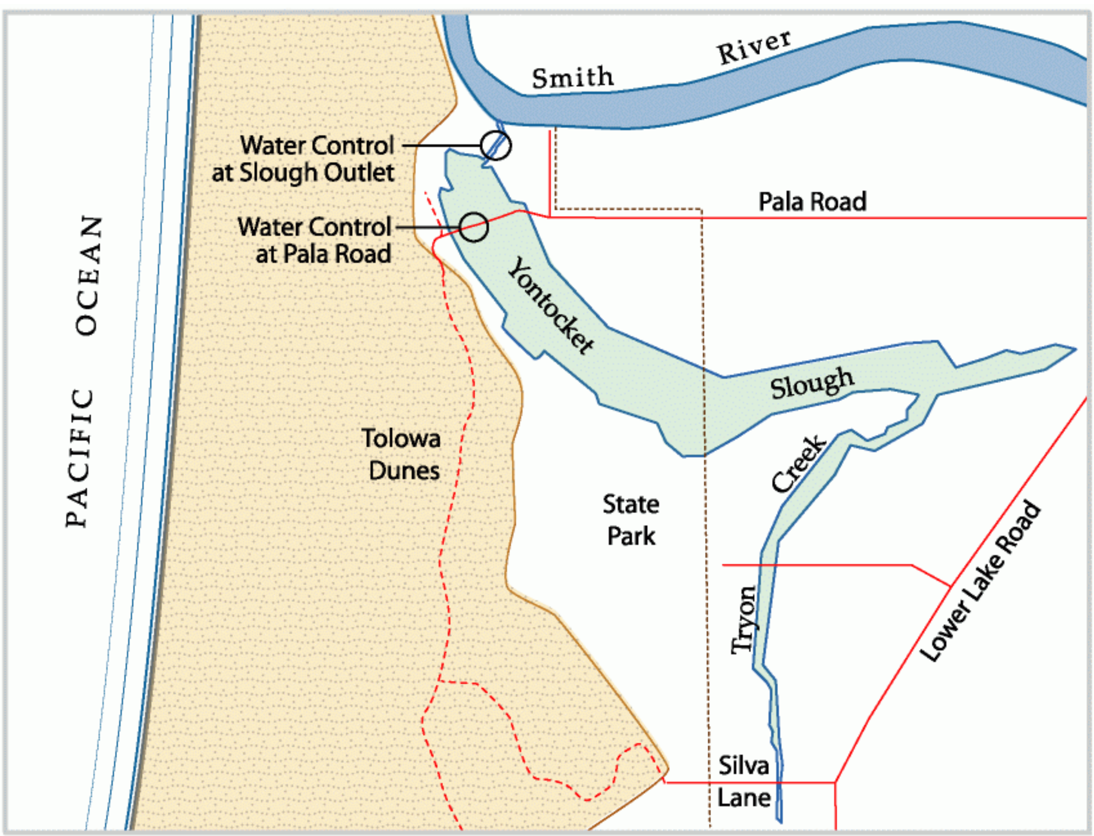


Figure 6.2 - Alternative locations of water control structures for inundation and fish passage.

Design of a roughened channel involves a bed stability analysis to identify the size of rock that will remain stable within the channel during the range of design flows. From this analysis a rock mixture is specified and used to construct the channel bed at the desired grade. This engineered streambed material is a mixture of rock sizes that reflect the distribution of material common to steep streams. The streambed mixture is placed around larger, boulder-sized rocks that act as stability and roughness elements.

6.1.2 Roughened Channel at Slough Outlet

At the outlet of Yontocket Slough (Figure 6.2) a roughened channel can be used to raise and maintain water levels throughout the slough. A concrete control structure with a drainage pipe can be installed at the upstream end of the roughened channel to allow for seasonal lowering of water levels within the slough, if needed.

Location

A roughened channel as a water control structure at the outlet of the slough would be located approximately 350 feet upstream from the Smith River. At this location the top width of the channel is approximately 24 feet and the top of the banks are above elevation 12 feet. This location was selected because it is the natural outlet of the slough. The ground surface adjacent to the channel banks is sufficiently high enough to contain the waters within the entire slough at water levels up to 12 feet.

Description

The roughened channel would be constructed with the top of the channel at elevation 10 feet designed to maintain water levels between 10 and 11 feet from the onset of fall rains through June. Water levels above 11 feet are expected during and immediately following flood events on the Smith River. To avoid increasing the duration of inundation on adjacent pastures, the roughened channel should contain sufficient high flow capacity to drain the slough back down to 11 feet at approximately the same rate as under existing conditions.

Construction of the roughened channel involves the placement of large rocks, and engineered streambed material on native backfill (Figures 6.3 and 6.4). Material is placed to ramp-up from the existing channel bed elevation (approximately 2.5 feet) to the desired elevation of 10.0 feet. The roughened channel is divided into two sections, the upper section is 110 feet long at a 5% slope and the lower section is 66 feet long at a 3% slope. The bottom of the roughened channel will almost always be backwatered by the Smith River, since even during periods of low-flow the water levels in the Smith River at the mouth Tryon Creek are generally above elevation 3 feet. During larger flow events within the Smith River, when juvenile and adult salmonids are believed to be moving into off-channel habitat, the lower half to two-thirds of the roughened channel will be backwatered.

Since the existing vertical banks are composed of unconsolidated sandy material and inherently unstable, they will need to be laid back to slopes less than 3H:1V. Since the upper end of the roughened channel will experience the highest scouring velocities, these banks will need to have rock slope protection (RSP). At the bottom end of the roughened channel the banks will need to be steepened to match the existing banks, requiring RSP for stabilization. The remaining areas should be revegetated with suitable riparian plants to provide canopy cover over the roughened channel.

To prevent excessive subsurface flow and flanking of the roughened channel, a sheet pile cut-off wall should be installed at the upstream end that extends at least 15 feet into each bank. Sheet pile is driven vertically into the ground to a depth that would be determined during the final design process based on material type and subsurface condition. Sheet pile can be installed to be hidden from view, maintaining the existing aesthetics of the area.

Providing a concrete weir box and drain pipe will allow for adjusting water surface levels during late summer and early fall, when water levels drop below the crest of the roughened channel. The water control structure allows for draining of the slough to provide for out-migration of fish trapped within the slough during summer months, or for other types of wetland management activities. The structure would consist of a concrete weir box with removable flashboards and a drain pipe that extends under the roughened channel. The outlet should be placed to avoid excessive scour of the downstream channel.

Additional Considerations and Uncertainties

Due to limited inflow from Tryon Creek into Yontocket Slough in late spring, maintaining water levels above elevation 10 feet through June may not be possible. Also, since it is likely that the historic slough mouth was cut-off by migrating dunes, there is a possibility that flow may infiltrate into sandy soils at a relatively high rate at the foot of the dunes along the southwest corner of the lower slough, making it difficult to maintain desired water levels during late spring.

Currently the slough becomes disconnected from the river during spring when water levels drop below approximately 7 feet. With the roughened channel at the outlet the objective is to maintain flowing water to the river into June. This should extend the period in which fish will be able to migrate out of the slough. However, during summer and early fall the slough will continue being disconnected from the river, similar to a coastal lagoon that becomes bared-over during summer. By improving water quality within the slough, salmonids within the slough should be able to survive throughout the summer.

The roughened channel crest height can be adjusted if needed. Since the crest of the roughened channel is constructed of rock, it can easily be lowered or raised by adjusting rock placement using hand labor or a backhoe.

This slough outlet experiences relatively high velocities during flood events. For this reason, a sheet pile cutoff wall should extend into the banks at least 15 feet on each side to avoid flanking by the stream. Because high velocities have the potential to scour smaller material within the upper portion of the roughened channel, there is the potential for winnowing of fines. This can lead to problems with low flows going subsurface.

The Smith River continues to migrate laterally in a southerly direction, towards Yontocket Slough. Between 1942 and 2003, the Smith River at the confluence of lower Tryon Creek had migrated more than 250 feet towards the south. If the river continues to migrate towards the slough at this rate, it could begin eroding the roughened channel within the next 30 to 50 years. This could shorten the life of the project.

Estimated Construction Costs

Estimated construction cost for a roughened channel at the slough outlet: $242,500 (Appendix D)

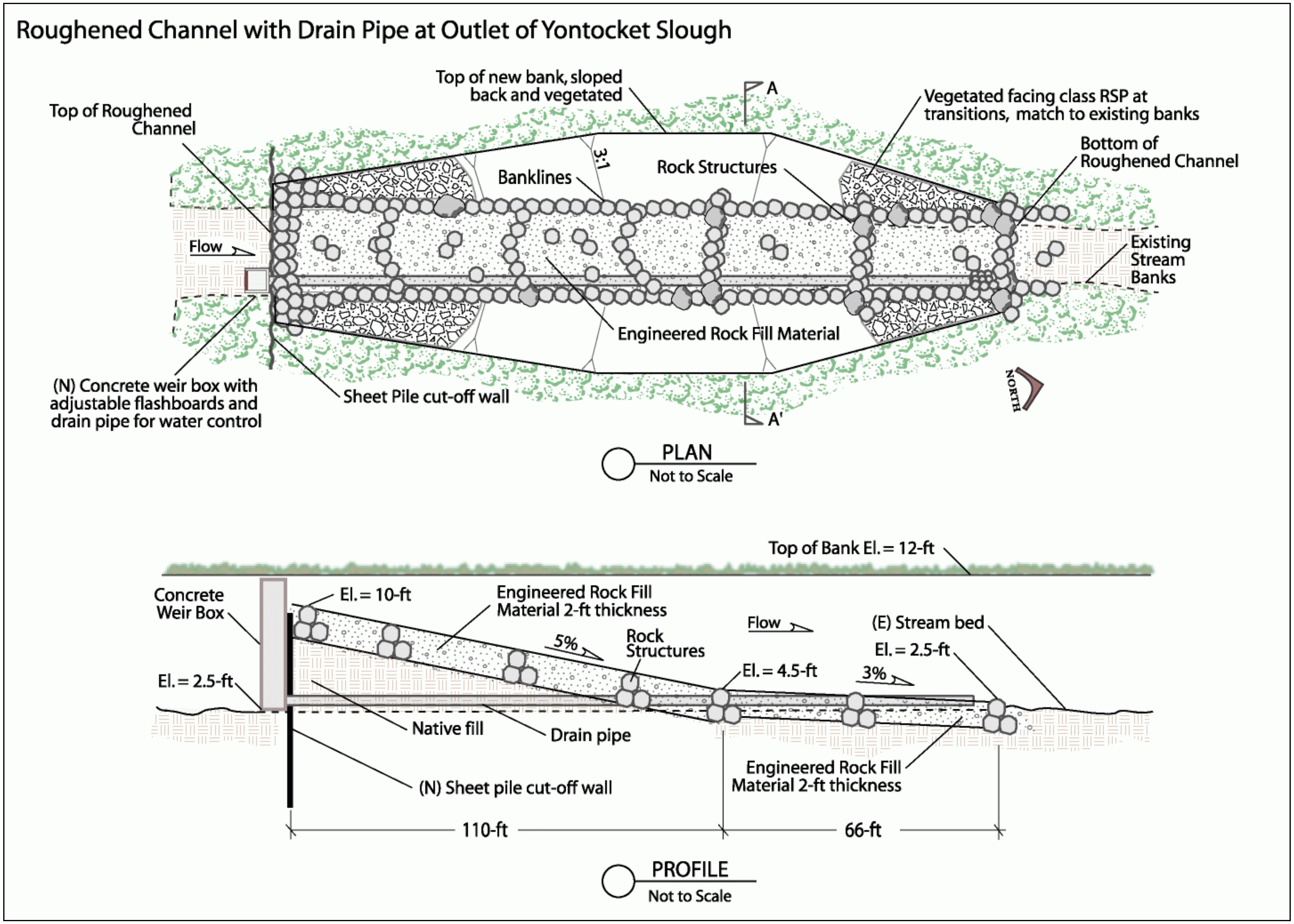


Figure 6.3 - Concept drawings of a roughened rock channel placed at the outlet of Yontocket Slough to control water levels throughout the entire slough. Roughened channels dissipate energy down the steep profile with large rock and roughness elements. Fish passage is facilitated by the numerous pathways that mimic a naturally steep stream.

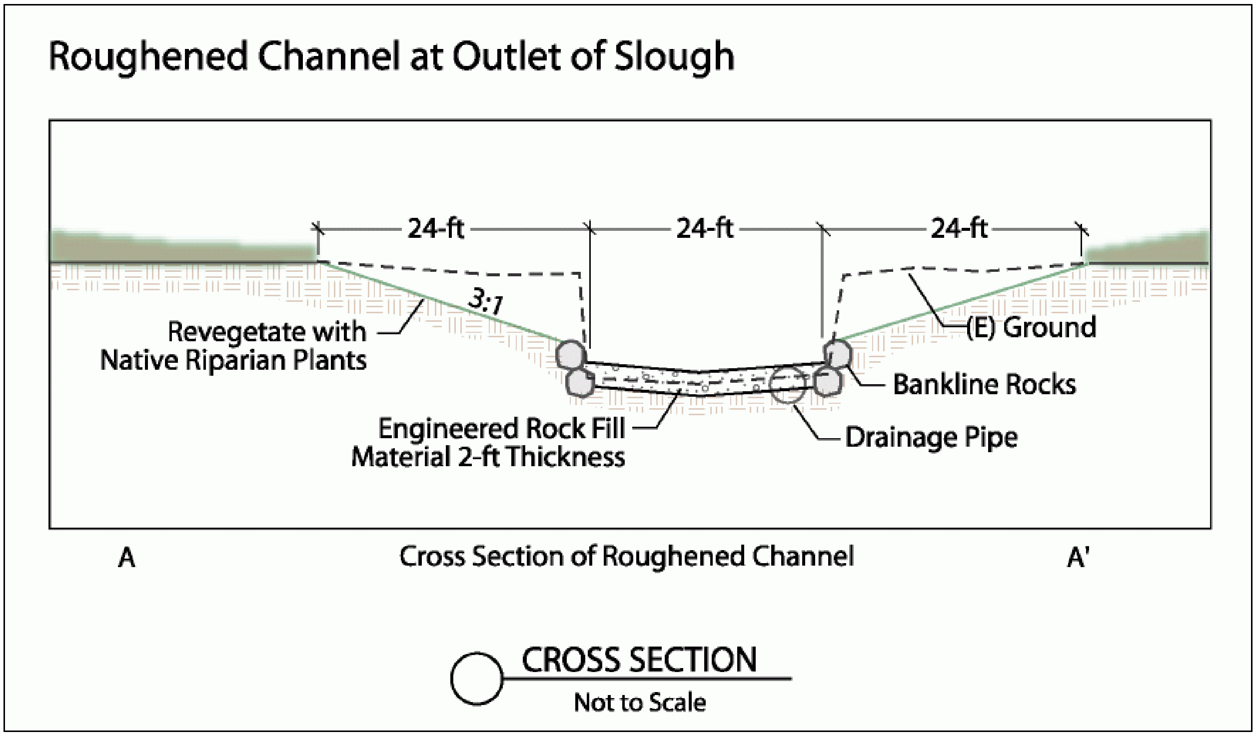


Figure 6.4 – Schematic cross section of conceptual roughened channel placed at the outlet of the slough.

6.1.3 Roughened Channel at Pala Road

Water levels within the upper slough can be controlled by replacing the existing culverts and standpipes at Pala Road with a wetted crossing and roughened channel. A concrete weir box and drainage pipe placed upstream of the roughened channel can be used to lower water levels within the slough if needed.

Location

The wet crossing on Pala Road would be constructed at the location of the existing culverts, towards the western portion of the slough, where the lower slough is deepest. The roughened channel would start at the northern edge of the road, ramping downward into the lower slough.

Description

Pala Road Crossing

The top of the roadbed, which acts as a levee across the slough, has elevations varying between 10.5 and 11.5 feet. As part of this option the road would be raised to elevation 11.5 feet across the entire slough, requiring adding approximately 100 cubic yard of material to the roadbed. A road dip would be constructed at the location of the roughened channel, which would function as a wet crossing from late fall through spring. Water would flow across the wetted crossing before entering the roughened channel. Water depths at the wet crossing would typically be less than 12 inches. Access would be maintained for foot and horse traffic as well as for ATV's and high clearance emergency vehicles. Stepping-stones could be placed along the edge of the wetted crossing to make pedestrian crossing easier.

Roughened Channel

The roughened channel would be constructed with the top of the channel at elevation 10 feet designed to maintain water levels between 10 and 11 feet from the onset of fall rains through June. Water levels above 11 feet are expected during and immediately following flood events on the Smith River. Water levels above 11.5 feet would overtop Pala Road adjacent to the wetted crossing but for shorter periods than under existing conditions. Water velocities across the road associated with overtopping are expected to be very slow, producing no scour.

Construction of the roughened channel involves the placement of large rocks, and engineered streambed material on native backfill (Figures 6.5 and 6.6). Material is placed to ramp-up from the existing channel bed elevation (approximately 6.0-ft) to the desired elevation of 10.0-ft. The roughened channel is divided into three sections; the upper section starts at the edge of the wet crossing and is a transition section at 1% slope for 20 feet. The channel then slopes at 4% for 95 feet. The last section is a 5% sloping apron for 20 feet. During periods of significant rainfall the lower slough water level is generally only slightly lower than the upper slough and most of the roughened channel will be submerged. Only the top (spillway) portion of the roughened channel is expected to experience high velocities.

Concrete Weir Box and Drain Pipe

Providing a concrete weir box and drain pipe will allow for adjusting water surface levels during late summer and early fall, when water levels drop below the crest of the roughened channel. The water control structure allows for draining of the slough to provide for out-migration of fish trapped within the slough during summer months, or for other types of wetland management activities. The structure would consist of a concrete weir box with removable flashboards and a drain pipe that extends under the roughened channel. The outlet should be placed sufficiently downstream of the roughened channel to avoid excessive scour of the channel.

Additional Considerations and Uncertainties

Due to limited inflow from Tryon Creek into Yontocket Slough in late spring, maintaining water levels above elevation 10 feet through June may not be possible. Currently the slough becomes disconnected from the river during spring, when levels drop below approximately 7 feet. With the roughened channel at Pala Road the objective is to maintain flowing water to the lower slough through June. This should extend the period in which fish will be able to migrate between the lower and upper slough. However, during summer and early fall the slough will continue being disconnected from the river, similar to a coastal lagoon that becomes barred-over during summer. However, by improving water quality within the upper slough, salmonids in the slough should be able to survive throughout the summer.

There may be some concerns regarding fish swimming through the wet crossing and vehicle traffic. The road is used extremely infrequently by vehicles and most of the use is during dryer periods and not during large flows when fish are migrating. The likelihood of a fish being injured or killed by a vehicle crossing the road is believed to be extremely small.

The roughened channel crest height can be adjusted if needed. Since the crest of the roughened channel is constructed of rock, it can easily be lowered or raised by adjusting rock placement using hand labor or a backhoe.

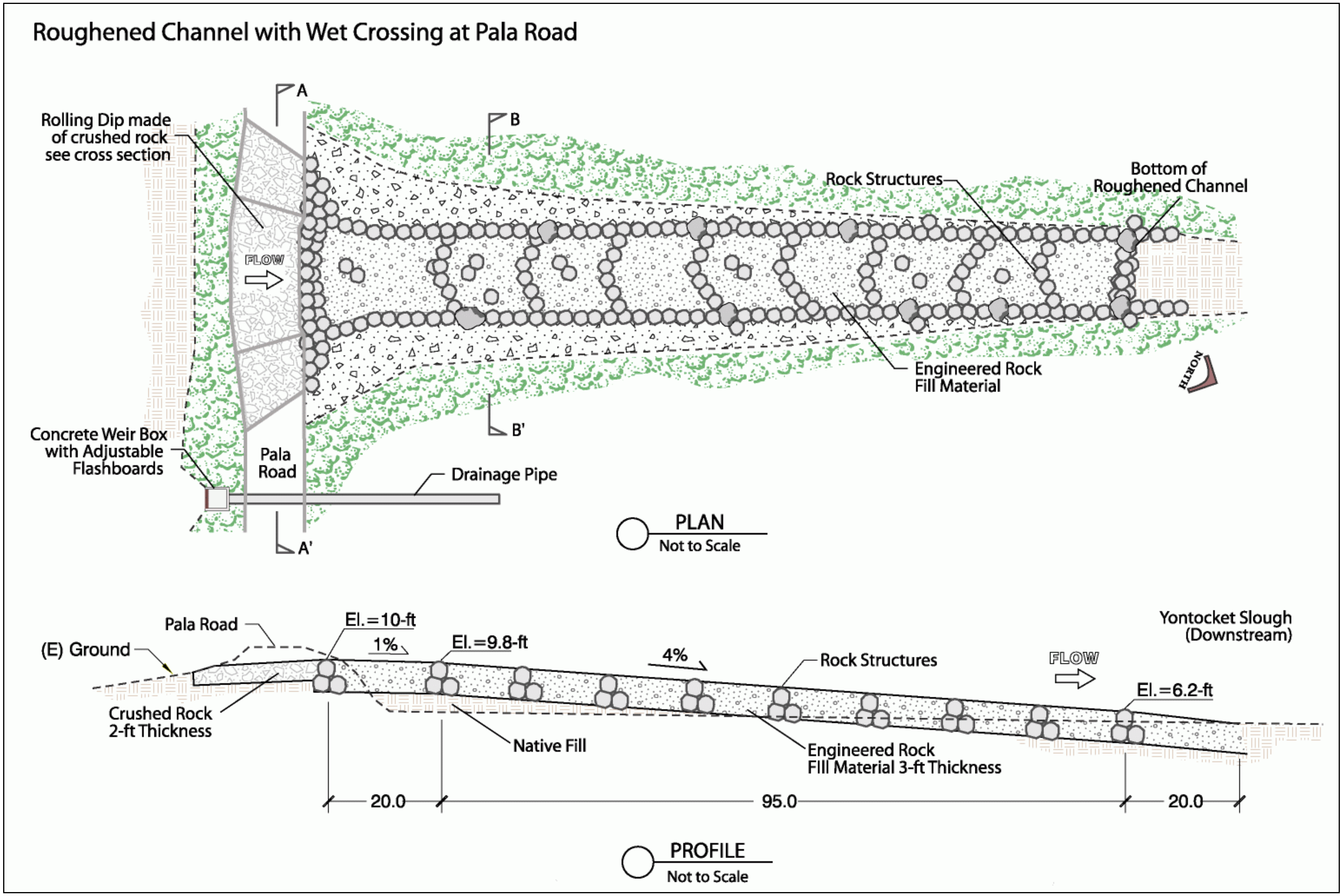


Figure 6.5 - Conceptual drawings of a roughened rock channel with wet crossing placed at Pala Road to control water levels within the upper slough. Roughened channels dissipate energy down the steep profile with large rock and roughness elements. Fish passage is facilitated by the numerous pathways that mimic a naturally steep stream.

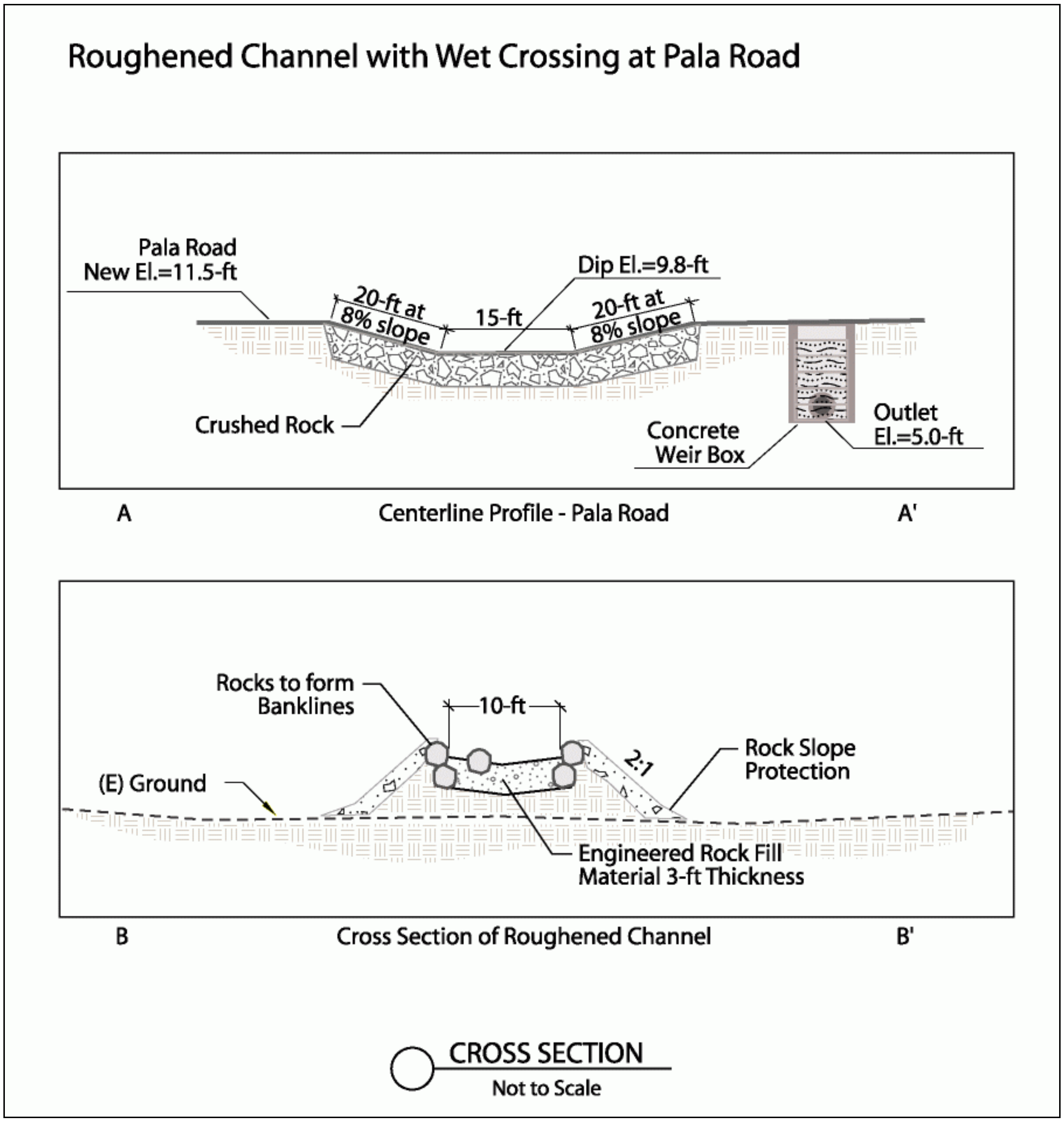


Figure 6.6 - Cross section view of (A) wet crossing at Pala Road and (B) the roughened channel downstream of Pala Road.

Estimated Construction Costs

The estimated construction cost for a roughened channel at the Pala Road, not including raising the road bed or constructing the wet crossing: $114,000 (see Appendix D for more detail)

6.1.4 Fish Ladder at Pala Road

Water levels within the upper slough could be controlled with a fish ladder containing adjustable weir boards. The fish ladder would be placed at the inlet of a new concrete box culvert. The structure would provide fish passage and be adjustable, allowing for adaptive management of water levels in the slough.

Location

The new culverts and fish ladder would be located along Pala Road where the lower slough is deepest, near the existing culverts.

Description

Drainage Under Road

As part of this option the existing culverts would be removed and replaced with two 6' x 6' prefabricated concrete box culverts. The top of the culverts would be placed at the elevation of the road bed.

