Oregon Watershed Enhancement Board

Project-Scale Effectiveness Monitoring

Annual Progress Report for Livestock Exclusion Projects

2006 Baseline Data

Prepared by
Tetra Tech EC, Inc. and KWA Ecological Sciences, Inc.

October 2006

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ACKNOWLEDGEMENTS

Jennifer Hampel, Coquille Watershed Association

Heather Lilienthal, Coquille Watershed Association

Coquille Valley Elks Golf Course, Land Owner

Mike Miranda, Land Owner

Mike Mader, Tenmile Lakes Watershed Coordinator

Bob and Fontella Hankins, Land Owners

Joe and Maria Goularte, Land Owners

Sarah Hendrickson, Union Soil and Water Conservation District

Aric Johnson, U.S. Forest Service

U.S. Forest Service, Land Owner

Marty Suter, Harney Soil Water Conservation District

Gary Marshall, Land Owner

Marc O'Toole, Land Owner

Cindy Thieman, Long Tom Watershed Council

Deborah Mattson, Land Owner

EXECUTIVE SUMMARY

The Oregon Watershed Enhancement Board (OWEB) is currently working cooperatively with local watershed groups in Oregon to establish an effectiveness monitoring program for salmon habitat restoration projects. As a pilot program, OWEB selected seven livestock exclusion projects for effectiveness monitoring: three are located in northeast Oregon and four are in southwest Oregon. The monitoring addressed livestock presence, bank erosion, and vegetation measurements at each project site. The protocol adopted for this monitoring have been used in Washington State in the Salmon Recovery Funding Board's (SRFB) Reach-scale Effectiveness Monitoring Program over the last 3 years and are applicable to the objectives identified in the OWEB projects. The use of this protocol and the survey design wee selected especially to compliment the activities undertaken by the SRFB Effectiveness Monitoring Program. Data and results will be shared between the two states to build a robust network of effectiveness monitoring and restoration in the Northwest. Adopting this survey design and protocol to monitor the effectiveness of livestock exclusion projects in Oregon allows for the development of a larger sample size for this monitoring category and also helps to maintain consistency in data collected across the region.

The sample design for each monitoring site consists of a Before-After-Control-Impact (BACI) design. The reach where the project action takes place is called the impact reach and the control reach is established on a nearby stream reach where conditions are not expected to change over the monitoring time frame of 10 years. Monitoring the control reach allows changes in environmental variation to be subtracted from changes due to both environmental variation and restoration action. The control reach, which is not affected by the action, reflects the natural environmental variation occurring at the project site. The impact reach is affected by the project action and by natural environmental variation. The values measured at the control site are subtracted from the impact site values to isolate the change that is due to the project action, allowing for changes observed to be attributed to the project action and not to changes in environmental conditions.

This Annual Progress Report summarizes the data collected during the 2006 field season. This season's data represent the pre-project implementation, (or "before" year) data for BACI design projects, and the first year of sampling (Year 1) for livestock exclusion projects. This report contains preliminary findings that will serve as baseline data for future years of data collection. Initial comparison of data to the baseline and basic data analysis will occur in the 2007 Annual Progress Report. This report includes a description of objectives, data collection methods, results from the 2006 season, including a description and map of each project site sampled, and a brief description of planned data analysis.

TABLE OF CONTENTS

FIGURES

FIGURES (CONTINUED)

TABLES

ACRONYMS AND ABBREVIATIONS

BACI	Before-After-Control-Impact
dbh	diameter at breast height
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
OWEB	Oregon Watershed Enhancement Board
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
SRFB	Salmon Recovery Funding Board

1. INTRODUCTION

The Oregon Watershed Enhancement Board (OWEB) is a state agency led by a policy oversight board whose collective mission is to "promote and implement programs to restore, maintain, and enhance the watersheds of the State of Oregon in order to protect the economic and social well being of the state and its citizens" (OWEB 2006). In order to accomplish this mission, OWEB's programs support efforts to recover salmon runs, improve water quality, and strengthen ecosystems, which lead to more healthy communities in Oregon. Over 20 million dollars annually has been spent in support of projects to improve the health of Oregon's watersheds. These projects are conducted in cooperation with local watershed councils and citizen's groups to address the specific needs of a basin at the local level. OWEB has a responsibility to evaluate the effectiveness of these significant investments that are intended to improve the health of watersheds (OWEB 2003).

The Monitoring Strategy for the Oregon Plan for Salmon and Watersheds (OWEB 2003) provides a framework to evaluate the effectiveness of the Oregon Plan for Salmon and Watersheds (the Oregon Plan). Monitoring efforts in Oregon are supported through collaborative efforts with the Washington State Salmon Recovery Office, the Washington Salmon Recovery Funding Board, NOAA Fisheries, the Northwest Fisheries Science Center, and the Columbia Basin Fish and Wildlife Authority. The Monitoring Strategy focuses on three outcomes which establish the scope and expectations for the monitoring program. Outcome Two is designed to determine the benefit of Oregon Plan restoration projects, management practices, and conservation programs to watershed health and salmon populations. Strategy Five directs OWEB and the Oregon Plan Monitoring Program to evaluate the local effectiveness of restoration efforts and management practices by monitoring representative samples of specific project, activity, and program types. This pilot project directly addresses this strategy and outcome.

Effectiveness monitoring helps to provide accountability for expenditures in the form of quantified information on the physical and biological responses to the project action. The objectives of effectiveness monitoring at the project scale are to use a robust sample design and responsive parameters to determine if change observed at a site from before project implementation to after project implementation is due to the project action itself. Additionally, data are analyzed to determine if, on the whole, a project category is successful in achieving the stated objectives of the projects within that category.

Project-scale effectiveness monitoring measures environmental parameters to ascertain whether the actions implemented were effective in creating a desired change in habitat conditions (PNAMP 2005). Effectiveness monitoring of projects has occurred at the local

level, but has not been consistently coordinated across the state. Additionally, the management of salmon requires coordinated data collection across the region such that restoration efforts can address the needs of species whose ranges cross state and jurisdictional boundaries. To address this need, OWEB began to develop a pilot program for regionally compatible project-scale effectiveness monitoring in 2006.

This pilot program specifically focuses on livestock exclusion projects for two reasons: 1) OWEB has funded many of these projects and several were available for pre-project baseline data to be collected, and 2) there is a regional need to increase the number of livestock exclusion projects that are monitored in order that data analysis can be conducted effectively. The objectives of livestock exclusion restoration projects are to exclude livestock from riparian areas where the animals can cause significant damage to the stream (e.g. by breaking down stream banks, increasing sedimentation, and damaging shade-producing trees and shrubs) and to allow or enhance recovery where damage has occurred. By excluding livestock, adverse impacts can be avoided and natural restoration of vegetation can take place (Crawford 2004). Damage recovery can be accelerated by planting riparian vegetation rather than waiting for natural recovery. Determination of the success and cost effectiveness of these projects requires a monitoring program that provides quantitative measures of success. The objectives of reducing active erosion and increasing riparian vegetation structure are typically applied in livestock exclusion projects and these parameters are measured and compared to change in a control site to determine if project actions are improving conditions at the site (i.e., if the project is effective). Changes are compared to defined success criteria over a specific time period to determine if the project category is successful.

Seven livestock exclusion projects were selected in different areas of Oregon. The existing protocols used in Washington State for the Reach-scale Effectiveness Monitoring Program that were implemented by the Salmon Recovery Funding Board (SRFB) were adopted for this pilot project. The use of these protocols allows for comparable data across the region, as well as a larger sample size for data analysis when data from the two states are combined. Additional cost savings was also achieved by using the same contractor for both data collection efforts. This group already had the equipment and technology in place to implement data collection, calculate summary statistics, and organize the data collected in a database.

Data collected through this effort provide the baseline against which post-project data will be compared in future years. Additional project categories will likely be added to increase the breadth of the OWEB Reach-Scale Effectiveness Monitoring Program beyond this pilot effort.

