CONFEDERATED SALISH AND KOOTENAI TRIBES

Jocko River Master Plan

A guide to ecological restoration activities in the lower main stem Jocko River corridor

Appendix C: Demonstration Reach Phase I Monitoring Plan

Prepared by the CSKT Fish, Wildlife, Conservation, and Wildland Recreation Program

December 2008

Jocko River Master Plan: A Guide to Ecological Restoration Activities in the Lower Mainstem Jocko River Corridor: Appendix C

Contributors to the Jocko River Master Plan:

Confederated Salish and Kootenai Tribes
Les A. Evarts
Craig A. Barfoot
Steven K. Klotezel
Seth V. Makepeace
Russel S. Sydnor

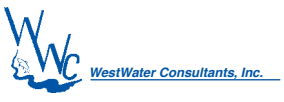
Geum Environmental Consulting, Inc
Sarah E. Flynn
Thomas G. Parker
Amy M. Sacry

River Design Group, Inc.
Andrew T. Belski
Troy M. Brandt
Mathew S. Daniels
John M. Muhlfeld

WestWater Consultants, Inc.
Garret T. Decker

Document Preparation:

CW Consulting
David Rockwell



APPENDIX C – JOCKO RIVER DEMONSTRATION REACH PHASE I: MONITORING PLAN AND ANNUAL REPORTING

JOCKO RIVER DEMONSTRATION REACH PHASE I

Monitoring Plan and Annual Reporting 2006

Confederated Salish and Kootenai Tribes
Natural Resources Department
Pablo, MT

Table of Contents

List of Tables

List of Figures

Introduction

This document describes the monitoring plan for the Jocko River Demonstration Reach, Phase I and results of baseline, implementation and the first year of effectiveness monitoring completed for the project. Section 4.0 of the Jocko River Master Plan (JRMP) describes the monitoring approach and how monitoring data fits into the overall restoration planning efforts in the Jocko River watershed. The Confederated Salish and Kootenai Tribes (CSKT) prepared the JRMP to guide restoration efforts in the Jocko River drainage.

Project Description

The Demonstration Reach includes approximately 9,000 feet of the main-stem Jocko River, upstream of Highway 93 and in the transition area between unconfined alluvial river sections, and more confined, forested river sections. This reach of the river has an extensive disturbance history starting with the channelization of 2,200 feet of the river (confined within approximately 3,270 feet of levees) in the 1950's. In addition, nearly 60 acres of floodplain vegetation have been cleared in the past 65 years, primarily to allow for livestock grazing. The levees have subsequently begun to erode (particularly following major flooding in 1997), and the artificially high sediment releases are jeopardizing potential restoration sites downstream. Overall, channelization has resulted in severe channel incisement and instability, and degradation of habitat for aquatic organisms. Associated down cutting of the river is also causing the floodplain to become drier, and many xeric and mesic weeds have become established in cleared sections of the floodplain.

The purpose of the Demonstration Reach project is to demonstrate the suite of restoration techniques and practices described in the Jocko River Master Plan (JRMP), as well as to restore this section of the channel. During the summer and fall of 2004, the CSKT in cooperation with contracted hydrologists and ecologists, completed the first phase of work at the Demonstration Reach to reverse the trend of channel incision and re-establish the connection between the active channel and the historical floodplain. The purpose of the project is to benefit bull trout by creating greater aquatic habitat diversity, reduce water temperatures, and improve water quality through reduction of sedimentation.

Project Goals and Objectives

The ARCO restoration team developed the following goals for the Jocko River Demonstration Reach restoration project.

- Re-connect floodplain to the main channel by restoring river bed elevation;
- Improve instream and floodplain habitat diversity and complexity through channel shaping and treatments, development of floodplain topography, and revegetation;
- Provide short-term channel stability as vegetation establishes in the near channel and floodplain environment;

- Implement and evaluate a suite of restoration tools that will have applicability for future work in the Jocko Drainage; and
- Achieve wetland and riparian credits as stipulated in the guiding Consent Decree.

The ARCO restoration team developed the following objectives for the Jocko River Demonstration Reach restoration project. These objectives are tied to evaluating the effectiveness of restoration techniques for purposes of improving restoration at future sites.

1. Raise the channel elevation between one and four feet to match historic channel/floodplain elevations;
2. Modify channel planform, pool frequency and channel dimensions to match the range of conditions measured in reference channel reaches and in historic air photos;
3. Improve habitat conditions for bull trout;
4. Stabilize high priority streambanks using bioengineering techniques. High priority streambanks are banks that function as elevated sediment sources, banks that will experience high near bank stresses following restoration, and banks where long-term revegetation will be facilitated through bioengineering;
5. Convert 80% of HGM cover type 10 (agricultural grass-dominated) floodplain to forested cover types within 10 years;
6. Decrease weed cover in the floodplain by 50% within 10 years;
7. Compare effectiveness of experimental several weed control treatment methods.
8. Enhance 130 acres of forested and scrub-shrub wetland and riparian habitat to achieve 130 HGM credits;
9. Reduce downstream water temperatures during late season, low flow periods; and
10. Raise the floodplain ground water table.

To accomplish these goals and objectives, the ARCO restoration team implemented the restoration strategies and techniques described in Table 1 during the summer and fall of 2004. We describe these techniques and strategies further in the JRMP.

Table 1. Summary of restoration strategies and techniques implemented at the Jocko River Demonstration Reach Phase I restoration project.

JOCKO RIVER DEMONSTRATION REACH PHASE I PROJECT SUMMARY		
RESTORATION STRATEGIES		
Reconstruct an appropriate stream type at the historical floodplain elevation		
Temporarily stabilize the new channel using structures to mimic natural channel features		
Stabilize streambanks at the land/water interface while vegetation becomes established		
Restore floodplain roughness and structural complexity		
Restore native plant communities to floodplain, streambanks and off-channel wetlands		
Control weeds and invasive species		
RESTORATION TECHNIQUES		
Channel re-alignment		
Convert abandoned channel segments to wetland/floodplain features		
Grade control and habitat structures		
	Rock cross vane	
	Log J-hook	
	Log cross vane	
	Cobble patch	
	Debris jams	
Soil bioengineering		
	Vegetated soil lifts	
	Coir log fascines	
Native shrub salvage and transplant		
Floodplain micro topography		
	Elevation grading	
	Placement of woody debris	
Floodplain revegetation		
	Native species containerized plantings	
		One gallon
		Ten cubic inch
		Tall one gallon PVC
	Browse protection	
	Mulch mats	
	Soil amendments	
Seeding		
	Wetland seed bank establishment	
	Native grass and forb mixes	
Mechanical weed control		
Herbicide weed control		
Experimental weed control plots		
	Continuous black polyethylene weed mat	
	Cardboard liner board with five inch layer of wood mulch	
	Six inch layer of wood mulch	
	Two-foot by two-foot mulch mats	

Monitoring Plan Overview

The CSKT is currently and will conduct three types of monitoring at the Demonstration Reach Phase I project. These include baseline, implementation and effectiveness monitoring. The JRMP describes these different phases of monitoring in more detail. Baseline monitoring documents the pre-restoration condition; implementation monitoring documents the restoration project as completed; and effectiveness monitoring addresses whether project objectives are being met. The CSKT chose monitoring methods and techniques that would most effectively evaluate whether project objectives are being achieved. The following table relates the monitoring techniques and metrics to be measured to the project objective which they will measure.

Table 2. Monitoring technique and metrics to be measured to evaluate Demonstration Reach Phase I project objectives.

Project Objective	Monitoring Type*	Discipline	Monitoring Technique	Monitoring Metric(S)
1	All	Geomorphic	Channel cross sections Longitudinal profile	Cross section dimensions Channel gradient
2	All	Geomorphic	Longitudinal profile Wolman pebble counts	Channel gradient Channel length Substrate size and distribution
3	All	Biological	Habitat surveys Redd counts Stock assessments	Habitat parameters including Number of redds Population estimates
4	Implementation Effectiveness	Vegetation	Bioengineering effectiveness	Percent survival Percent cover Percent degradation of coir fabric
5	All	Vegetation	Survival plots Wetland Assessment	Survival HGM assessment
6	All	Vegetation	Survival plots	% cover by species
7	Implementation Effectiveness	Vegetation	Survival plots	% Survival Growth metric % cover by species
8	All	Vegetation	HGM Riverine Wetland Assessment	8 functional variables
9	Baseline Effectiveness	Water Quality	Stream temperature Shallow groundwater wells	Continuous recording temperature data Water temperature Synoptic seepage flows Dye tracer studies
10	Baseline Effectiveness	Hydrologic/ Groundwater	Shallow groundwater wells	Water depth Slug tests

*Refers to three types of monitoring-baseline, implementation and effectiveness monitoring described in the JRMP.

Monitoring Schedule

The following schedule outlines the timing, frequency and duration of monitoring for the Demo Reach Phase I project by discipline.

Table 3. Demonstration Reach Phase I effectiveness monitoring schedule.

Discipline	Technique/Metric	Timing	Frequency	Duration**
Geomorphic*	Channel profile and cross section surveys	Low flows	Annual	10 year min
	Wolman pebble counts	Low flows	Annual	10 year min
	Aerial photos	Low flows	As Available	10 year min
Hydrologic/ Groundwater	Groundwater monitoring wells	Early-late Season	Annual	10 year min
	Stream gauges	year-round	daily flows	10 year min
Water Quality	Temperature	Continuous	Continuous	10 year min
Biological	Population Estimates	Late summer/low-flows	Annual	10 year min
	Habitat Surveys	Low flows	Bi-annual	10 year min
	Redd surveys	August-September	Annual	10 year min
Vegetation	Species survival	Late summer	Annual	10 year min
	Valley-wide transects	Late summer	Annual	10 year min
	Bioengineering	Late summer	Annual	10 year min
	Green line photo monitoring	Summer	Annual	10 year min
	HGM Functional Assessments	Growing Season	Two times: (1) prior to project (2) after 10 year period	10 year min
	Aerial photos	During growing season	As Available	10 year min

*The frequency of geomorphic monitoring may decrease and be completed in response to hydrologic events that modify channel boundaries and instream structures.
**Duration in this table is related to Demonstration Reach Phase I project goals not long-term program goals.

Monitoring Methods

Geomorphic

Geomorphic baseline, implementation and effectiveness monitoring data collection includes channel surveys, surface particle distributions and aerial photo interpretation. Sampling locations differ between baseline monitoring and implementation and effectiveness monitoring due to restoration-related channel re-alignment. Channel survey and particle distribution data are collected at the same locations for both implementation monitoring and subsequent effectiveness monitoring.