Roadbed

The elevation of the roadbed where Pala Road crosses the slough varies between 10.1 and 11.5 feet. Under the fish ladder option, Pala Road as it crosses the slough would be raised to 11.5 feet. At the new culverts the road would ramp up to 12 feet elevation. In total, this will require adding approximately 120 cubic yards of fill material to the roadbed. Raising the road will reduce the frequency of overtopping and allow for maintaining higher water levels within the upper slough than under existing conditions.

Fish Ladder

A fish ladder would be constructed extending upstream from the inlet of one of the box culverts. The ladder would be 25 feet long, constructed from sheet pile and adjustable wooden weirs (Figure 6.7). The weir boards would slide into brackets bolted or welded to the sheet pile. The ladder would be designed to maintain water levels between 10 feet and 11 feet through spring. The ladder would be designed for upstream passage of both adult and juvenile salmonids, following DFG and NMFS fish passage guidelines.

The second box culvert would contain an adjustable weir at the inlet of the culvert. This culvert would serve as an overflow, providing additional hydraulic capacity when water levels are above 10.5 feet. The additional capacity will reduce the frequency of road overtopping and avoid increased flooding of adjacent pastures.

Additional Considerations and Uncertainties

Due to limited inflow from Tryon Creek into Yontocket Slough in late spring, maintaining water levels above elevation 10 feet through spring may not be possible. Currently the slough becomes disconnected from the river during spring when levels drop below approximately 7 feet. The fish ladder at Pala Road is intended to maintain flowing water until June. This should extend the period in which fish will be able to migrate between the lower and upper slough. However, during summer

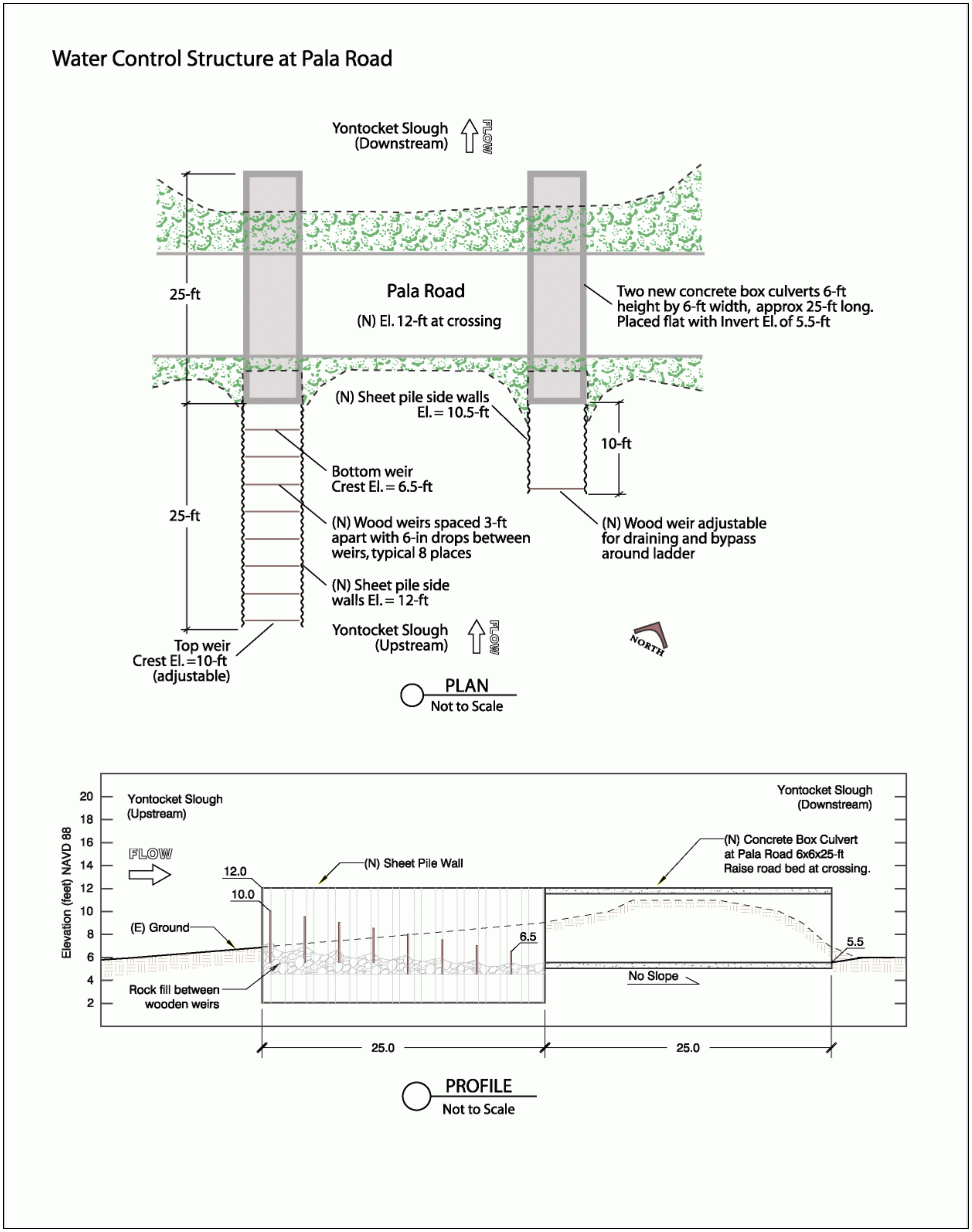


Figure 6.7 – Conceptual drawings of a fish ladder and overflow culvert at Pala Road to control water levels within the upper slough. The ladder is designed for adult and juvenile fish passage. The two new culverts would increase hydraulic capacity, decreasing the frequency of road overtopping and flooding of adjacent pastures.

and early fall the slough will continue being disconnected from the river, similar to a coastal lagoon that becomes barred-over during summer. However, by improving water quality within the upper slough, salmonids in the slough should be able to survive throughout the summer.

Other concerns include the potential for plugging of the fish ladder and culverts with detritus from reed canary grass. The ladder and culverts are sized to help minimize this risk. However, after flood events it will be necessary to check the functionality of the ladder and clean out any problematic debris.

As part of an adaptive management approach to water levels within the slough, the weir boards within the fish ladder can be raised or lowered. To drain the slough in summer, if needed, the weir board at the inlet of the overflow culvert can be removed.

Estimated Construction Costs

The estimated construction cost for a Fish Ladder, at the Pala Road, not including the new culverts or raising the roadbed: $21,400 (see Appendix D for more detail).

6.1.5 No Water Control Structures

One option for the site is to remove all water control structures, and rely on the natural control at the outlet of the slough. At a minimum, this would entail removal of the existing standpipes at Pala Road. The existing four culverts (two 24-inch and two 36-inch diameter culverts) provide inadequate capacity during large flows and frequently plug with debris and detritus from reed canary grass, causing water to flow over the road. Therefore, if no water control structure is used, the existing culverts should be replaced with substantially larger culverts to restore the hydrologic connectivity between the lower and upper slough and to ensure continuous fish passage.

Additional Considerations and Uncertainties

Removing all water control structures will cause water levels within the upper slough to be roughly 6 inches lower during winter and 1 foot lower during late spring than under existing conditions (see Section 3.5). Since inundation at depths greater than between 18 and 24 inches through June is typically required to prevent growth of reed canary grass, removal of all water control structures would likely result in the spread of reed canary grass into many areas currently devoid of it.

Currently, reed canary grass doesn't grow below about elevation 5 feet. By opening up the hydrologic connection of the slough we anticipate lower water levels upstream of Pala Road during late spring. If the upper slough's water levels were lowered by 1 foot in late spring, reed canary grass is expected to begin growing down to elevation 4 feet or lower. This could result in reed canary grass becoming established in another 16 acres of the slough, leaving less than 4 acres of the slough free from it. Additionally, an increase in frequency and magnitude of draw-downs during extended dry periods in the winter may increase the occurrence of floating mats of reed canary grass, which could allow the grass to colonize the remaining 4 acres.

Although this option removes the structural barrier to fish passage, additional reed canary grass would likely colonize much of the channel, making it difficult for fish to swim up and downstream. Increased reed canary grass would further degrade the fisheries habitat value of the slough by decreasing available dissolved oxygen and reducing open water habitat.

6.1.6 Pilot Project with Temporary Water Control Structure

Using a staged implementation approach could allow for evaluating the effectiveness of using inundation in Yontocket Slough for controlling RCG. Inundation has not been specifically used along the North Coast to control RCG and there remain uncertainties surrounding available water supply from Tryon Creek during late spring to maintain desired inundation levels. Before constructing a relatively expensive and permanent water control structure, a temporary structure could be constructed at Pala Road. This would likely involve raising the road level, plugging the two smaller culverts under the road and replacing the existing standpipes with new ones. The disadvantage of this option is that fish passage would not be provided by the temporary water control structure.

6.2 Options for Pala Road at Yontocket Slough

6.2.1 Road Removal

Although evaluating the impacts of removing Pala Road at Yontocket Slough may be beyond the scope of this project, it was discussed at the advisory group meetings as a possible option. Road removal would fully reconnect the hydrology between the lower and upper slough. However, it would also greatly reduce public access to the Tolowa Dunes and Yontocket Memorial Village.

Removal of the road and associated fill would entail excavation and disposal of approximately 3,300 cubic yards of material (footprint of 0.15 acres to remove 420 feet of road).

Providing Alternative Public Access

Currently, Pala Road is frequently used by hikers and equestrians to reach the Tolowa Dunes. Removal of the road will likely require creating an alternative public access route to the Tolowa Dunes. One possible route is from Silva Road, which connects with Pala Road within the Tolowa Dunes State Park (Figure 2.1).

West of Tryon Creek, Silva Road and adjacent lands are managed by the State and have adequate flat ground to construct a parking facility. The wooden bridge crossing on Silva Road would need to be replaced with a higher loading-capacity crossing. Silva Road currently crosses directly in front of a house on State Park property that serves as the residence for the Park Ranger. A trail may need to be constructed that goes around the residence and then rejoins the road.

Another access point that was considered is downstream of the slough outlet. However, after field reconnaissance this site was considered infeasible due to the entrenchment of the stream channel and associated unstable banks, susceptibility of the area to swift floodwater from the Smith River, and steepness of the dunes west of Tryon Creek.

Further consideration of this alternative would need to be addressed as part of the State Park's general planning process.

Estimated Construction Costs

Estimated construction cost for removal of the road: $80,400 (see Appendix D).
Cost estimates were not developed for relocating the public access point.

6.2.2 New Drainage Culverts Under Road

In the case of placement of a water control structure at the outlet of the slough, or removal of all water control structures within the slough, the drainage at Pala Road should be improved. Currently the four small culverts under Pala Road do not provide sufficient hydrologic connectivity between the lower and upper slough. The small culverts often plug with detritus from the reed canary grass, making them ineffective. As a result, water often flows over the road instead of through the culverts.

Installing two 6' x 6' prefabricated concrete box culverts will greatly increase the hydraulic capacity of the drainage structures at Pala Road. This type of culvert is relatively inexpensive, long-lasting, can directly accommodate vehicle loading with minimal fill cover, and does not need any footings or other work that requires extensive geotechnical investigations. The bottom of the box culverts can be countersunk below the channel bed in the slough to provide adequate water depth for fish passage.

Currently the roadbed elevation as it crosses the slough varies between 10.1 and 11.5 feet. To reduce overtopping of the road, the roadbed should be raised to 11.5 feet across the entire slough, conveying flood flows through the new culverts. This will require adding roughly 100 cubic yards of material to the roadbed.

Estimated Construction Costs

Estimated construction cost for replacement culverts and raising road: $53,273
(see Appendix D for more detail).

6.2.3 Pala Road Wet Crossing connected to Roughened Channel

In combination with construction of a roughened channel on the downstream side of Pala Road the road bed should be raised to elevation 11.5 feet and a rolling dip should be constructed, which would serve as a wet crossing. Water would flow through the wet crossing and into the roughened channel. Water depths within the wet crossing would typically be less than 12 inches during the winter and would allow for horse and foot crossing, as well as crossing by authorized high clearance vehicles and ATV's. During summer and early fall the crossing would be dry.

Estimated Construction Costs

Estimated construction costs for rebuilding the road with installation of a wet crossing: $9,800
(see Appendix D for more detail)

6.3 Vegetation Management

6.3.1 Inundation to Control Reed Canary Grass

As discussed in Chapter 4 and in the Biological Report (Appendix F), an area must remain inundated with standing water between 18 and 24 inches deep from late fall through June to suppress growth of reed canary grass (RCG).

Maintaining standing water at least 24 inches deep through spring is typically sufficient to prevent growth of RCG. Therefore, excavation can be used to increase the depth of the slough, thus enlarging the area that will have sufficient inundation characteristics to prevent RCG growth.

A number of control measures need to be carried out in advance of, and in conjunction with, inundation in order for it to function as intended.

Control Burning

Control burning should be incorporated into alternatives that involve inundation with the use of a water control structure. Although burning alone will not eliminate reed canary grass (RCG), it does reduce biomass, which is beneficial for water quality when using inundation. Otherwise, the large buildup of detritus will continue to decompose, putting a demand on available oxygen in the water. Decomposition can negatively affect dissolved oxygen levels for many years.

Burning in Open Areas

Within the portions of the slough currently managed by State Parks there are small colonies of native plants, with woody riparian shrubs and trees located along portions of the west bank of the slough only. Open areas that will be inundated to prevent regrowth of RCG are ideal for a large-scale control burn. If excavation or scraping is used in shallower areas of the slough, the bare soil can serve as a firebreak.

Burning adjacent to Riparian Vegetation

Woody riparian vegetation, such as the hooker willow, surrounds the banks of the privately owned portions of the upper slough. This location is not conducive to large-scale control burning. Instead, these areas could be spot burned using a hand-held torch. Using a torch, native plant species can be saved while the invasive plants are burned. This type of treatment can be labor intensive, and should be first tried on a smaller scale pilot project to evaluate its effectiveness.

Timing

Burning should not be conducted until water control structures are in place, because reed canary grass will resprout from rhizomes in as little as 5 days after burning. Burning should be conducted in the late fall (September-October), when the plant is nearing senescence and translocating energy below-ground. Burning should not occur in the early spring as this will result in greater stimulation of above-ground growth.

Permits and Public Notification

Coordination with the Air Quality Management District (AQMD) and California Department of Fire and Forestry Protection (CDF) will be necessary to secure required permits and employ best management practices, such as burning on approved days. Public communication will also be critical before, during, and after burning for safety and community understanding of the project.

Estimated Implementation Costs

The estimated Unit cost for large area control burning and spot burning: $650/acre

6.3.2 Excavation for Control of Reed Canary Grass

Alternatives that involve use of a water control structure designed to maintain water levels at or above 10 feet elevation through spring can be combined with excavation to increase the effectiveness of controlling RCG. If the depth of excavation extends to 18 inches, areas between elevation 7 feet and 9 feet could be excavated as shown in Figure 6.8.

Development of this option involves balancing the cost of removing the large volume of material with the overall benefit gained. In this conceptual design phase excavation of the slough was ultimately limited to areas that (1) would be upstream of a new water control structure, (2) are on State property, (3) have existing ground surface elevation between 7 and 9 feet, and (4) are located along the gradually sloping northeast side of the slough.

Excavation is expected to start with scraping to a depth of 6 to 8 inches, in order to remove surface and rhizome material. When done by a skilled equipment operator the scraped material can be rolled like sod and moved to the adjacent pasture, where it is placed in large piles and either covered with plastic to be composted or burned. Composting can take up to two years.

Once the canary grass has been removed, the topsoil will be removed using a grader, or similar types of equipment. A front-end loader will be used to load the excess soil into dump trucks for offsite disposal. There are several potential near-by spoils disposal sites, including several large gravel mining pits that can hold in excess of 50,000 cubic yards of material. It is likely that an approved disposal location will be located close-by, resulting in a roundtrip haul of less than 15 miles.

Additional Considerations

The stratigraphic investigation performed by Pacific Watershed Associates (Appendix F) suggests that the slough accumulated between 12 and 18 inches of sediment during the 1964 flood event. Limiting excavation to depths less than 18 inches should avoid disturbance of pre-1860's cultural deposits.

Excavation of the entire slough to a depth of 18 inches to remove flood deposits would involve excavation and hauling of roughly 200,000 cubic yards of material. Such large-scale excavation was deemed cost prohibitive, undesirable, and unnecessary. However, control of RCG and creation of more open water habitat can be accomplished with limited excavation at selected locations.

A geologist should be on site to precede excavation and grading equipment to determine the exact depth to the bottom of the suspected 1964 sediment deposits. This will help ensure that only young sediments are excavated and that pre 1860's cultural deposits are not disturbed. Additionally, a cultural monitor or archaeologist is required to be on-site during all excavation and ground disturbance activities.

To avoid creating conditions beneficial to mosquito breeding, the new channel bottom should slope gently downwards towards the deeper portions of the slough. This should allow receding water to drain and avoid ponding as water levels recede within the slough.

Excavation in Lower Slough

Excavation downstream of Pala Road, such as shown in Figure 6.8, is an option if a water control structure is placed at the slough outlet. Areas between elevation 7 feet and 9 feet along the northwestern portion of the slough would not be excavated due to the presence of beneficial native woody riparian species. Excavation of sediments within the lower slough that lie between elevations

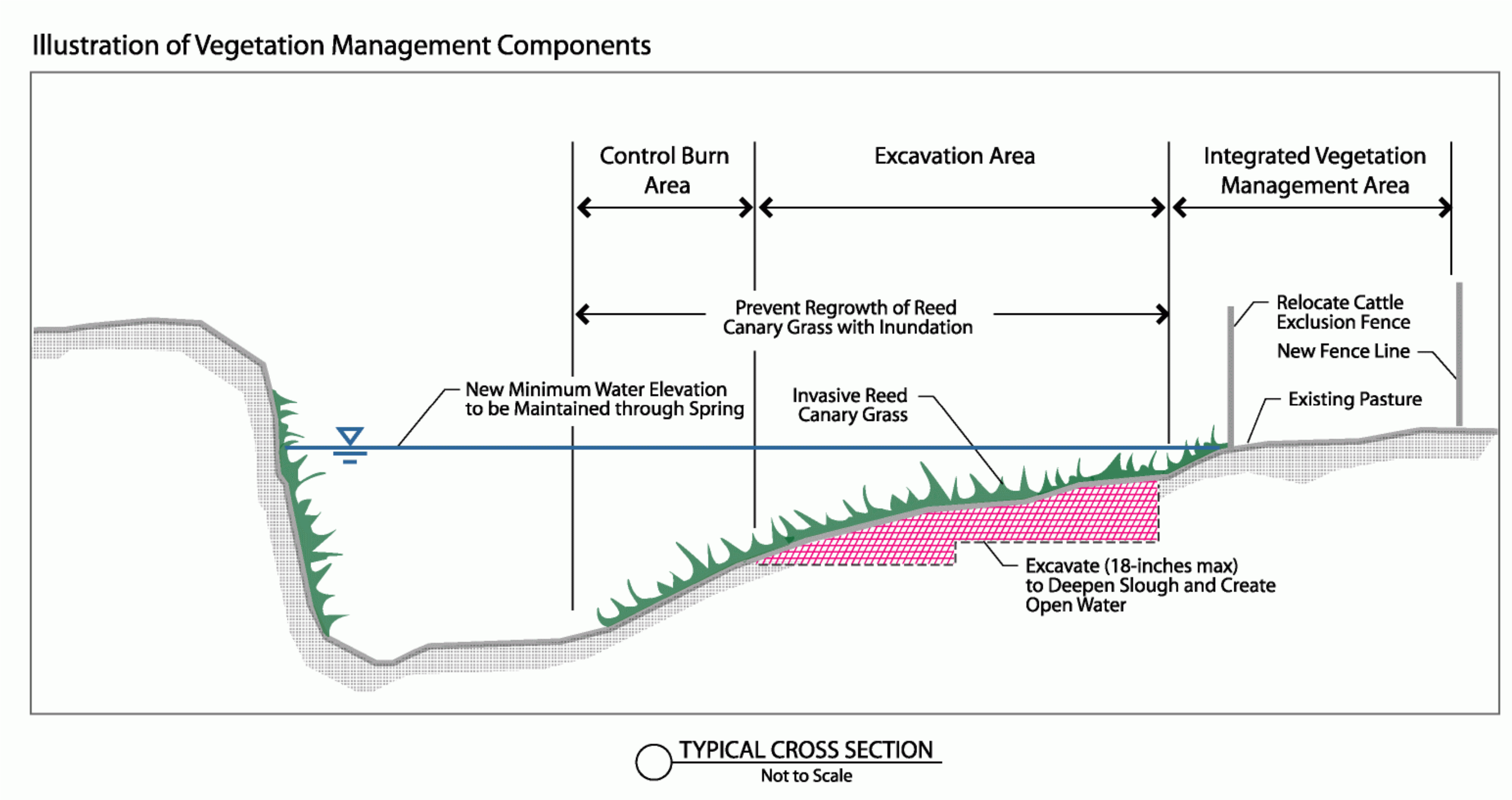


Figure 6.8 - Typical cross section illustrating the various vegetation control methods that can be applied in Yontocket Slough. This scenario assumes a water control structure would be constructed downstream to raise and maintain water levels.

7 feet and 9 feet, as described above, would involve scraping 3,000 cubic yards of reed canary grass biomass for composting and removal of 6,000 cubic yards of sediment over 3.4 acres.

Excavation in Upper Slough

Excavation within the upper slough (upstream of Pala Road) is an option if a water control structure is placed either at the slough outlet or at Pala Road. Excavation would be limited to the east side of the slough since the west side of the slough has relatively steep banks, making excavation ineffective.

Excavation as previously described, would entail scraping 10,000 cubic yards of reed canary grass biomass for composting and removal of 20,000 cubic yards of sediment over an area of 12.3 acres.

Estimated Construction Costs

Estimated unit costs for excavation of the Upper and Lower Slough are:

Scraping, stockpiling, and composting of reed canary grass: $20,000/acre
Excavation, haul, and disposal of accumulated sediments: $28/cubic yard

6.3.3 Excavation of a "Fish Passage Channel" below Pala Road

If a water control structure is constructed at Pala Road there may still be problems with fish passage through the lower slough due to the dense growth of reed canary grass. Improving fish passage in this reach can be accomplished by excavating a clear path from the slough outlet to Pala Road. The excavation would be approximately 18 inches deep and 600 feet long, and would follow the deepest sections of the slough. Excavation of a "fish passage channel" within the lower slough would involve removal of roughly 3,400 cubic yards of material.

Integrated vegetation management options would need to be applied to the area adjacent to the excavated channel to prevent recolonization with reed canary grass.

Estimated Construction Costs

Estimated cost for excavation of a "fish passage channel" in the lower slough: $95,000
(see Appendix D for more detail)

6.3.4 Mosquito Populations and Inundation

During the field data collection part of this project, including the summer of 2005, field crews noted little to no mosquitoes within the vicinity of Yontocket Slough. Given that the spring of 2005 was extremely wet suggests that mosquitoes at Yontocket Slough are generally not a problem under existing conditions.

Artificially raising water levels within Yontocket Slough through use of a water control structure has the potential of increasing mosquito populations, creating a public nuisance and public health issue. To avoid or minimize increases in mosquito populations, best management practices need to be incorporated into both the design of the project as well as operation of any water control structures.

There are two types of mosquitoes, those that lay there eggs in standing water verses floodwater mosquitoes. Floodwater mosquitoes lay there eggs on dry land, which then lies dormant until they become rewetted. Given the cool climate within the project area, mosquitoes only thrive once temperatures increase to suitable levels, typically from late spring through summer.

Design strategies can be employed to reduce the chance of increased mosquito populations related to this project. These measures include ensuring any scraped or excavated areas are graded to slope towards the deeper portions of the slough drain, thus avoiding collection of standing water. Additionally, by maximizing the area that is converted to deep open water and minimizing the width of the aquatic vegetation areas will help minimize mosquito production

Operational management of the water levels within the slough can be used to minimize production of standing water mosquitoes. *Culex tarsalis,* an important vector for the West Nile virus along the California coast, lays its eggs in standing warm water and is most abundant in spring and early fall. To avoid increasing the populations of standing water mosquitoes, the slough should be drained back down to current levels after June using the concrete weir box and drain pipe. This would still provide an adequate period of inundation to control RCG while avoiding any increase in the amount of standing water from July through October.

One of the most common causes leading to increased mosquito populations along the North Coast is having fluctuating water levels during the warmer periods of the year. This allows floodwater mosquitoes to lay their eggs on the dry land when water levels recede and then hatch once they become flooded. There is little inflow into Yontocket Slough during late spring, when temperatures are suitable for floodwater mosquitoes. Rising water levels within the slough during this period would be extremely rare, therefore preventing the creation of suitable floodwater mosquito habitat.

6.4 Integrated Vegetation Management other than Inundation

As discussed in Chapter 5 and the Biological Report (Appendix E), control of reed canary grass (RCG) through combined use of burning, excavation, and inundation is preferred for deeper portions of the slough. For areas with inundation depths less than 24 inches through the growing season, alternative vegetation management strategies should be employed.

There are no easy methods for controlling RCG. In general, the objective is to encourage growth and establishment of a mixture of different native vegetation to create a complex canopy and understory to shade-out and out-compete the aggressive RCG. Managing for the establishment of native vegetation requires actively controlling the growth of the RCG for several years.

The following suite of treatment options were selected as the most feasible, least environmentally damaging methods, for control of reed canary grass in areas where inundation is not sufficient to prevent regrowth. Employed in combination, these options represent an **Integrated Vegetation Management** restoration component.

6.4.1 Moving Fence Lines

Parts of the State owned pastures along the northeast portion of slough currently become inundated when the slough level is above approximately 9 feet. If a water control structure is constructed at the slough outlet or at Pala Road, integrated vegetation management strategies should include setting back the fence line so it is located on higher ground. Placing the fence line roughly along the 11 foot contour will create a suitable area for establishment of a riparian area composed of native plant species located along the slough margins. This riparian area will be located along the northeastern banks of the slough, on the State Park property. It will serve as a buffer to control the spread of the reed canary grass that currently grows within the pastures. Moving the fences back and cultivating riparian plants will also increase the buffer between the pasture and the slough and reduce the amount of nitrogen-rich runoff derived from cattle waste.

Lower Slough

Locating water control structures at the outlet of Yontocket Slough would require moving the fence line between the outlet and Pala Road away from the slough approximately 330 feet. This would reduce the size of this pasture by about 5 acres.

Upper Slough

Use of a water control structure at the slough outlet or at Pala Road would require moving the fence line between Pala Road and the State Park property boundary away from the slough approximately 100 feet. The new fence line would be located roughly along the 11-foot elevation contour. This would reduce the size of this pasture by about 7.6 acres.

Estimated Construction Costs

Estimated cost for removal of existing fence in the lower slough is: $2,900
Estimated cost for construction of new fence in the lower slough is: $8,700

Estimated cost for removal of existing fence in the upper slough is: $7,882
Estimated cost for construction of new fence in the upper slough is: $32,200
(see Appendix D for more detail)

6.4.2 Scrape and Till, Replant, and Mulch

Scraping and Tilling

Scraping and removal of RCG and its rhizomes is recommended for areas along banks and upper elevations, to the greatest extent feasible. These areas are accessible with heavy equipment, enabling significant removal of RCG material. A skilled equipment operator should be able to roll the reed canary grass like sod, which can then be carefully deposited on adjacent lands in multiple piles and covered with plastic to compost the organic material for up to two years. Refer to Section 4.4 for more details on the scraping technique.

Following excavation of the upper 6 to 8 inches of the soil horizon, disking (tillage) of the soil should occur to loosen the soil surface and stimulate the native seed bank.

Exposed soils should be stabilized using Best Management Practices (BMPs) appropriate for the area to prevent and minimize erosion. In order to minimize dispersal of seed and plant material, all equipment should be thoroughly washed at an approved location in the project area prior to moving offsite.