2. SITE SELECTION, REACH SELECTION, AND LAYOUT

Protocols used in this pilot project were from the Washington State SRFB Protocol for Monitoring Effectiveness of Riparian Livestock Exclusion Projects (hereinafter referred to as SRFB Protocol) (Crawford 2004). These protocols, in turn, were drawn from the U.S. Environmental Protection Agency's (EPA's) Environmental Monitoring and Assessment Program (EMAP) approach for monitoring habitat in wadeable streams developed at the EPA laboratory in Corvallis, Oregon. The SRFB Protocol takes the EMAP approach and applies it using a Before-After-Control-Impact (BACI) sample design in which control and impact reaches are established at each project site. Change in a given parameter is calculated by subtracting the control from the impact reach in Year 0, prior to project implementation, and comparing that difference to the difference between impact and control in Year 1, after project implementation. The subtraction of the control reach value allows the data to truly reflect the results of the project action instead of changes in environmental conditions.

2.1 SITE SELECTION

OWEB staff worked with grantees to identify the areas where livestock exclusion projects were recently approved by the OWEB board and soon to be implemented. The areas selected for monitoring had several projects within a close radius to reduce travel time and improve the efficiency of the monitoring for the pilot project. Grantees worked with landowners prior to the sampling effort to gain access and to determine locations for control reaches. Sites selected for monitoring were clustered in southwest and northeast Oregon (Figure 2-1).

Field survey teams contacted grantees to discuss the needs for the control reaches, and the final selection for the impact and control reaches was made in the field.

2.2 ACCESS

Permission to access each project site was obtained from the landowner(s) as arranged through the grantees before starting seasonal fieldwork. The access issues were prioritized so that those sites that needed to be sampled first were the initial focus (e.g., sites with near-term implementation dates).

Grantees also provided valuable information and assistance in determining potential control sites for BACI design projects. These reaches were often on adjacent properties and permission to access the control site over time was also gained prior to or during this initial contact. Potential control sites were examined and it was determined in the field if they were suitable.

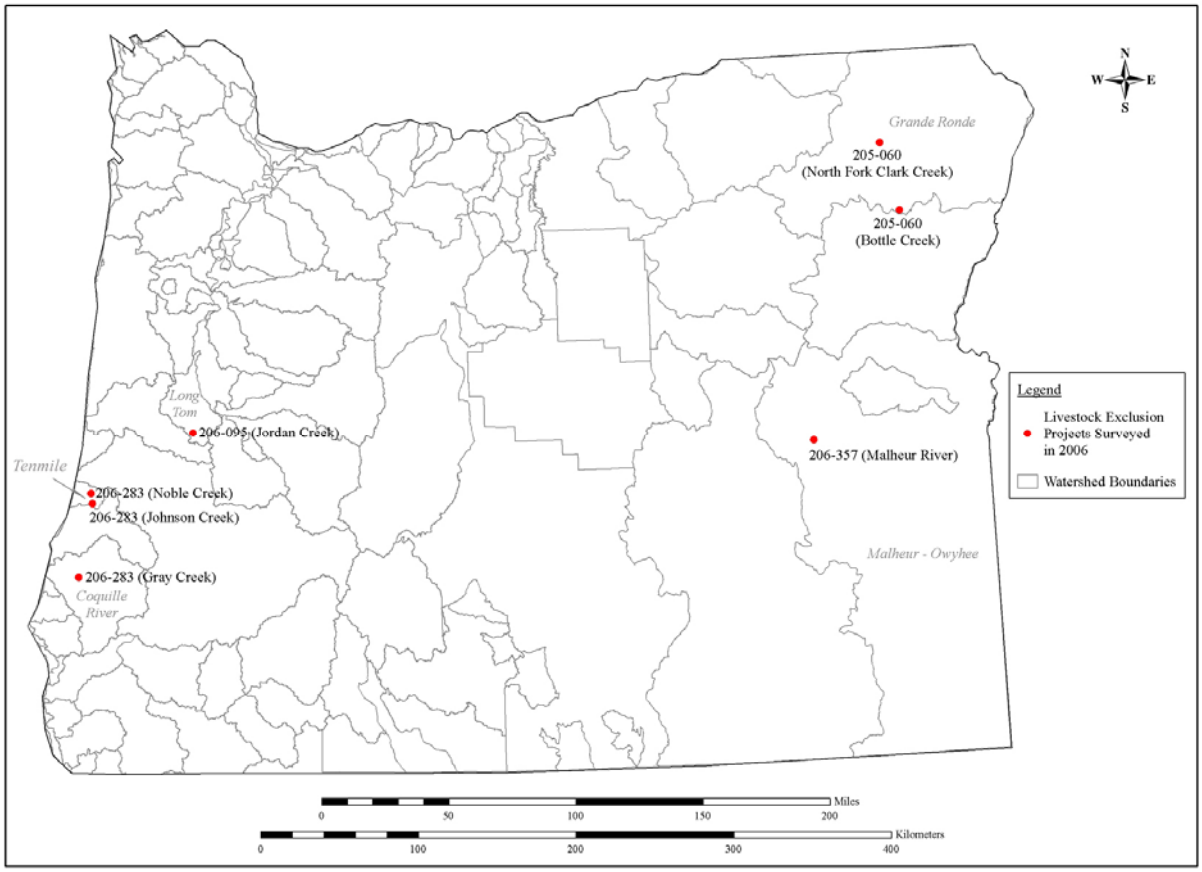

Figure 2-1. Monitoring Site Locations

2.3 DIGITAL DATA COLLECTION

Data were recorded using Husky FEX 21® hand-held computers and Trimble® global positioning system (GPS) units. Electronic field forms for each monitoring task were built either in Visual CE® or Microsoft Excel® software. Field data were downloaded to field laptops and sent to a permanent centralized database located in the Tetra Tech EC Office in Portland, OR. Digital files for each project include a project site map with topographic maps, digital data collection forms for hand-held data loggers, photographs of the transects in the control and impact reaches, and database structures to house the field data collected and calculate the appropriate summary statistics.

2.4 BACI DESIGNS

For this sample design, control and impact reaches were established and documented. These reaches were sampled before project implementation and will be re-sampled for several years after project implementation. As shown in Figure 2-2, for each project site, the "X" point was located using a GPS unit, and control and impact reaches were located in reference to the "X" point. The "X" site was the center of the sample reach. Each reach was selected in accordance

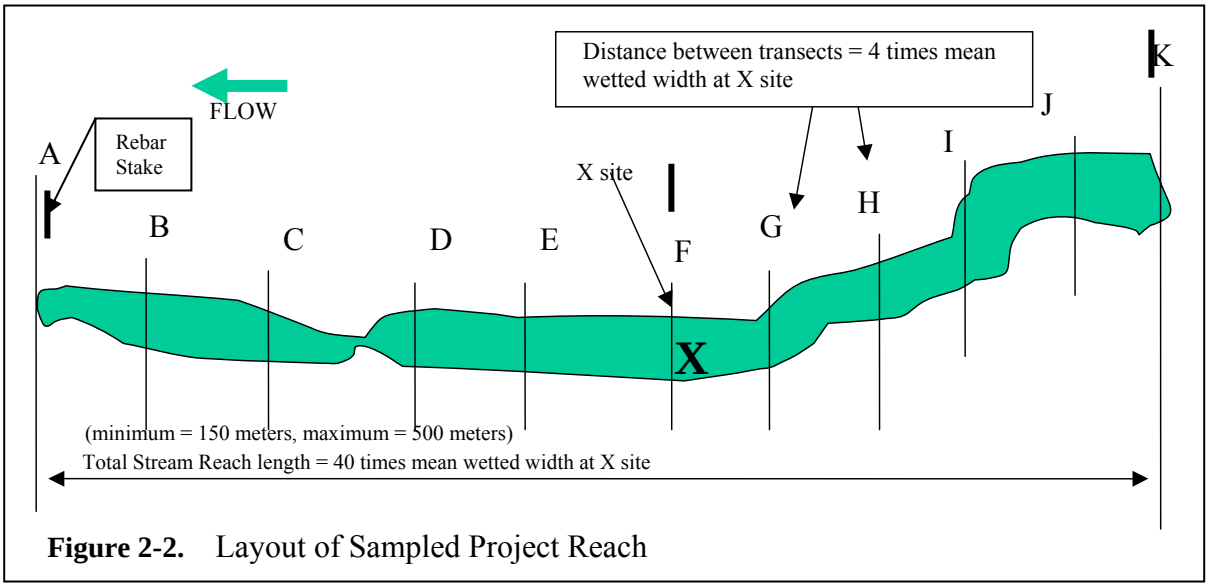

Figure 2-2. Layout of Sampled Project Reach

with the SRFB Protocols. Within each reach, 11 equally spaced sampling transects, labeled A through K, were established and flagged. The total length of the sample reach was based on 40 times the average wetted width of the channel, but was at least 150 meters. Permanent rebar stakes were placed at Transects A, F, and K to facilitate relocating the sample reach (Figure 2-2).