Aerial Photos

Year 2002 aerial photography of the Jocko River Demonstration Reach Phase I restoration project forms the base map layer to monitor changes in channel migration and geomorphology. Aerial photos were flow during peak flow in 2005, and will be flown on an ongoing, but intermittent basis.

Channel Bed Elevation Surveys

Channel bed elevation and cross sectional surveys are completed following general procedures defined in Harrelson et al. (1995) and Platts (1983); surveys are completed for baseline, implementation and effectiveness monitoring. For baseline monitoring, we established control points throughout the project area to support design and implementation of construction efforts, and to provide ground-truth points to support construction of a digital terrain model (DTM) of the project area. Baseline channel geometry information was partially constructed by cutting cross sections from the DTM, and partly through direct field surveying.

Features surveyed during implementation and effectiveness monitoring are monumented with permanent field benchmarks with GPS locations. Crews also established photo points at each cross section approximately corresponding with benchmark locations. For implementation and effectiveness monitoring, we located cross sections at representative major habitat or geomorphic channel units that were installed, or modified, during construction. Locations of monumented cross sections are shown in Appendix A, Figure 1.

Substrate Sampling

Wolman pebble counts and surface bar samples are utilized to characterize surface particle size distribution. Crews collected surface substrate samples at channel cross sections according to methods defined in Harrelson et al. (1995).

Hydrologic/Groundwater

Floodplain groundwater data is being collected through a CSKT sponsored, study at the University of Montana's Geology Department. The scope of the evaluation is extensive, and includes the following data collection efforts:

- Install and monitor an array of shallow wells constructed in the floodplain and streambed environment;
- Install a set of stream gages and conduct synoptic seepage runs to understand gaining and losing stream reaches;
- Characterize subsurface hydraulic properties in streambed and floodplain sediments using slug test procedures;
- Measure vertical water temperature profiles in wells; and
- Complete specific work applicable to the student's research questions such as dye tracer studies.

Ground water well installations and monitoring work is being completed following standard procedures reported by many authors, for example Driscoll (1986). The University of Montana will complete a final report providing the details for the methods. CSKT staff will maintain all, or a portion of the groundwater monitoring network at lower measurement intensity for a longer time horizon.

The current CSKT surface water monitoring network continues to be maintained and the location of monitoring sites permits flow to be estimated through the Demonstration Reach. Using the gaging network, reach-scale accumulation or infiltration of ground water from the river channel can be calculated.

Water Quality

Stream water temperature is collected, and is an important measurement link between the physical environment and the biological response to physical restoration effort. Continuous stream temperature data is collected along the entire alluvial section of the Jocko River using digital data loggers for baseline and effectiveness monitoring. Baseline data will consist of temperature data collected at a downstream long-term monitoring site and effectiveness data will be collected using digital data loggers installed upstream and downstream of the project reach.

Currently, the Tribes are completing a basin-wide water quality assessment. The scale of the assessment will not provide necessary resolution to evaluate changes in water quality conditions in the demonstration reach, but the results will provide insight into the ambient water quality condition through the assessment reach.

Biological

Biological monitoring efforts have focused on stream stock assessments, redd counts, and a quantitative, transect-based habitat survey. Information is collected for both baseline and effectiveness monitoring.

Stream Stock Assessments

Stream stock assessments are completed to monitor long-term trends in fish abundance, size, condition, and species composition within the project area according to the CSKT Work Plan for Stream Stock Assessments (CSKT, Unpublished document, 2000a). In the Demonstration Reach, complete stock assessments are completed primarily using a tote barge and to a lesser extent backpack electrofishing equipment and snorkeling (Thurow 1994).

To estimate fish populations, we use mark-recapture and depletion methods. Alternatively, catch-per-unit-effort (CPUE) is used to measure relative abundance when fish population estimates are not possible. Field and analytical techniques are described in several sources including Shepherd and Graham (1983), Robson and Reiger (1964) and Vincent (1971).

Redd Counts

We conduct redd counts during baseline and effectiveness monitoring to provide long-term monitoring of salmonid populations according to CSKT Field Operating Procedures for salmonid redd determination (CSKT, Unpublished document, 2000b). Redd counts are done during the fall, prior to the end of October, to target bull trout and during November and December to target brown trout. Spring redd counts are completed to assess *Oncorhynchus* spp. as flow conditions allow.

Macro invertebrate Sampling

We do not plan to use macro invertebrate sampling to monitor the project. However, if we do chose to sample macro invertebrates for effectiveness monitoring, we will collect samples using EPA protocols (USEPA, 2004).

Habitat Surveys

Transect-based habitat monitoring is completed for baseline condition, implementation condition, and will be completed as warranted for the effectiveness component of the monitoring effort following protocols described in Huntington (2003). This method involves collecting data on various 'interval parameters' of stream and riparian habitat.

Vegetation

Vegetation monitoring data for the project includes baseline, implementation and effectiveness monitoring.

Aerial photography and input parameters to complete a Hydrogeomorphic (HGM) riparian assessment, following procedures defined in Hauer et al., 2002, were collected for baseline vegetation monitoring for Phase I of the Demonstration Reach.

Implementation monitoring data for the major revegetation components of the Phase I Demonstration Reach restoration project include:

- Photo monitoring points to document as-built channel conditions to determine location of the vegetation green line and green line composition;

- Documentation of as-built conditions for planted areas; and
- Documentation of as-built conditions for bioengineering structures.

Effectiveness monitoring will be completed on an annual or semi-annual basis with focus on all or a subset of the following:

- Input parameters to complete Hydrogeomorphic (HGM) wetland assessment;
- Photo monitoring to document changing conditions of the vegetation green line and green line composition along the channel;
- Plant survival plots along the channel and within the floodplain;
- Natural recruitment and weed colonization within survival plots;
- Experimental weed treatment plant survival, growth and weed control effectiveness;
- Valley-wide transects to document changes in floodplain plant communities;
- Bioengineering structure willow survival and percent cover; and
- Aerial photo remote sensing.

Aerial Photos

Aerial photography is used to monitor changes in vegetation succession for baseline, implementation and effectiveness monitoring.

HGM Assessments

We completed baseline monitoring in 2003 using the HGM Riverine assessment protocol (Hauer et al., 2002) to characterize vegetation conditions in the floodplain prior to project implementation. Methods and results for HGM assessments are provided in a separate document (CSKT, 2005).

Green line Photo Documentation

Green line photos are used to document changes in vegetation along the newly constructed channel for implementation and effectiveness monitoring. Photo direction and orientation is recorded along with a GPS location at each photo point. Notes to accompany each photo generally describe composition of riparian vegetation. Notes include comments on success and survival of transplanted shrubs and trees. The photo points we establish during implementation monitoring are repeated for effectiveness monitoring.

Plant Survival

Plant survival is reported as part of effectiveness monitoring. Plant survival data is collected in late August or September of each year to determine survival of tree, shrub and herbaceous species planted as part of the restoration project. Twelve, 30 by 30-foot permanent monitoring plots are established within the floodplain planting polygons. Plot corners are marked using capped re-bar or stakes and a GPS location is recorded at the center of each plot. We established permanent photo monitoring points during the first year of monitoring for each plot.

In addition to floodplain planting survival plots, we have established survival monitoring plots in streambank and wetland planting areas along the newly constructed channel. Plots are distributed based on geomorphic variability along the channel (e.g., newly created point bars (depositional areas), saturated or ponded riparian terraces or off-channel wetlands, floodplains at outer bends above bankfull, point bars, and terraces. Six, 30 x 30-foot permanent plots are established on these representative surfaces. Crews have marked corners of each plot using capped re-bar or stakes and a GPS location at the center of each plot. We established permanent photo monitoring points during the first year of monitoring for each plot. We record data including species, survival, original plant container type, and plant type whether salvage or nursery stock for one hundred percent of planted species within each permanent monitoring plot. Additionally, within each permanent vegetation plot, the percent cover of naturally recruited native and invasive species will be tracked. Percent cover is estimated using the USDA Forest Service Northern Region ECODATA (1989) class codes, defined in Table 4. Canopy cover classes are recorded as the midpoint of the range for each class when data is entered electronically.

Permanent plot information will be extrapolated to the entire Demonstration Reach to understand cumulative vegetative community condition and trends.

Table 4. Percent cover codes for use in experimental weed treatment plots at the Demonstration Reach project.

Code	Percent Cover	Midpoint
T	<1%	0.5%
P	1<5%	3.0%
1	5<15%	10%
2	15<25%	20%
3	25<35%	30%
4	35<45%	40%
5	45<50%	50%
6	55<65%	60%
7	65<75%	70%
8	75<85%	80%
9	85<95%	90%
F	95-100%	97.5%

Experimental Weed Control Plots

Crews will annually monitor each experimental weed control plot for species survival and weed control effectiveness. Information is recorded on species survival, plant height and diameter to develop a growth index, percent cover of invasive species, and native species colonization.

A growth index is calculated for each plant by multiplying plant height by the basal area of the stem for each plant. For those plants with multiple stems, the mean basal area is

used and multiplied by the number of stems (height x mean basal area x the number of stems).

Valley-wide Transects

Three surveyed, valley-wide transects are used to monitor change changes in existing floodplain plant communities in response to raising the elevation of the channel bed for implementation and effectiveness monitoring.. Transects are located perpendicular to the stream and correspond to locations of monumented channel cross sections. Valley-wide transects extend between each edge of the ecological floodplain, excluding the wetted channel.

During each monitoring period, we will collect the following data on planted species and species survival and the start and end point of plant communities within a two-meter band along each transect.

Bioengineering Structures

Bioengineering structures are monitored to determine willow survival and overall, structure stability. The long-term success of these structures is based largely on the establishment of willow cuttings and development of binding root mass to stabilize streambank earth materials. The following data is recorded for each structure:

- Number of stems per five-foot length of structure per lift;
- Percent canopy cover of willow cuttings per five-foot length of structure per lift;
- Documentation of any maintenance needs such as loose ends, rips, scour or other instabilities;
- Documentation of biodegradation of fabric recorded as a percent of total area; and
- Photo documentation of each structure.

Results and Discussion

This section is a summary of baseline, implementation and effectiveness monitoring data collected for the Demonstration Reach restoration project to date.

The following tables summarize the baseline (Table 5), implementation (Table 6) and effectiveness (Table 7) monitoring data collected to date.