Replanting

Native seed and plant material should be planted immediately. A high-density native seed mix at a rate of 15,000 pure live seeds (PLS) m^{-2} should be used, with native species sown in equal proportion. An average seeding rate of 17 lbs per acre has been successfully used in other projects, with grass comprising 13 lbs per acre and forbs comprising 4 lbs per acre.

In addition to use of native seed, plugs of material should be planted immediately to enable occupation and establishment of native species before RCG germinates again. Enabling a complex canopy structure to establish will further compromise the ability of RCG to reestablish. Creating a complex topography within the planting area will further facilitate the establishment of species-rich native vegetation. Use of species such as slough sedge, skunk cabbage, soft rush, salmonberry, red alder, and Sitka spruce along channel banks are recommended. Preparation of a planting plan should be done by a qualified biologist familiar with the goals of the project.

Eradication of RCG seedlings over multiple growing seasons is needed to deplete the seed bank over time. If necessary, controlled burning or spot flaming may be used to control reed canary grass resprouts prior to installation of native seed and plant material.

Mulching

Use of mulch combined with replanting can also be an effective means of controlling RCG by covering the grasses and encouraging native growth. A light mulching using seedless hay can be spread across large areas. A heavy mulch of wood chip or shredded cardboard can be placed around plantings in thicknesses of about 6 inches. Although mulching on a large scale can be cost prohibitive, strategically selecting areas for mulching may be effective. This could include mulching along the areas bordering adjacent pastures to prevent the spread of RCG by creeping rhizomes.

Estimated Implementation Costs

Unit Cost for Scraping and Tilling, Replanting, and Mulching:

Scraping, stockpiling and composting of reed canary grass: $20,000/acre
Disking and tilling: $400/acre
Combined planting with native starts and drilled seed bed planting: $3,000/acre
Heavy mulching with woodchips or cardboard: $8,000/acre
(see Appendix D for more detail)

6.4.3 Use of Herbicides for Controlling Sprouts

Use of herbicides is a common and effective technique for controlling growth of RCG seedlings after the initial clearing and replanting. However, at the advisory group meetings State Parks staff informed the attendees that herbicide usage is considered an undesirable option by the agency. However, CDFG may take over management authority for Yontocket Slough in the future and would like to consider herbicide use as part of any developed vegetation control alternative.

An additional consideration is that the Alexandre Dairy, a certified organic dairy, currently leases the state owned pasture for grazing cattle. The National Organic Program (NOP) does not have specific prescriptive requirements for buffering organic crops, such as neighboring non-organic farms, from potential herbicide contaminants. However, prior to implementation of the NOP, 25 feet was used a baseline for appropriate buffers. This baseline is still used by California Certified Organic Farmers (CCOF) as a general guideline for their decision process in addition to other mitigating factors such as physical barriers and agricultural practices (from CCOF Website).

6.4.4 Need for Pilot Projects and Vegetation Monitoring

Given the large size of the project area and numerous uncertainties associated with any type of vegetation management strategy, the use of small-scale vegetation management pilot projects should be considered. Using well designed pilot projects, various methods for controlling RCG can be tried and their effectiveness evaluated. Additionally, there is a considerable amount of uncertainty regarding the actual cost of implementing different vegetation management strategies. Conducting pilot projects will provide improved understanding of costs, as well as improving field implementation methods.

These pilot projects could be initiated at the beginning stages of the project. They would likely involve trying various scraping, excavation, disking, mulching, and even possibly herbicide treatments. Equally important is trying different techniques and various types of equipment for each treatment as well as applications in different soil conditions (i.e. lower elevation sections where the soils are saturated year-round verses higher ground). Successful establishment of different plant species and planting methods should also be evaluated in these pilot projects.

7 Developed Alternatives

Restoration components developed in Chapter 6 were divided into three main categories:
1. Water Control,
2. Pala Road, and
3. Vegetation Management.

Four comprehensive project alternatives were then developed using the selected components from each of the categories (Figure 7.1). This section describes each of the developed alternatives. Refer to Chapter 6 for detailed information relative to each individual component.

7.1 Basis for Cost Estimates for Developed Alternatives

Estimated design and implementation costs for each of the alternatives were developed from the restoration component costs presented in Chapter 6. The costs are presented here as a guide for comparison of each alternative and should be compared relative to each other. Estimates were based on the best available information at the time and while they may not reflect final costs they serve as a basis for comparison. The itemized cost estimates can be found in Appendix D.

The following items were included in each estimate for final design and environmental documentation costs as appropriate:
- Project Management
- Engineering and Design including:
  - Additional topographic survey
  - Water control design
  - Earthworks design and specifications
  - Integrated Vegetation Management design
- Permitting and Environmental Documents including:
  - Biological Assessments
  - NEPA, CEQA Documentation

The following items were included in each estimate of implementation costs as appropriate:
- Final Permit Applications
- Mobilization /Demobilization /Cleanup
- Clearing/Grubbing
- Water Diversion, erosion sediment control
- Fish Removal
- Construction Inspection and Management
- Cultural Monitoring
- Geotechnical Investigation
- Water Control Structure Construction
- Pala Road Modification
- Vegetation Management, including excavation (lower and upper slough)
- Project Monitoring

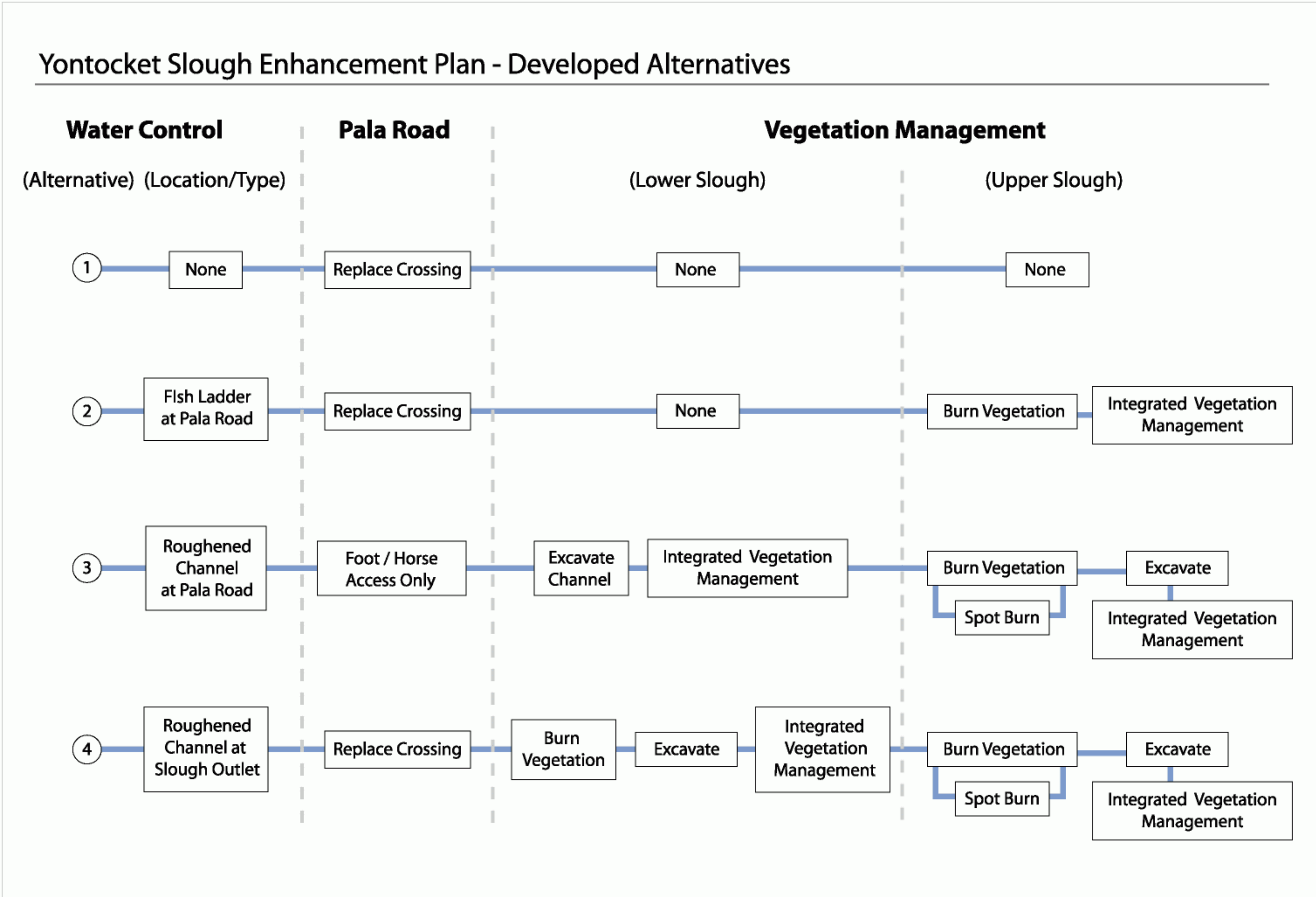


Figure 7.1 - Selected combination of the various restoration components used for developing four project alternatives.

7.2 Alternative 1: No Water Control Structure

Alternative 1, the *no water control option* is the minimum action alternative. It involves replacing the existing culverts at Pala Road and slightly raising the road bed elevation across the slough. Figure 7.2 summarizes Alternative 1.

7.2.1 Restoration Components for Alternative 1

1. **Remove water control structures at Pala Road.** Water surface will be controlled by natural constriction at slough outlet. Water surface levels upstream of Pala Road are expected to become lower than under the current management regime; about 6 inches lower during wet periods (late fall through early spring) and approximately 12 inches lower during late spring into early summer.

2. **Install new drainage culverts at Pala Road** to improve hydrologic connection between the lower and upper slough. Replacing the existing culverts with two 6 x 6 foot precast concrete box culverts will greatly increase the connectivity between the lower and upper slough and provide for unimpeded fish passage under the road. This type of culvert is relatively inexpensive, long-lasting, can directly accommodate vehicle loading with no minimum fill cover, and does not need any footings or other work that requires extensive geotechnical investigations or concrete form work.

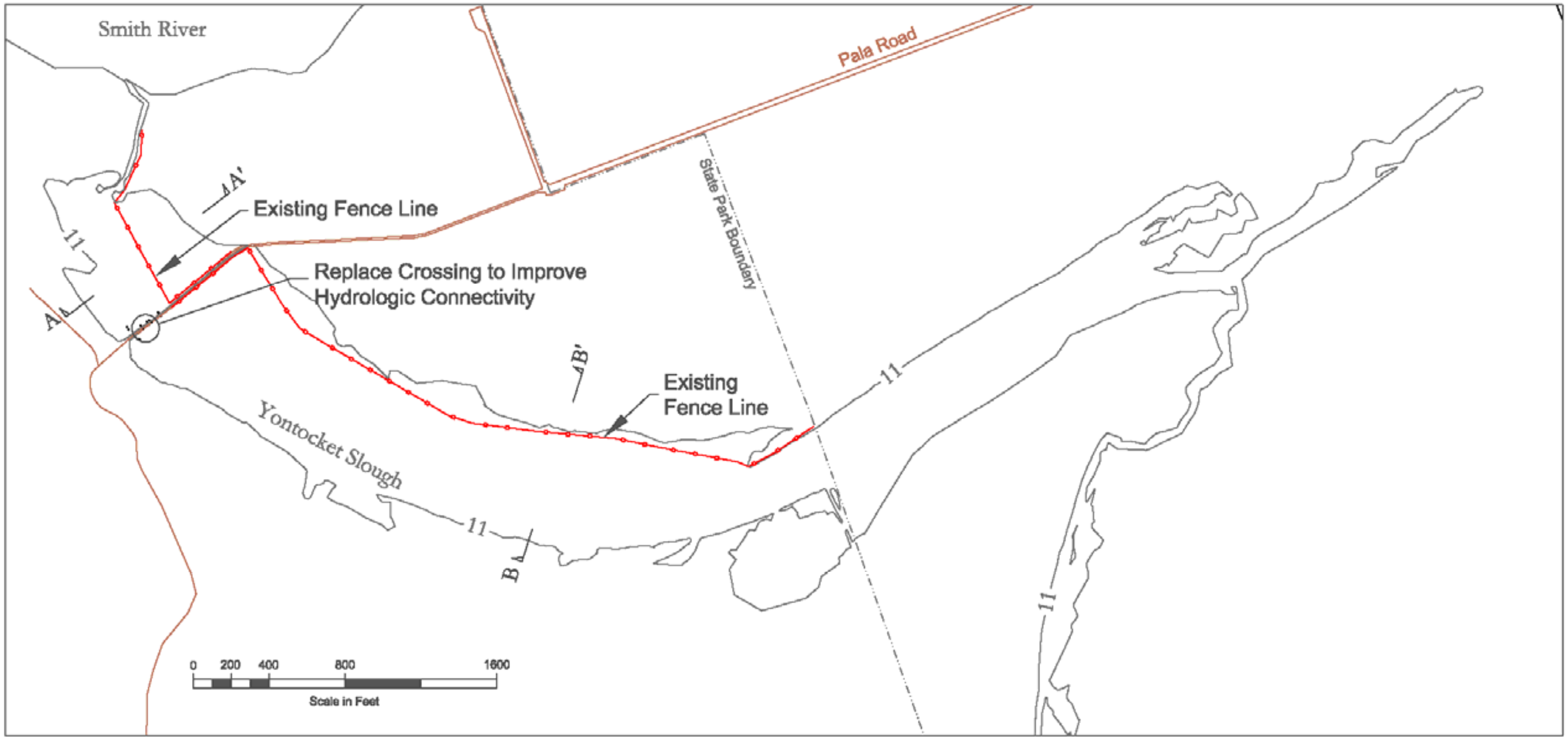
3. **Raise road bed across the slough to elevation 11.5 feet.** Currently the roadbed elevation as it crosses the slough varies between 10.1 feet and 11.5 feet. To reduce overtopping of the road, the roadbed should be raised to 11.5 feet across the entire slough. This will allow for increased conveyance of flood flows through the new culverts instead of over the road.

4. **No active vegetation management.** Some riparian planting along the edge of Yontocket Slough would be included in the final design. However, no active vegetation management activities would be undertaken to control existing reed canary grass, nor would there be any activities to limit the spread of reed canary grass into portions of the slough as a result of lower water levels in spring.

7.2.2 Alternative 1 Cost Estimates

The estimated implementation costs for Alternative 1 are:

Design and Environmental Documentation…………………….$31,000
Implementation…………………………………………….........$99,000



Alternative - 1

Yontocket Slough Fish Passage and Habitat Enhancement Project

1. Water Control Structure
None
(Remove existing stand pipes at Pala Road crossing)

2. Pala Road
Continue use of road, raise road elevation to 11.5-ft, install new concrete box culverts for improved flow connectivity between upper and lower slough.

3. Vegetation Management

Lower Slough (downstream of Pala Rd):
None

Upper Slough (upstream of Pala Rd):
None

Figure 7.2 - Plan view and description of Alternative 1, the No Water Control Alternative with minimal vegetation management.

7.3 Alternative 2: Water Control at Pala Road (No Excavation)

7.3.1 Restoration Components for Alternative 2

Alternative 2, *Water Control at Pala Road with No Excavation*, involves providing fish passage at Pala Road while controlling reed canary grass (RCG) within portions of the upper slough through inundation. This alternative does not attempt to control RCG within the lower slough. The only excavation proposed in this alternative is associated with installation of new culverts and fish ladder at Pala Road. Figure 7.3 summarizes Alternative 2.

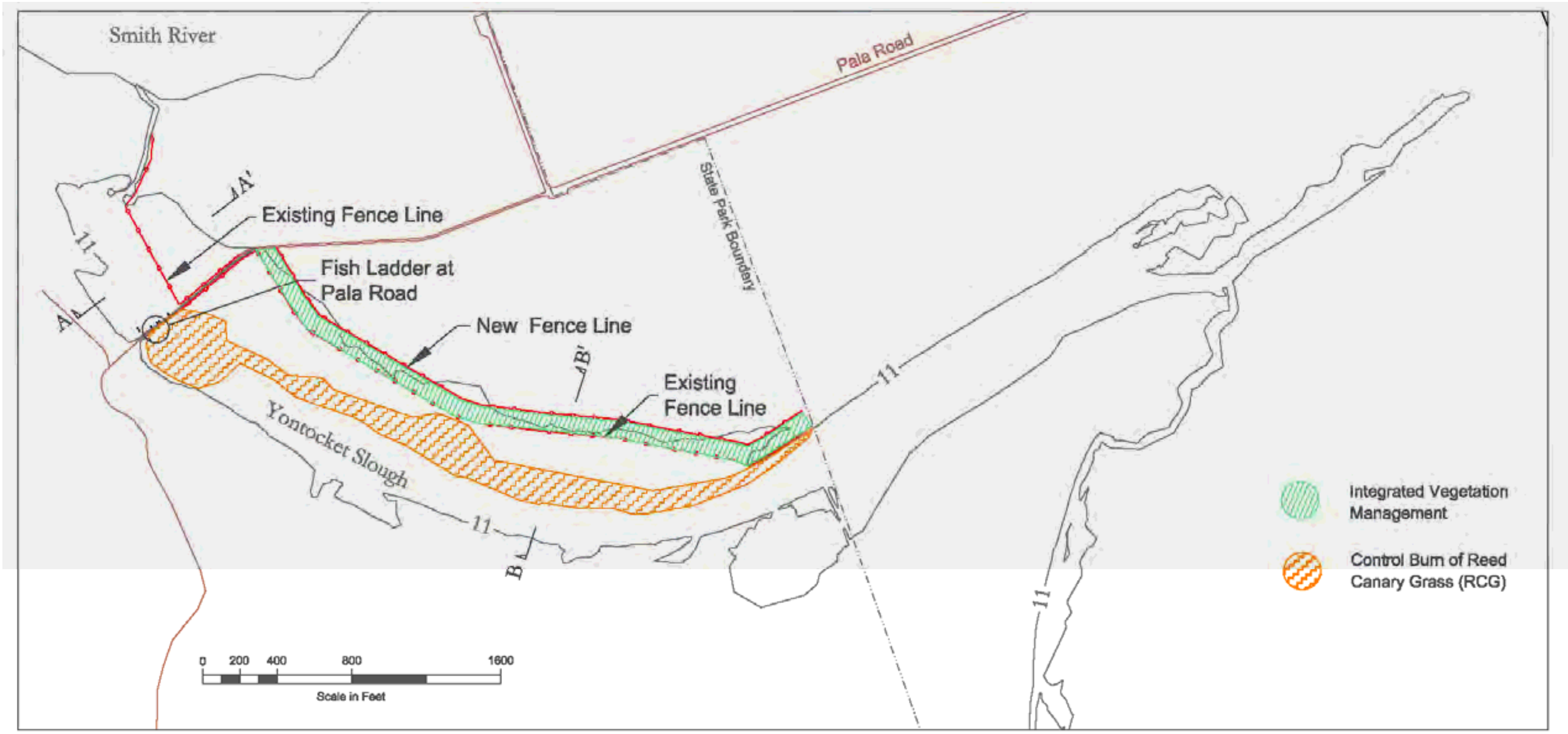
1. **Construct fish ladder at Pala Road to maintain water surface at or above 10 feet elevation through spring**. The fish ladder would provide fish passage for both adult and juvenile salmonids. The wooden weirs in the ladder would likely require some maintenance associated with clearing accumulated debris and possible seasonal adjustments to the flashboards to drain the slough during summer months. Maintaining water levels above 10 feet elevation through June is expected to eliminate reed canary grass within areas of the upper slough below approximately 8 feet elevation.

2. **Remove existing Pala Road culverts, install new larger culverts, and raise roadbed.** The existing culverts would be removed and replaced with two 6 x 6 foot precast concrete box culverts. The new fish ladder would be located at the inlet of one of the culverts. Installing these larger culverts would increase hydraulic outflow capacity during flood events, and reduce frequency of culvert plugging. The roadbed across Yontocket Slough would be raised to elevation 11.5 feet to reduce frequency of overtopping and keep water flowing through the new culverts.

3. **Manage vegetation on State land** to increase deep open-water habitat within the upper slough and provide suitable conditions for establishment of native riparian vegetation along the eastern edge of the slough.

    a. **Burning and inundation** to eliminate RCG below elevation 8 feet within the State managed portion of the upper slough. Burning RCG prior to inundation will reduce biomass leading to improved oxygen levels in the water.

    b. **Limited Integrated Vegetation Management along upper slough margin** to control reed canary grass. Integrated vegetation management would occur along the eastern edge of the upper slough on State managed land to establish a riparian buffer. This buffer would be located between the existing fence (to be removed) and the new 100 foot setback fence line. Techniques could include tilling, planting of seed and live plants, heavy mulching, as well as control of RCG sprouts through torching or spot herbicide application. Effectiveness and cost of different techniques would be evaluated through implementation of smaller scale pilot projects.



Alternative - 2

Yontocket Slough Fish Passage and Habitat Enhancement Project

1. Water Control Structure at Pala Road
Fish Ladder with adjustable wiers. Designed to maintain minimum water level at elevation 10-ft for open water habitat and vegetation control through inundation.

2. Pala Road
Continue use of road, raise road elevation to 11.5-ft, install new concrete box culverts for improved flow connectivity between upper and lower slough.

3. Vegetation Management

<u>Lower Slough (downstream of Pala Rd):</u>
None

<u>Upper Slough (upstream of Pala Rd):</u>
1) Burn RCG below elev. 8-ft on State property (13.3-ac),
2) Integrated Vegetation Management from old fence line to new fence line to establish riparian buffer (7.6-ac),
3) Set back existing fence 100-ft, remove 3,941-ft, new 3,220-ft.

Figure 7.3 - Alternative 2: Water Control at Pala Road with No Excavation of Slough and limited vegetation management.

7.3.2 Alternative 2 Cost Estimates

The estimated implementation costs for Alternative 2 are:

Design and Environmental Documentation………………….$90,000
Implementation……………………………………….…......$347,000

7.4 Alternative 3: Water Control at Pala Road (with Excavation)

Alternative 3, *Water Control at Pala Road with Excavation*, involves controlling reed canary grass (RCG) within the upper slough through inundation and integrated vegetation management while providing fish passage at Pala Road using a roughened channel combined with a wet crossing. This alternative does not use inundation to control RCG within the lower slough, but instead relies on various intergrated vegetation management strategies. Figures 7.4 and 7.5 summarize Alternative 3.

7.4.1 Restoration Components for Alternative 3

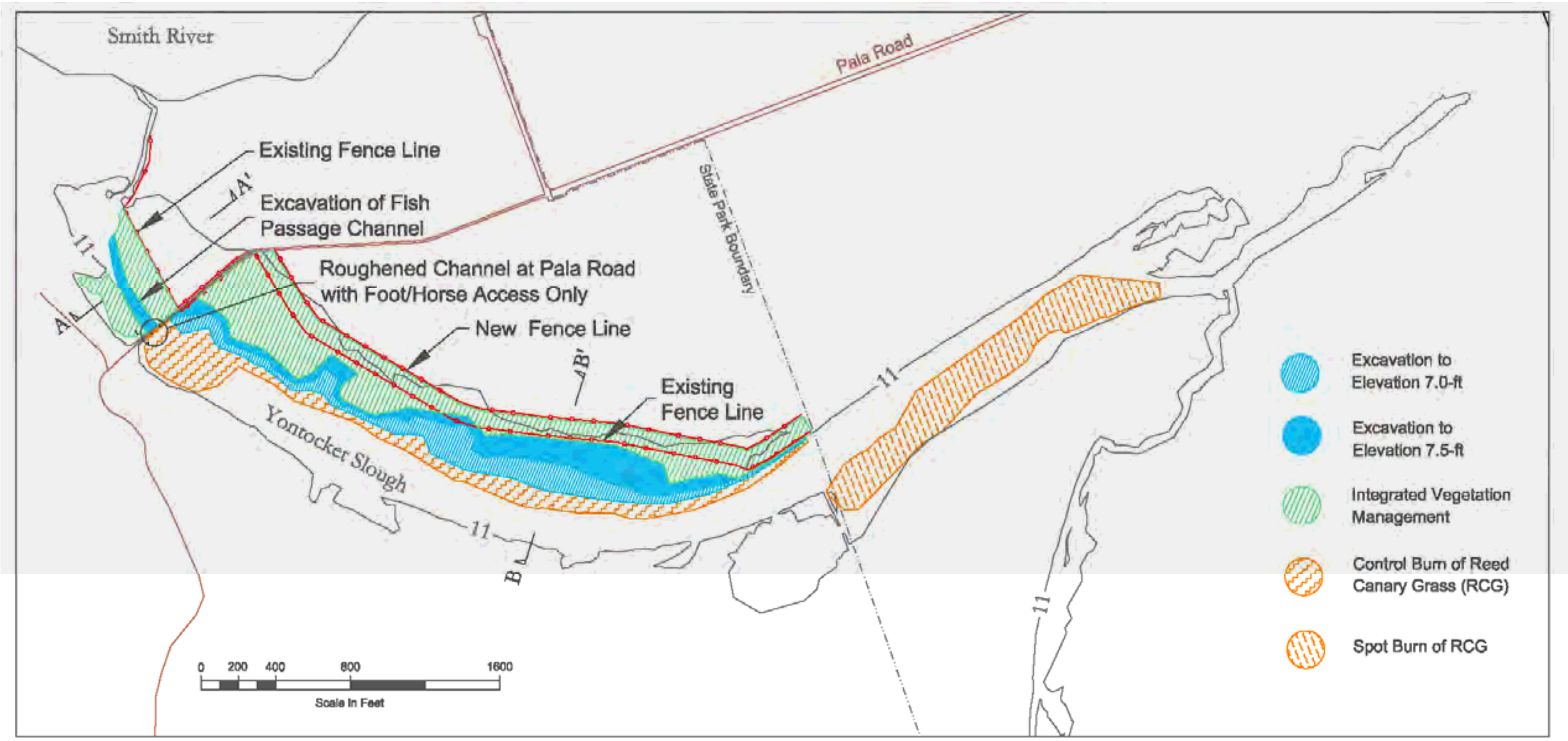
1. **Construct roughened channel over Pala Road to maintain water surface at or above 10 feet elevation through spring**. The roughened channel would provide fish passage for both adult and juvenile salmonids and would require minimal maintenance. Maintaining water levels above 10 feet elevation through June is expected to eliminate reed canary grass within areas of the upper slough below approximately 8 feet elevation.

2. **Remove existing culverts, construct wet crossing at top of roughened channel, and raise roadbed.** The existing culverts would be removed and all water would flow across the road at an engineered wet crossing located at the top of the roughened channel. The remainder of the roadbed would be raised to elevation 11.5 feet to reduce frequency of overtopping. The wet crossing would continue to allow public access via horse and foot and allow for access by high clearance emergency vehicles and ATV's.

3. **Manage vegetation** to increase deep open-water habitat within the upper slough, control growth of reed canary grass in shallow water areas and along the margins of the slough, and provide suitable conditions for establishment of native vegetation.

    a. **Burning, excavation, and inundation** to eliminate reed canary grass (RCG) below elevation 9 feet within the upper slough. RCG within the deeper portions of the upper slough (below elevation 7 feet) would be burned using large control burns in open areas and spot burning more confined areas. Portions of the upper slough on State Property that lie between elevations 7 feet and 9 feet would be scraped clear of RCG and then excavated a maximum of 18 inches. These two areas would become sufficiently inundated to prevent regrowth of RCG.

    b. **Excavate channel in lower slough** connecting the outlet of Yontocket Slough to bottom of the roughened channel. This cleared channel is intended to improve fish passage conditions by providing a migratory channel clear of RCG.



Alternative - 3

Yontocket Slough Fish Passage and Habitat Enhancement Project

1. Water Control Structure at Pala Road
Roughened Channel with concrete weir box and drainage pipe. Designed to maintain minimum water level at elevation 10-ft for open water habitat and vegetation control.