Transect F was located in the center of the sample reach and served as the "X" site. GPS points were recorded for each sample reach at Transects A, F, and K where the rebar stakes were placed. Photographs were taken of the view upstream and downstream at Transects A,F, and K to help relocate the transects. Additionally, a reach map was drawn for each sample reach with the location of each transect and reach-scale landmarks to help relocate the sample reach. The combination of the GPS points, rebar stakes, reach description, site directions, photographs, and a reach map was deemed sufficient documentation to relocate the sample reaches in subsequent sampling efforts.

3. MONITORING METHODS

Seven livestock exclusion projects were identified for the 2006 field season (Figure 2-1). Monitoring data collected at these sites included livestock presence, riparian vegetation structure, shading, and bank erosion in control and impact reaches. Livestock presence was assessed before project implementation and presence or absence of livestock will be documented after project implementation. These parameters are discussed further below.

3.1 LIVESTOCK PRESENCE

Livestock presence was assessed prior to implementation using the SRFB Protocol (Crawford 2004), and this monitoring will be repeated after implementation. Photographs were taken to document any effects from or evidence of livestock use and to determine the point of entry for any livestock. Livestock exclusions will be considered effective if 80 percent of the projects continue to exclude livestock after 10 years, or the maximum project agreement length, which ever is greater. Any entrance of livestock into the riparian area would be an example of project failure. Data analysis methods are discussed further in Section 5.

3.2 RIPARIAN VEGETATION

The SRFB Protocol (Crawford 2004) was used to measure for riparian structure. At each lettered transect, crews visually estimated 5 meters upstream and 5 meters downstream and 10-meter horizontal distance into the bank riparian vegetation. This formed a conceptual 10 meter x 10 meter square straddling the transect along each bank. The vegetation was then mentally divided into three vertical layers:

- **Canopy—**vegetation greater than 5 meters (16 feet),
- **Understory**—vegetation between 0.5 meter to 5 meters (20 inches to 16 feet) in height
- **Ground cover**—vegetation less than 0.5 meter (20 inches) high.

Dominant vegetation type for the canopy was categorized as Deciduous, Coniferous, Broadleaf Evergreen, Mixed, or None. The canopy was considered mixed if more than 10 percent is another type. Aerial cover class of large trees (greater than 0.3 meter or 1 foot diameter at breast height [dbh]) and small trees (less than 1 foot dbh) was also determined within the canopy layer:

- None—0
- 1— sparse <10 percent

- 2—low 10-40 percent
- 3—moderate 40-75 percent
- 4—heavy >75 percent

Dominant vegetation was also recorded for the understory layer (Deciduous, Coniferous, Broadleaf Evergreen, Mixed, or None). Aerial cover class for woody shrubs and saplings within the understory was estimated as above. Aerial cover was similarly determined for the ground layer for woody shrubs and seedlings, non-woody vegetation, and the amount of bare ground/duff. These estimates were completed for both banks at each transect along the reach.

3.3 SHADING

The SRFB Protocol (Crawford 2004) was used to measure shading for riparian plantings. Six densiometer measurements of canopy cover were taken at each cross section. By counting the number of grid intersection points within the "V" that were covered by a tree, leaf, or high branch, a score between 0 and 17 was assigned for canopy cover at each measurement point. Four measurements were taken from the center of the stream: facing downstream, upstream, toward the left bank, and toward the right bank. Two measurements were taken at the banks; one facing each bank. If the measure could not be taken, it was indicated in the data form with an explanation. Stream center scores were averaged to produce a mean canopy density at midstream. Bank measurements were averaged to produce a mean bank canopy cover as well. Densiometer scores were reported as an average of all readings, which ranged from 1 to 17 over the entire reach.

3.4 ACTIVELY ERODING STREAM BANKS

The SRFB Protocol (Crawford 2004) was used to estimate the percent of the linear distance of the channel on both sides at each transect that was actively eroding at active channel height. Active erosion consists of active bank slumping, or clear impacts due to livestock use of the banks that are not completely revegetated. The project will be considered effective if a 20 percent reduction in percent bank length that is actively eroding is observed within 10 years.

4. RESULTS

This section summarizes the results for each project, the data collected, and includes specific project information pages (in a special format). Some of the summary parameters will be compared to decision criteria once the project has been implemented and change can be detected. Other summary parameters were used to provide the length of the sample reach (Reach Length) and the length of stream affected by the installation of the project (Stream Length).

4.1 DECISION CRITERIA

Decision criteria are used to determine if a project has been successful with respect to creating measurable change at the project site where the project is implemented. A value of 20 percent change was selected for most parameters as a threshold used to determine the success of a project, and can be used within a single project, or in looking at the projects as a group. The decision criterion of 80 percent for the functional exclusion parameter is based on the performance of all the projects in the monitoring category (e.g., all the livestock exclusions monitored). Table 4-1 identifies the summary statistics for livestock exclusions. The determination on functional exclusions will be made after implementation.

Table 4-1. Decision Criteria for Livestock Exclusions

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Functional Exclusion	The number of livestock exclusions meeting the design criteria for excluding livestock from the stream (EXCLDESIGN)	#	None. Count of functional exclusions	≥ 80% of exclusions are functional by Year 10. "Functional" means there are no holes in the fencing and no recent signs of livestock inside the exclusion.
Riparian Condition	Mean canopy density at the bank Densiometer Reading (XCDENBK)	1-17 score	Paired *t*-test	Alpha = 0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Three-layer riparian vegetation presence (proportion of reach) (XPCMG)	%	Paired *t*-test	Alpha = 0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Actively eroding banks (BANK)	%	Paired *t*-test	Alpha = 0.10 for one-sided test. Detect a minimum 20% change between Impact and control by Year 10

Source: Crawford 2004
[1/] Variable names in all caps relate to database variables.

4.2 PROJECT-SPECIFIC SUMMARIES

Project results below are grouped together based on the grant funding used to implement the project and the project sponsor that received the funding to implement the project. Project sponsors included the Coquille Watershed Association, Tenmile Lakes Basin Partnership, Union Soil and Water Conservation District, Harney Soil and Water Conservation District, and Long Tom Watershed Council.

4.2.1 Coquille Watershed Association

The Coquille River Watershed is the largest watershed that originates in the Coast Range. It covers 1,059 square miles and lies primarily in Coos County in southeastern Oregon. Smaller portions of the watershed are in Douglas and Curry County. There are three main tributaries, which join the mainstem Coquille River close to Myrtle Point, Oregon. The river flows into the Pacific Ocean at Bandon, Oregon.

The majority of the watershed (70 percent) is forested. The population is concentrated in the valleys where the land usage consists of residential, industrial, agriculture, grazing, and gravel extraction. The hills and steeper slopes above the valleys support timber, agriculture, and some mining. The upper reaches of the main tributaries and many tidewater streams are commercial forest.

The Coquille Watershed Association is a nonprofit corporation formed in 1994 by local citizens. The association has grown considerably since then and is managing over 40 active projects that range from riparian restoration and erosion control to fish passage, instream habitat, and wildlife enhancement. A visible commitment to adaptive management and the use of monitoring is shown by the inclusion of a monitoring coordinator in its organization. While specific protocols have not been selected, the organization has incorporated monitoring into its mission, goals, and objectives. The association's Action Plan includes an emphasis on the use of monitoring to track project implementation and project effectiveness. The Coquille Watershed Association website is http://www.coquillewatershed.org/index.html.

One project sponsored by the Coquille Watershed Association was included for monitoring in this pilot study. This project is located in Gray Creek and specific project information is presented in the following project pages.

206-072: Gray Creek Livestock Exclusion Project

Left: Year 0 (2006)—Impact reach; evidence of livestock use along stream
Right: Year 0 (2006)—Control site on Gray Creek looking upstream at transect F

Location

The project area is located in the Coquille Watershed, about 0.5 mile from the Watershed Council Office along State Highway 42 southwest of Coquille, Oregon. The habitat within the proposed project area is a low-gradient meandering stream that runs through a dairy at the site. The control reach is located at the Coquille Valley Elks Golf Course, upstream along Gray Creek, across Highway 42. See Figure 4-1 for a map of the reach locations.