Table 5. Summary of baseline data collected for the Demonstration Reach Phase I project.

BASELINE DATA COLLECTED FOR DEMONSTRATION REACH PHASE I		
Discipline	**Metric**	**Data Collection Date**
Geomorphic	Channel profile and cross section surveys	Summer 2004
	Substrate Samples	Summer 2004
	Aerial photos	Summer 2002
Hydrologic/Groundwater	Groundwater monitoring wells	On-going
	Stream gauges	On-going
Water Quality	Temperatures	2003, 2004
Biological	Fish population survey	Late Summer 2002
	Habitat Surveys	Summer 2003
	Redd surveys	Fall 2003
Vegetation	HGM Functional Assessments	Summer 2003
	Aerial photos	Summer 2002

Table 6. Summary of implementation data collected for the Demonstration Reach Phase I project.

IMPLEMENTATION MONITORING DATA COLLECTED FOR DEMONSTRATION REACH PHASE I		
Discipline	**Metric**	**Data Collection Date**
Geomorphic	Channel profile and cross section surveys	Late Fall 2004
	Substrate Samples	Late Fall 2004
	Aerial photos	Runoff period summer 2005
Hydrologic/Groundwater	Groundwater monitoring wells	ongoing through 9/05
	Stream gauges	On-going
Water Quality	Temperatures	2003, 2004
Biological	Habitat Survey	Early Winter 2004
Vegetation	Green line photo monitoring	Fall 2005
	As-built documentation	Fall 2005
	Aerial photos	Fall 2005

Table 7. Summary of monitoring data collected to date for the Demonstration Reach project.

EFFECTIVENESS MONITORING DATA COLLECTED FOR DEMONSTRATION REACH PHASE 1I		
Discipline	**Metric**	**Data Collection Date**
Geomorphic	Channel profile and cross section surveys	Summer 2005
	Substrate Samples	Summer 2005
	Aerial photo remote sensing	Summer 2005
Hydrologic/Groundwater	Groundwater monitoring wells	intermittent
	Stream gauges	On-going
Water Quality	Temperature	2005
Biological	Species survival	Late summer 2005
	Population Estimates	Summer 2005
	Redd surveys	Fall 2005
Vegetation	Valley-wide transects	Late summer 2005
	Bioengineering	Late summer 2005
	Green line photo monitoring	Late summer 2005
	Aerial photo remote sensing	Spring 2005

Geomorphic

Channel Longitudinal Profile and Cross Section Surveys

Figure A-1 in Appendix A shows the longitudinal profile start and end points and the cross section locations we established to support implementation and effectiveness monitoring. The cross section locations are given by their station distance along the longitudinal profile established post-construction for implementation and effectiveness monitoring. The design stationing was also recorded for each cross section. These stations are those used during project construction and have a different start and end point compared with the longitudinal profile stations.

Figure 1 shows the results of the long profile survey through the Demonstration Reach conducted for baseline monitoring prior to construction of the project. This profile includes both Phase I and future phases of the Demonstration Reach. The lack of pools is apparent on this profile. Figure 2 is a longitudinal profile through the reach surveyed during implementation monitoring to document as-built conditions. This profile shows bed and water surface elevations, bankfull elevations, and select design elevations to compare with as-built conditions. The overall slope is 0.008 ft/ft, similar to the pre-

construction slope. Comparison of the pre- and post-construction longitudinal profiles demonstrates a dramatic increase in bed topographic diversity and a notable increase in pool habitat. This pattern corresponds to an increase in overall instream habitat diversity through the reach. Although not directly evident on the longitudinal profiles, overall bed elevation was raised up to four feet. This will increase the interaction between the active channel and floodplain, and may lead to an overall increase in the elevation of the floodplain water table.

Figure 3 shows the results of the long profile survey through the Demonstration Reach conducted in 2004 for implementation monitoring (Figure 2) overlaid with the long profile survey conducted in 2005 for effectiveness monitoring. In June 2005, prior collection of 2005 effectiveness monitoring data, a flood with a recurrence interval exceeding a 20 year event, occurred in the Jocko River. The effects of this event is partially evident in Figure 3 and include (1) bed mobilization where an armour layer had not re-formed, (2) scour and loss of designed cobble tailouts leading to bed degradation and some scour below vane logs, (3) re-sorting of bed material leading to transient aggradation in pool features, deepening in some pool features, and (4) steepening of the design slope for many of the constructed point bars. In four locations, minor work was completed following the effectiveness monitoring event to improve structure stability.

We have been unable to reconcile the baseline or pre-construction longitudinal profile surveying with the post-construction, implementation and effectiveness monitoring and cannot directly overlay profiles for these dates. While unfortunate, this has become part of our adaptive management learning process that we will address in future monitoring efforts.

Cross Section Surveys

Figures 4-10 show the results of cross section surveys completed for implementation monitoring overlaid with cross section data collected in 2005 for effectiveness monitoring. Cross section #5 was not surveyed for either implementation or 2005 effectiveness monitoring. Again, these cross sections bracket the project response to a significant flood event.

Implementation monitoring, cross section information corroborates the observations made for the longitudinal profile results, demonstrating more diverse bed topography and larger pool elements than the pre-construction channel. The cross sections generally indicate that overbank flow can access the floodplain, in contrast to the former, incised conditions in the channel. The significant movement of channel substrate resulting from the spring 2005 flood event can be seen from these cross section comparisons.

Table 8 compares the surveyed cross sectional geometry with the general, template design cross sectional geometry. Some divergence in the values should be expected, as construction is adapted to onsite conditions.

Table 8. Comparison of surveyed cross section geometry with design cross sectional geometry.

FEATURE AT BANKFULL	Riffle	Pool	Glide
Design width	52 ft +/- 2 ft	63 ft +/-5 ft	72 ft +/- 2 ft
Surveyed widths	47.7 ft; 50.0 ft	64.0 ft; 56.9 ft	54.0 ft; 53.9 ft; 48.1 ft
Design mean depth	2.1 ft; 2.2 ft	1.9 ft +/-0.1 ft	2.4 ft +/-0.1 ft
Surveyed mean depth	3.1 ft +/- 0.1 ft	3.1 ft; 2.7 ft	2.4 ft; 2.0 ft; 1.7 ft
Design maximum depth	2.6 ft+/-0.1 ft	6.0 ft +/- 1.0 ft	2.5 ft +/- 0.1 ft
Surveyed maximum depth	3.1 ft; 3.0 ft	6.3 ft; 4.9 ft	3.8 ft; 2.8 ft; 2.6 ft
Design cross sectional area	110 ft^2	145 ft^2	165 ft^2
Surveyed cross sectional area	103 ft^2; 103 ft^2	155.5 ft^2; 199.3 ft^2	91.8 ft^2; 91.8 ft^2; 130.4 ft^2

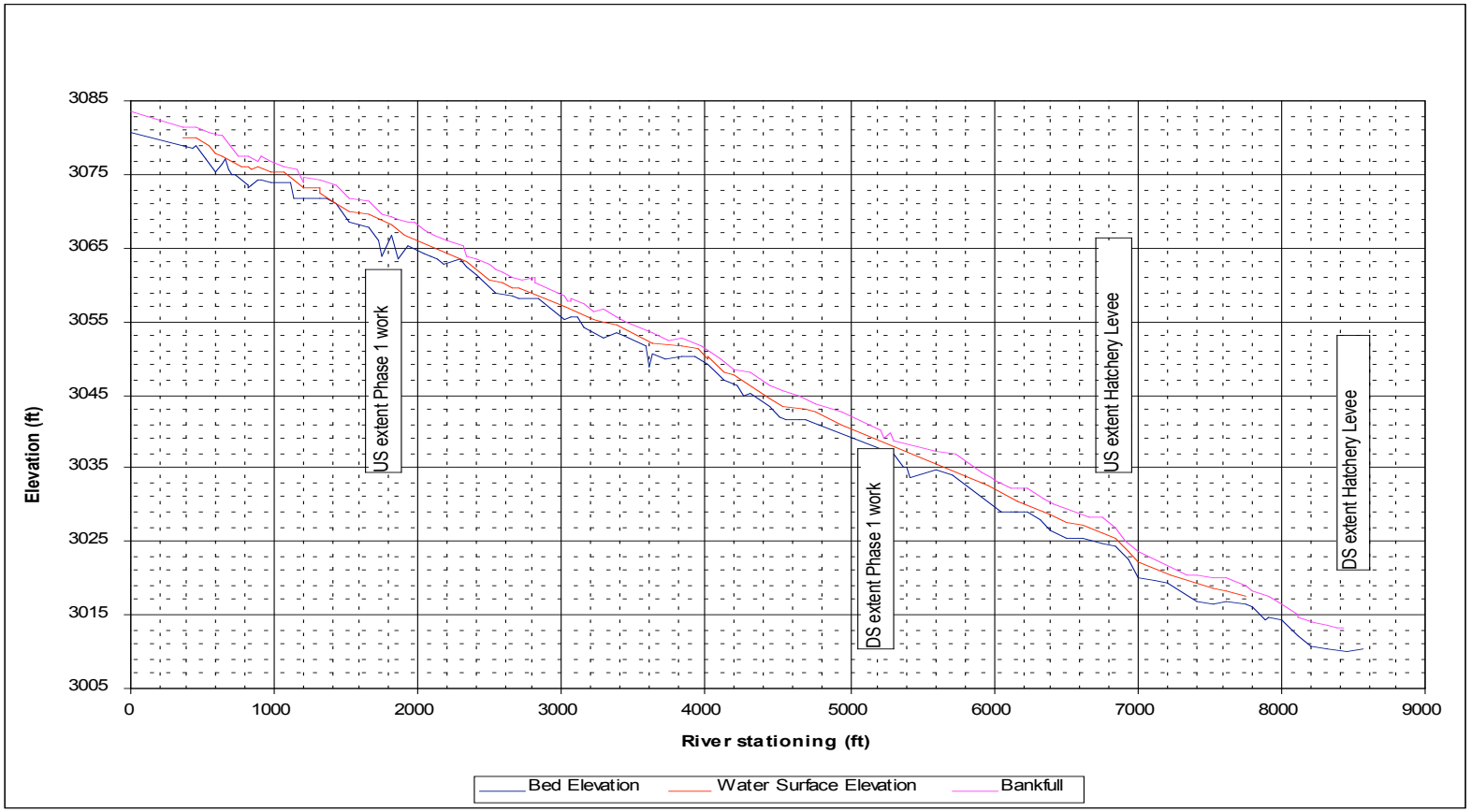


Figure 1. Baseline, pre-construction monitoring long profile survey of Demonstration Reach Phases I and II