2. Pala Road
Wet crossing at Pala Road. Use of road by horse and foot traffic, and vehicle access.

3. Vegetation Management

Lower Slough (downstream of Pala Rd):
1) Excavate slough channel (0.7-ac),
2) Integrated Vegetation Management from right bank of slough to fence line (1.9-ac) and left bank of slough to elev. 8-ft (1.0-ac)

Upper Slough (upstream of Pala Rd):
1) Burn RCG below elev. 7-ft on State property (7.8-ac),
2) Spot burn RCG below elev. 8-ft in riparian areas on private property (9.6-ac),
3) Excavate slough from elev. 7 to 9-ft (12.3-ac),
4) Set back existing fence 100-ft, remove 3,941-ft, new 3,220-ft
5) Integrated Vegetation Management from 9-ft to new fence line (14.5-ac).

Figure 7.4 - Alternative 3: Water Control at Pala Road and excavation of Slough with vegetation management.

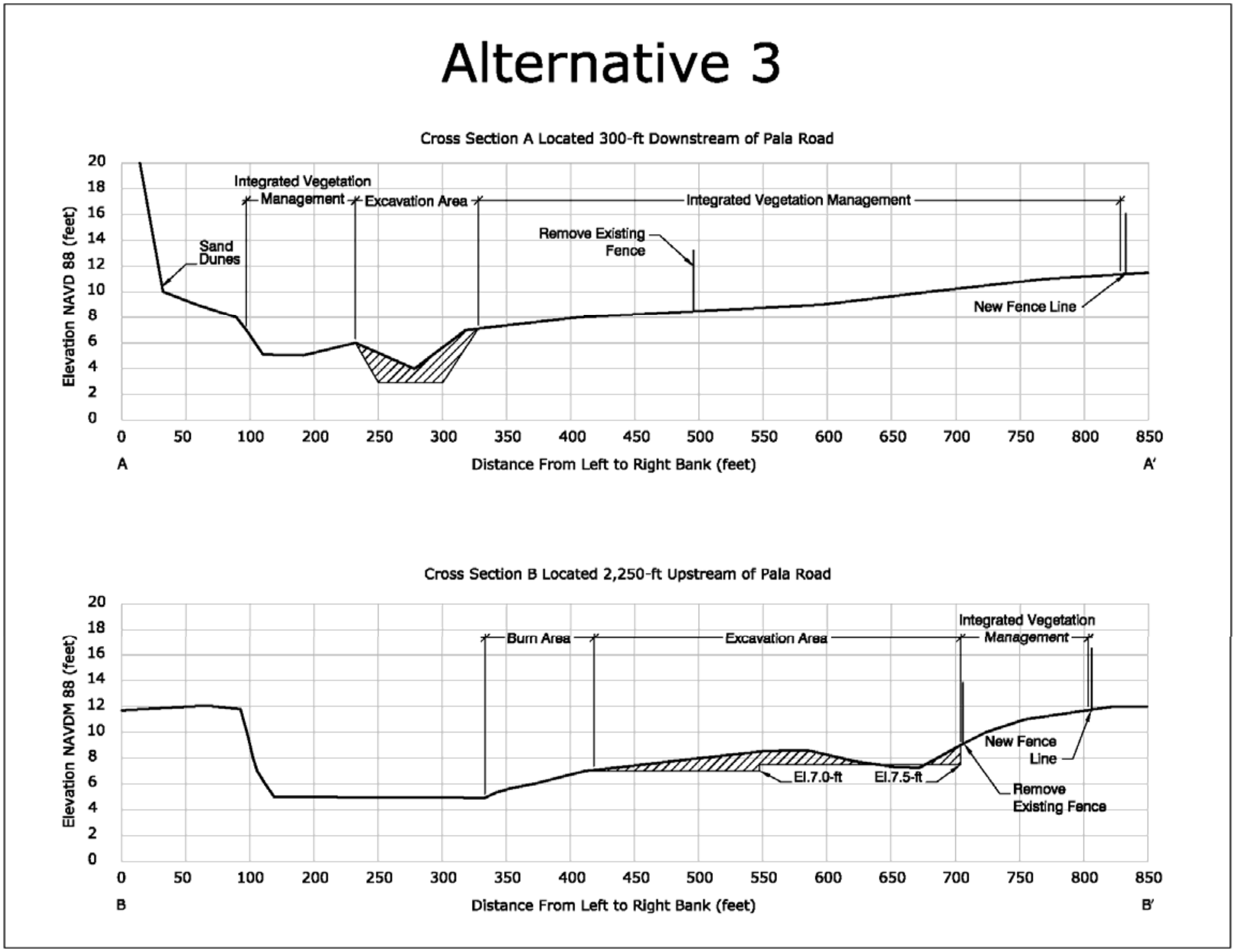


Figure 7.5 - Cross sections illustrating activities associated with Alternative 3.

c. **Integrated Vegetation Management** to control reed canary grass within the shallow areas and along the banks of the slough. Integrated vegetation management involves scraping RCG from the ground surface and then applying a variety of techniques to promote the establishment of native vegetation. Techniques could include tilling, planting of native seed and live plants, mulching, and control of RCG sprouts with torching or spot herbicide application. Effectiveness and cost of different techniques would be evaluated through implementation of smaller scale pilot projects.

7.4.2 Alternative 3 Cost Estimates

The estimated implementation costs for Alternative 3 are:

Design and Environmental Documentation………………...….$200,000
Implementation…………………………………….…........$2,280,000

7.5 Alternative 4: Water Control at Slough Outlet (with Excavation)

Alternative 4, *Water Control at Slough Outlet with Excavation*, involves controlling reed canary grass (RCG) within both the lower and upper portions of the slough through inundation and integrated vegetation management. Water levels would be raised by constructing a roughened channel located downstream of the outlet of Yontocket Slough. This structure would require minimal maintenance and be designed to provide fish passage at Pala Road while maintaining elevated water levels through spring within the slough. Figures 7.6 and 7.7 summarizes Alternative 4.

7.5.1 Restoration Components for Alternative 4

1. **Construct roughened channel at outlet of Yontocket Slough to maintain water surface at or above 10 feet elevation through spring.** The roughened channel would provide fish passage for both adult and juvenile salmonids and would require minimal maintenance. Maintaining water levels above 10 feet elevation through June is expected to eliminate reed canary grass within areas of the lower and upper slough below approximately 8 feet elevation. Roughened channel would include a concrete weir box and drain pipe to drain slough during summer and fall, if needed.

2. **Remove existing Pala Road culverts, install new larger culverts, and raise roadbed**. To fully restore hydrologic connectivity between the lower and upper slough, the existing culverts would be removed and replaced with two 6-ft x 6-ft precast concrete box culverts. The roadbed across Yontocket Slough would be raised to elevation 11.5 feet to reduce frequency of overtopping and keep water flowing through the new culverts.

3. **Manage vegetation to increase deep open-water habitat** throughout the entire slough, control growth of reed canary grass in shallow areas and along the margins of the slough, and provide suitable conditions for establishment of native vegetation.

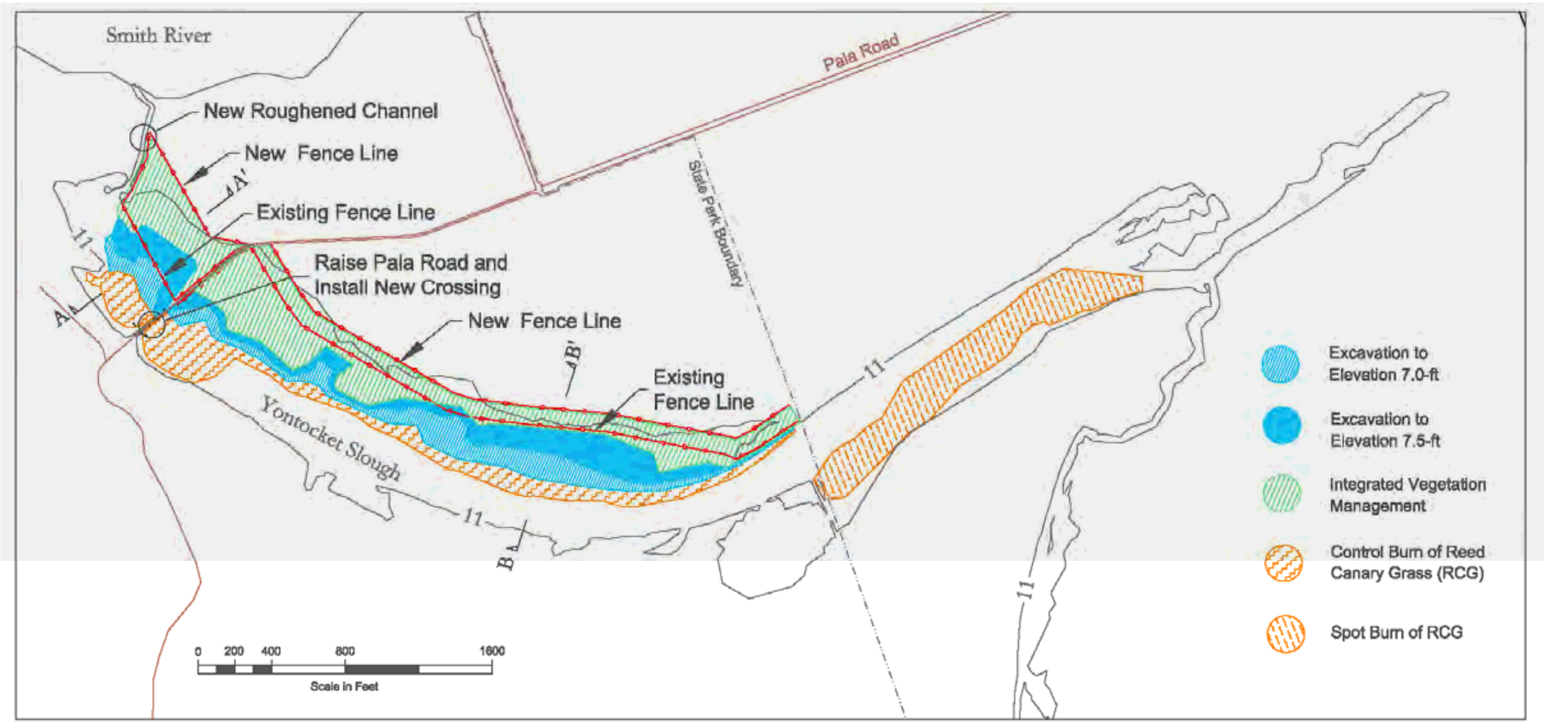
a. **Burning, excavation, and inundation** to eliminate reed canary grass (RCG) below elevation 9 feet within the entire slough. RCG within the deeper portions of the slough (below elevation 7 feet) would be burned using large control burns in open areas and spot burning performed in more confined areas. Portions of the slough on State Property that lie between elevations 7 feet and 9 feet would be scraped clear of RCG and then excavated a maximum of 18 inches. These two areas would become sufficiently inundated to prevent reestablishment of RCG.

b. **Integrated Vegetation Management** to control reed canary grass within the shallow areas and along the banks of the slough. Integrated vegetation management involves scraping RCG from the ground surface and then applying a variety of techniques to promote the establishment of native vegetation. Techniques could include tilling, planting of seed and live plants, mulching, and control of RCG sprouts through torching or spot herbicide application. Effectiveness and cost of different techniques would be evaluated through implementation of smaller scale pilot projects.

7.5.2 Alternative 4 Cost Estimates

The estimated implementation costs for Alternative 4 are:

Design and Environmental Documentation………………..…..….$213,000
Implementation……………………………………….…........$2,810,000



Alternative - 4

Yontocket Slough Fish Passage and Habitat Enhancement Project

1. Water Control Structure at Outlet of Slough
Roughened Channel with concrete weir box and drainage pipe. Designed to maintain minimum water level at elevation 10-ft for open water habitat and vegetation control through inundation.

2. Pala Road
Continue use of road, raise road elevation to 11.5-ft, install new concrete box culverts for improved flow connectivity between upper and lower slough.

3. Vegetation Management

Lower Slough (downstream of Pala Rd):
1) Burn RCG below elev. 7-ft on State property (1.4-ac),
2) Excavate slough from elev. 7 to 9-ft (3.4-ac),
3) Set back existing fence 330-ft, remove 1450-ft, new fence 870-ft.
4) Integrated Vegetation Management from elev. 9-ft to new fence line (4.4-ac).

Upper Slough (upstream of Pala Rd):
1) Burn RCG below elev. 7-ft on State property (7.8-ac),
2) Spot burn RCG below elev. 8-ft in riparian areas on private property (9.6-ac),
3) Excavate slough from elev. 7 to 9-ft (12.3-ac),
4) Set back existing fence 100-ft, remove 3,941-ft, new 3,220-ft
5) Integrated Vegetation Management from 9-ft to new fence line (14.5-ac).

Figure 7.6 - Alternative 4: Roughened Channel at Slough Outlet with Excavation and extensive vegetation management.

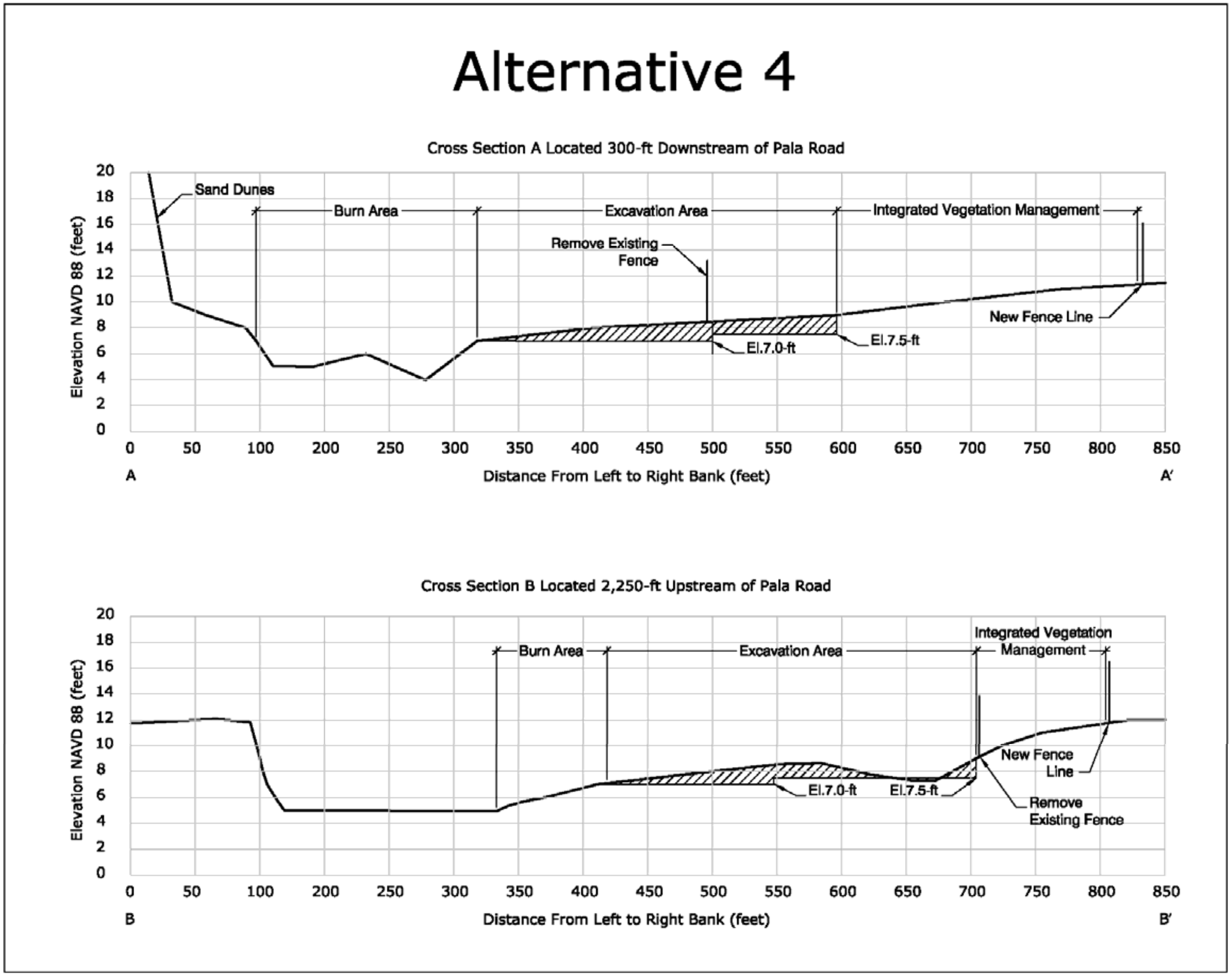


Figure 7.7 - Cross sections illustrating activities associated with Alternative 4.

8 Comparison of Alternatives

Table 8.1 was compiled to help facilitate evaluation and compare the level of effort associated with each alternative. Additionally, the four alternatives were evaluated using the criteria developed by the project team, reviewed and approved by the advisory group members, and presented in Chapter 5. Table 8.2 briefly summarizes each alternative's ability to satisfy the project goals and objectives and address additional considerations.

8.1 Ability of Alternatives to Satisfy Project Objectives

This section briefly summarizes each alternative's ability to satisfy the main project goals and objectives of (1) improving fish passage at Pala Road, (2) reducing reed canary grass within Yontocket Slough, (3) improving water quality (dissolved oxygen) within Yontocket Slough, and (4) increasing overall habitat complexity throughout Yontocket Slough. The section also includes a brief summary of the primary uncertainties associated with each alternative.

8.1.1 Alternative 1 – Replace Culverts at Pala Road

Alternative 1, replacement of existing culverts and standpipes with two new large culverts and raise the road level, should eliminate the fish migration barrier at Pala Road but will likely further degrade the slough's habitat value for both salmonids and waterfowl. The new culverts will improve the hydrologic connectivity between the lower and upper slough but is expected to result in lower water levels (approximately 12 inches lower) within the upper slough during spring. Lower water levels during spring will allow reed canary grass (RCG) to spread into lower portions of the slough that are currently either open water or contains yellow pond lily. This alterative is expected to result in the colonization of an additional 18 acres of the slough by RCG, leaving only roughly 4 acres free from the invasive species.

8.1.2 Alternative 2 –Fish Ladder at Pala Road, Replace Culverts, and Burning

Alternative 2, construction of fish ladder at Pala Road, replacement of the culverts and burning RCG within portion of the upper slough (13.3 acres), should provide for adult and juvenile fish passage while maintaining higher water levels within the upper slough through spring. The higher and more constant water levels during the spring are expected to eliminate RCG within roughly 24 acres of the upper slough through inundation. There will continue to be large areas of RCG throughout the lower slough and within the shallower areas of the upper slough.

Uncertainties associated with this alternative include:

1. Whether the anticipated reduction in RCG will be sufficient to increase dissolved oxygen within the slough to suitable levels for salmonids, and

2. Is there sufficient inflow to maintain the desired water level through spring given that there are large water withdrawals occurring upstream on Tryon Creek for agricultural uses and large amounts of transpiration associated with remaining RCG.

8.1.3 Alternative 3 –Roughened Channel at Pala Road, Burning, Excavate, and Vegetation Management

Alternative 3, construction of a roughened channel with a wet crossing at Pala Road, burning RCG within portion of the upper slough (17.4 acres), excavation of portions of the upper slough (12.3 acres) and large scale integrated vegetation management (17.4 acres) to establish native aquatic and riparian plant communities, should provide for adult and juvenile fish passage while maintaining higher water levels within the upper slough through spring and improving both deep and shallow water habitats within the upper slough. The higher and more constant water levels during the spring are expected to eliminate RCG within roughly 38 acres of the upper slough through inundation. Much of the remaining shallow water areas and shorelines of the slough will be scraped clear of RCG and aggressively managed for establishment of native plant species.

Uncertainties associated with this alternative include:

1. Level of follow-up and overall effectiveness associated with different vegetation management strategies for controlling RCG within the slough and

2. Is there sufficient inflow to maintain the desired water level through spring given that there are large water withdrawals occurring upstream on Tryon Creek for agricultural uses and large amounts of transpiration associated with remaining RCG.

8.1.4 Alternative 4 –Roughened Channel at Slough Outlet, Replace Culverts, Excavate, and Vegetation Management

Alternative 4, construction of a roughened channel at the slough outlet, replace culverts at Pala Road, burning RCG within portion of the upper and lower slough (18.8 acres), excavation of portions of the lower and upper slough (15.7 acres) and large scale integrated vegetation management (18.8 acres) to establish native aquatic and riparian plant communities, should provide for adult and juvenile fish passage while maintaining higher water levels within the slough through spring and improving both deep and shallow water habitats within the entire slough. The higher and more constant water levels during the spring are expected to eliminate RCG within roughly 44 acres of the slough through inundation. Much of the remaining shallow water areas and shorelines of the slough will be scraped clear of RCG and aggressively managed for establishment of native plant species.

Uncertainties associated with this alternative include:

1. Level of follow-up and overall effectiveness associated with different vegetation management strategies for controlling RCG within the slough,

2. Stability and longevity of the roughened channel given the high water velocities within the area and the rapid lateral migration of the river towards the slough, and

3. Is there sufficient inflow to maintain the desired water level through spring given that there are large water withdrawals occurring upstream on Tryon Creek for agricultural uses and large amounts of transpiration associated with remaining RCG.

8.2 Impacts to Other Wildlife

8.2.1 Aleutian Geese

Alternative 1 would not affect the pastures currently used for foraging by wintering Aleutian Geese. However, the further lowering of Yontocket Slough and resulting spread of RCG would likely reduce the amount of open water habitat available to the geese. Alternatives 2-4 would result in loss of varying acreages of pasture currently used by foraging Aleutian Geese (7.6 acres for Alt. 2 and 3, 12.7 acres for Alt 4). However, there would be a large increase in the amount of high quality wetlands and open water habitat associated with these alternatives, likely providing a mix of habitats suitable for the geese.

8.2.2 Waterfowl

Alternative 1 will substantially decrease waterfowl habitat quality by allowing the further spread of RCG into the deeper portions of the slough. This alternative will also reduce the duration that the habitat is suitable for waterfowl usage since water levels within the slough will recede more rapidly than under current conditions.

Alternative 2-4 will substantially improve habitat quality for waterfowl by increasing the area of the slough containing both open water and native aquatic plants (such as yellow pond lily). Since the water control structure in each of these alternatives will maintain higher water levels for a longer duration, the amount of potential waterfowl habitat will increase. Alternatives 3 and 4 have the additional benefit of reestablishing native aquatic vegetation along the slough margins. This could greatly benefit waterfowl by increasing the availability of desirable foraging plants.

With Alternatives 2-4, efforts include attempting to reestablish riparian species along the margins of the slough. Depending on the planting design, this may have an impact on accessibility to portions of the slough to hunting.

Table 8.1 – Quantities associated with the four alternatives

Component	Alternative 1	2	3	4
Water Control Structure				
No Water Control Structure	-	-	-	-
Footprint of New Fish Ladder at Pala Road	-	510 SF (6x50 & 6x35 FT)	-	-
Footprint of Roughened Channel at Pala Road	-	-	2,800 SF (10x140 FT)	-
Footprint of Roughened Channel at Sough Outlet	-	-	-	5,520 SF (25x176 FT)
Vegetation Management				
Excavation Passage Channel in Lower Slough	-	-	3,400 CY	-
Spot Burn	-	-	9.6 AC	9.6 AC
Control Burn	-	13.3 AC	7.8 AC	9.2 AC
Scraped vegetation before excavation	-	-	12.3 AC	15.7 AC
Scraped vegetation for Integrated Veg. Mgmt	-	-	17.4 AC	18.8 AC
Stockpile and compost all scraped material	-	-	21,500 CY	27,800 CY
Excavation and end-haul of deposited sediments	-	-	20,000 CY	26,000 CY
Integrated Vegetation Management	-	7.6 AC	17.4 AC	18.8 AC
Remove existing fence	-	3,941 LF	3,941 LF	5,300 LF
Install new fence	-	3,220 LF	3,220 LF	4,100 LF
Affected Areas				
Inundated to 10 FT through spring	0 AC	75 AC	75 AC	83 AC
Inundated sufficiently to Control RCG ($\geq$24 inches deep through spring)	3 AC	45 AC	59 AC	65 AC
Managed for Establishment of Native Plants	0 AC	7.6 AC	17.4 AC	18.8 AC

Table 8.2 – Qualitative evaluation of alternatives based on project criteria presented in Chapter 5.

Evaluation Criteria	**Alternative 1** **No Water Control Structure** **(No Excavation)**	**Alternative 2** **Fish Ladder at Pala Road** **(No Excavation)**	**Alternative 3** **Roughened Channel at Pala Road** **(With Excavation)**	**Alternative 4** **Roughened Channel at Slough Outlet** **(With Excavation)**
PROJECT GOALS				
Provide Fish Passage				
Meet DFG/NOAA juvenile and adult fish passage criteria	**Yes**, two large embedded box culverts designed to meet agency stream simulation criteria.	**Yes**, fish ladder 25 feet long with 8 weirs. Drops over weirs do not exceed 6-inches.	**Yes**, roughened channel 135 feet long at 4% slope, providing flow characteristics similar to a natural channel.	**Yes**, roughened channel 176 feet long with slopes ranging between 3% and 5%, providing flow characteristics similar to a natural channel.
Reduce Reed Canary Grass (RCG)				
Areal distribution of reed canary grass	**Increase of 18 acres** by RCG within the upper slough due to reduction in water levels of approx. 12 inches during growing season. No change in lower slough	**Reduction of 31.6 acres of RCG**, in upper slough**.** Inundation will eliminate 24 acres of RCG and integrated vegetation management along eastern shore will eliminate 7.6 acres.	**Reduction of 55.4 acres** within the entire slough**.** Inundation will eliminate 38 acres of RCG and integrated vegetation management will eliminate 17.4 acres of RCG.	**Reduction of 62.8 acres** within the entire slough**.** Inundation will eliminate 44 acres of RCG and integrated vegetation management will eliminate 18.8 acres of RCG.
Fish movement throughout slough:				
Lower Sough:	**Unchanged**	**Unchanged**	**Moderate Improvement.** A cleared channel will lead from the slough outlet, through the lower slough, to Pala Road. 3.0 acres adjacent to channel will be scraped clean of RCG with integrated vegetation management applications.	**Most Improvement.** Excavation and Integrated Management applications control RCG.
Upper Slough:	**Decreased.** Impediments to movement will increase due to colonization of deeper portions of the upper slough by RCG.	**Improved** due to decrease in areal coverage of RCG, by inundation.	**Most Improvement.** Excavation and Integrated Management applications control RCG.	**Most Improvement.** Excavation and Integrated Management applications control RCG.
Suitability of slough as foraging habitat for rearing salmonids	**Poor** suitability from early spring through fall due to density of RCG and low dissolved oxygen levels resulting from decomposition of vegetation.	**Moderate**. Increase open water habitat in upper slough by 24 acres. Uncertain if remaining submerged RCG will continue to produce stressful dissolved oxygen levels during summer and fall.	**High**. Increase open water habitat within upper slough by 38 acres and remove RCG within shallow waters. Expect excellent rearing conditions throughout the year.	**High**. Increase open water habitat within entire slough by 44 acres and removal of RCG within shallower waters. Expect excellent rearing conditions throughout the year.
Improve Water Quality				
Dissolved oxygen	**Decrease**, from spread of RCG into deeper areas where it currently does not grow.	**Small to Moderate Increase** through reduction of at least 24 acres of decomposing RCG biomass. Uncertain if remaining submerged RCG will continue to reduce dissolved oxygen to stressful levels.	**Large Increase** through decreasing load of decomposing organics by removing large areas of RCG in both the lower and upper slough.	**Largest Increase** through decreasing loading of decomposing organics by removing large areas of RCG in both the lower and upper slough.
Nutrient loading from livestock	**Unchanged**	**Moderate Decrease** through fence setback in upper slough and establishment of native riparian buffer along eastern shore.	**Moderate Decrease** through fence setback in upper slough and establishment of native riparian buffer along eastern shore.	**Moderate to High Decrease** through fence setback in lower and upper slough and establishment of native riparian buffer along eastern shore.
Increased Habitat Complexity				
Composition of habitat types suitable for salmonids	**Further Impaired.** Existing deep water areas of upper slough, currently containing native yellow pond lily, will likely be colonized by RCG.	**Small to Moderate Improvement** through increased area of open water (21 to 45 acres). However areas with aquatic vegetation will remain composed primarily of RCG, providing minimal complexity.	**Large Improvement** through increased area of open water (21 to 59 acres), replacing RCG in shallow water with native aquatic plants, and establishment of riparian buffer area along the eastern shore of the slough.	**Largest Improvement** through increased area of open water (21 to 65 acres), replacing RCG in shallow water with native aquatic plants, and establishment of riparian buffer area along the eastern shore of the slough.