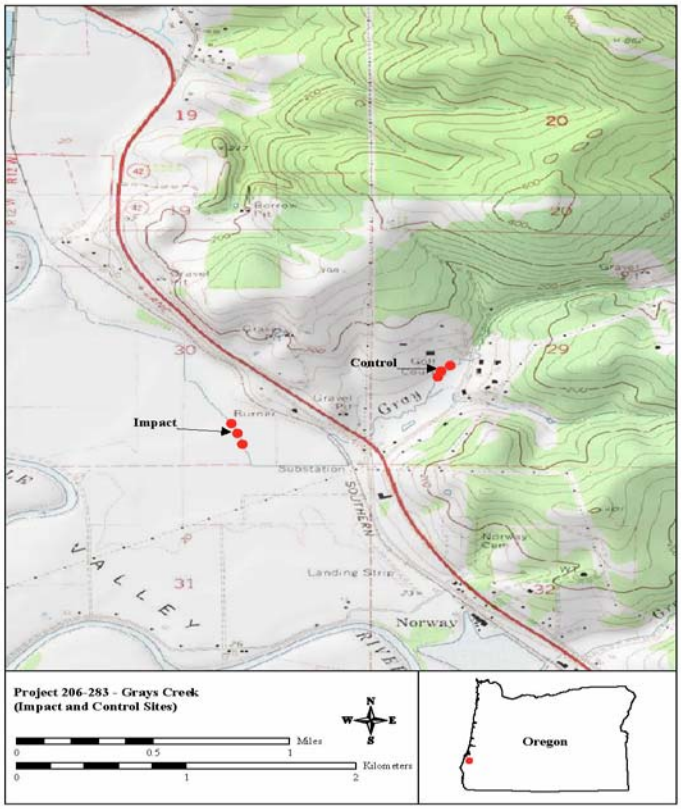

Figure 4-1. Map depicting the location of control and impact reach reference points for Project No. 206-072

Background/Sponsor Monitoring

Logging and agriculture from the early 1900s removed many of the trees along the streams in the Coquille Watershed. Species such as Himalayan blackberry, reed canary grass, and red alder are common in the watershed. Additionally, grazing has caused erosion along streams and increased sedimentation (OWEB Grant Application #206-072, 2005).

The project site is located on an active dairy and the land has been in agriculture for at least the past 25 years. There are about 120 cattle that use the land adjacent to the creek for grazing and had access to the creek before the project was implemented (H.

Lilienthal, personal communication). Active use of the site by cattle was apparent, and cattle were present at the time of the survey. Part of the stream has been straightened and runs through a ditch along the pasture edge. Vegetation includes grasses and some Himalayan blackberry. The target species for this project are coho and steelhead, both of which use Gray Creek for spawning and rearing.

The current monitoring for projects implemented by the Coquille Watershed Association includes both pre-project and post-project assessments of erosion, bank height, riparian and fence setbacks (if present), riparian cover by species, and measures of invasive species such as blackberry. Pre-project assessments also include measurements of gradient and substrate and the distribution of riparian vegetation species. The number of acres for the property and the number of animals grazed on the property are also recorded. Post-project monitoring assesses the same parameters as well as the tree height of primary and secondary trees planted at the site, tree survival, and documentation of fencing and functional tubes or cages to protect the trees. The type of monitoring conducted by the Coquille Watershed Association is similar to the approach outlined here, except for the presence of a control reach and some of the specific methods used for data collection.

Objective/Intent

Early agricultural practices have resulted in highly degraded riparian zones in the Coquille Watershed. The Gray Creek project involves fencing both sides of the creek for 1,981 meters, using 13,000 feet of fence. The fence will prevent livestock access to the creek. The total acres to be fenced will be 2.8. The fence will have two set backs, one at 5 feet and one at 12 feet to allow for maintenance of the waterway. Fencing should allow riparian vegetation cover and bank stability to increase along Gray Creek.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	1,981
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	9.53	12.18
Riparian Vegetation Structure (% with three layers)	0	0
Length of Actively Eroding Banks (% of total bank)	63.18	13.41
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 6/8/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Coquille Watershed Association

Contact: Jennifer Hampel, Heather Lilienthal, Coquille Watershed Association

Land Owners: Coquille Valley Elks Golf Course (control reach), Mike Miranda (impact reach)

4.2.2 Tenmile Lakes Basin Partnership

The Tenmile Watershed encompasses approximately 98 square miles and is located in Coos and Douglas Counties on the southern Oregon coast. The watershed originates as six major tributaries in the Coast Mountains that drain to the lakes complex. Ten Lakes, which make up 5 percent of the watershed, drain through one outlet, Tenmile Creek, to the Pacific Ocean. Coastal sand dunes often encroach on the mouth of Tenmile Creek in the summer months preventing surface flows.

The lakes are considered important fishery as well as recreational resources. They also serve as a primary drinking water supply for many lakeshore residents. The City of Lakeside, located on South Tenmile Lake near Tenmile Creek, is the only incorporated area in the watershed and utilizes Eel Lake as its drinking water source.

The watershed is predominantly forested uplands. Approximately one-third of the watershed is in Elliot State Forest and another quarter is commercial forest. The Oregon Dunes Natural Resource Area occupies 14 percent of the watershed. Some of the areas in the tributary valleys upstream of the lakes are functioning as wetlands and others are managed as agricultural wetlands. The agricultural wetlands are generally characterized by channelized or simplified channels. These areas are principally used for livestock grazing and hay production.

The Tenmile Lakes Basin Partnership involves industry, local citizens, natural resource agencies, Native American tribes, and conservation groups to promote ecosystem health and diversity. They have participated in many projects including the development of a watershed-wide voluntary Water Quality Implementation Plan. The plan is designed to guide implementation and track and report the results of actions that are conducted to improve water quality. The Partnership also focuses on technical support and education to support land management. Riparian enhancement, sediment abatement, education and outreach, as well as assessment and planning are other examples of Tenmile Lakes Basin Partnership projects. Water quality monitoring programs are also being implemented by the Tenmile Lakes Basin Partnership. The website for the Tenmile Lakes Basin Partnership is http://tlbp.presys.com/.

Two projects sponsored by the Tenmile Lakes Basin Partnership were included for monitoring in this pilot study. They are located on Johnson Creek and on Maria Gulch Creek, a tributary to Noble Creek. Information on these projects is provided in the following project pages.

206-283: Johnson Creek Livestock Exclusion Project


Left: Year 0 (2006)—Johnson Creek impact reach; evidence of livestock use along stream
Right: Year 0 (2006)—Control site on Johnson Creek looking upstream at transect F

Location

The project area is located in the Tenmile Lakes Watershed. The property is located south of the town of Lakeside, east of Highway 101. The control reach is just upstream of the impact reach. The control reach is currently fenced and will remain fenced for the duration of the monitoring. See Figure 4-2 for a map of the reach locations.

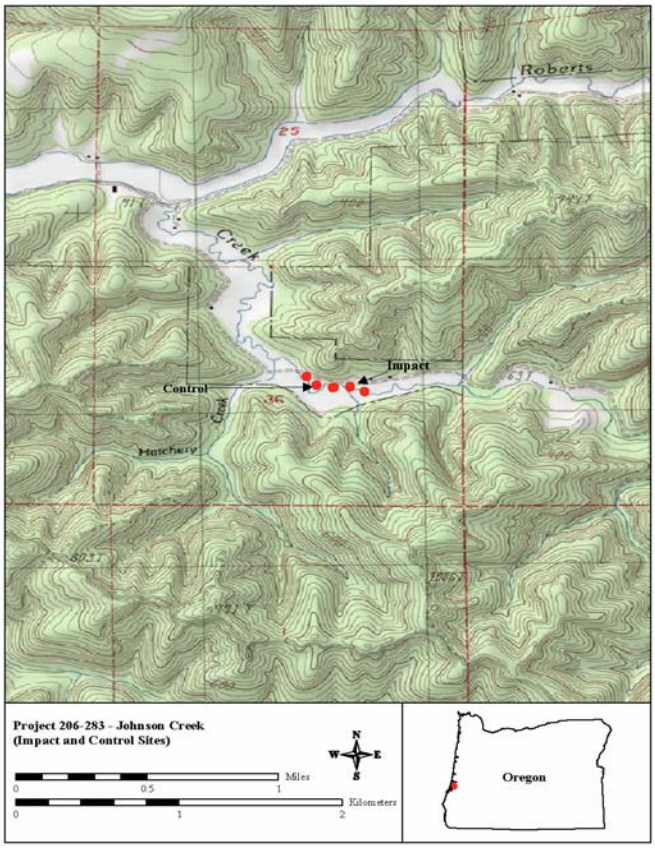

Figure 4-2. Map showing location of impact and control reaches for Project No. 206-283

Background/Sponsor Monitoring

This project is located on private land that has been managed for agriculture since the late 1920s. The land around Johnson Creek was one of the first areas developed for farming in the region (OWEB Grant Application #206-283, 2005). The pasture where the creek is located currently has 90 animals grazing, which will be excluded from the creek when the project is implemented (M. Mader, personal communication). Current cattle use is evident along the creek and cattle were present at the time of the survey.