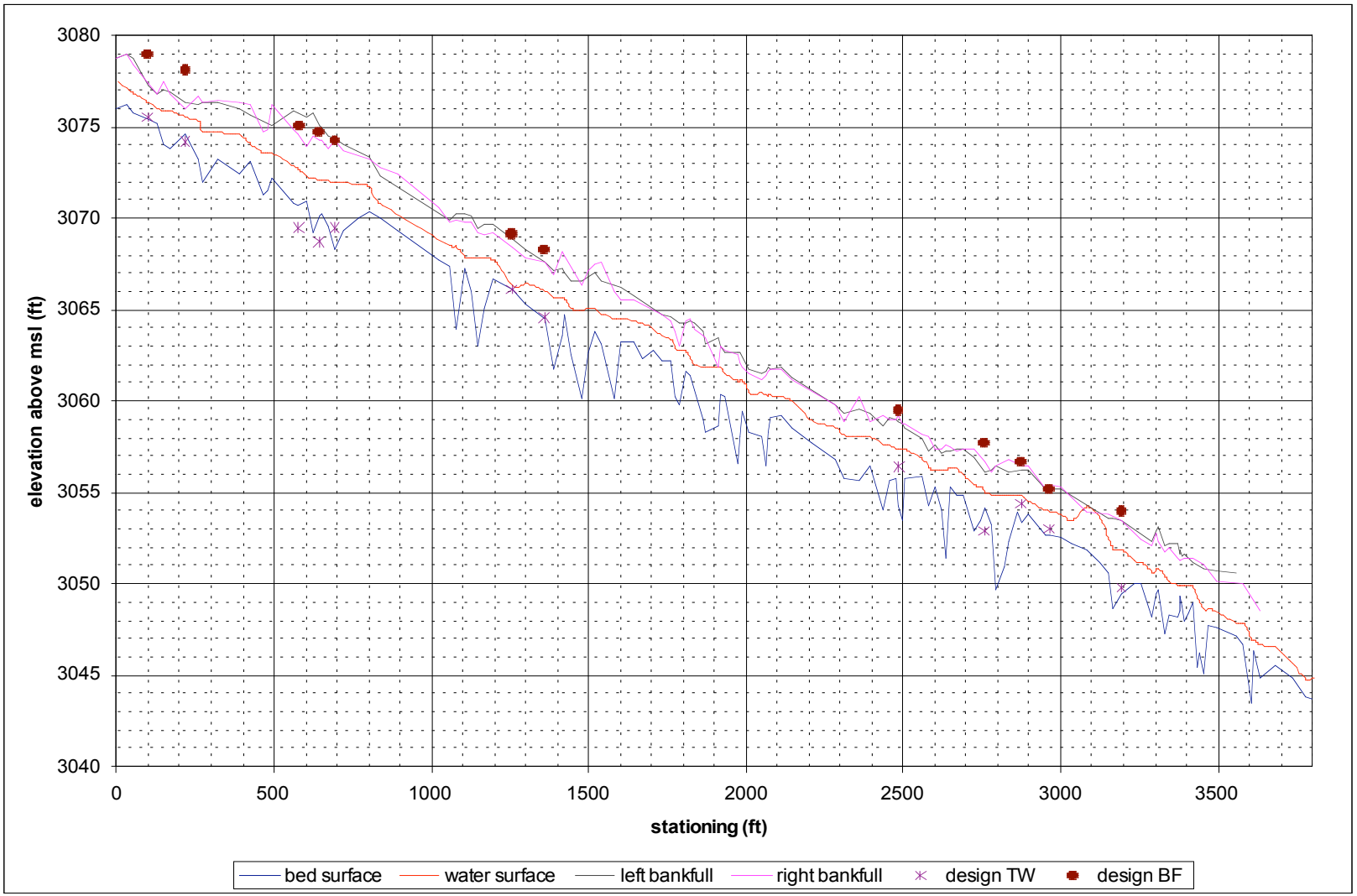


Figure 2. Demonstration Reach longitudinal survey conducted during implementation monitoring (11/04) to document as-built conditions

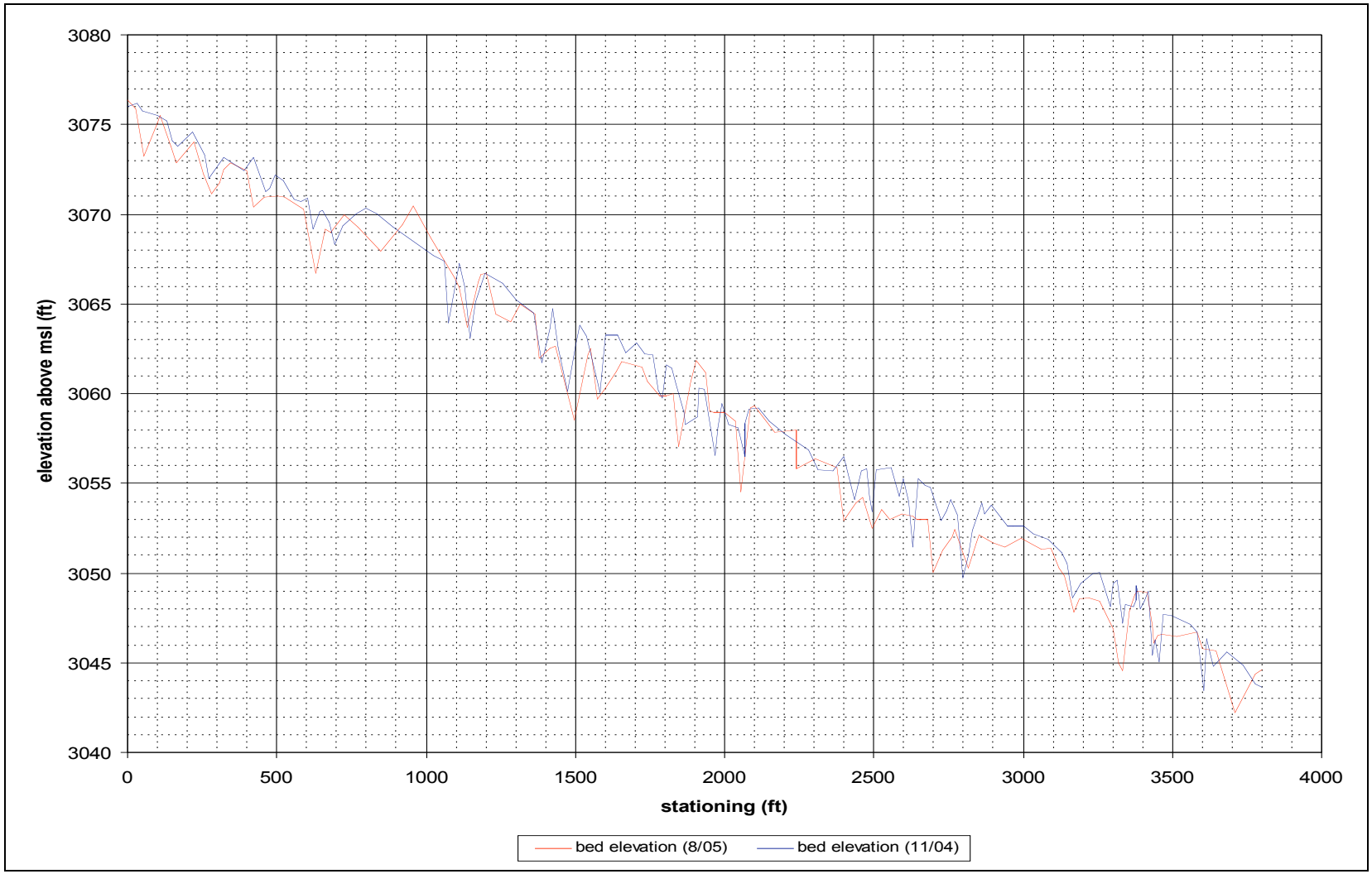


Figure 3. Implementation (blue line) and 2005 effectiveness monitoring (red line) longitudinal profile for Demonstration Reach Phase I

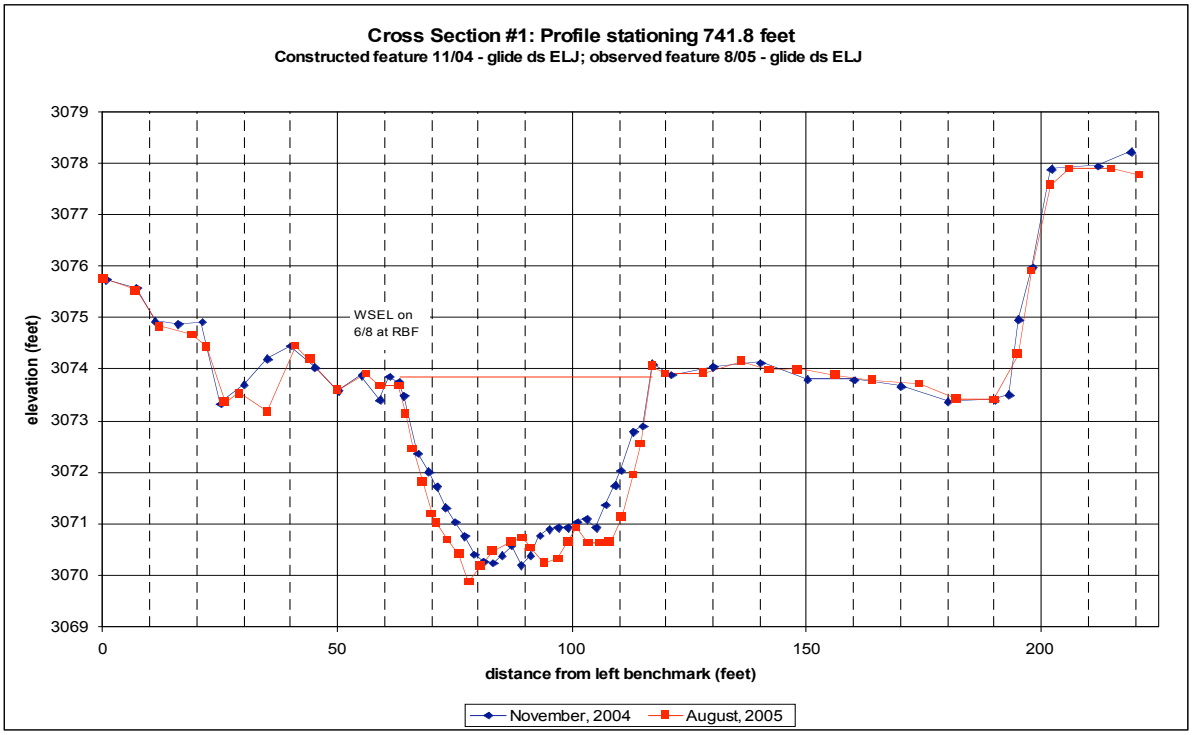


Figure 4. Results of implementation and 2005 effectiveness monitoring for Cross Section #1.