Evaluation Criteria	Alternative 1 No Water Control Structure (No Excavation)	Alternative 2 Fish Ladder at Pala Road (No Excavation)	Alternative 3 Roughened Channel at Pala Road (With Excavation)	Alternative 4 Roughened Channel at Slough Outlet (With Excavation)
OTHER CONSIDERATIONS				
Cultural Resources				
Risk of disturbance during implementation	**Low**. Only ground disturbance would be associated with removal of existing culverts and installing new culverts, all contained within the road fill prism.	**Low**. Only ground disturbance would be associated with removal of existing culverts and installing new culverts and some light ground disturbance for planting native riparian species along slough margin.	**Moderate to High.** Earthwork associated with scraping of vegetation and excavation. Excavation expected to disturb post 1900's sediment deposits only.	**Moderate to High.** Earthwork associated with scraping of vegetation and excavation. Excavation expected to disturb post 1900's sediment deposits only.
Risk of disturbance from changes to public access	**No change**. Continued public access by horse and foot traffic to the Tolowa Dunes through Yontocket Memorial Village from the Pala Road parking lot.	**No change**. Continued public access by horse and foot traffic to the Tolowa Dunes through Yontocket Memorial Village from the Pala Road parking lot.	**No change**. Continued public access by horse and foot traffic to the Tolowa Dunes through Yontocket Memorial Village from the Pala Road parking lot.	**No change**. Continued public access by horse and foot traffic to the Tolowa Dunes through Yontocket Memorial Village from the Pala Road parking lot.
Waterfowl Habitat				
Total surface area of slough	**Decrease** of roughly 10 Acres of wetted area from late fall through winter.	**Small** increase in winter. Much less fluctuation in water levels. **Large** increase in spring and fall	**Small** increase in winter. Much less fluctuation in water levels. **Large** increase in spring and fall	**Moderate** increase in winter in lower slough and small increase in upper slough. Much less fluctuation in water levels. **Large** increase in spring and fall
Distribution of habitat types	**Decrease** of deep water habitat (>18") and increase of shallow-water (<18") vegetated habitats, composed primarily of RCG.	**Increase** of deep water habitat (>18") and decrease of shallow-water (<18") vegetated habitats, composed primarily of RCG.	**Increase** of deep water habitat (>18") and decrease of shallow-water (<18") vegetated habitats	**Largest Increase** of deep water habitat (>18") and decrease of shallow-water (<18") vegetated habitats
Goose Habitat				
Quantity and quality of habitat	**No change** in short grass foraging habitat, loss of some open water habitat in slough	**Increase** in open water habitat **No Change** aquatic foraging habitat **Decrease** of 7.6 acres of short grass foraging habitat resulting from setting back fence 100 feet on State land along the upper slough.	**Increase** in open water habitat **Increase** aquatic foraging habitat **Decrease** of 7.6 acres of short grass foraging habitat resulting from setting back fence 100 feet on State land along the upper slough.	**Increase** in open water habitat **Increase** aquatic foraging habitat **Decrease** of12.7 acres of short grass foraging habitat resulting from setting back fence 100 feet on State land along the upper slough and 300 feet along the lower slough.
Grazing area on State Park and private lands	**Unchanged**	**Decrease** of 7.6 acres of pasture	**Decrease** of 7.6 acres of pasture	**Decrease** of 12.7 acres of pasture
Safety, Accessibility, & O&M				
Conform to existing safety/road standards	**Yes.** Frequency of road overtopping will decrease. Will continue to be inundated during overbank flow events on the Smith River	**Yes.** Frequency of road overtopping will decrease. Will continue to be inundated during overbank flow events on the Smith River	**Unknown**. Depends on State requirements for wet crossing. Depth of water at wet crossing will typically be less than 12 inches.	**Yes.** Frequency of road overtopping will decrease. Will continue to be inundated during overbank flow events on the Smith River
Changes to public accessibility	**Small increase** in accessibility to Pala Road from decrease in frequency of road overtopping due to raising of road and new culverts.	**Small increase** in accessibility to Pala Road from decrease in frequency of road overtopping due to raising of road and new culverts. May need to close access to some areas during initial replanting of riparian buffer	**Small decrease** in access with wet crossing at Pala Road. The wet crossing will have less than 12 inches of standing water at most times and be dry during summer and early fall. Crossing will be suitable for use by high clearance vehicles. Stepping stones can be placed to allow for foot crossing.	**Small increase** in ease of Pala Road accessibility from decrease in frequency of road overtopping due to raising of road and new culverts.

Evaluation Criteria	Alternative 1 No Water Control Structure (No Excavation)	Alternative 2 Fish Ladder at Pala Road (No Excavation)	Alternative 3 Roughened Channel at Pala Road (With Excavation)	Alternative 4 Roughened Channel at Slough Outlet (With Excavation)
Level of O&M required at water control structure	**Less than existing**. New larger culverts will decrease plugging.	**Moderate**. Requires routine inspection and occasional clearing of debris caught in ladder. May require seasonal removal of weirs in June and reinstallation in fall depending of fish management requirements.	**Low**. Roughened channels typically require little to no maintenance. May require seasonal removal of boards from concrete weir box in June and reinstallation in fall depending of fish management requirements.	**Low to Moderate**. Roughened channels typically require little to no maintenance. Due to high water velocities below the slough outlet, some maintenance may be required (adding rock) after large flood events on the Smith River. Like Alt 2 and 3, seasonal adjustments may be required.
Level of vegetation management follow-up	**None**. No vegetation management in this option	**Lowe to Moderate**. Establishment of native riparian buffer (7.6 acres) along eastern shore will require follow-up treatment for 2-3 years. Likely approach vegetation management through smaller scale pilot projects over several years.	**Highest** level of effort associated with the management of 17.4 acres of native aquatic and riparian vegetation and associated control of RCG. Expect to take 3 or more years of follow-up efforts to give new vegetation competitive advantage over RCG.	**High** level of effort associated with the management of 18.8 acres of native aquatic and riparian vegetation and associated control of RCG. Less aquatic vegetation than Alt. 3, slightly reducing level of effort for follow-up. Expect to take 3 or more years of follow-up efforts to give new vegetation competitive advantage over RCG.
Cost and Time to Obtain Benefits				
Implementation/Capital costs	**Lowest** ($130,000)	**Moderate** ($440,000)	**High** ($2,500,000)	**Highest** ($3,000,000)
Short-term follow-up cost	**None**	**Low to Moderate** associated with establishment of native riparian species on 7.6 acres in upper slough	**High** associated with vegetation management on 17.4 acres. Anticipate high follow-up effort for 2-3 years after initial planting.	**High** associated with vegetation management on 18.8 acres. Anticipate high follow-up effort for 2-3 years after initial planting.
Long-term Maintenance	**None**	**Low to Moderate**. Relatively small area of vegetation management. Some O&M associated with fish ladder.	**Moderate to High**	**Moderate to High**
Time to Obtain Benefits	**Fish Passage Immediately**. Only benefit is removal of fish passage barrier at Pala Road	**Immediately** for fish passage and control of RCG through inundation. Riparian planting will take at least 5-10 years to become well established. Remaining RCG may continue creating low dissolved oxygen levels.	**Immediately** for fish passage and habitat within the upper slough. The excavated and scraped areas will remove biomass, resulting in increased dissolved oxygen. Riparian and aquatic plant species will take at least 5-10 years to become well established.	**Immediately** for fish passage and habitat within the upper slough. The excavated and scraped areas will remove biomass, resulting in increased dissolved oxygen. Riparian and aquatic plant species will take at least 5-10 years to become well established.
Levels of Uncertainty				
Ability to maintain desired water level	**Not Applicable.** No water control structure in this alternative	**Moderate**. Possibility of transpiration from remaining RCG and upstream water withdrawals for irrigation may cause slough levels to drop rapidly in spring.	**Moderate**. Possibility of evaporation and transpiration from vegetation and upstream water withdrawals for irrigation may cause slough levels to drop rapidly in spring.	**Low to Moderate**. Largest surface area combined with evapotranspiration, possibility of subsurface flow through sandy soils near outlet and water withdrawals from upstream irrigation may cause slough levels to drop rapidly in spring.
Long-term viability of water control structure.	**Not Applicable.** No water control structure in this alternative	**High**. Expect fish ladder to be viable for long-term. Lifespan of this type of structure can exceed 30 years.	**High**. The roughened channel at Pala Road is not expected to experience high water velocities. The structure should last for 30 years or more.	**Moderate**. High water velocities below the slough outlet may result in some rock movement during high flows, requiring follow up maintenance. Additionally, migration of the river towards the slough continues, the river may erode the roughened channel within the next 30-50 years.

9 Recommendations and Project Phasing

9.1 Recommendations

Presented in this document are four developed alternatives and a list of restoration components that can be used to develop additional alternatives. Based on the evaluation of the cost and effectiveness of each of the alternatives, we consider the preferred option to be Alternative 3: *Roughened Channel at Pala Road with Excavation of the Upper Slough*. This alternative, or a modified version of it, would provide a large amount of suitable salmonid and waterfowl habitat and require low maintenance once native vegetation becomes established. A less ambitious vegetation management strategy in combination with excavation and a roughened channel at Pala Road may also have similar benefits for substantially less cost. These options could be examined at the final design phase.

9.2 Project Phasing

Successful implementation of any of these alternatives will require an involved, and possibly long-term, process likely consisting of:

1. Selecting a preferred alternative,
2. Pursuing funding for final design and environmental documentation,
3. Developing final engineering designs for Pala Road and the water control structure (if applicable),
4. Designing pilot projects for vegetation management,
5. Preparing environmental documents to comply with CEQA, NEPA, State and Federal ESA, Clean Water and Clean Air Acts, SHPO, and California Coastal Act,
6. Obtaining funding for implementation,
7. Constructing new structures and conducting control burns and excavation (if applicable),
8. Implementing vegetation pilot projects,
9. Evaluating effectiveness of vegetation management strategies,
10. Developing and implementing larger scale vegetation management project,
11. Follow-up treatment for control of reed canary grass, and
12. Monitoring of project effectiveness and adaptive management of slough as needed.

The following sections summarize the recommended project phasing.

9.2.1 Phase 1 – Planning and Selection of a Preferred Alternative

The various stakeholders, which include State Parks, California Department of Fish and Game, the Smith River Rancheria, and adjacent private land owners need to work together to select a preferred alternative. Selection of a preferred alternative should rely on information presented within this document. Once a preferred alternative is selected the next phase of final design and preparation of environmental documents will commence.

9.2.2 Phase 2 – Final Design and Environmental Documentation

Once funding is available, final design of the Pala Road and water control improvements should begin. If the preferred alterative involves a large vegetation management component, it will likely be best to begin by designing several pilot projects to evaluate the effectiveness of various techniques and refine the vegetation management methods for the site. Additionally, if vegetation management activities are implemented on adjacent lands within the next year, as anticipated, those sites should be monitored to collect information that can be applied to this project.

An environmental assessment (EA) should be prepared as part of this phase. Even if project implementation is going to be conducted in phases, the EA should cover all anticipated future actions. Milestones associated with Phase 2 include completion of engineering design and design of vegetation management pilot projects and associated follow-up effectiveness monitoring and compliance with CEQA and NEPA.

9.2.3 Phase 3 – Staged Implementation

Funding should be obtained for implementation based on revised cost estimates originating from Phase 2 (final design). Included in Phase 3 of Implementation is obtaining permits not obtained as part of Phase 2.

Implementation should be conducted in the following stages:

Stage 1 - Construction of new a water control structure and conducting controlled burns, followed by initiation of several separate pilot projects to test the various techniques (i.e. excavation, scraping, sod disposal, replanting) and evaluate effectiveness.

Stage 2 - Once preferred techniques are identified, begin second stage involving large scale implementation of vegetation management.

9.2.4 Phase 4 – Ongoing Vegetation Management

Using information from the pilot projects, a larger scale vegetation management plan should be fully developed and implemented. As part of this plan, follow-up treatment should be prescribed. Funding should be secured for at least 3 years of follow-up vegetation treatment to control reed canary grass and give the native plants a competitive advantage.

9.3 Further Study, Monitoring, and Adaptive Management

9.3.1 Needs for Further Investigation

Tryon Creek Instream Flows

As with any project of this scale, there are numerous areas that additional data and investigation could help further guide the selection of an alternative. The largest unknown factor, that could have the most significant impact on the overall effectiveness of the project, is the quantity and variability of water flowing into Yontocket Slough from Tryon Creek during spring. Given the water withdrawals occurring upstream of the slough, there is potential that there won't be sufficient inflow to maintain the desired water level within the slough during late spring. This could have major implications on the effectiveness of controlling reed canary grass through inundation. We recommend that further investigation into instream conditions within Tryon Creek be conducted, and potentially looking at feasibility of establishing alternative water supply sources (ground water or Smith River) for the upstream landowners.

Water Quality Monitoring

Another data gap pertains to water quality. Extremely low dissolved oxygen levels measured repeatedly throughout Yontocket Slough were attributed to the decomposition of organic mater originating from reed canary grass. Although this is the most likely explanation, as documented in other similar projects, some of the organic loading within the slough is likely originating from cattle waste running-off the adjacent pasture. Additional water quality studies should be initiated to determine more exactly the impacts of runoff from adjacent lands and other non-point sources on water quality, and dissolved oxygen in particular.

Testing for Soil Contamination

Although there is no known reason to believe that the recently deposited soils within Yontocket Slough contain contaminates, soil tests should be conducted prior to any excavation. If the preferred alternative involves excavation or scraping within the slough, soils testing should likely be completed as part of preparing the environmental assessment documents.

9.3.2 Monitoring and Adaptive Management

Enhancing fisheries and waterfowl habitat through controlling invasive plant species and reestablishing native plant communities can be extremely challenging. Many factors can influence the success of the project including: climate and climate variability; water quality, quantity, and timing; inundation depths; implementation techniques; plant species and stock viability for revegetation; and, operation of water control structures, among others. The use of pilot projects, effectiveness monitoring, and adaptive management are essential to making the overall project a success. Through careful monitoring of environmental responses to each activity undertaken, the restoration techniques and management actions implemented for Yontocket Slough can be revised and improved upon through time. Adaptive management for this project will be most effective through the use of a staged implementation approach.

9.4 Conclusion

Yontocket Slough was historically a significant part of the Smith River estuary, likely providing critical rearing habitat for juvenile chinook and coho salmon. However, installation of fish migration barriers at Pala Road and habitat degradation from sedimentation, loss of riparian habitat, and establishment of monotypic stands of invasive reed canary grass has severely degraded the habitat value of the slough. Specific limiting factors to salmonids identified as part of this project area (1) blockage to migration at Pala Road and (2) monotypic stands of reed canary grass that choke the slough leading to increased sedimentation and lethal levels of dissolved oxygen during summer through late fall.

Four specific project alternatives were developed for improving fish passage and enhancing the slough habitat. Alternatives range from simply replacing the culverts at Pala Road to constructing water control structures with fish passage, excavation of portions of the slough, and application of integrated vegetation management strategies throughout the State managed portions of the slough to control reed canary grass, establish native riparian and aquatic plants, and improve water quality. Given the size of the impacted area, the alternatives that will have the largest benefit will require a concerted effort to implement.

Estuaries, backwater sloughs, and other types of off-channel habitat have been identified by many as being the habitat type most lacking for salmonids. Within the lower Smith River this type of habitat was once plentiful, but much of it has been severely altered or destroyed. Restoring access and habitat within Yontocket Slough would provide great benefit for salmonid populations within the entire Smith River Watershed.

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APPENDIX A

ADVISORY GROUP MEETING NOTES

Yontocket Slough and Tryon Creek
Fish Passage and Salmonid Habitat Enhancement Project
Planning Meeting #1

Offices of Alexandre Dairy
20-October-2004

Participants:

Zack Larson (Smith River Advisory Council)	Michael Love (Michael Love & Assoc.)
Dr. Walt Duffy (Calif. Coop Fish Unit)	Blake Alexandre (Alexandre Dairy)
Brad Cass (Smith River Rancheria)	Richard Tryon (Tryon Ranch)
David Ammerman (USACOE-Eureka)	Bob Tedsen (Tedsen & Son)
Mitch Farro (PCFWWRA)	Harry Tedsen (Tedsen & Son)
Larry Preston (DFG)	Keith Witte (CA State Parks)
Daniel Beck (DFG Game Warden)	Roger Goddard (CA State Parks)
Kevin Gale (DFG, Project contract manager)	Dan Free (NOAA Fisheries)
Tim Williamson (DFG)	Mike McCain (USFS-Smith River NRA)

Historical Background Information

Larson introduced the project and mentioned its priority status in the 2004 DFG Recovery Strategy for California Coho recommendations. Longtime local ranchers and the Smith River Rancheria tribal representative provided historical background discussion:

Yontocket Slough to River

- R. Tryon: When Yontocket Slough was in Bliss Ranch, Pala Road crossed slough. Road had two at-grade culverts that allowed free flow exchange.
- B. Tedsen: Use to be able to catch 50 trout at a time in lower section of slough.
- R. Tryon and B. Tedsen: Slough had no reed canary grass (*Phalaris arundinacea*) prior to the 1960's.
- The 2,500 acre Bliss Ranch acquisition occurred in 1970's. Funds came through State bond and acquisition was collaborative effort between CDFG and CA State Parks. Remained undeeded/unclassified until 1990's. Currently managed by State Parks
- Shortly after acquisition, two standpipes were attached to the culvert inlets on Pala Road at Yontocket Slough.
- The Pala Road access creates loop to Silva Road. Drivability of Silva Road through marsh during wet season is unknown.

- B. Tedsen: Slough filled with silt from 1964 flood. Prior to flood slough extended to Lower Lake Road. After flood slough filled with lily pads. It has remained relatively unchanged since the 1964 flood, with the exception of the introduction of canary grass
- B. Tedsen: Mouth of Tryon Creek used to be grazed and was much wider and more open to tidal effects. Since acquisition, no grazing and willows have become thick in lower reach below Pala Road. However, the slough was never tidally influence, except during flooding by the Smith River.
- B. Tedsen: Flooding of Pala Road usually occurs with successive heavy rains. Occurs every year or two.
- B. Alexandre: In summer Alexandre Dairy grazes and irrigates State Park property adjacent to slough to create suitable public land for Aleutian geese to utilize, relieving pressures on adjacent private lands. Grazing has successfully reclaimed pasture covered in canary grass.
- B. Alexandre: Canary grass typically creates root-mass that collects silt and leads to slow rising of ground. Likely occurred in slough upstream and downstream of Pala Road.
- B. Tedsen: During flooding over Pala Road Smith River has typically backwatered to road surface.
- B. Cass: Yontocket Slough historically connected to Lake Earl and served as a connecting waterway to villages along the dunes. Since then, dunes have moved inland covering portions of the historic slough.
- R. Tryon: The existing ponds in the dunes are remnants of the slough channel that connected to Lake Earl.
- B. Cass (tribe): There was an Indian massacre at Yontocket near Pala Road, and that there are burial grounds in the dunes above the slough.

<u>Waterfowl Usage</u>

- R. Tryon: Redheads are primarily in Lake Earl. Puddle Ducks are found widely throughout the slough.
- M. Farro (PCFWWRA): High usage of Ringneck Ducks throughout the entire system. Also see an occasional Canvas Back Duck in slough.

<u>Tryon Creek above Yontocket Slough</u>

- R. Tryon: In Tryon Creek prior to 1964 flood would catch a dozen trout up to the 2-ft range within 20 minutes. In 1985 hook and line sampling caught 2-16" cutthroat trout.

- R. Tryon: In 1985 Tryon Ranch received Coastal Conservancy Grant for steam restoration that included pulling some wood and dredging silt that was deposited during 1964 flood. The dredging helped deepen pools for fish. Project also included fencing the riparian areas and planting trees (spruce, alder, willow).
- Z. Larson (SRAC): In 2002, SRAC and Alexandre Dairy developed and implemented a cattle exclusion and riparian enhancement project (funded by DFG Fisheries Restoration Grants Program) in approximately one mile of Tryon Creek above the 1985 project site. Adult cutthroat trout were observed in the project area.
- R. Tryon: The Westbrook off-channel 200 hp turbine pump was installed on Moseley Ranch in early half of 1970's, which caused ¾ mile of stream to be dewatered. Later, mitigation measures were put in place, including recharge of steam with cold pumped water.
- R. Tryon and B. Tedsen: Silva Road is the watershed divide between Tryon Creek and Lake Earl.

Project Background and Objectives

Michael Love gave background of grant funding process - The "Yontocket Slough access and habitat enhancement planning project" is funded through the CDFG fisheries grants program. The project is for planning only, and will not include final designs or implementation. The key objective is to develop feasible alternatives for providing salmonids access to the slough and improving habitat within the slough. However, developed alternatives will also attempt to address other issues such as effects on waterfowl habitat, invasive species, and cultural resources.

<u>Michael then described the planning process</u>:

- Initial planning meeting to gather background information and gain feedback on project from stakeholders (such as - desired project outcome, concerns, constraints).
- Field work –
    - Topographic survey of slough and development of working base map.
    - Monitoring of water levels in slough and at mouth of Tryon Creek to determine tidal effects and seasonal variation in size and volume of slough.
    - Periodic water quality sampling of DO (dissolved oxygen), water temperature, and salinity at various locations.
- Second planning meeting to (1) review initial field findings, (2) review and revise a list of project goals and objectives that will be used to guide the selection of preferred alternatives, and (3) discuss

potential fish passage and habitat improvement alternatives that should be evaluated.

- Detailed analysis and evaluation of various fish passage and habitat improvement alternatives for the slough.
- Third planning meeting to present and discuss results of alternatives analysis.
- Draft report by December 2005, which will be sent out for review. Final report to CDFG by March 2006.

Michael said that he wanted to hear from everyone about concerns, constraints, limiting factors, waterfowl issues, historical information, and about current and future ownership/management of Yontocket Slough.

Group Discussion

General Comments

- W. Duffy: It is important to get the hydrology right to have a successful project. Natural hydrology of wetting/drying can be important in allowing nitrogen to volatize. Work in coastal Oregon shows that fish move down to estuaries then up into sloughs. In general estuaries are important in the transition a anadromous fish makes from fresh to salt water. Waterfowl, such as redheads, don’t nest in sloughs but use it as important foraging grounds. What would be the impact of removing the standpipes on resident ducks?
- D. Free (NOAA-Fisheries): Bottleneck of Smith River is the estuary. We need to restore the estuaries function, including Yontocket Slough. It is very important to restore the natural hydrology of the slough and to allow the tidal prism to function properly.
- D. Ammerman (ACOE): The Army Corps has authorities under Section 404 of Clean Water Act and Section 10 of ESA. Permitting options for implementation – Corps issued DFG a Regional General Permit for its funded project that includes fish passage and habitat restoration. The RGP does not cover work performed within tidal lands. Will have to consult with FWS, NOAA Fisheries and would have to work with tribes for archeological issues. Also, it would be useful to have a wetland delineation. The Corps uses a 3-phase approach.

Current and Future Ownership and Management of Yontocket Slough

- L. Preston (DFG): Land swap currently being negotiated between CA State Parks and CDFG. He suspects title to property to end up in DFG by January [2005].
- T. Williamson (DFG): Management of the slough won’t change too much with a land swap, with the exception of possibly implementing some small habitat improvement projects. There is as much as 2,500 acres (old Bliss Ranch) that is up for transfer.

- R Goddard (SP): Much less optimistic about land swap going through. Site is difficult to manage because it has a mix of land management objectives, some not falling within State Parks' directive. State Parks is responsible for protecting cultural resources, which is an important element of the Bliss Ranch property. But, State Parks is not in the business of overseeing rotational cattle grazing, managing for migratory bird, or allowing hunting on their properties. He also mentioned that there might be deed restrictions as well as potential issues with Smith River Rancheria that could hinder any potential land swap. Any land swap would have to be acreage neutral.
- B. Cass (tribe): Smith River Rancheria received permission about 6 months ago to create 50 new burial plots, which is located near the historical burial area just west of the slough. Also, tribe is concerned with illegal diggings in burial grounds, which has occurred recently. Tribe has asked State Parks to increase patrol of the area. They have concerns about allowing such easy public access by foot and horse via Pala Road. They feel it's disrespectful to have horses riding over burial grounds. Brad said that he couldn't speak to all of the tribe's concerns, and it would be best to talk to other tribal representatives.
- M. Farro (PCFWWRA): Troubled that there has been no opportunity for public input regarding the land swap. The land was purchased through public funds (bond monies) that were meant for acquisition of waterfowl habitat for hunting. Therefore, any consideration regarding changes in management of the land should be an open process with opportunities for public input.
- B. Alexandre: Regarding ownership – does it matter who owns the land during the planning process? Both DFG and State Parks are State agencies and should be able to work together. Can't we just move forward?

<u>Waterfowl Issues and Concerns</u>

- L. Preston (DFG): DFG wildlife staff was unable to attend and asked Larry to convey their concerns. There are concerns that removing standpipes could adversely affect waterfowl habitat. They want to make sure that the projects final report clearly identifies effects on available wetlands/waterfowl habitat and that alternatives should still provide for hunting opportunities.
- R. Tryon: Could graze other side of Silva Lane to make ponds to compensate for any loss of slough size.
- W. Duffy: Air photos could show vegetation patterns suggesting locations of historic wetlands that may be able to restore to mitigate loss of slough size.

<u>Site Visit Discussion</u>

During the site visit to the Pala Road crossing, various land swap alternatives were discussed and questions were asked. Discussions included the idea of having the dunes portion remain in State Parks ownership to protect cultural resources while having the lowlands to the east, including the slough, be transferred to DFG ownership. Mitch Farro expressed concern that under this alternative State Parks would maintain ownership of numerous existing ponds within the dunes (remnant slough channels covered by encroaching dunes), which are utilized by waterfowl and are unique hunting areas in the State. He's concerned that State Parks would no longer allow hunting in this area if they maintained ownership after a land swap.

Other ideas expressed during the site visit included moving the Pala Road crossing away from the burial grounds, and to a more suitable location (i.e. Silva Lane DPR easement).

Knowledge Gaps and Potential Data Needs identified by Participants

- Want quantified assessment of what will be lost in terms of wetland/waterfowl habitat with any proposed alternative.
- Wetland delineation would be very useful.
- Core samples could show extent of recent sedimentation of slough.
- Air photos could show vegetation patterns suggesting locations of historic wetlands that may be able to restore to mitigate loss of slough size.
- What standards does the Pala Road Crossing need to meet? Does it need to be a dry crossing at all times of the year? Can it be a low-water crossing?
- How drivable (dry season only?) is the Silva Road portion of the loop that connects with Pala Road?