Monitoring that is currently conducted at projects implemented by the Tenmile Lakes Watershed Council staff includes documentation using photograph points once the fence is installed. The condition of the fence and any need for repairs are noted. The

vegetation growing inside the fence is described, as is the amount of new growth. Evidence of erosion, sediment, and the presence of spawning gravel are identified and noted. Water temperature at the site is also recorded. If plantings or seedlings are present, the height of the seedlings is measured when they are planted. Seedling height is re-measured later and any predation on the plants is noted. Maintenance operations are recorded and photographs of the site are taken. Canopy closure and percent shading are also recorded as are plant communities surrounding the project (Tenmile Watershed Council 2006a, 2006b). The monitoring conducted by the Tenmile Lakes Watershed Council is similar to the approach used in this report, except for the presence of a control reach.

Objective/Intent

The objective of this project is to improve the riparian condition and reduce sediment input into Johnson Creek. The riparian zone functions and bank stability in this creek has been reduced due to past land use practices. As identified in the project applications, actively eroding banks in Johnson Creek and other creeks are contributing to a 10-fold increase in the amount of sediment delivered to Tenmile Lakes and are affecting salmon habitat and water quality (OWEB Grant Application #206-283, 2005). Fencing along Johnson Creek will provide benefits to the watershed in the form of increased ground water storage, reduction in non-point source runoff, increases in stream complexity, and increases in shading of the channel.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	1,067
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	7.15	2.97
Riparian Vegetation Structure (% with three layers)	0	0
Length of Actively Eroding Banks (% of total bank)	4.32	80.23
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 6/7/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Tenmile Lakes Basin Partnership

Contact: Mike Mader, Tenmile Lakes Watershed Coordinator

Land Owners: Bob and Fontella Hankins

206-283: Noble Creek/Maria Gulch Livestock Exclusion Project

Left: Year 0 (2006)—Maria Gulch impact reach; evidence of livestock use along stream
Right: Year 0 (2006)—Control site on Noble Creek looking downstream at transect F

Location

The project area is located in the Tenmile Lakes Watershed east of Lakeside Oregon, off Noble Creek Road. See Figure 4-3 for a map of the reach locations. The control reach is a currently fenced site that will remain fenced over the period of monitoring. The impact reach is currently unfenced, but will be fenced in 2007.

Background/Sponsor Monitoring

This project is located on private land that has been managed for agriculture since the late 1920s. The pasture where the creek is located currently has 40 animals grazing, which will be excluded from the creek when the project is implemented (M. Mader, personal communication). Cattle use is present along the creek and cattle were grazing at the time of the survey.

Monitoring that is currently conducted at projects implemented by the Tenmile Lakes Watershed Council staff includes documentation using photograph points once the fence is installed. The condition of the fence and any need for

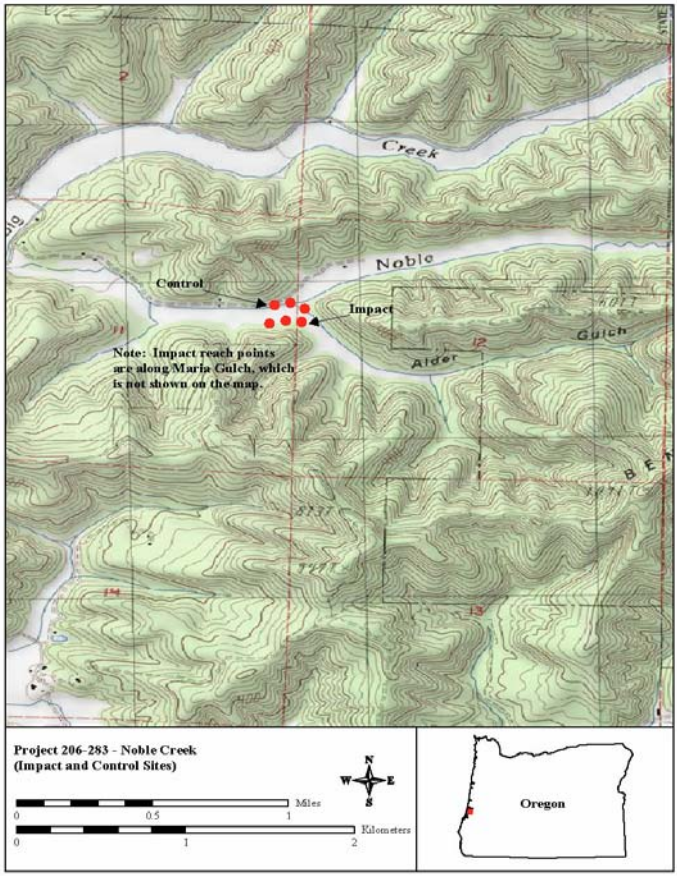

Figure 4-3. Map showing the locations of impact and control reaches for Project No. 206-283

repairs are noted. The vegetation growing inside the fence is described, as is the amount of new growth. Evidence of erosion, sediment, and the presence of spawning gravel are identified and noted. Water temperature at the site is also recorded. If plantings or seedlings are present, the height of the seedlings is measured when they are planted. Seedling height is re-measured later and any predation on the plants is noted. Maintenance operations are recorded and photographs of the site are taken. Canopy closure and percent shading are also recorded as are plant communities surrounding the project (Tenmile Watershed Council, 2006a, 2006b). The monitoring conducted by the Tenmile Lakes Watershed Council is similar to the approach used in this report, except for the presence of a control reach.

Objective/Intent

Riparian zone function, bank stability, and shading are much reduced from past conditions due to land use practices. This project will provide fencing and riparian planting to reduce the input of sediment from bank erosion in Maria Gulch, a tributary to Noble Creek. These fencing and planting projects are intended to prevent livestock access to the stream, reduce sediment input and non-point source runoff, and improve riparian vegetation quality and shading.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	1,524
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	6.79	11.58
Riparian Vegetation Structure (% with three layers)	0	0
Length of Actively Eroding Banks (% of total bank)	0	49.55
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 6/6/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Tenmile Lakes Basin Partnership

Contact: Mike Mader, Tenmile Lakes Watershed Coordinator

Land Owners: Joe and Maria Goularte

4.2.3 Union Soil and Water Conservation District

The Grande Ronde River originates in the Blue and Wallowa Mountains in northeast Oregon. It flows generally northeast to the Snake River about 20 miles upstream of Asotin, Washington. After leaving the Blue Mountains, it flows through the Grande Ronde Valley, one of the two major valleys in the watershed. The Grande Ronde River slows and meanders along the Grande Ronde Valley floor, which lies at a relatively high elevation (2,600 to 2,800 feet). The Bottle and North Fork Clark Creek project areas are in this valley.

The land in the Grande Ronde Valley is mostly privately owned, compared to the land to the east and west in the mountains, which is National Forest land. Outside of the population centers, most of the land is agricultural and used for range and cropland. The Grand Ronde basin includes large portions of Union and Wallowa Counties and a small portion of Umatilla County in Oregon. It also includes about a third of Asotin County and small portions of Columbia and Garfield Counties in Washington.

The Union Soil and Water Conservation District, located in Union County, helps landowners, managers, and residents protect near-stream areas and reduce the transport of chemicals and nutrients to streams from sedimentation or runoff. Their projects include riparian planting, fence installation, establishment of conservation tillage, construction of watering facilities, and implementing measures to prevent soil erosion and spread of invasive weeds. They also provide technical assistance, education, and outreach. The Union Soil and Water Conservation District website is http://www.grmw.org/.

Two projects sponsored by the Union Soil and Water Conservation District were included for monitoring in this pilot study. They are located in Bottle Creek and in a tributary to the North Fork of Clark Creek. Information on these projects is included in the following project pages.