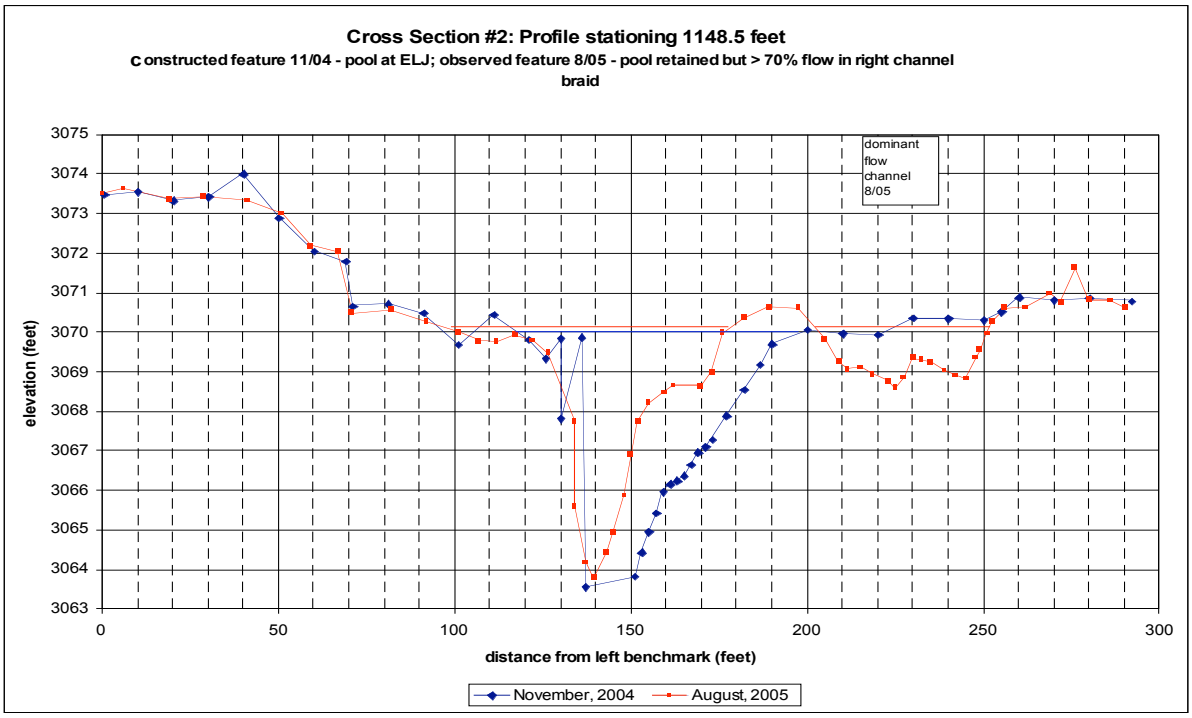


Figure 5. Results of implementation and 2005 effectiveness monitoring for Cross Section #2**.**

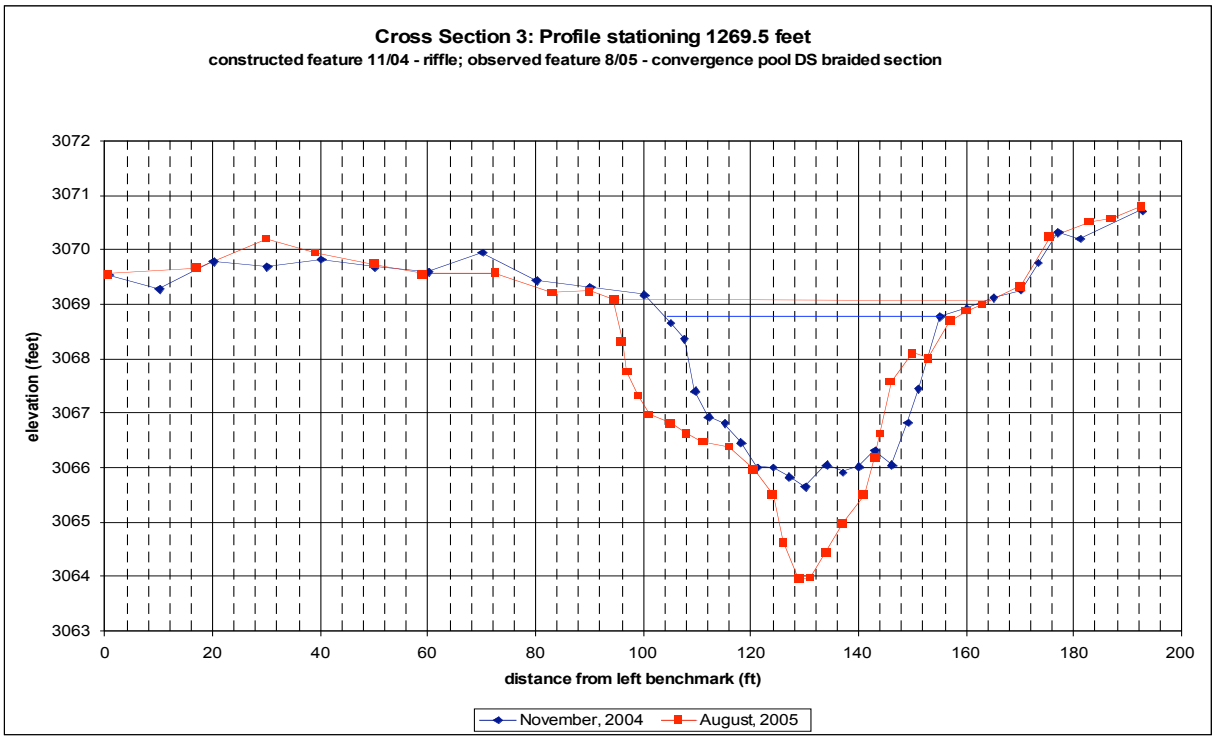


Figure 6. Results of implementation and effectiveness monitoring for Cross Section #3.

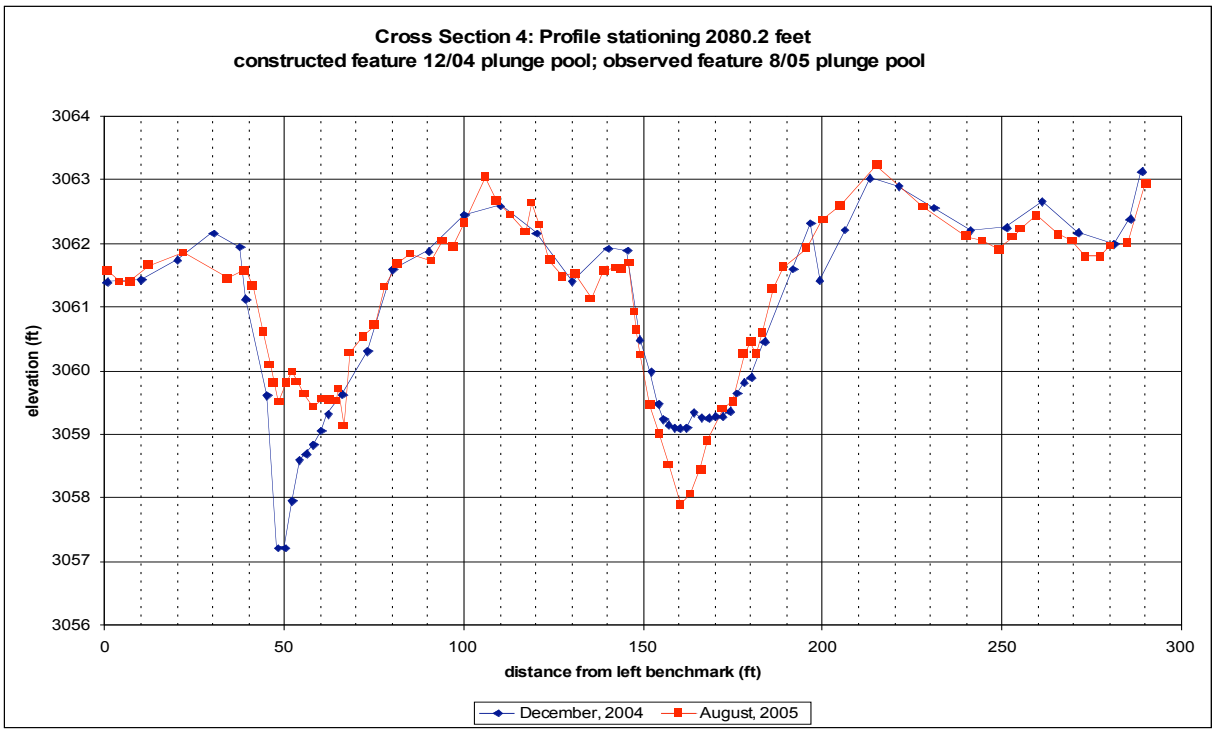


Figure 7. Results of implementation and effectiveness monitoring for Cross Section #4.