Potential Solutions Discussed

- Extend cattle fencing into slough (or use temporary fencing) to use grazing to control Canary Grass. Canary Grass can be controlled by cutting followed by short but intensive grazing once a year.
- Examine possibility of just removing culvert risers or installing bridge/box culvert at grade with upstream and downstream slough elevations.
- Examine possibility of installing water control structures that provide fish passage (ladder, roughened channel). Passage could be provided through a separate structure too.
- Examine potential for dredging sediments from slough (while addressing potential disturbance of cultural resources).
- Examine means of enlarging mouth of Yontocket Slough by controlling Canary Grass through grazing or dredging or other means.
- Examine potential of reestablishing riparian along slough to create shade and slow Canary Grass. Historic coverage is spruce, alder, and willow. What would be the effect on waterfowl and hunting?

Yontocket Slough and Tryon Creek
Fish Passage and Salmonid Habitat Enhancement Project
Planning Meeting #2

Offices of Alexandre Dairy
16-May-2005

Participants:

Zack Larson (Smith River Advisory Council)	Michael Love (Michael Love & Assoc.)
Greg Gray (USFWS)	Antonio Llanos (Michael Love and Assoc.)
Brad Cass (Smith River Rancheria)	Kelly Miess (Michael Love and Assoc.)
Brock Richards (Smith River Rancheria)	Billy Tedsen (Tedson & Son Dairy)
Mitch Farro (PCFWWRA)	Valerie Gizinski (CA State Parks)
David Lancaster (DFG)	Patrick Vaughn (CA State Parks)
Kevin Gale (DFG)	Keith Witte (CA State Parks)
Dan Free (NOAA Fisheries)	Marilyn Murphy (CA State Parks)

Review of Planning Goals and Objectives

Larson: A few words about Richard Tryon who passed away since the last meeting. He was very involved in the wildlife and stream restoration efforts on his property and wanted to see this continue. Field visit later in the day to the restoration area on his property.

Mike Love distributed a handout that described project goals, objectives and additional considerations. Issues affecting fisheries habitat within the slough include water quality (dissolved oxygen (DO), water temperature, water availability, nutrient loading, and salinity), the lack of riparian cover, and invasive reed canary reed grass (*Phalaris arundinacea*). Issues affecting fish passage include the stand pipes and culverts at Pala Road and the intrusion of canary grass into the water way.

Tedsen: Mentioned sediment issues in relation to bank erosion.

Gizinski: Mentioned Al Wellman's (RWQCB) water sampling information and findings of high Nitrate content and high levels of Total Suspended Solids (TSS) from dairy runoff.

Cass: mentioned need for cattle exclusion from riparian areas

Larson: All of Alexandre's land adjacent to Tryon Creek has cattle exclusion fencing (from riparian areas) or funding in place for future fencing projects. Tedson and Son Dairy also has a proposal submitted to the FRGP (Dept. of Fish and Games Fish

Restorations Grants Program) for cattle exclusion fencing along their ownership of the slough. Cows do not have access to Yontocket Slough on State Park property.

Love: Updated group on activities to date including topographic survey, water surface elevation monitoring and photo points. Handed out maps and figures depicting the project area and described the addition of staff plates and crest gages at the Silva Lane crossing, Pala Road Crossing, and at the mouth of Yontocket Slough. Mike walked us through graphs and figures derived from existing water surface elevation data and discussed canary grass and riparian distribution and function. Water levels at the mouth of Tryon Creek vary tidally and the slough is significantly backwatered by the Smith River during high flows and higher tides. Recent field visit with Larson, Love and Llanos identified downstream channel control (knickpoint) controlling water surfaces in slough.

Future field work will include collecting DO/salinity/water temperature data as well as mapping of canary grass by a consulting botanist. The botanist will also research measures for controlling the invasive species appropriate for the area.

Love: Based on calculations from Tryon creek (5.5-mi^2) the estimated 100-year event is approximately 1,000 cfs into the slough.

Larson: Asked Kelly Miess if she had any fish carcasses in the project area.

Meiss: Yes, she observed an adult “salmon” in a pasture swale adjacent to Pala Road.

Larson: Salmonid fry were observed in the slough.

POTENTIAL FISH PASSAGE ALTERNATIVES

Mike Love presented a few alternatives to existing conditions within the project area and requested that the committee provide input on the proposed alternatives.

<u>Alternatives</u>

1. Do nothing
2. Remove existing standpipe (allow open access, a small decrease in waterfowl habitat)
3. Construct fish passage structure at Pala Road
4. Remove road
5. Construct low water crossing
6. Remove road/standpipes and construct log structures to control grade and provide fish passage

(See color inundation map by MLA depicting water levels and resulting acreage of inundation.)

2. Remove existing standpipe
What would be the impact to the system if the standpipes were removed?

Water level monitoring upstream and downstream of the standpipe between December and March shows that on average the stand pipes raise water levels by only a few tens of a foot. Based on preliminary analysis of inundation maps, removing the standpipes would result in about a 10 acre seasonal loss of inundation. One concern of lowering the water level even a few tens of a foot is that it may increase the spread of canary grass into areas that currently maintain open water. The mapping of where canary grass is currently able to grow will help better define this possibility.

3. Construct fish passage structure at Pala Road

A new crossing structure, such as a large prefabricated concrete box culvert, would be installed at Pala Road. A pool-weir type fishway could be placed at the upstream end of the crossing. This would leave the current water surface elevations unchanged and improve fish passage. Also, having a larger crossing structure would increase flow capacity and reduce the frequent overtopping of the road by the slough.

4. Remove road

What would be the impact of removing the road?
Impacts include public access (hiking and horse riding), waterfowl habitat and canary grass encroachment.

Actually removing the road will not be large job, permitting and documentation may be lengthy.

Impacts to Waterfowl habitat
Removing the road with providing no water elevation control would result in a small reduction of area inundated by seasonal flood waters. Without canary grass control, reduced inundation has the potential to increase grass encroachment. Lower water levels may result in reduced waterfowl habitat.

Witte: Is there give and take regarding fish and waterfowl in removing the road.

Lancaster: Even if we drop the water a bit we may end up with higher quality wetland/fish habitat, which is needed.

Llanos: Current acreage of open water is based on contour map and does not quantify the quality of water fowl habitat. Alternatives would investigate balancing water levels with grass control to improve waterfowl habitat with reduced water levels.

Public Access

Cass: The rancheria supports removal of the road to decrease ease of public access to the Yontocket Village and burial site. Visitors have caused disturbance to cultural resources/graves via Pala Road access. Horse traffic off trail has caused damage to the village in the past. During any ground disturbance activities at the site (such as road removal), it will be necessary to have cultural monitors.

Tedsen: Reported damage from 4wd traffic. Ranger could not do anything since they were not caught in the act.

Tedsen: Geese using the Park's pasture are scared by visitors using Pala Road. This causes the geese to move to nearby private land and increase depredation.

Can Access be moved to Silva Road?

Murphy: Yes but there is no place to park horse trailers…

Could change access point to end of Pala road.

Witte: Could a horse/foot/small vehicle bridge be constructed near the mouth of the slough? Aggregate base excavated from Pala Road could be used for a trail leading to and from this bridge.

Noted habitat for bank swallows along bank of Smith River and need to consider impacts to bank if access is relocated to lower area.

Farro: A lower slough bridge would catch debris from high SR/slough flows.

Murphy: Finding money for access issues/changes is key.

5. Construct low water crossing

Generally not considered a feasible option.

6. Remove road or standpipes and construct log controls downstream

Log structures could be placed at the outlet of the slough, a few hundred feet downstream of Pala Road. Located at the existing knick point in the outlet channel, the log drop structures could be used to raise water levels while providing fish passage. Cited DFG stream Habitat manual for type of structures keyed into banks. This alternative could be used with either the road removal alternative or the remove standpipes alternative.

Larson: Wood is likely available for restoration work.

EXCAVATION AND EARTH MOVING DISCUSSION

Excavation can be used to create deep water and potentially drown out the canary grass. Sediment is not routed through the slough with the exception of during extremely high water events, such as during the 1964 flood. In that case, the slough filled with sediment instead of scouring it out.

Tryon Property restoration (see below) was cited as an example of creation of deep water areas.

Love: Asked for input regarding physical road removal and the use of heavy equipment.

Farro: Special equipment needed to work in wet soft ground, like rice field machines.

Cass: During any ground disturbance activities at the site, it will be necessary to have cultural monitors. (excavation, exploratory coring grass removal)

Tedsen: Richard Tryon project spoils placed in pasture --- clay layer under topsoil.

Vaughn: If any excavation occurs is there concern for possible soil contaminants?

Vaughn: What amount of sediment that has accrued in the slough (asked if tidal data was analyzed and if available?)? Maybe deposition from Tsunamis could be determined?

Love: We would need to take core samples to determine sediment accrual during historic events (1964 flood, other floods, pre-1860's, tsunami).

Coring

Llanos: Discussed possibilities of removing the road and mentioned that coring would assist in providing this information. Data on sediment deposition and timing would help predict depth of excavation and potential for "Inadvertent Discovery" of tribal cultural resources.

Love: Coring would tell us the timing of deposition. Coring instruments reach 15-16' – Coring with hand equipment. Both DFG and Smith River Alliance may be willing to help fund reconnaissance level coring. Finds would provide extremely useful information for assessing alternatives dealing with road removal or exaction of the slough to increase water depth/control canary grass.

CANARY GRASS CONTROL AND VEGETATION DISCUSSION

Canary Grass control has surfaced as a major component of the Yontocket Slough project. Complete eradication is not a realistic option and effective control will be the focus of restoration efforts. In open water grasses form mats and out-compete other species. Data gaps include aerial extent of grass, methods of control and eradication, depth and timing of aquatic growth of grass.

Farro: Canary grass is the least favorable wetland species. It doesn't allow other wetland plants to grow and produce food for waterfowl.

Miess: It would be beneficial to have/see vegetation survey results.

Farro: Is there salt water intrusion in the lower slough channel? Why is there no canary grass there?

Gizinski: Discussion regarding the Fall River Valley State Park project using water control structures to drown grass (contact name: Daphne Hatch). Described the removal of invasive beach grass at Pt Reyes which involved excavating and reburying to kill grasses.

Gizinski: Burning is initial method of removal, recommended doing control areas to test removal methods.

Gizinski: (If excavated) What do you do with the spoils? Rebury? Do we have any groundwater data? Had a question about inundation of the area and mentioned that CDF battalion chief is an expert burner;

Canary grass rhizomes will regrow, not really a seed reproduction, more rhizomic. For beach grass need a 3 to 4 foot depth of cover to bury.

Love: Literature mentions successful read canary grass control when herbicide was applied to affected areas after manual removal.

Murphy: They have used herbicides but it is a last ditch effort for management on Park land.

Direction of State Parks and the Rancheria is to avoid the use of herbicides.

Tedsen: Asked about the use of shade cloth.

Gizinski: Hot foam/steam application has been used, may be a follow-up application.

Grazing and Riparian

Riparian cattle fencing needed, future projects discussed by Larson (see above).

Love: Fields on State Park land around the slough that are not grazed have much more canary grass. Grazing is possibly an option for controlling the canary grass in certain areas.

Gale: Maybe room for goose habitat in the project area.

Farro: Discussed cattle grazing in relation to goose habitat.

Gizinski: If State Parks stays in the Pala Unit (re land swap) she would like to see riparian enhancement. Riparian replanting is a priority of State Parks. Willows and alders

Lancaster: May want spruce for more effective shading of canary grass.

MISCELLANEOUS COMMENTS AND NOTES

Gizinski: Mentioned salt wedge in the lower Russian River and how extensive it was and that salt water may extend up the Smith River further than we expect. The group responded with the fact that the Russian contains many water diversions resulting in low flows and greater salt/tidal intrusion.

Tedsen: has noted tidal effect on Smith River up to Baily Hole, about ½ mile upstream of Hwy 101 bridge.

Beavers use the slough.

Susan Bicknell (HSU) did a report for State Parks on pre-sediment conditions.

Farro: Puddle ducks only use max 18” of water depth. Diving ducks use max 5 to 8 feet and need more open water for take off.

SITE VISITS:

Pala Road: Everyone agreed there was an abundance of tall canary grass choking the slough and eliminating most open water habitat.

Tryon Property/project visit: The group accessed the Tryon property via permission and observed the creek/slough at a point approximately 0.5 miles upstream from the Lower Lake Road Crossing. RCAA contracted for this project in the early 1980s. A drag line bucket was used to remove sediment from the channel, cattle fence was installed and spruce was planted. It appeared that the banks were not feathered- rather channel was deepened along the banks too. The slough contained small patches/amounts of canary grass along the slough margins and the riparian canopy predominately consisted of ~20 year old spruce and willow. Inundated portions of the slough were dominated by pond lilies and other aquatic vegetation between areas of open water - Farro mentioned that this other aquatic vegetation was important waterfowl forage.

DRAFT NOTES

Yontocket Slough and Tryon Creek
Fish Passage and Salmonid Habitat Enhancement Project
Planning Meeting #3

Del Norte Resource Conservation District Office
6820 Lake Earl Drive
Fort Dick, CA 95538
13 Dec 2005

Participants:

Zack Larson (Smith River Advisory Council)	Michael Love (Michael Love & Assoc.)
Dan Free (NOAA Fisheries)	Antonio Llanos (Michael Love and Assoc.)
Margaret Tauzer (NOAA Fisheries)	Jay Patton (Pacific Watershed Associates)
Carol Heidsiek (ACOE)	Mitch Farro (PCFWWRA)
Gary Flosi (DFG)	Billy Tedsen (Tedson & Son Dairy)
Michelle Gilroy (DFG)	Robert Tedsen (Tedson & Son Dairy)
David Lancaster (DFG)	Brock Richards (Smith River Rancheria)
Kevin Gale (DFG)	Valerie Gizinski (CA State Parks)
Gayle Garman (DFG)	Keith Witte (CA State Parks)
Tim Williamson (DFG)	Randy Hooper (Del Norte County Planning)
Andrea Souther (NRCS)	

Review of Project Goals, Objectives and Plan Status

The slough is slightly tidally influenced and salinity is up to 1-2 ppm

Elevation mapping 2 feet seems to be the elevation that kills canary grass

Soil Stratigraphy and Historical Morphology

Jay Patton, PWA

Summarized stratigraphy analysis from soil coring conducted October 2005.
Upstream of road they limited the amount of coring in the area of 1860 massacre.
Longitudinal profile of the soil revealed two key strata correlated to each core:
Peat One and Clay One (on top of Peat one)
Slough area located downstream of the road was too dry for coring. So they used a streambank description to classify soils.
Peat develops from organic material and takes a long time to develop, common rate for coastal California is ~1mm/year.

Cross-section 1: at boundary with State Park and Private, Sand and gravel at higher elevations along left bank.

Cross-section 2: near cemetery upstream of Pala Road
Cross Section 3: downstream of Pala Road

Clay One could be either:
1964 deposit, not very thick as slough filled in followed by water Lilies
-or-
Backwater deposits from dune migration cutting off the mouth of the slough, clays would be expected from quiet waters.

Concludes that 1964 deposits are likely the layer of Mud and Peaty Mud above Clay One and Peat One. Notes that the slough has filled in about 1.5-ft since the land management changes about 150-years ago. Tedsen confirms that there was about 1.5-ft of mud deposited after the 1964 flood.

Summary of Historical Changes:

About 900 years ago the Smith river abandoned Yontocket Channel.

1850's (and 1863 ?) map shows Tryon Ck flowing into Lake Earl, not Yontocket. It turned somewhere around Silva Lane.

1870 map shows no hydrologic connection with the Smith River. Shows agricultural development.

1942 map shows no direct connection from the Smith River, but appears that Tryon creek may be providing the discharge that causes the headward migration of erosion from the mouth of the outlet.

Billy Tedsen –notes that maps showing disconnectivity are likely from surveys during low water periods and may not accurately show the flow direction.

Concludes that there are uniform deposits throughout the slough. Some lateral variability corresponding to a deeper bend in the abandoned Ox-Bow. River has been migrating to the left bank of the smith since around 1860. Speculates that the slough was cut off from the river by dune migration. No cultural remains were discovered but recommends that any future excavation should have coring in front of any work.

Water Quality Monitoring - Mike Love

Reviewed results of water quality monitoring:

- Parameters measured; Salinity Dissolved Oxygen, Temperature
- Some salinity measured up to the mouth of the slough
- Very low D.O. measured (<2 ppm)
- Dying vegetation uses up D.O. during decomposition.

- D.O. gets lower moving toward the mouth of the slough

Canary Grass Mapping and Control
Mike Love summarized findings from Tamara Gedlich (sp?) report

Fence lines were the boundary of the survey. Mapping of vegetation type and location presented.
Everything at 5 foot contour level is open water, and greater than 2-ft deep through June. No canary grass is found in these areas.
Reed canary grass information from 1991 lake Earl project showed more open water.
Grass seed will persist for a year or two, grazing can spread seeds and nutrients which are bad for water quality.

<u>Controlling Canary Grass (CG)</u>
1. Inundate 24" deep through June (inundate for 1 year)
2. Burning followed with inundation or herbicides (burning stimulates new growth within 10 days)
3. Scrape or excavate sod to depth of 5 to 6 inches, stockpile and cover
4. Disk or till with frequent mowing or grazing to suppress seeds
5. Mulching with cardboard and/or wood chips in combo with disking and grazing

In some cases CG will grow in shaded areas getting nutrients through connected rhizomes from plants in sunlight. Trench around treated and untreated areas to break rhizome connection. Variety of canopies important to control regrowth, understory scraping an mulching has been successful up north, likely requires hand labor.

More detail about CG control to be provided in Final Report

Alternatives for Fish Passage and Habitat Improvement

Remove crossing, upstream water levels are the same in the winter, during spring the water levels drops faster and can recolonize with Canary Grass.

Alternatives can be describes as "controlling water levels or not", each has similar vegetation control measures.
1. Water control at outlet of slough maintain water levels to 10-ft with fish passage, gets rid of grass through flooding.
2. New water control at Pala Road with fish passage
3. Remove all water control.

Considerations for locating water control structure include migration of river and location of sand dunes.

ALTERNATIVE -1 (See handout)
1. Water Control Structure at Outlet of slough adjustable to maintain water level at 10-ft

Structure and Fish Passage Options:

a) Fish ladder made of sheet pile and wooden weirs
b) Combination roughened rock channel with adjacent fish ladder made of sheet pile, wooden weirs and rock

2. No water control at Pala Road

Pala Road Options:

a) Remove road and recontour ground surface, new parking lot, trailhead, and bridge at Silva Road
b) Continue use of road, raise road elevation, install new concrete box culverts for flow connectivity

3. Vegetation Management: Inundation to 10-ft to create open water habitat

Vegetation Control Sequence:

1) burn canary grass at elevations 5 to 8 ft.
2) Excavate canary grass at elevations 8 to 10 fit, replant with native vegetation.
3) Tilling and reseeding of areas between 10-ft and the fence line, followed by frequent mowing.
4) Scraping, mulching and plant with native understory in areas under hardwoods.

ALTERNATIVE - 2

1. Water Control structure at Pala Road adjustable to maintain water level elevation 10-ft

a) Raise road elevation, install new concrete box culverts for flow connectivity and as water level control.
b) Install fish ladder 30-ft long extending upstream from the inlet of box culvert

2. Vegetation Management

Vegetation Control Sequence:

1) Burn canary grass at elevations 5 to 8 –ft upstream of Pala Rd.
2) Excavate canary grass at elevations 8 to 10-ft upstream of Pala Rd and 5 to 8-ft downstream of Pala Rd, replant with native vegetation.
3) Till and reseed areas between 10-ft and the fence line upstream of Pala Rd and 8-ft to fence line downstream of Pala Rd.
4) Scraping, mulching and plant with native understory in areas under hardwoods.

ALTERNATIVE – 3

1. Water level controlled by constriction in slough

Pala Road Options:

a) Remove road and recontour ground surface, new parking lot, trailhead, and bridge at Silva Road.
b) Continue use of road, raise road elevation, install new concrete box culverts for flow connectivity

2. Vegetation Management

Vegetation Control Sequence:

1) Excavate grass at elevations 5 to 8-ft and replant

2) Disking of areas between 8-ft to the fence line. Reseed and mow frequently
3) Scraping, mulching and plant with native understory in areas under hardwoods.

Group Discussion:
What salinity levels kill canary grass?

Zack - Land swap timeline? – February but not likely.

Valerie - Alternative 1 probably okay with the parks but may have trouble finding funds for maintenance.

Kevin - Recurring maintenance costs for veg management – scraping is a one-time event

Mike - Could set up a pilot reach

Zack – NRCS and Alexandre Dairy could be starting place for pilot reach. Plan to scrape and plant from Silva Road downstream for CG management ~$35,000

Question – is Tryon Creek an artificial channel? Can it be rerouted back to Lake Earl.

Mike – Using water management can the water be stored through June? Considering current irrigation demand.

Zack – Feasibility for alternate water source?

Mitch - This year we had high spring rainfall that provided water late in to the summer, was this an anomaly?

Mike – Uncertainties exist around the inundation times. Holding the water may stop the hydroponic growing.

Gary F – Was sediment removal considered? How does the cost compare to ongoing maintenance costs of the other alternatives

Mike – Cost and quantity of sediment removal may not be cost effective.

B. Tedsen - Local ranchers would likely take the dirt.

Jay – material is mostly mineral soils with some organics.

Tedsen – Tryon dredged and raised adjacent land. Fish came back right away.

Mike - We will look at developing an excavation alternative.

Mitch – Why a combination rock channel and fish ladder for fish passage.

Mike – Ladder provides water level control and passage when flows drop, rock channel provides overflow and passage for other species.

Tedsen - Do fish still enter the slough when water levels are > 10 ft?

Mike – unknown but goals include increasing the range of fish passage flows

Mitch – raised concern about maintenance of the ladder and possible vandalism

Valerie – water quality concerns

Mike – WQ should improve as a result of previous fencing, also more water provides more treatment.

Zack – Currently no known long term WQ monitoring.

Tedsen – Access is a high priority for hiking and biking. Fishing access erodes left bank of Smith river.

Valerie – State wants to keep road.

Brock – tribe prefers removal of road, does not mind accessing via Silva lane road.

Valerie – Access issues are usually addressed in a General Plan meeting which has not been done for Yontocket.

Tedsen – For a bout 2 weeks Pala Road is inaccessible.

(?) NRCS – Concerns about vegetation control. There is a wide source of re-seeds and what native re-plant can out compete CG. It will be a continual battle to keep out CG. If it is removed and replaced what a bout a re-infestation source.

Mike – It will require ongoing maintenance. Roodeo/AquMaster does kill it and is the preferred alternative in combination with burning.

Gary – Will we estimate costs for vegetation treatments.

Mike - yes

Zack – Alexandre not likely to support use of herbicides.

Mitch – Need to try and create conditions to favor natives (riparian shading and open water) Noted that it will still persist out side of wet / shade areas.

Mike – large wood with spruce planting has worked in other areas.

Zack - how can we go about getting consensus on a preferred project?

Dave L – On going maintenance will be difficult. Water control looks good for ducks, but requires maintenance of control structure. Fish and Game has policy of no net loss of wetlands, and excavation may conflict with no net loss.

Kevin – Likely can internally find consensus and mitigation.

Mike – likely no loss just change in timing

Gary – when D.O. levels drop do fish go out or up tributaries.

Tedsen – Pumps from upstream cause some of the problems.

Valerie – is it feasible to move Pala Rd access to the location of the downstream outlet alternative.

Mike – the dunes on the left bank of the slough and migration of the river may make this impractical.

Mike – First step is pilot study, note that flooding needs to happen right after scraping.

Mitch - Consider simplifying the alternative and think of it as a lagoon that closes at certain times.

APPENDIX B

WATER LEVEL OBSERVATIONS AND WATER QUALITY FIELD DATA

Water Levels at the Silva Road Bridge

Top of Crest Gage Cap, Elev. =	12.295 feet (NAVD88)
Distance from Top Cap to Bottom of Crest Gage =	4.05 feet

[1] During Daylight Savings Time Subtract 1 Hour
[2] Times of crest gage readings estimated from timing of obseved rainfall.
[3] Measured from the top crest gage cap to water surface
[4] Measured from lip on bottom cap of crest gage.