205-060: Bottle Creek Livestock Exclusion Project

Left: Year 0 (2006)—Upper portion of Bottle Creek treatment site before livestock fencing
Right: Year 0 (2006)—Bottle Creek control site

Location

The project area is located in the Grande Ronde Valley, in Union County, east of the town of Union on U.S. Forest Service land. The control reach is located upstream from a U.S. Forest Service road crossing and the treatment reach is located downstream. See Figure 4-4 for a map of the control and impact reaches. The control reach and the impact reach are not fenced.

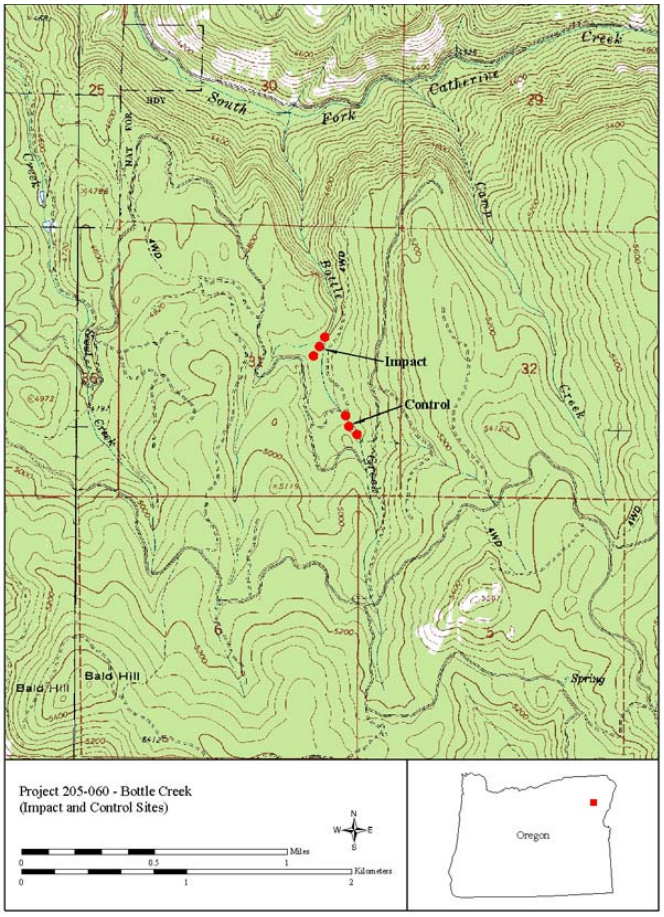

Figure 4-4. Map showing the locations of impact and control reaches for Project No. 205-060

Background/Sponsor Monitoring

The treatment site is associated with past timber harvest, which has resulted in ready access to the stream by cattle. Cattle have had access to the treatment area for approximately 80 years. Currently, 400 head of cattle are permitted to use the broader pasture area surrounding the project. The use of electric fences to exclude cattle from the treatment site has been tried for the past 3 years with limited success. An estimated 50 to 100 head of cattle access the project area directly Although not observed directly during the 2006 OWEB survey, US Forest Service personnel indicated that significant elk activity does occur as the Bottle Creek site. Fences are designed to keep our livestock, but

may not prevent elk from accessing the creek, so this source of bank degradation will still be present at the impact reach. Future monitoring after project implementation may require some refinement in order to distinguish effects of elk from those of livestock. The presence of elk sign (track, hair dung) could be used as distinguishing characteristics (A. Johnson, personal communication).

Monitoring by the project sponsor will consist of representative photographic points taken annually for 5 years to document lack of use by livestock, improvements in riparian vegetation, and streambank recovery. Effectiveness monitoring conducted by the project sponsor will be used to document that fences are properly maintained and effective in keeping livestock out of riparian areas. The U.S. Forest Service La Grande Ranger District Range Management Specialist will periodically inspect the fence throughout the grazing season for 10 years (A. Johnson, personal communication).

These largely qualitative monitoring efforts by the project sponsor are expected to complement the newly initiated quantitative effectiveness monitoring program conducted through OWEB by providing a long-term photographic record documenting measured changes in riparian structure, shading, and bank erosion.

Objective/Intent

This project is intended to benefit steelhead and resident redband rainbow trout (and potentially bull trout and spring chinook) by replacing the existing temporary electric fence with permanent, four-strand, barbed wire "let down" fence to exclude livestock from 2,000 (610 meters) feet of Bottle Creek.

The specific project objectives are to exclude cows from the riparian area, protect and enhance deciduous riparian vegetation, increase streambank stability, increase stream shade, and decrease sedimentation to streams.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	610
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	14.12	10.36
Riparian Vegetation Structure (% with three layers)	54.50	18.20
Length of Actively Eroding Banks (% of total bank)	6.50	11.00
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 6/19/06 and 6/20/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Union Soil and Water Conservation District
Contact: Aric Johnson, U.S. Forest Service
Land Owner: U.S. Forest Service

205-060 North Fork Clark Creek Tributary Exclusion Project

Left: Year 0 (2006)—Control site on unnamed tributary to North Fork Clark Creek (small stream in foreground)
Right: Year 0 (2006)—Example of trampled banks at unnamed tributary to North Fork Clark Creek treatment site

Location

The project area is located in Union County within the Upper Grande Ronde Watershed. The impact and control reaches are located near the town of Elgin (Oregon) on U.S. Forest Service land. See Figure 4-5 for a map of the control reach and impact reach. The control reach and the impact reach are not fenced.

Background/Sponsor Monitoring

The treatment site is associated with past timber harvest, which has resulted in ready access to the stream by cattle. Cattle have had access to the treatment area for approximately 25 to 30 years. Currently, 160 head of cattle are permitted to use the broader pasture area surrounding the project. The use of electric fences to exclude cattle from the treatment site has been tried for the past 3 years with limited success. An estimated 50 to 100 head of cattle access the project area directly. Although not observed directly during the 2006 OWEB survey, US Forest Service personnel indicated that significant elk

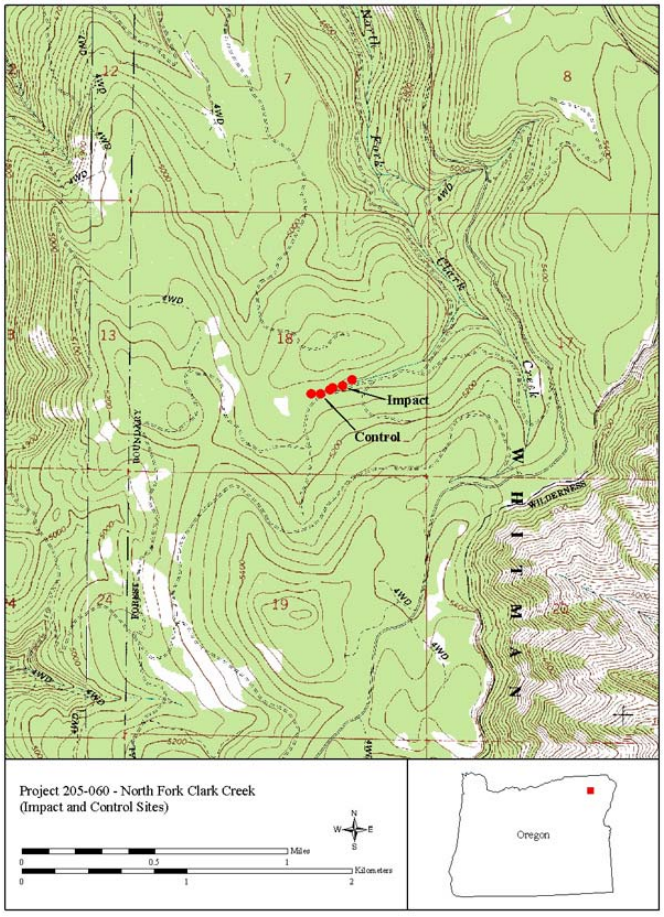

Figure 4-5. Map showing the locations of impact and control reaches for Project No. 205-060

activity does occur as the North Fork Clark Creek site. Fences are designed to keep our livestock, but may not prevent elk from accessing the creek, so this source of bank degradation will still be present at the impact reach. Future monitoring after project implementation may require some refinement in order to distinguish effects of elk from those of livestock. The presence of elk sign (track, hair dung) could be used as distinguishing characteristics (A. Johnson, personal communication).