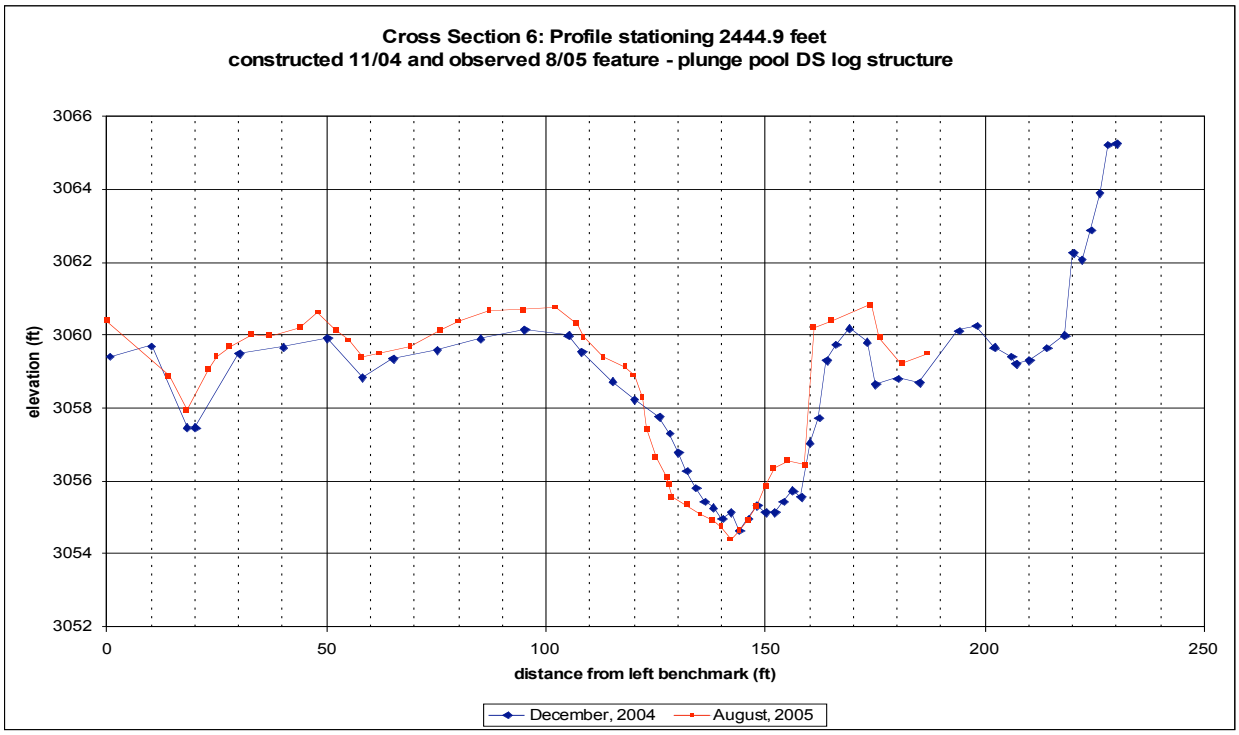


Figure 8. Results of implementation and effectiveness monitoring for Cross Section #6.

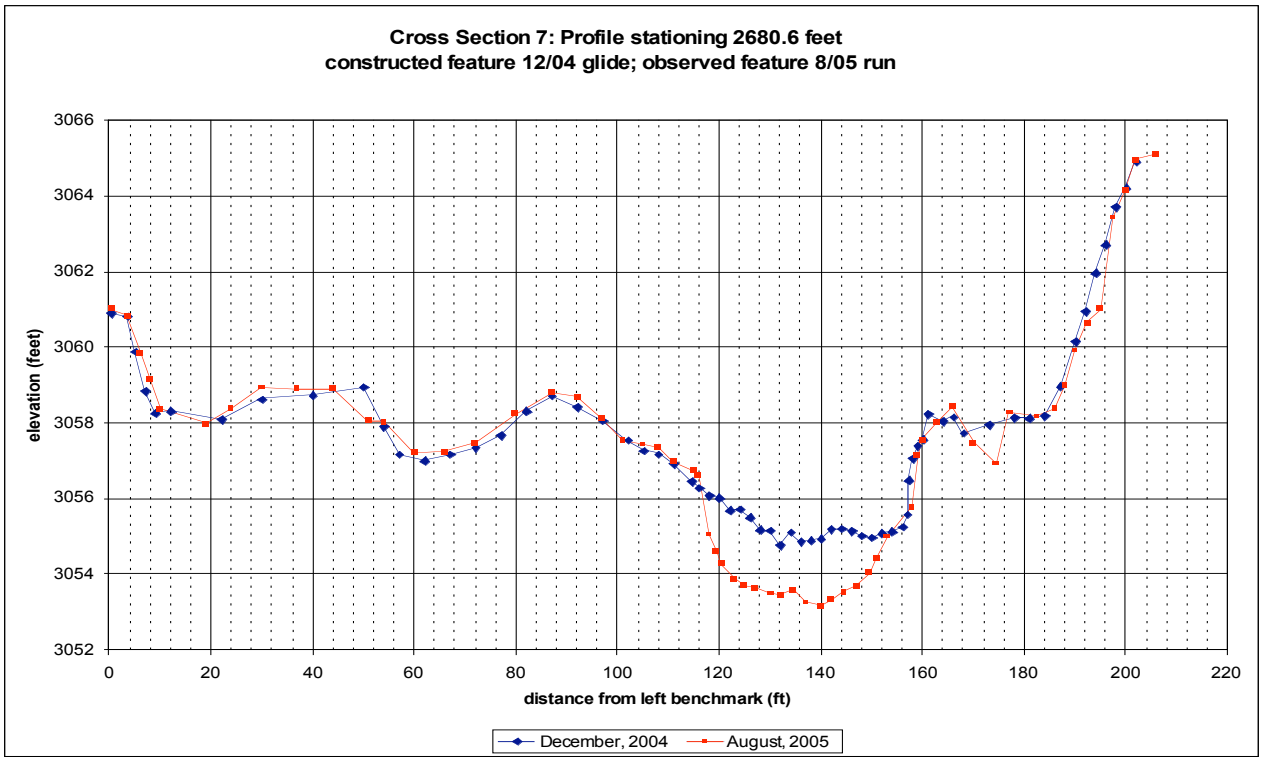


Figure 9. Results of implementation and effectiveness monitoring for Cross Section #7.

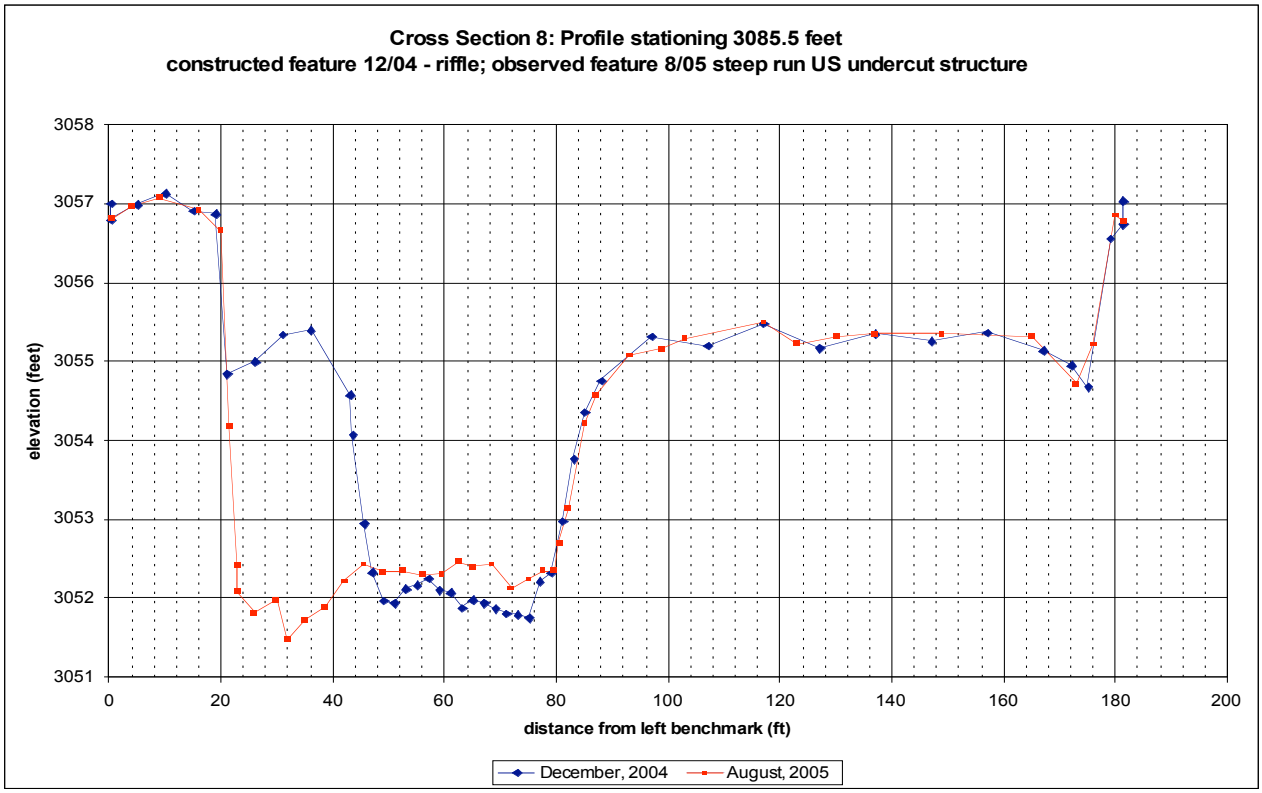


Figure 10. Results of implementation and effectiveness monitoring for Cross Section #8.

Substrate Sampling

Table 9 shows the results of substrate surveys conducted for baseline, implementation and 2005 effectiveness monitoring. The spring 2005 flood event resulted in significant redistribution of channel bed materials.

Table 9. Summary of substrate sampling data collected for Demonstration Reach Phase I project.

	particle size				
YEAR/TYPE OF MONITORING (LOCATION)	**D15**	**D35**	**D50**	**D84**	**D90**
2004/Baseline	24.0	51.5	73.0	149.1	236.9
CROSS SECTION 1, LONG PROFILE STATION 741.8					
2004/Implementation	24.8	48.9	63.0	117.2	172.8
2005/Effectiveness	33.7	58.9	74.0	134.1	188.4
CROSS SECTION 2, LONG PROFILE STATION 1148.5					
2004/Implementation	35.3	54.2	81.2	150.1	240.8
2005/Effectiveness	21.1	38.1	55.4	106.4	162.2
CROSS SECTION 3, LONG PROFILE STATION 1269.5					
2004/Implementation	25.7	56.0	81.3	131.4	205.0
2005/Effectiveness	20.5	44.4	68.0	116.7	178.8
CROSS SECTION 4, LONG PROFILE STATION 2080.2					
2004/Implementation	20.1	33.8	46.3	110.2	161.5
2005/Effectiveness	21.7	36.8	47.5	96.0	134.7
CROSS SECTION 5					
No Data					
CROSS SECTION 6, LONG PROFILE STATION 2444.9					
2004/Implementation	No data collected due to water depth				
2005/Effectiveness	40.0	69.7	99.5	167.8	197.6
CROSS SECTION 7, LONG PROFILE STATION 2680.6					
2004/Implementation	12.1	33.1	40.9	118.3	210.3
2005/Effectiveness	42.1	77.7	107.3	172.8	217.8
CROSS SECTION 8, LONG PROFILE STATION 3083.5					
2004/Implementation	12.1	33.1	40.9	118.4	210.3
2005/Effectiveness	42.5	67.1	83.2	156.2	208.4

It is difficult to interpret the trends in the surface substrate size distribution. In general, at cross sections where the bed degraded or incised, the substrate caliber decreased. This may be due to the scouring and removal of the placed surface armour documented in the implementation monitoring after the 2005 flood event. In the lowermost two cross sections substrate size increased. This corresponds to an increase in slope and a shift in the channel units to high energy runs. Higher energy river segments may have lead to transport of smaller size fractions and/or deposition of a coarse surface armour.