Observer	Date [2]	Time (PST) [1]	Obs Stage [3]	Crest Stage [4]	Elevation (ft)	Crest	Notes
K Miess	12/22/2004	11:00	-3.16		13.185		
K Miess	12/27/2004			1.88	14.175	14.18	
K Miess	1/7/2005	10:00	-2.84		13.505		
K Miess	1/9/2005	14:20	-2.61		13.735		
K Miess	1/10/2005			1.55	13.845	13.85	
K Miess	1/14/2005	10:15	-2.92		13.425		
K Miess	1/21/2005	13:55	-3.22		13.125		
K Miess	1/28/2005			1.26	13.555	13.56	
K Miess	2/2/2005	14:55	-3.26		13.085		
K Miess	2/6/2005	12:30	-3.41		12.935		
K Miess	2/7/2005			1.01	13.305	13.31	
K Miess	2/12/2005	10:25	-3.77		12.575		Water level ~8" deep at T-Post
K Miess	2/18/2005	9:50	-4.35		11.995		Top of bottom cap to top of top cap is 4.05'; Crest gage dry
K Miess	2/20/2005	15:00	-4.35		11.995		Minimal flow
K Miess	2/25/2005	10:00	-4.82		11.525		Creek dry at T-Post, no flow, Pulled line DS ~50' to get water level
K Miess	3/4/2005	9:40	-5.18		11.165		Creek dry at T-Post, no flow, Pulled line DS ~50' to get water level
K Miess	3/12/2005	15:55	-5.80		10.545		Creek dry at T-Post, no flow, Pulled line DS ~50' to get water level
K Miess	3/19/2005	16:00	-5.81		10.535		Creek dry at T-Post, no flow, Pulled line DS ~50' to get water level
K Miess	3/20/2005			1.22	13.515	13.52	
K Miess	3/26/2005	9:00	-3.25		13.095		Flow at T-Post
K Miess	3/29/2005			2.42	14.715	14.72	
K Miess	3/30/2005	11:50	-2.04		14.305		
K Miess	3/30/2005			2.44	14.735	14.74	
K Miess	4/2/2005	11:30	-2.40		13.945		
K Miess	4/3/2005			2.30	14.595	14.60	
K Miess	4/6/2005	8:40	-2.32		14.025		
K Miess	4/8/2005			2.52	14.815	14.82	
K Miess	4/9/2005	9:50	-1.59		14.755		
K Miess	4/9/2005			2.6	14.895	14.90	
K Miess	4/16/2005	8:30	-2.24		14.105		
K Miess	4/17/2005			1.91	14.205	14.21	
K Miess	4/23/2005	7:50	-2.66		13.685		
K Miess	4/30/2005	7:30	-3.11		13.235		
K Miess	5/8/2005	3:00		1.44	13.735	13.74	

Observer	Date [2]	Time (PST) [1]	Obs Stage [3]	Crest Stage [4]	Elevation (ft)	Crest	Notes
K Miess	5/8/2005	10:25	-2.92		13.425		
K Miess	5/10/2005	5:00		1.68	13.975	13.98	
K Miess	5/13/2005	8:15	-2.81		13.535		
K Miess	5/19/2005	13:00		2.80	15.095	15.10	Crest reading suspect--gage hard to read, cork flushed out
K Miess	5/22/2005	9:20	-2.44		13.905		Crest reading suspect--gage hard to read, cork flushed out
K Miess	5/28/2005	9:20	-2.88		13.465		
K Miess	6/4/2005	13:15	-3.32		13.025		
K Miess	6/7/2005	10:00		1.67	13.965	13.97	
K Miess	6/11/2005	9:55	-3.53		12.815		
K Miess	6/12/2005	5:00		0.55	12.845	12.85	
K Miess	6/18/2005	9:05	-3.89		12.455		
K Miess	6/27/2005	9:15	-4.27		12.075		
K Miess	7/2/2005	8:45	-5.52		10.825		Creek dry at T-Post, no flow, Pulled line DS ~50' to get water level
K Miess	7/9/2005	9:50	-999		DRY		Creek dry at T-Post, no flow, no WS within sight
K Miess	7/16/2005		-999		DRY		DRY: weekly check performed to ensure creek bed is dry, resume measurements after rains
K Miess	11/7/2005	10:25	-3.14		13.205	0.87	First measurement of rain year-crest hard to read, mixture of old & new cork
K Miess	11/12/2005	11:30	-4.25		12.095		(BAD CREST READING)
K Miess	11/19/2005	1:30	-3.84		12.505		
K Miess	11/25/2005	9:00		0.96	13.255	13.26	
K Miess	11/26/2005	10:15	-3.87		12.475		
K Miess	12/1/2005	14:00		1.83	14.125	14.13	
K Miess	12/3/2005	9:20	-2.63		13.715		
K Miess	12/4/2005			1.52	13.815	13.82	
K Miess	12/10/2005	9:40	-2.91		13.435		
K Miess	12/17/2005	9:50	-3.27		13.075		
K Miess	12/24/2005			3.67	15.965	15.97	
K Miess	12/31/2005	13:25	-0.75		15.595		
K Miess	1/3/2006			3.75	16.045	16.05	
K Miess	1/7/2006	9:55	-2.09		14.255		
K Miess	1/10/2006			3.03	15.325	15.33	
K Miess	1/14/2006	9:25	-1.68		14.665		
K Miess	1/17/2006			2.57	14.865	14.87	
K Miess	1/21/2006	9:45	-1.81		14.535		
K Miess	1/24/2006			2.66	14.955	14.96	
K Miess	1/28/2006	9:30	-2.12		14.225		
K Miess	1/31/2006			2.47	14.765	14.77	
K Miess	2/4/2006	9:25	-1.96		14.385		

Yontocket Slough Water Levels at Pala Road

Location	Elevation (RTK Survey)	Elevation (Level Survey)	Difference
Rebar TBM	14.791	Use RTK Elev.	-
US Staff	5.785	5.781	0.004
DS Staff	5.963	5.981	-0.018
US Crest 1	8.096	8.081	0.015
US Crest 2		8.320	
US Crest 3	3.430		
DS Crest	7.320	7.321	-0.001

*** During Daylight Savings Time Subtract 1 Hour**

Observer	Date of Observation and Approx Date of Crest	Time (PST)*	US Crest Stage (ft)	DS Crest Stage (ft)	US Staff #1 Stage (ft)	US Staff #2 Stage (ft)	US Staff #3 Stage (ft)	DS Staff Stage (ft)	Upstream Crest Elev (ft)	Downstream Crest Elev (ft)	Upstream1 Staff WS Elev (ft)	Upstream2 Staff WS Elev (ft)	Upstream3 Staff WS Elev (ft)	Downstream Staff WS Elev (ft)	Notes
Z Larson	12/9/2004	14:00									12.15				Based on WS in photo of crossing that Zack Larson took
Z Larson	12/13/2004	13:00									10.57				0.5 feet above top of stand pipe.
K Miess	12/16/2004	13:00			4.42			3.86			10.20			9.84	Installed Staff Plates
K Miess	12/22/2004	10:10			3.27			2.87			9.05			8.85	Pala Road mostly dry
K Miess	12/27/04		2.20	2.66					10.28	9.98					
Z Larson	1/3/2005	8:30			4.22			3.64			10.00			9.62	
Z Larson	1/5/2005	9:05			4.00			3.48			9.78			9.46	
K Miess	1/7/2005	9:25			3.76			3.30			9.54			9.28	
K Miess	1/9/2005	13:45			4.03			3.53			9.81			9.51	
K Miess	01/10/05		1.78	2.57					9.86	9.89					
K Miess	1/14/2005	9:30			3.62			3.17			9.40			9.15	
K Miess	1/21/2005	13:20			2.96			2.50			8.74			8.48	
K Miess	01/28/05		1.41	1.81					9.49	9.13					
K Miess	2/2/2005	14:15			2.82			2.40			8.60			8.38	
K Miess	2/6/2005	11:45			2.52			2.12			8.30			8.10	
K Miess	02/07/05		0.55	1.08					8.63	8.40					
Z Larson	2/8/2005	16:00			2.38			2.02			8.16			8.00	
K Miess	2/12/2005	9:45			2.12			1.78			7.90			7.76	Water level ~2" below top of lower US crest cap; ~5" above lower DS cap
K Miess	2/18/2005	9:30			1.72			0.92			7.50			6.90	Water level aprox 12" below US and 6" below DC Crest caps
K Miess	2/20/2005	14:25			1.68			0.80			7.46			6.78	
K Miess	2/25/2005	9:30			1.45			0.46			7.23			6.44	
K Miess	3/4/2005	9:10			1.44			0.33			7.22			6.31	No flow across Pala Road
K Miess	3/12/2005	15:00			1.23			0.00			7.01			5.98	No flow across Pala Road
K Miess	3/19/2005	15:25			1.04						6.82				Cannot read DS gage-no water w/in sight of DS gage, heavy vegetation
K Miess	03/20/05		0.28	0.63					8.36	7.95					
K Miess	3/26/2005	8:20			2.34			1.98			8.12			7.96	
Z Larson	3/28/2005	13:06			3.10			2.60			8.88			8.58	
K Miess	03/29/05		2.36	2.92					10.44	10.24					
K Miess	3/30/2005	11:05			4.68			4.02			10.46			10.00	
K Miess	03/31/05		3.45	2.89					11.53	10.21					
K Miess	4/2/2005	10:55			4.30			3.63			10.08			9.61	
K Miess	04/03/05		3.02	2.62					11.10	9.94					
K Miess	4/6/2005	8:15			4.39			3.68			10.17			9.66	
K Miess	04/08/05		3.09	3.42					11.17	10.74					
K Miess	4/9/2005	8:50			4.98			4.35			10.76			10.33	Flow OVER Pala Rd
K Miess	04/10/05		3.72	3.18					11.80	10.50					
K Miess	4/16/2005	8:00			4.18			3.52			9.96			9.50	US Crest reading unsure: 1.95 or 3.72? Gage clogged?
K Miess	04/17/05		2.90	2.28					10.98	9.60					
K Miess	4/23/2005	7:00			3.33			2.80			9.11			8.78	
K Miess	4/30/2005	6:35			2.68			2.12			8.46			8.10	
K Miess	05/08/05		1.58	1.50					9.66	8.82					
K Miess	5/8/2005	9:55			2.30			1.82			8.08			7.80	
K Miess	05/09/05		1.55	2.05					9.63	9.37					

Observer	Date of Observation and Approx Date of Crest	Time (PST)*	US Crest Stage (ft)	DS Crest Stage (ft)	US Staff #1 Stage (ft)	US Staff #2 Stage (ft)	US Staff #3 Stage (ft)	DS Staff Stage (ft)	Upstream Crest Elev (ft)	Downstream Crest Elev (ft)	Upstream1 Staff WS Elev (ft)	Upstream2 Staff WS Elev (ft)	Upstream3 Staff WS Elev (ft)	Downstream Staff WS Elev (ft)	Notes
M. Love	5/12/2005	10:15			2.87			2.40			8.65			8.38	Field visit with Zack Larson and Tony Llanos
K Miess	5/13/2005	7:45			2.86			2.38			8.64			8.36	
	05/18/05		2.10	2.61					10.18	9.93					
K Miess	5/22/2005	8:35			3.27			2.75			9.05			8.73	
K Miess	5/28/2005	8:45			2.84			2.29			8.62			8.27	
K Miess	6/4/2005	12:50			2.14			1.18			7.92			7.16	
K Miess	6/11/2005	9:30			1.75			0.65			7.53			6.63	Both Crest Gages out of water--W.S. declining despite precipitation
K Miess	6/18/2005	8:45			1.39			0.03			7.17			6.01	Both Crest Gages out of water--W.S. declining despite precipitation
K Miess	6/27/2005	8:55			1.30						7.08				DS Staff gage dry--no W.S. in sight
K Miess	7/2/2005	8:25			1.03						6.81				DS Staff gage dry--no W.S. in sight
K Miess	7/9/2005	9:25			0.68						6.46				DS Staff gage dry--no W.S. in sight
K Miess	7/16/2005	9:15										6.01			Both gages dry (US#1 &DS)
K Miess	7/29/2005	11:20				-2.77						5.55			
K Miess	8/7/2005	10:20				-3.12	-2.43					5.20	1.00		
K Miess	8/14/2005	11:15				-3.37	-2.57					4.95	0.86		Installed US#3 at Pala US of US #2 by several hundred yds
K Miess	8/20/2005	9:30					-2.59						0.84		US #2 dry for first time this season
K Miess	8/27/2005	9:40					-2.67						0.76		
K Miess	9/3/2005	9:35					-2.79						0.64		
K Miess	9/10/2005	9:10					-2.88						0.55		
K Miess	9/17/2005	9:40					-2.80						0.63		
K Miess	9/24/2005	8:55					-2.58						0.85		
K Miess	10/1/2005	9:40					-2.61						0.82		
K Miess	10/8/2005	9:10					-2.47						0.96		
K Miess	10/17/2005	8:00				-3.09	-2.32					5.23	1.11		
K Miess	10/22/2005	9:05				-2.98	-2.25					5.34	1.18		
K Miess	10/29/2005	9:15				-2.78	-2.09					5.54	1.34		Added fresh cork to all crest gages
K Miess	11/06/05			1.40						8.72					
K Miess	11/7/2005	9:00			1.98	-0.56		1.78			7.76	7.76		7.76	US#3 Underwater? Cannot locate
K Miess	11/08/05			0.75						8.07					
K Miess	11/12/2005	10:35			1.98			1.88			7.76			7.86	
K Miess	11/19/2005	14:15			2.17			1.85			7.95			7.83	
K Miess	11/25/05			0.65						7.97					
K Miess	11/26/2005	11:00			1.77			1.20			7.55			7.18	
Z Larson	12/2/2005	11:20			6.16			5.92			11.94			11.90	
K Miess	12/3/2005 12/01/05	10:40			5.43			5.05			11.21			11.03	Could not reach either crest gage--too deep. Aprox 5" and 13" showing on DS and US crest gages respectively. DS crest probably overtopped.
K Miess	12/10/2005	10:30			3.92			3.51			9.70			9.49	Refilled cork on both crest gages
K Miess	12/17/2005	10:40			2.93			2.60			8.71			8.58	
K Miess	1/7/2006	10:50			5.26			4.67			11.04			10.65	Could not reach either crest gage--too deep. Evidence suggests both crest gages were overtopped
K Miess	1/14/2006	10:30			5.65			5.30			11.43			11.28	Could not reach either crest gage--too deep. Evidence suggests both crest gages were overtopped
K Miess	1/21/2006	10:40			5.45			4.90			11.23			10.88	Could not reach either crest gage--too deep.
K Miess	1/28/2006	10:20			4.84			4.15			10.62			10.13	Refilled both Crest Gages w/ Fresh Cork
K Miess	2/4/2006	10:20			5.25			4.55			11.03			10.53	Could not reach either crest gage--too deep.

Yontocket Slough Water Levels at Pala Road

	NAVD88 Elevation		
	RTK Survey	Level Survey	Note
T-Post 1	13.04	13.04	Uppermost
T-Post 2	8.80	8.79	
T-Post 3	6.15	6.15	Lowermost
TMB2	-	18.07	

Date	Time (PST)*	Location	Stage (ft)	T-Post 3 NAVD88	T-Post 2 NAVD88	T-Post 1 NAVD88	All Posts NAVD88	Dr Fine Bridge WS (ft)	Crescent City Tides (ft)	* During Daylight Savings Time Subtract 1 Hour Notes
12/22/2004	10:35	T-Post 3	-1.99	4.16			4.16	17.90	1.85	Saw one river otter
1/7/2005	9:40	T-Post 2	-1.99		6.81		6.81	18.52	3.87	
1/9/2005	13:55	T-Post 3	-1.43	4.72			4.72	19.89	4.65	
1/14/2005	9:50	T-Post 3	-2.60	3.55			3.55	18.62	5.12	
1/21/2005	13:30	T-Post 3	-1.96	4.19			4.19	19.74	4.83	
2/2/2005	14:30	T-Post 3	-2.59	3.56			3.56	18.77	5.59	
2/6/2005	12:05	T-Post 3	-2.35	3.80			3.80	18.34	3.33	
2/12/2005	10:00	T-Post 3	-3.15	3.00			3.00	17.75	6.82	
2/18/2005	9:30	T-Post 3	-1.26	4.89			4.89	17.47	4.05	
2/20/2005	14:40	T-Post 3	-3.13	3.02			3.02	17.81	5.43	
2/25/2005	9:40	T-Post 3	-2.66	3.49			3.49	17.47	5.93	
3/4/2005	9:20	T-Post 3	-2.68	3.47			3.47	18.11	2.94	
3/12/2005	15:25	T-Post 2	-4.39		4.41		4.41	17.44	4.75	
3/19/2005	15:35	T-Post 3	-3.42	2.73			2.73	17.30	1.94	
3/26/2005	8:35	T-Post 3	-2.42	3.73			3.73	19.09	1.92	
3/28/2005	13:20	T-Post 2	-0.60		8.19		8.19	23.66	5.38	By Zack Larson and noted as 7.25 inches--assumption is -7.25 inches or -0.6'
3/30/2005	11:20	T-Post 2	-1.94		6.86		6.86	22.68	0.52	
4/2/2005	11:10	T-Post 3	-1.71	4.44			4.44	19.93		
4/6/2005	8:25	T-Post 3	-0.53	5.62			5.62	19.93		
4/9/2005	9:15	T-Post 2	-0.86		7.94		7.94	24.26		
4/23/2005	7:20	T-Post 3	-2.40	3.75			3.75	19.09		Missed readings due to aggressive bull in field adjacent to site
4/30/2005	7:05	T-Post 3	-2.64	3.51			3.51	18.51		
5/8/2005	9:30	T-Post 3	-1.94	4.21			4.21	19.74		
5/12/2005	12:00	T-Post 3	-1.03	5.12			5.12	19.66		
5/13/2005	7:15	T-Post 3	-2.28	3.87			3.87			
5/22/2005	9:00	T-Post 3	-1.69	4.46			4.46			
5/28/2005	9:00	T-Post 3	-2.84	3.31			3.31			
6/4/2005	12:40	T-Post 3	-2.73	3.42			3.42			
6/11/2005	9:20	T-Post 3	-3.18	2.97			2.97			
6/18/2005	8:35	T-Post 3	-1.58	4.57			4.57			Saw 1 River Otter
6/27/2005	8:40	T-Post 3	-3.22	2.93			2.93			
7/2/2005	8:15	T-Post 3	-3.21	2.94			2.94			
7/9/2005	9:15	T-Post 3	-3.48	2.67			2.67			
7/16/2005	9:00	T-Post 3	-3.22	2.93			2.93			
7/23/2005	9:45	T-Post 3	-3.68	2.47			2.47			

Date	Time (PST)*	Location	Stage (ft)	**T-Post 3** NAVD88	**T-Post 2** NAVD88	**T-Post 1** NAVD88	All Posts **NAVD88**	Dr Fine Bridge **WS (ft)**	Crescent City **Tides (ft)**	* During Daylight Savings Time Subtract 1 Hour **Notes**
8/7/2005	10:05	T-Post 3	-3.76	2.39			2.39			
8/14/2005	12:25	T-Post 3	-3.70	2.45			2.45			
8/20/2005	8:55	T-Post 3	-3.78	2.37			2.37			~50 1" fish b/w confluence & T-Post 3
8/27/2005	9:00	T-Post 3	-3.38	2.77			2.77			
9/3/2005	9:00	T-Post 3	-3.80	2.35			2.35			~200 1" fish b/w confluence & T-Post 3
9/10/2005	9:40	T-Post 3	-3.87	2.28			2.28			~200 1" fish b/w confluence & T-Post 3
9/17/2005	9:40	T-Post 3	-2.31	3.84			3.84			~20 1" fish b/w confluence & T-Post 3
9/24/2005	9:20	T-Post 3	-3.83	2.32			2.32			~200 1" fish b/w confluence & T-Post 3
10/1/2005	10:10	T-Post 2	-4.29		4.51		4.51			fish present-hard to count W.S. high
10/8/2005	9:40	T-Post 3	-3.49	2.66			2.66			fish present-few and scattered
10/17/2005	8:40	T-Post 3	-2.67	3.48			3.48			fish present-few and scattered
10/22/2005	9:50	T-Post 3	-3.34	2.81			2.81			fish present-few and scattered
10/29/2005	9:55	T-Post 2	-3.50		5.30		5.30			fish present-few and scattered
11/7/05 0:00	10:00	T-Post 2	-2.55		6.25		6.25			water too murky to spot any fish
11/12/2005	10:05	T-Post 2	-3.09		5.71		5.71			1-2" fish present--too many to count, WS high
11/19/2005	14:00	See	Notes							All three T-Posts out of commission. T-Posts #1 and #2 fell into Tryon Creek with creek bank. T-Post#3 bent to 45 degree angle (from fall?).
12/3/2005	11:00	Visual Est					7.50			Visual Estimate by Kelly M.

CONFLUENCE WITH SMITH RIVER

Date mm/dd/yy	Time PST	Date and Time PST	Location	Temp °C	Salinity ppt	DO (ppm) ppm	DO (%) %	Notes
08/14/05	12:30	8/14/05 12:30	Smith	14.5	<1.0	4.5	44.4	
08/20/05	8:50	8/20/05 8:50	Smith	14.4	3.2	4.5	44.4	
08/27/05	8:55	8/27/05 8:55	Smith	14.8	<1.0	5.3	52.1	
09/03/05	9:00	9/3/05 9:00	Smith	14.0	1.5	3.7	37.2	
09/10/05	9:40	9/10/05 9:40	Smith	13.5	<1.0	2.5	23.7	
09/17/05	9:40	9/17/05 9:40	Smith	16.6	<1.0	6.6	68.0	
09/24/05	9:20	9/24/05 9:20	Smith	11.2	<1.0	2.6	23.9	
10/01/05	10:10	10/1/05 10:10	Smith	16.4	<1.0	6.1	62.0	
10/08/05	9:40	10/8/05 9:40	Smith	13.7	<1.0	5.8	55.0	
10/17/05	8:40	10/17/05 8:40	Smith	14.1	<1.0	6.0	58.0	
10/22/05	9:50	10/22/05 9:50	Smith	14.1	<1.0	6.9	67.5	
10/29/05	9:55	10/29/05 9:55	Smith	12.0	<1.0	8.6	80.4	
11/07/05	9:55	11/7/05 9:55	Smith	11.1	<1.0	4.6	41.1	
11/12/05	10:05	11/12/05 10:05	Smith	10.5	<1.0	6.3	56.4	Could not calibrate salinity meter--was off by +0.3 ppt
12/03/05	10:10	12/3/05 10:10	Smith	8.7	<1.0	3.2	27.7	
12/10/05	10:50	12/10/05 10:50	Smith	7.6	<1.0	3.5	29.2	
12/17/05	11:00	12/17/05 11:00	Smith	5.7	<1.0	5.5	43.5	
01/07/06	11:05	1/7/06 11:05	Smith	10.4	<1.0	3.6	32.2	
01/14/06	10:50	1/14/06 10:50	Smith	10.4	<1.0	3.4	30.6	
01/21/06	10:55	1/21/06 10:55	Smith	9.9	<1.0	7.4	64.6	
01/28/06	10:45	1/28/06 10:45	Smith	8.9	<1.0	9.4	86.3	
02/04/06	10:35	2/4/06 10:35	Smith	11.5	<1.0	6.9	64.2	

DOWNSTREAM OF PALA ROAD NEAR STAFF PLATE

Date mm/dd/yy	Time PST	Date and Time PST	Location	Temp °C	Salinity ppt	DO (ppm) ppm	DO (%) %	Notes
11/07/05	9:40	11/7/05 9:40	DS Staff	10.9	<1.0	2.3	20.9	
11/12/05	10:25	11/12/05 10:25	DS Staff	11.1	<1.0	1.2	11.0	
11/19/05	14:15	11/19/05 14:15	DS Staff	8.9	<1.0	1.5	13.0	
11/26/05	11:00	11/26/05 11:00	DS Staff	9.2	<1.0	1.6	14.0	
12/03/05	10:30	12/3/05 10:30	DS Staff	9.2	<1.0	2.8	24.6	
12/10/05	10:30	12/10/05 10:30	DS Staff	7.4	<1.0	2.4	19.8	
12/17/05	10:40	12/17/05 10:40	DS Staff	5.6	<1.0	1.6	12.5	
01/07/06	10:45	1/7/06 10:45	DS Staff	10.4	<1.0	3.5	30.9	
01/14/06	10:25	1/14/06 10:25	DS Staff	10.4	<1.0	3.2	28.7	
01/21/06	10:35	1/21/06 10:35	DS Staff	9.8	<1.0	6.8	60.1	
01/28/06	10:20	1/28/06 10:20	DS Staff	8.9	<1.0	9.9	85.8	
02/04/06	10:10	2/4/06 10:10	DS Staff	11.5	<1.0	7.5	69.8	

UPSTREAM OF PALA ROAD NEAR STAFF PLATE

Date mm/dd/yy	Time PST	Date and Time PST	Location	Temp °C	Salinity ppt	DO (ppm) ppm	DO (%) %	Notes
07/29/05	11:25	7/29/05 11:25	US#2	17.3	<1.0	0.7	6.5	
08/07/05	10:20	8/7/05 10:20	US#2	15.7	<1.0	5.0	55.0	DO meter not working? Suspect DO reading is too high
08/14/05	11:55	8/14/05 11:55	US#2	18.6	<1.0	3.3	35.2	
10/17/05	8:20	10/17/05 8:20	US#2	10.6	<1.0	1.3	11.5	
10/22/05	9:30	10/22/05 9:30	US#2	12.5	<1.0	1.6	14.0	
10/29/05	9:40	10/29/05 9:40	US#2	10.5	<1.0	2.2	19.3	Could not calibrate salinity meter--was off by +0.5 ppt
11/07/05	9:40	11/7/05 9:40	US#1	10.9	<1.0	1.6	14.3	Could not calibrate salinity meter--was off by +0.3 ppt
11/12/05	10:35	11/12/05 10:35	US#1	11.6	<1.0	1.0	8.8	
11/19/05	14:20	11/19/05 14:20	US#1	11.5	<1.0	1.1	10.1	
11/26/05	11:05	11/26/05 11:05	US#1	8.9	<1.0	0.6	5.5	
12/03/05	10:30	12/3/05 10:30	US#1	8.8	<1.0	2.4	20.8	
12/10/05	10:30	12/10/05 10:30	US#1	7.6	<1.0	2.7	22.6	
12/17/05	10:40	12/17/05 10:40	US#1	5.0	<1.0	1.2	9.2	
01/07/06	10:45	1/7/06 10:45	US#1	10.2	<1.0	3.6	31.4	
01/14/06	10:25	1/14/06 10:25	US#1	10.4	<1.0	3.2	28.7	
01/21/06	10:35	1/21/06 10:35	US#1	9.8	<1.0	6.8	60.1	
01/28/06	10:20	1/28/06 10:20	US#1	9.0	<1.0	9.9	84.9	
02/04/06	10:10	2/4/06 10:10	US#1	11.5	<1.0	7.5	69.8	

NEAR STATE PARKS PROPERTY BOUNDARY

Date mm/dd/yy	Time PST	Date and Time PST	Location	Temp °C	Salinity ppt	DO (ppm) ppm	DO (%) %	N o t e s
08/14/05	11:15	8/14/05 11:15	US#3	16.7	<1.0	1.9	19.8	
08/20/05	9:30	8/20/05 9:30	US#3	15.5	<1.0	1.6	16.4	
08/27/05	9:40	8/27/05 9:40	US#3	14.5	<1.0	2.2	21.5	
09/03/05	9:30	9/3/05 9:30	US#3	15.8	<1.0	2.2	21.8	
09/10/05	9:00	9/10/05 9:00	US#3	14.0	<1.0	2.4	23.3	
09/17/05	9:05	9/17/05 9:05	US#3	14.9	<1.0	1.9	19.0	
09/24/05	8:50	9/24/05 8:50	US#3	10.6	<1.0	1.3	11.9	
10/01/05	9:35	10/1/05 9:35	US#3	14.1	<1.0	1.0	9.9	
10/08/05	9:10	10/8/05 9:10	US#3	11.3	<1.0	1.3	12.1	
10/17/05	8:00	10/17/05 8:00	US#3	10.6	<1.0	1.0	9.2	
10/22/05	9:05	10/22/05 9:05	US#3	11.7	<1.0	1.1	9.7	Could not calibrate salinity meter--was off by +0.4 ppt
11/07/05	9:00	11/7/05 9:00	US#3	10.3	<1.0	1.5	13.2	Reading taken near, not at US#3 T-Post
11/12/05	11:00	11/12/05 11:00	US#3	12.0	<1.0	1.6	14.7	Reading taken near, not at US#3 T-Post
11/19/05	14:45	11/19/05 14:45	US#3	12.9	<1.0	3.1	29.4	Reading taken near, not at US#3 T-Post
12/10/05	10:05	12/10/05 10:05	US#3	7.0	<1.0	2.8	23.6	Reading taken near, not at US#3 T-Post
12/17/05	10:15	12/17/05 10:15	US#3	4.5	<1.0	2.7	20.1	
01/07/06	10:20	1/7/06 10:20	US#3	10.7	<1.0	1.8	16.1	
01/14/06	9:50	1/14/06 9:50	US#3	10.3	<1.0	3.6	32.2	
01/21/06	10:15	1/21/06 10:15	US#3	9.8	<1.0	7.4	64.6	
01/28/06	10:00	1/28/06 10:00	US#3	9.2	<1.0	9.2	79.8	
02/04/06	9:50	2/4/06 9:50	US#3	11.5	<1.0	6.4	58.7	