Monitoring by the project sponsor will consist of representative photographic points taken annually for 5 years to document lack of use by livestock, improvements in riparian vegetation, and streambank recovery. Effectiveness monitoring conducted by the project sponsor will be used to document that fences are properly maintained and effective in keeping livestock out of riparian areas. The La Grande Ranger District Range Management Specialist will periodically inspect the fence throughout the grazing season for 10 years (A. Johnson, personal communication).

These largely qualitative monitoring efforts by the project sponsor are expected to complement the newly initiated quantitative effectiveness monitoring program conducted through OWEB by providing a long-term photographic record documenting measured changes in riparian structure, shading, and bank erosion.

Objective/Intent

This project is intended to benefit steelhead and resident redband rainbow trout (and potentially bull trout and spring chinook) by replacing existing temporary electric fence with permanent, four-strand, barbed wire "let down" fence to exclude livestock from 2,400 feet (732 meters) of an unnamed tributary to the North Fork Clark Creek.

The specific project objectives are to exclude cows from the riparian area, protect and enhance deciduous riparian vegetation, increase streambank stability, increase stream shade, and decrease sedimentation to streams.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	732
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	13.44	14.56
Riparian Vegetation Structure (% with three layers)	36.40	36.40
Length of Actively Eroding Banks (% of total bank)	37.00	38.50
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 6/20/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Union Soil and Water Conservation District
Contact: Aric Johnson, U.S. Forest Service
Land Owner: U.S. Forest Service

4.2.4 Harney Soil and Water Conservation District

The Malheur Lakes Basin watershed is in Harney County in southeast Oregon. It is made up of several closed basins, none of which ultimately flow to the Pacific Ocean. It covers a little over 6 million acres in the southeast portion of Oregon. The average elevation for the basin is 4,200 feet and most of the basin is arid high desert uplands. Approximately 10 percent of the basin in the north portion is forested. Most of the land is used for agriculture, primarily grazing and hay production. Almost three-quarters of the land is administered by federal and state agencies. The U.S. Fish and Wildlife Service manages the 187,000-acre Malheur National Wildlife Refuge at the base of Steens Mountain.

The Harney Soil and Water Conservation District, located in Harney County, helps landowners, managers, and residents protect near-stream areas and reduce the transport of chemicals and nutrients to streams from sedimentation or runoff. Their projects include exclusion fence installation, construction of watering facilities, establishment of buffers and riparian plantings, implementation of grazing management practices, stream stabilization, wetland restoration, and implementing measures to prevent soil erosion and spread of invasive weeds. They also provide technical assistance, education, and outreach. The Harney Soil and Water Conservation District information can be found on the Oregon Association of Conservation Districts website at http://www.oacd.org/.

One project sponsored by the Harney Soil and Water Conservation District is included for monitoring in this pilot project. This project is located in the Middle Fork Malheur River subbasin and information is provided in the following project pages.

206-357 Middle Fork Malheur River Bank Stabilization Project

Left: Year 0 (2006)—Upper portion of Middle Fork Malheur River treatment area before livestock fencing
Right: Year 0 (2006)—Control site downstream from transect K on Middle Fork Malheur River

Location

The project area is located in Harney County within the Middle Fork Malheur River subbasin. The impact reach is located on the Marshall property at the overlook to the Malheur River. The treatment site is located immediately below and the control approximately 0.4 mile upstream. See Figure 4-6 for a map of the impact and control reaches. The control reach and the impact reach are not fenced.

Background/Sponsor Monitoring

The project area has been in agricultural production since at least the early 1900s. Approximately 100 head of cattle will be excluded from over 1 mile of the Middle Fork Malheur River when the project is completed (M. Suter, personal communication).

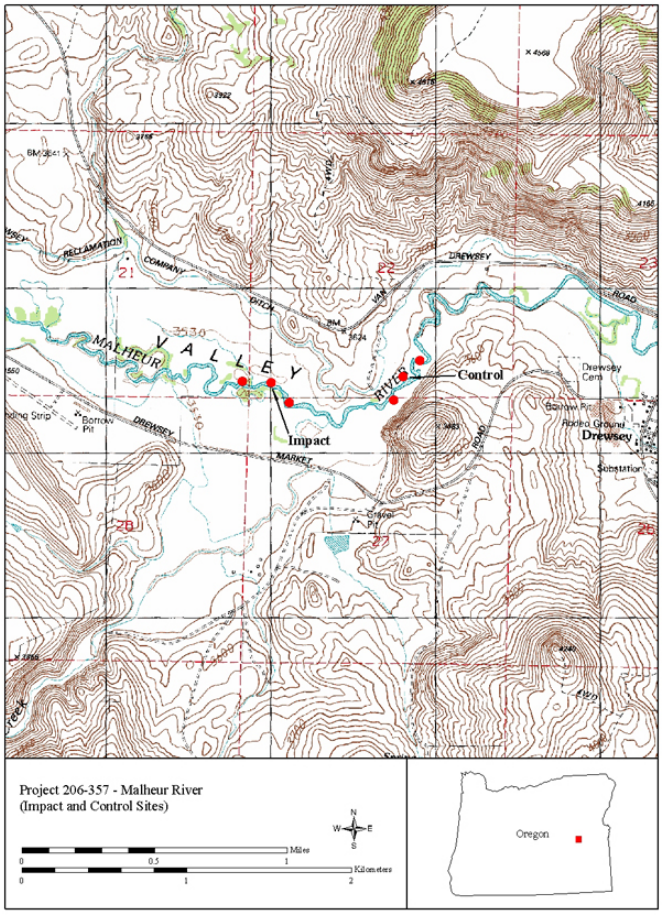

Figure 4-6. Map showing the locations of impact and control reaches for Project No. 206-357

Future monitoring efforts by the project sponsor will focus on the bank re-sloping portion of the project and will consist of visual inspections and photographic documentary to ensure that the project instream structures do not erode away and that bank re-vegetation occurs (M. Suter, personal communication). These largely qualitative monitoring efforts by the project sponsor are expected to complement the newly initiated quantitative effectiveness monitoring program conducted through OWEB by providing a long-term photographic record documenting measured changes in riparian structure, shading, and bank erosion.

Objective/Intent:

The objective of this project is to improve fish habitat, including habitat for bull trout listed on the Endangered Species List, and reduce excessive bank erosion on the Middle Fork of the Malheur River in the Drewsey Valley by rehabilitating several badly downcut and eroding sections of streambank. The downcutting and erosion are the result of livestock in the area accessing the creek as a water source. Rosgen J-hook vane structures, bank sloping and re-vegetation, and buffer fencing will be used to re-direct streamflows away from the eroding bank, create pool habitat, and re-establish riparian vegetation.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	1,609
Reach Length (meter)	375	375
Riparian Characteristics		
Mean Canopy Density (1-17)	0.53	1.24
Riparian Vegetation Structure (% with three layers)	0	0
Length of Actively Eroding Banks (% of total bank)	58.50	71.25
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 8/16/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Harney Soil Water Conservation District

Contact: Marty Suter, Harney Soil Water Conservation District

Land Owners: Gary Marshall and Marc O'Toole

4.2.5 Long Tom Watershed Council

Jordan Creek is in the southeastern portion of the Long Tom Watershed, one of the major watersheds in the upper Willamette River Basin. The Long Tom River originates in the forested Coast Range Mountains, flows through agricultural, rural, and urban areas to Fern Ridge Reservoir, and then through larger farms until it joins the Willamette River. The central and eastern portion of the watershed has gentler gradients making it suitable for agriculture and urban development. The project area is located in the southeastern portion of the watershed that is largely agricultural or urban development.

Long Tom Watershed is in Lane County and is mostly (88 percent) privately owned. The Long Tom Watershed Council is a volunteer community organization, which was formed in response to a statewide call for collaborative watershed restoration at the local level. The organization started in 1996 and formalized its structure over the next couple years. The Long Tom Watershed Council works to improve watershed and water quality condition through education, coordination, consultation, and cooperation among interests. Restoration projects, including exclusion fencing, plantings, and other stream and wetland improvements, are being undertaken throughout the watershed by the Council and a number of partners.

The Long Tom Watershed Council has a monitoring program that is focused on water quality. The monitoring started in 1999 and includes routine water quality monitoring at over 40 sites. Monitoring parameters include temperature, dissolved oxygen, turbidity, conductivity, E.coli, nutrients, and suspended solids. The Council website is at http://www.longtom.org/.