Aerial Photo Remote Sensing

In the following table (Table 10), we describe channel conditions derived through aerial photo interpretation to document pre-project baseline conditions between 1937 and 2002. An aerial photo of the project area before project implementation is shown in Figure 10. This figure shows the historical channel traces based on remote sensing of historical photos. Figure A-1 in Appendix A provides an implementation monitoring photo. Figure A-2 in Appendix A provides a photo of the June 2005 flood event. We have not completed any aerial photo interpretation of channel changes as a result of the flood event.

Table 10. Aerial photo remote sensing data for baseline monitoring.

PHOTO YEAR	STREAM LENGTH (FT)	VALLEY LENGTH (FT)	SINUOSITY	BELT WIDTH (FT)
2002	16,162	13,050	1.24	132
1937	17,437	13,050	1.34	276

Hydrologic/Groundwater

Water Table Elevation Maps

Figures 12 and 13 show baseline water table elevations contours for the Demonstration Reach. Red dots on the map are the locations for shallow wells and the yellow flags represent stream gage locations. The maps show the flow field for floodplain groundwater and the seasonal migration of the gaining and losing reaches of the river. The large spring discharge area utilized by the Arlee Fish Hatchery shows as a groundwater upwelling area for both time periods. We will continue monitoring groundwater throughout the project reach to determine effects from the project.

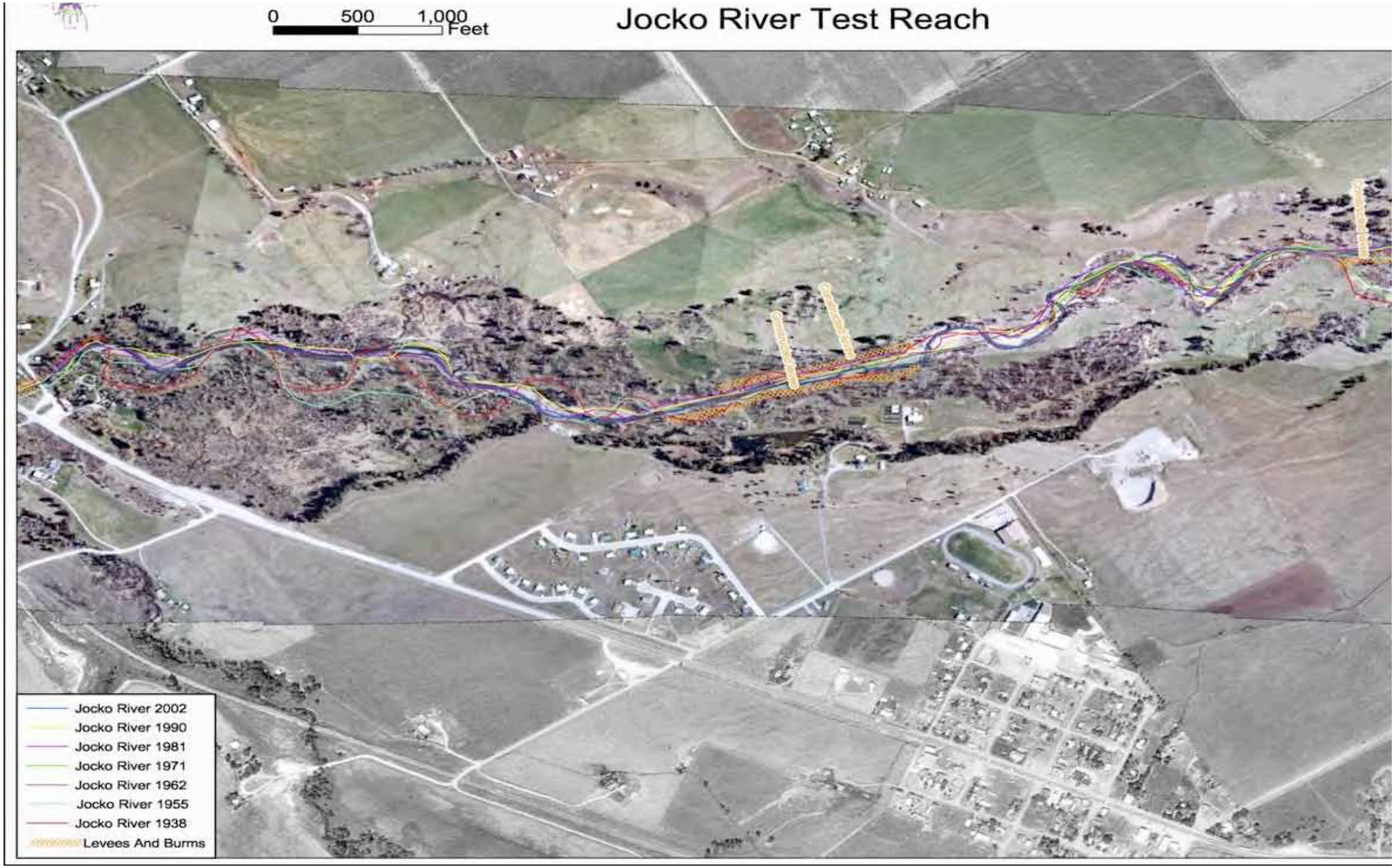


Figure 11. Baseline aerial photo of Jocko River Demonstration Reach including all phases of the project showing locations of historic channel traces and levees.

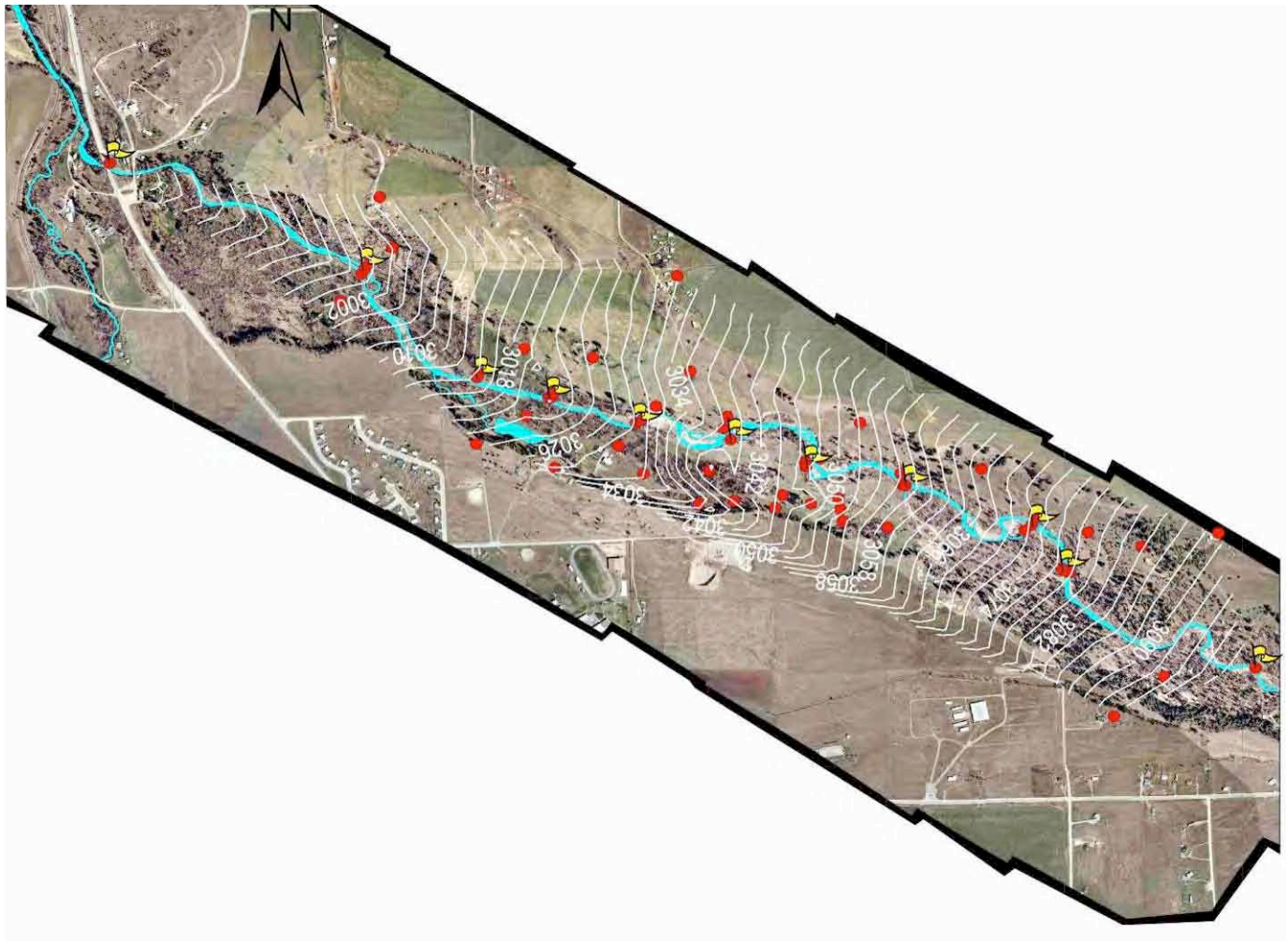


Figure 12. Shallow groundwater baseline monitoring map for the Demonstration Reach project area created from data collected from groundwater monitoring wells in February 2004. Well locations are shown in red. Yellow flags represent stream gage locations.