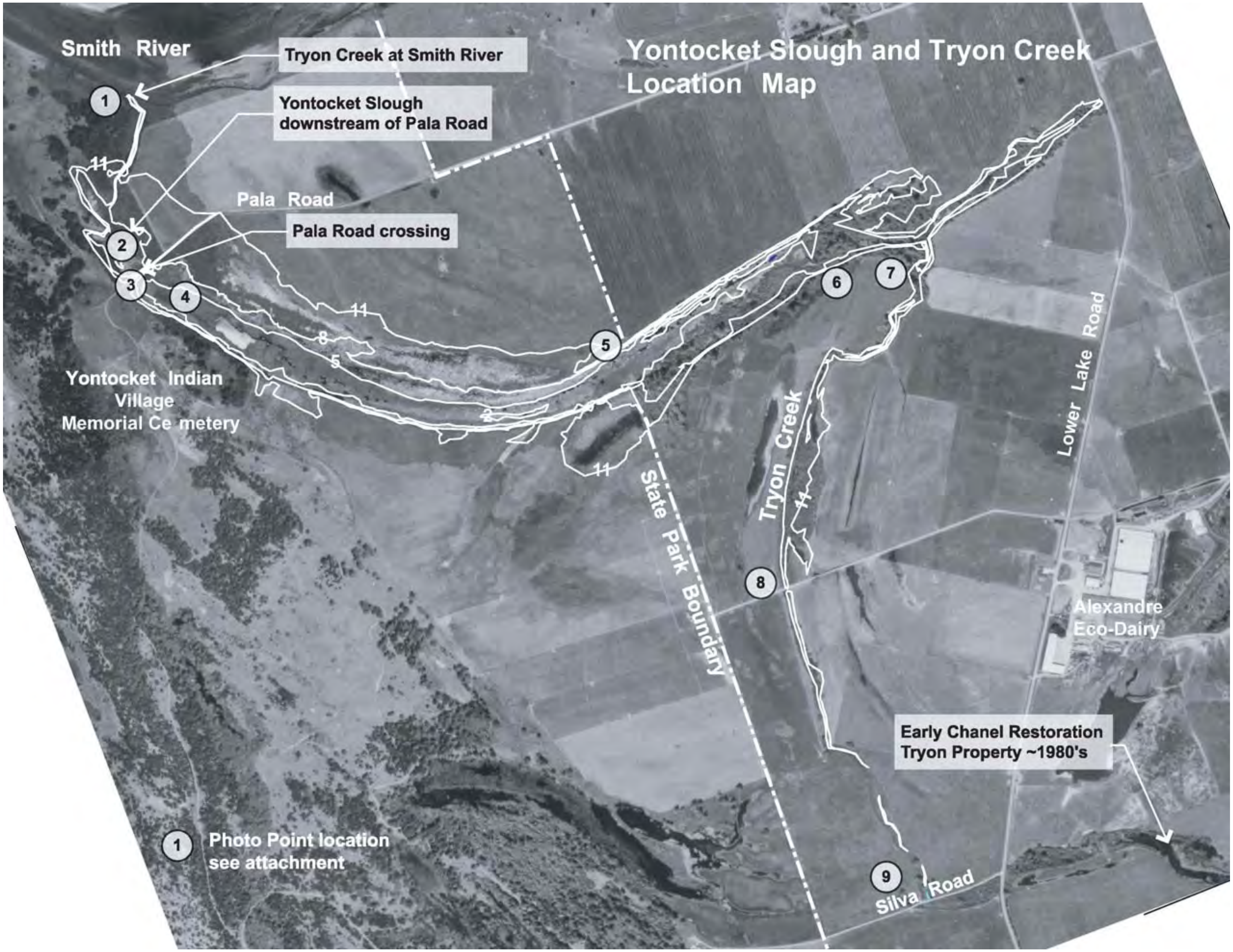
SILVA ROAD BRIDGE

Date mm/dd/yy	Time PST	Date and Time PST	Location	Temp °C	Salinity ppt	DO (ppm) ppm	DO (%) %	Notes
11/07/05	10:25	11/7/05 10:25	Silva	11.3	<1.0	5.2	47.9	
11/12/05	11:30	11/12/05 11:30	Silva	11.0	<1.0	1.3	11.9	
11/19/05	13:30	11/19/05 13:30	Silva	10.2	<1.0	2.0	18.0	Could not calibrate salinity meter--was off by +0.3 ppt
11/26/05	10:20	11/26/05 10:20	Silva	9.3	<1.0	2.5	21.8	Could not calibrate salinity meter--was off by +0.4 ppt
12/03/05	9:20	12/3/05 9:20	Silva	8.7	<1.0	3.0	26.6	Could not calibrate salinity meter--was off by +0.4 ppt
12/10/05	9:40	12/10/05 9:40	Silva	8.9	<1.0	4.2	36.1	Could not calibrate salinity meter--was off by +0.1 ppt
12/17/05	9:50	12/17/05 9:50	Silva	6.8	<1.0	3.3	25.4	
01/07/06	9:55	1/7/06 9:55	Silva	11.2	<1.0	4.9	44.6	
01/14/06	9:25	1/14/06 9:25	Silva	10.3	<1.0	5.8	53.6	
01/21/06	9:45	1/21/06 9:45	Silva	10.0	<1.0	7.2	62.6	
01/28/06	9:30	1/28/06 9:30	Silva	9.6	<1.0	8.8	78.5	
02/04/06	9:25	2/4/06 9:25	Silva	11.7	<1.0	8.0	73.9	

APPENDIX C

PHOTOGRAPHIC DOCUMENTATION OF PROJECT AREA

Yontocket Slough Photos



LOCATION 1 – Confluence of Tryon Creek with the Smith River. River levels are tidally influenced. During spring tides and higher river levels the Smith River will backwater and fill the lower portion of Yontocket Slough. When the river at Dr. Fine Bridge is near monitoring stage, the Smith River will completely inundate Yontocket Slough and Pala Road.

LOCATION 2 – Downstream of Pala Road, reed canary grass has colonized almost the entire slough.

LOCATION 3 – Pala Road during high water in December. The road was overtopped by the Smith River, filling Yontocket Slough**.**

LOCATION 4 - Yontocket Slough upstream of Pala Road one week after filling by Smith River overflow.

LOCATION 4 - Yontocket Slough upstream of Pala Road during mid-spring. Reed canary grass dominates much of the slough, with yellow (Spatterdock) lily growing among the grass and in deeper sections that are free from grass.

LOCATION 5 – Yontocket Slough at the State Park property boundary. Reed canary grass dominates much of the banks and rafts in the mid sections of the slough. There is a lack of riparian vegetation within the State Park properties.

LOCATION 5 – Yontocket Slough within the State Park. This section of slough lacks riparian vegetation. Reed canary grass has colonized the margins and rafts within the slough.

LOCATION 6 – Yontocket Slough near confluence with Tryon Creek. Dense softwood riparian with spruce trees grow on south bank. This section is characterized by areas of open water and lilies with reed canary grass along the margins.

LOCATION 7 – Tryon Creek near confluence with Yontocket Slough is characterized by dense hardwood riparian with reed canary grass growing throughout channel.

LOCATION 8 – Tryon Creek is unfenced along the right bank and has little riparian vegetation. In this reach, the channel is poorly defined with water spreading outward during high flows.

LOCATION 9 – Tryon Creek downstream of Silva Road Bridge.

LOCATION 9 – Staff gage at Silva Road Bridge

APPENDIX D

COST ESTIMATES FOR ALTERNATIVES AND RESTORATION COMPONENTS

Yontocket Slough Enhancement Plan					Date 3/15/06	
Alternative - 1						
Replace crossing at Pala Road (no excavation for inundation)						
Item	**Description**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	**Notes**
Implementation Phase						
1	Final Permit Applications	1	LS	$ 3,000.00	$ 3,000	
2	Mob/Demob/Cleanup	1	LS	$ 3,000	$ 3,000	
3	Clearing/Grubbing	1	LS	$ 1,000	$ 1,000	
4	Water Diversion, erosion sediment control	1	LS	$ 2,000	$ 2,000	
5	Fish Removal	-	LS	$ -	$ -	
6	Construction Inspection	10	DAY	$ 850	$ 8,500	
7	Construction Management	10	DAY	$ 600	$ 6,000	
8	Cultural Monitoring	5	DAY	$ 800	$ 4,000	
9	Geotechnical Investigation	2	DAY	$ 850	$ 1,700	
10	**Water Control Structure**	**-**	**LS**	**$ -**	**$ -**	N/A
11	**Replace Crossing w/ Concrete Box Culvert1**	**1**	**LS**	**$ 53,273**	**$ 53,273**	2
12	**Vegetation Management (lower slough)**	**1**	**LS**	**$ -**	**$ -**	N/A
13	**Vegetation Management (upper slough)**	**-**	**LS**	**$ -**	**$ -**	N/A
14	Project Monitoring	TBD				
Subtotal					$ 82,473	
15.	Estimating Contingency @ 20%				$ 16,000.00	
16.				**SUBTOTAL CONSTRUCTION**	**98,473**	
Final Design and Environmental Documentation						
17.	Project Management	1	LS	$ 8,000.00	$ 8,000.00	
Engineering and Design						
18.	Additional topographic survey	-	LS	$ -	$ -	
19.	New culverts and road improvements	1	LS	$ 8,000.00	$ 8,000.00	
20.	Earthworks	-	LS	$ -	$ -	
21.	Integrated Vegetation Management Design	-	LS	$ -	$ -	
Permitting and Environmental Documents						
22.	Biological Assessments	1	LS	$ 10,000.00	$ 10,000.00	
23.	NEPA, CEQA Documentation	1	LS	$ 5,000.00	$ 5,000.00	
	SUBTOTAL DESIGN AND DOCUMENTATION				**31,000**	
24.				**TOTAL**	**129,473**	
Notes:						
2) See Restoration Components for Pala Road						

Yontocket Slough Enhancement Plan Date 3/15/06

Alternative - 2

Fish Ladder at Pala Road, Vegetation Management up and downstream (no excavation for inundation)

Item	Description	Qty	Unit	Unit Cost	Total Cost	Notes
Implementation Phase						
1	Final Permit Applications	1	LS	$ 5,000.00	$ 5,000	
2	Mob/Demob/Cleanup	1	LS	$ 5,000	$ 5,000	
3	Clearing/Grubbing	1	LS	$ 2,750	$ 2,750	
4	Water Diversion, erosion sediment control	1	LS	$ 2,000	$ 2,000	
5	Fish Removal	-	LS	$ -	$ -	
6	Construction Inspection	20	DAY	$ 850	$ 17,000	
7	Construction Management	25	DAY	$ 600	$ 15,000	
8	Cultural Monitoring	15	DAY	$ 800	$ 12,000	
9	Geotechnical Investigation	5	DAY	$ 850	$ 4,250	
10	**Fish Ladder at Pala Road**	**1**	**LS**	**$ 21,345**	**$ 21,345**	1
11	**Replace Crossing w/ Concrete Box Culvert**	**1**	**LS**	**$ 53,273**	**$ 53,273**	2
12	**Vegetation Management (lower slough)**	**-**	**LS**	**$ -**	**$ -**	N/A
13	**Vegetation Management (upper slough)**	**1**	**LS**	**$ 150,567**	**$ 150,567**	3
14	Project Monitoring	TBD				
Subtotal					$ 288,185	
15.	Estimating Contingency @ 20%				$ 58,000.00	
16.				**SUBTOTAL CONSTRUCTION**	**346,185**	
Final Design and Environmental Documentation						
17.	Project Management	1	LS	$ 15,000.00	$ 15,000.00	
Engineering and Design						
18.	Additional topographic survey	1	LS	$ 3,000.00	$ 3,000.00	
19.	Fish Ladder at Pala Road with new culverts	1	LS	$ 30,000.00	$ 30,000.00	
20.	Earthworks	-	LS	$ -	$ -	
21.	Integrated Vegetation Management Design	1	LS	$ 12,000.00	$ 12,000.00	
Permitting and Environmental Documents						
22.	Biological Assessments	1	LS	$ 20,000.00	$ 20,000.00	
23.	NEPA, CEQA Documentation	1	LS	$ 10,000.00	$ 10,000.00	
				SUBTOTAL DESIGN AND DOCUMENTATION	**90,000**	
24.				**TOTAL**	**436,185**	

<u>Notes:</u>

1) See Restoration Components Water Control Structure

2) See Restoration Components for Pala Road

3) See Alternative 2 - Itemized Vegetation Management Costs

Yontocket Slough Enhancement Plan

Alternative 2 - Itemized Vegetation Management Costs

Estimated Costs for Removal of reed canary grass with Burning and Pilot scale management — Date 3/15/06

Item	Description	Qty	Unit	Unit Cost	Total Cost
Downstream of Pala Road (Lower Slough)					
1	**Total**				**$ -**
Upstream of Pala Road (Upper Slough)					
2	Control Burn	13.3	AC	$ 650	$ 8,645
3	Integrated Vegetation Management	7.6	AC	$ 13,400	$ 101,840
4	Remove existing fence	3,941.0	LF	$ 2	$ 7,882
5	Install new fence	3,220.0	LF	$ 10	$ 32,200
6	**Total**				**$ 150,567**

Notes:

1) See Unit Costs for Vegetation Management for more detail

2) Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative

Yontocket Slough Enhancement Plan					Date 3/15/06	
Alternative - 3						
Roughened Channel at Pala Road Vegetation Management up and downstream						
Item	**Description**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	**Notes**
Implementation Phase						
1	Final Permit Applications	1	LS	$ 5,000.00	$ 5,000	
2	Mob/Demob/Cleanup	1	LS	$ 15,000	$ 15,000	
3	Clearing/Grubbing	1	LS	$ 2,750	$ 2,750	
4	Water Diversion, erosion sediment control	1	LS	$ 2,000	$ 2,000	
5	Fish Removal	1	LS	$ 2,000	$ 2,000	
6	Construction Inspection	60	DAY	$ 850	$ 51,000	
7	Construction Management	40	DAY	$ 600	$ 24,000	
8	Cultural Monitoring	60	DAY	$ 800	$ 48,000	
9	Geotechnical Investigation	20	DAY	$ 850	$ 17,000	
10	**Roughened Channel at Pala Road**	**1**	**LS**	**$ 113,935**	**$ 113,935**	1
11	**Rebuild Road with wet crossing for Pedestrian/Horse Access**	**1**	**LS**	**$ 9,798**	**$ 9,798**	2
12	**Vegetation Management (lower slough)**	**1**	**LS**	**$ 173,800**	**$ 173,800**	3
13	**Vegetation Management (upper slough)**	**1**	**LS**	**$ 1,434,203**	**$ 1,434,203**	3
14	Project Monitoring	TBD				
Subtotal					$ 1,898,486	
15.	Estimating Contingency @ 20%				$ 380,000.00	
16.				**SUBTOTAL CONSTRUCTION**	**2,278,486**	
Final Design and Environmental Documentation						
17.	Project Management	1	LS	$ 30,000.00	$ 30,000.00	
Engineering and Design						
18.	Additional topographic survey	1	LS	$ 6,600.00	$ 6,600.00	
19.	Roughened Channel at Pala Road	1	LS	$ 30,000.00	$ 30,000.00	
20.	Earthworks	1	LS	$ 80,000.00	$ 80,000.00	
21.	Integrated Vegetation Management Design	1	LS	$ 17,000.00	$ 17,000.00	
Permitting and Environmental Documents						
22.	Biological Assessments	1	LS	$ 24,000.00	$ 24,000.00	
23.	NEPA, CEQA Documentation	1	LS	$ 12,000.00	$ 12,000.00	
	SUBTOTAL DESIGN AND DOCUMENTATION				**199,600**	
24.				**TOTAL**	**2,478,086**	
Notes:						
1) See Restoration Components Water Control Structure						
2) See Restoration Components for Pala Road						
3) See Alternative 2 - Itemized Vegetation Management Costs						

Yontocket Slough Enhancement Plan

Alternative 3 - Itemized Vegetation Management Costs

Estimated Costs for Removal of reed canary grass with Excavation, Burning and Pilot scale management — Date 3/15/06

Item	Description	Qty	Unit	Unit Cost	Total Cost
	Downstream of Pala Road (Lower Slough)				
1	Excavation of Channel	3,400.0	CY	$ 10	$ 34,000
2	Disposal and haul	3,400.0	CY	$ 18	$ 61,200
3	Scrape vegetation for Integrated Veg Mgmt	3.0	AC	$ 8,000	$ 24,000
4	Stockpile and cover RCG sod	3.0	AC	$ 12,000	$ 36,000
5	Integrated Vegetation Management Water Control at Pala Rd	3.0	AC	$ 6,200	$ 18,600
6	**Total**				**$ 173,800**
	Upstream of Pala Road (Upper Slough)				
1	Spot Burn	9.6	AC	$ 650	$ 6,240
2	Control Burn	7.8	AC	$ 650	$ 5,070
3	Scrape vegetation between 7.0 and 9.0-ft	12.3	AC	$ 24,222	$ 297,931
4	Stockpile and cover	12.3	AC	$ 12,000	$ 147,600
5	Excavation to elevation 7.0 and 7.5-ft	20,000.0	CY	$ 10	$ 200,000
6	Disposal and haul	20,000.0	CY	$ 18	$ 360,000
7	Scrape vegetation for Integrated Veg Mgmt	14.4	AC	$ 8,000	$ 115,200
8	Stockpile and cover RCG sod	14.4	AC	$ 12,000	$ 172,800
9	Integrated Vegetation Management	14.4	AC	$ 6,200	$ 89,280
10	Remove existing fence	3,941.0	LF	$ 2	$ 7,882
11	Install new fence	3,220.0	LF	$ 10	$ 32,200
12	**Total**				**$ 1,434,203**

Notes:

1) See Unit Costs for Vegetation Management for more detail

2) Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative

Yontocket Slough Enhancement Plan Date 3/15/06

Alternative - 4

Roughened Channel at Slough Outlet, replace crossing, Vegetation management up and downstream

Item	Description	Qty	Unit	Unit Cost	Total Cost	Notes
Implementation Phase						
1	Final Permit Applications	1	LS	$ 5,000.00	$ 5,000	
2	Mob/Demob/Cleanup	1	LS	$ 15,000	$ 15,000	
3	Clearing/Grubbing	1	LS	$ 2,750	$ 2,750	
4	Water Diversion, erosion sediment control	1	LS	$ 4,800	$ 4,800	
5	Fish Removal	1	LS	$ 2,000	$ 2,000	
6	Construction Inspection	70	DAY	$ 850	$ 59,500	
7	Construction Management	40	DAY	$ 600	$ 24,000	
8	Cultural Monitoring	70	DAY	$ 800	$ 56,000	
9	Geotechnical Investigation	26	DAY	$ 850	$ 22,100	
10	**Roughened Channel at Outlet of Slough**	**1**	**LS**	**$ 242,505**	**$ 242,505**	1
11	**Replace Crossing w/ Concrete Box Culvert**	**1**	**LS**	**$ 53,273**	**$ 53,273**	2
12	**Vegetation Management (lower slough)**	**1**	**LS**	**$ 418,945**	**$ 418,945**	3
13	**Vegetation Management (upper slough)**	**1**	**LS**	**$ 1,434,203**	**$ 1,434,203**	3
14	Project Monitoring	TBD				
Subtotal					$ 2,340,075	
15.	Estimating Contingency @ 20%				$ 468,000.00	
16.				**SUBTOTAL CONSTRUCTION**	**2,808,075**	
Final Design and Environmental Documentation						
17.	Project Management	1	LS	$ 30,000.00	$ 30,000.00	
Engineering and Design						
18.	Additional topographic survey	1	LS	$ 4,800.00	$ 4,800.00	
19.	Roughened Channel at Slough Outlet at new culverts	1	LS	$ 45,000.00	$ 45,000.00	
20.	Earthworks	1	LS	$ 80,000.00	$ 80,000.00	
21.	Integrated Vegetation Management Design	1	LS	$ 17,000.00	$ 17,000.00	
Permitting and Environmental Documents						
22.	Biological Assessments	1	LS	$ 24,000.00	$ 24,000.00	
23.	NEPA, CEQA Documentation	1	LS	$ 12,000.00	$ 12,000.00	
	SUBTOTAL DESIGN AND DOCUMENTATION				**212,800**	
24.				**TOTAL**	**3,020,875**	

Notes:

1) See Restoration Components Water Control Structure

2) Restoration Components for Pala Road

3) Alternative 2 - Itemized Vegetation Management Costs

Yontocket Slough Enhancement Plan

Alternative 4 - Itemized Vegetation Management Costs

Estimated Costs for Removal of reed canary grass with Excavation, Burning and Pilot scale management — Date 3/15/06

Item	Description	Qty	Unit	Unit Cost	Total Cost
Downstream of Pala Road (Lower Slough)					
1	Control Burn	1.4	AC	$ 650	$ 910
2	Scrape vegetation between 7.0 and 9.0-ft	3.4	AC	$ 24,222	$ 82,355
3	Excavation to elevation 7.0 and 7.5-ft	6,000.0	CY	$ 10	$ 60,000
4	Disposal and haul	6,000.0	CY	$ 18	$ 108,000
5	Stockpile and cover	3.4	AC	$ 12,000	$ 40,800
6	Scrape vegetation for Integrated Veg Mgmt	4.4	AC	$ 8,000	$ 35,200
7	Stockpile and cover RCG sod	4.4	AC	$ 12,000	$ 52,800
8	Integrated Vegetation Management Water Control at Outlet	4.4	AC	$ 6,200	$ 27,280
9	Remove existing fence	1,450.0	LF	$ 2	$ 2,900
10	Install new fence	870.0	LF	$ 10	$ 8,700
11	**Total**				**$ 418,945**
Upstream of Pala Road (Upper Slough)					
1	Spot Burn	9.6	AC	$ 650	$ 6,240
2	Control Burn	7.8	AC	$ 650	$ 5,070
3	Scrape vegetation between 7.0 and 9.0-ft	12.3	AC	$ 24,222	$ 297,931
4	Stockpile and cover	12.3	AC	$ 12,000	$ 147,600
5	Excavation to elevation 7.0 and 7.5-ft	20,000.0	CY	$ 10	$ 200,000
6	Disposal and haul	20,000.0	CY	$ 18	$ 360,000
7	Scrape vegetation for Integrated Veg Mgmt	14.4	AC	$ 8,000	$ 115,200
8	Stockpile and cover RCG sod	14.4	AC	$ 12,000	$ 172,800
9	Integrated Vegetation Management	14.4	AC	$ 6,200	$ 89,280
10	Remove existing fence	3,941.0	LF	$ 2	$ 7,882
11	Install new fence	3,220.0	LF	$ 10	$ 32,200
12	**Total**				**$ 1,434,203**

Notes:

1) See Unit Costs for Vegetation Management for more detail

2) Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative

Item	Description	Qty	Unit	Unit Cost	Total Cost
Yontocket Slough Enhancement Plan					
Restoration Components Water Control Structure					
Estimated Costs for Water Control structure at Slough Outlet and Pala Road					Date 3/15/06
Item	**Description**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
A	**Roughened Channel at Outlet of Slough**				
1	Excavation	930.0	CY	$ 5	$ 4,650
	Disposal and Haul	800.0	CY	$ 18	$ 14,400
2	Stockpile and place Native Backfill	117.0	CY	$ 25	$ 2,925
3	Engineered stream bed Material	525.0	CY	$ 250	$ 131,250
4	Rock Weirs and Forcing Rocks	42.0	TON	$ 115	$ 4,830
5	Banklines	187.0	TON	$ 115	$ 21,505
6	Sheet Pile (cut-off wall)	2000.0	SF	$ 15	$ 30,000
7	Concrete Control Structure with adjustable weirs	1.0	EA	$ 3,000	$ 3,000
8	Drain Pipe (36")	170.0	LF	$ 36	$ 6,120
9	Erosion control and revegetation stream banks	6600.0	SF	$ 1	$ 6,600
10	RSP	265.0	TON	$ 65	$ 17,225
11	**Total**				**$ 242,505**
B	**Roughened Channel at Pala Road**				
1	Excavation	70.0	CY	$ 5	$ 350
2	Stockpile and Re-Use Native Backfill	70.0	CY	$ 25	$ 1,750
3	Engineered stream bed Material	250.0	CY	$ 250	$ 62,500
4	Rock Weirs and Forcing Rocks	50.0	TON	$ 115	$ 5,750
5	Aprons	27.0	TON	$ 115	$ 3,105
6	Banklines	120.0	TON	$ 115	$ 13,800
7	RSP	320.0	TON	$ 65	$ 20,800
8	Concrete Control Structure with adjustable weirs	1.0	EA	$ 3,000	$ 3,000
9	Drain Pipe (36")	80.0	LF	$ 36	$ 2,880
10	**Total**				**$ 113,935**
C	**Fish Ladder at Pala Road**				
1	Excavation	45.0	CY	$ 5	$ 225
2	Stockpile and Re-Use Native Backfill	45.0	CY	$ 25	$ 1,125
3	Sheet Pile Side Walls	1000.0	SF	$ 15	$ 15,000
4	Wooden Weirs with support connectors	9.0	EA	$ 500	$ 4,500
5	Rock fill for weirs	11.0	CY	$ 45	$ 495
6	**Total**				**$ 21,345**
Notes:					
Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative					

Yontocket Slough Enhancement Plan

Restoration Components for Pala Road

Estimated Costs for Pala Road Options — Date 3/15/06

Item	Description	Qty	Unit	Unit Cost	Total Cost
Remove Road					
1	Excavation (420 lineal feet to elev. 6-ft)	3,276.0	CY	$ 5	$ 16,380
2	Disposal of Excavated Material	3,276.0	CY	$ 18	$ 58,968
3	Erosion control and soil stabilization	1.0	LS	$ 5,000	$ 5,000
4	**Total**				**$ 80,348**
Replace Crossing w/ Concrete Box Culvert					
1	Demo and dispose existing culverts	1.0	LS	$ 5,000	$ 5,000
2	Excavation for installation	150.0	CY	$ 5	$ 750
3	Concrete Box Culvert (6x6x25-ft)	50.0	LF	$ 604	$ 30,200
4	Install new culvert	2.0	EA	$ 5,000	$ 10,000
5	Raise Road Elev. to 11.5-ft	101.0	CY	$ 23	$ 2,323
6	Erosion control and soil stabilization	1.0	LS	$ 5,000	$ 5,000
7	**Total**				**$ 53,273**
Rebuild Road with wet crossing for Pedestrian/Horse Access					
1	Raise Road to Elev to 11.5-ft	101.0	CY	$ 23	$ 2,323
2	Crushed Rock for Rolling dip wet crossing	55.0	CY	$ 45	$ 2,475
3	Erosion control and soil stabilization	1.0	LS	$ 5,000	$ 5,000
4	**Total**				**$ 9,798**

Notes:

Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative

Yontocket Slough Enhancement Plan

Unit Costs for Vegetation Management

Estimated Costs for Removal of reed canary grass with Excavation, Burning and Pilot scale management — Date 3/15/06

Item	Description	Qty	Unit	Unit Cost	Total Cost
1	Control Burn		AC	$ 650	$ -
2	Spot Burn		AC	$ 650	$ -
3	Channel Excavation		CY	$ 10	$ -
4	Scrape vegetation		AC	$ 8,000	$ -
5	Stockpile and cover RCG sod		AC	$ 12,000	$ -
6	Excavation to elevation 7.0 and 7.5-ft		CY	$ 10	$ -
7	Disposal and haul		CY	$ 18	$ -
8	Solarization (in situ covering)		AC	$ 3,800	$ -
9	Remove existing fence		LF	$ 2	$ -
10	Install new fence		LF	$ 10	$ -
11	Mowing		AC	$ 200	$ -
12	Chemical Application		AC	$ 300	$ -
13	Seed Bed Planting (Drill)		AC	$ 500	$ -
14	Seed Bed Planting (Broadcast)		AC	$ 350	$ -
15	Mulch (Straw) for erosion control		AC	$ 600	$ -
16	Heavy Mulch (wood chip/cardboard)		AC	$ 8,000	$ -
17	Live planting		AC	$ 5,000	$ -
18	Combined planting schedule		AC	$ 3,000	
19	Heavy Mulch (wood chip/cardboard) along fence line (30-ft)		AC	$ 1,200	$ -
20	2-year follow up maintenance		AC	$ 2,000	
21	**Integrated Vegetation Management**		**AC**	**$ 6,200**	
22	Disking/Tilling		AC	$ 400	
23	Combined planting schedule		AC	$ 3,000	
24	Heavy Mulch (wood chip/cardboard)		AC	$ 8,000	
25	2-year follow up maintenance		AC	$ 2,000	
26	**Limited Integrated Vegetation Management (Alt 2)**		**AC**	**$ 13,400**	

Notes:

Mobilization/Demobilization, clearing and grubbing, water diversion, fish removal, cultural monitoring, etc are included in costs for each alternative

APPENDIX E

BIOLOGICAL REPORT FOR MANAGEMENT OF REED CANARY GRASS AT YONTOCKET SLOUGH AND TRYON CREEK

APPENDIX F

FINAL REPORT: SEDIMENTATION IN YONTOCKET SLOUGH AND TRYON CREEK, LOWER SMITH RIVER, DEL NORTE COUNTY, CALIFORNIA