One project sponsored by the Long Tom Watershed Council is included for monitoring in this pilot project. This project is located on Indian Creek and information is provided on the following project pages.

206-095: Jordan Creek Livestock Exclusion Project

Left: Year 0 (2006)—Evidence of livestock presence at treatment site before livestock fencing
Right: Year 0 (2006)—Downstream view from the control site at transect K on Jordan Creek

Location

Jordan Creek is in the southwest region of the Long Tom Watershed in the Upper Willamette River Basin. The site is in Lane County within the Long Tom Watershed and Coyote Creek sub-watershed. See Figure 4-7 for a map of the control and impact reach locations. Neither the control nor the impact reach is fenced and both are actively used by horses.

Background and Sponsor Monitoring

The project area has been in agricultural production for approximately the past 50 years. Eighty-two hundred feet of fencing will be installed on Jordan Creek to exclude approximately 40 head of cattle and 8 horses from over 7.8 acres of streamside habitat (C. Theiman, personal communication).

Future monitoring efforts by the project sponsor will consist of visual inspections of fencing, off-channel watering, and riparian planting survival; stream surveys to include percent bank erosion, percent native riparian cover, and

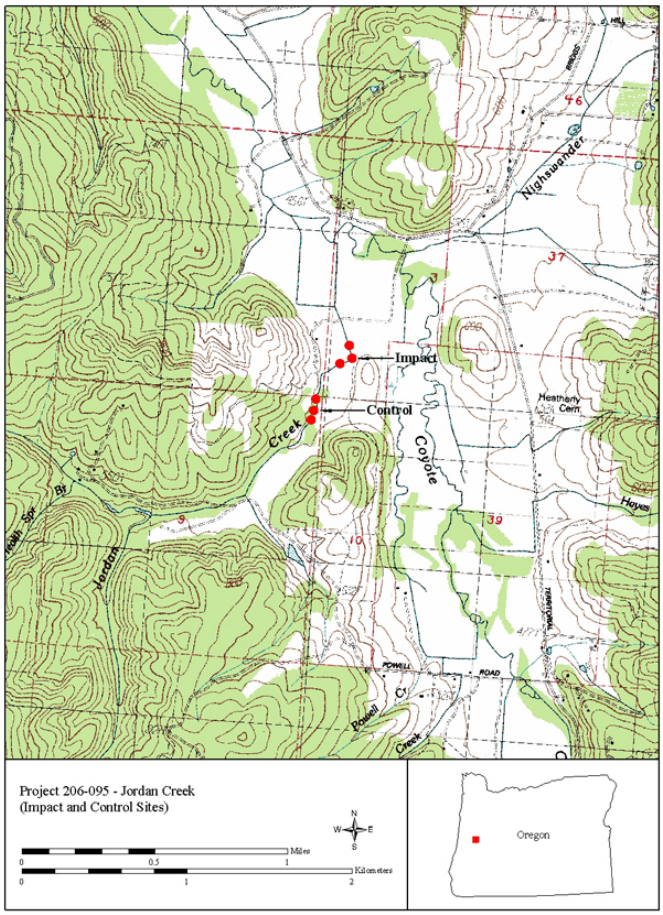

Figure 4-7. Map showing the locations of impact and control reaches for Project No. Z206-095

percent shade; up and downstream continuous summer temperature monitoring; and photograph points of riparian plantings, typical channel cross-sections, and off-channel watering (C. Thieman, personal communication).

These monitoring efforts by the project sponsor are expected to complement and augment the newly initiated OWEB effectiveness monitoring program by providing long-term comparative measured changes in riparian structure, shading, and bank erosion, as well as supporting photographic documentation of changes at the project site. Additional information regarding native versus non-native riparian composition will be provided through the monitoring efforts of the project sponsor, which are not included in the OWEB monitoring program protocols.

Objective/Intent

This project will primarily benefit cutthroat trout as well as other cold water species (i.e., state-listed western brook lamprey), which may also be present in Jordan Creek and the Coyote Creek sub-watershed. The project will enhance the riparian zone and instream habitat through installing woven wire fencing approximately 35 feet back from Jordan Creek, establishing off-channel watering facilities for livestock, laying back the bank in areas where the bank is too steep for riparian plantings, and planting trees and shrubs. Riparian zone restoration will begin with the removal and long-term control of blackberry followed by re-vegetation with native trees.

The specific objectives of this project will be to reduce bank erosion; eradicate and control blackberry and other invasive, non-native vegetation; increase native tree and shrub cover to 80 percent of the riparian area; shade over 80 percent of the channel and reduce summer stream temperatures in Jordan Creek by an average of 2°C; and increase large wood, pool frequency and channel sinuosity.

Summary Statistics for Pre-installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable	**Control**	**Impact**
Stream Length (meter)	N/A	1,609
Reach Length (meter)	150	150
Riparian Characteristics		
Mean Canopy Density (1-17)	16.74	1.62
Riparian Vegetation Structure (% with three layers)	100.00	0
Length of Actively Eroding Banks (% of total bank)	100.00	94.50
Livestock Exclusions		
Functional Exclusion (yes/no)	N/A	no
Area Excluded by Livestock Fencing (acres)	N/A	N/A

*Data collected 8/14/06

The riparian characteristics identified above are intended to track the health and stability of the riparian corridor along the livestock exclusion. After implementation, mean canopy density and riparian vegetation structure are expected to increase. Length of actively eroding banks it expected to decrease, and the exclusion is expected to remain functional. The area excluded by fencing will be measured after implementation. Stream length and reach length are not expected to change.

Project Sponsor: Long Tom Watershed Council

Contact: Cindy Thieman, Long Tom Watershed Council

Land Owner: Deborah Mattson

5. DATA ANALYSIS

Data analysis will be conducted once the post-project (Year 1) data have been collected at the sample sites. A t-test will be used to compare the Year 1 results with the baseline (Year 0) results. This test will be applied to all livestock exclusion projects monitored to determine if the project action of fencing to exclude livestock was generally effective across the project category. Each numerical parameter in the data tables (excluding reach length and stream length) will be tested separately to determine if the difference between the impact and control reaches in Year 1 is greater than the difference between the impact and control reaches in Year 0 across all the projects monitored. This analysis approach is appropriate for the BACI sample design. As more projects are added to the sampling frame, the power of the t-test will increase. If more projects are needed, data from projects sampled in Washington can be used to increase the sample size and the power of the test, because these projects were sampled using the same protocols and decision criteria.

6. SUMMARY

In accordance with the desired outcomes and strategies for the Monitoring Strategy for the Oregon Plan (OWEB 2003), this pilot program has incorporated regional protocols to monitor the effectiveness of one group of restoration projects. These results will help to provide accountability for restoration investments, one of OWEB's responsibilities. Effectiveness monitoring of livestock exclusion projects conducted for the OWEB provides consistent data across the state that can be used to assess project performance and improve the design of future livestock exclusion projects where appropriate. These data may serve to connect the efforts at livestock exclusion from different watershed councils and may facilitate sharing of approaches between councils. These data can be used to track the success of projects through time and can be used to determine whether project objectives are being met.

This report is an example of one project type that can be monitored using existing protocols for reach-scale effectiveness monitoring. Other project types may be added to this program in the future. Protocols can be adopted by local watersheds to monitor additional projects in their areas and report effectiveness of these additional projects to OWEB. Through time, as additional project types are added to the monitoring program, cost-effectiveness comparisons can be completed comparing project types and project performance across regions of the state. These programs could help to better direct efforts to fund projects that will be most effective in a given region. Data collected using these protocols will be comparable across the state, and across the region, allowing for better allocation of restoration efforts and funding resources to address limiting factors for salmon recovery and watershed health improvements.

7. REFERENCES

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8. LIST OF CONTRIBUTORS

Courtney Shaff – Oregon Watershed Enhancement Board

Greg Sieglitz – Oregon Watershed Enhancement Board

Jennifer O'Neal – Tetra Tech EC, Inc.

Brita Woeck – Tetra Tech EC, Inc.

Anna Ritchie – Tetra Tech EC, Inc.

Paul Wagner – KWA Ecological Sciences, Inc.

John Nugent – KWA Ecological Sciences, Inc.

KWA Ecological Sciences, Inc.

TETRA TECH EC, INC.