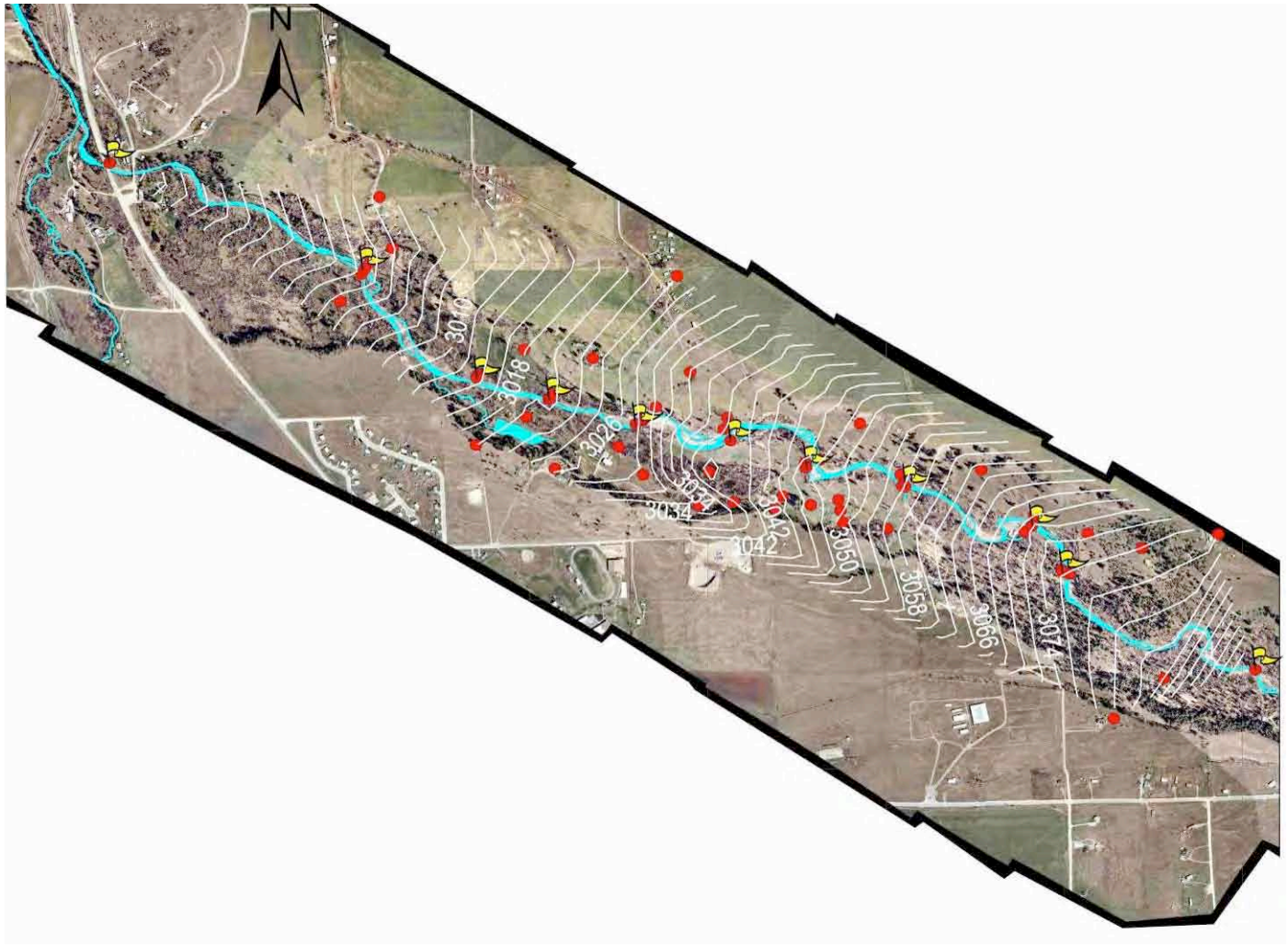


Figure 13. Shallow groundwater baseline monitoring map for the Demonstration Reach project area created from data collected from groundwater monitoring wells in July 2004. Well locations are shown in red. Yellow flags represent stream gage locations.

Stream Temperature

We collected six years of baseline temperature data prior to restoration activities at the Demonstration Reach from a long-term monitoring site located approximately two km downstream of the Demonstration Reach; however, no long-term data are available from immediately within the Demonstration Reach area. This downstream monitoring station will be maintained for the foreseeable future as part of a large-scale (19 stations) water temperature monitoring program in the Jocko River drainage. Long-term data from this site will not be presented in this report, but are available upon request. In addition to the data from the long-term site, we also installed thermographs and measured water temperatures immediately above and below the Demonstration Reach project area beginning in early August, 2004 at the onset of active channel restoration in the Demonstration Reach. Interpreting patterns in data from those thermographs is complicated by the fact that upstream of the project area the stream is a losing reach and downstream of the project it is a gaining reach (see groundwater section). These surface water-ground water interactions appear to influence local water temperature regimes.

The data we collected during 2004 suggest that when mean daily water temperatures exceeded approximately 11 to12 ºC, upstream areas were up to 1 ºC warmer, whereas when temperatures were low (e.g., < 6 º C) the upstream area was up to 4 ºC cooler, demonstrating the moderating effects of large groundwater inputs immediately downstream of the project area (Figure 14). One of the goals of the Demonstration Reach project was to extend the gaining reach upstream into the restored area by increasing groundwater-surface water interactions, thus moderating temperature regimes. Such a temperature shift would best be detected by examining differences between water and air temperatures above and below the reach before and after restoration. However, we currently do not monitor local air temperatures. Our hypothesis was that increased floodplain-channel interactions resulting from the project might elevate water levels in the floodplain aquifer and result in a greater temperature differential between the upstream and downstream monitoring stations. Thus, we will continue temperature monitoring at the upper and lower boundaries of the Demonstration Reach as a means of effectiveness monitoring.

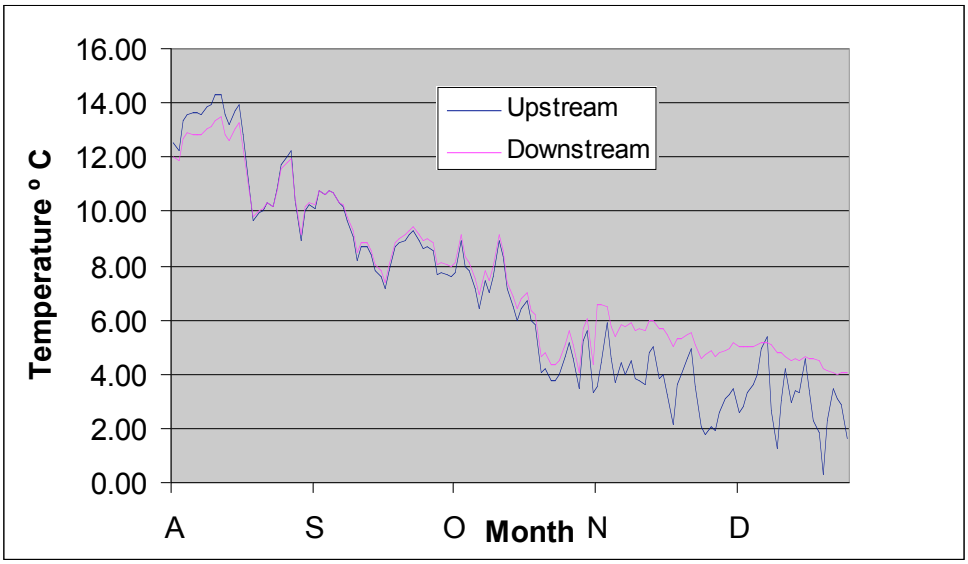


Figure 14. Mean daily water temperatures at monitoring locations immediately upstream and downstream of the Jocko River Demonstration Reach near Arlee, Montana during August through December 2004. Restoration actions generally occurred from August through October.

We monitored temperatures through 2005, but comparisons with earlier data are complicated by the loss or failure of three different thermographs, resulting in missing data through much of 2005, particularly when we might anticipate temperature divergence between upper and lower sites from groundwater inputs (Figure 15). Thus, any inferences from effectiveness monitoring of temperatures during 2005 are generally equivocal. However, additional temperature and hydrology data collected during groundwater studies may supplement surface water temperature monitoring and more thoroughly answer questions about surface water-groundwater interactions before and after restoration.

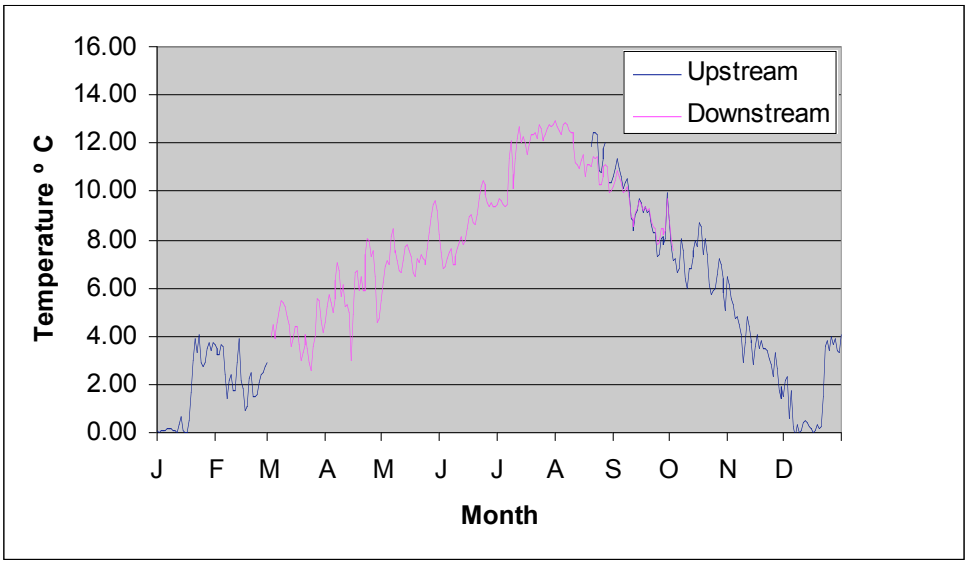


Figure 15. Mean daily water temperatures at monitoring locations immediately upstream and downstream of the Jocko River Demonstration reach near Arlee, Montana during 2005. Note missing data resulting from the loss and failure of thermographs during the monitoring period.

Biological

Stock Assessments

We conducted relatively limited amounts of baseline sampling prior to restoration actions in the Demonstration Reach. We sampled approximately 4,000 feet of channel primarily within the upper (Phase I) one-half of the Demonstration Reach during the fall of 2002 to document fish populations prior to proposed restoration actions and to compare species and size compositions with other main-stem fisheries data collected in two downstream long-term monitoring sections, located at river miles 1 and 9.8. Because of shallow habitats in the over-widened channel, we were unable to use our typical shocking equipment (drift boat or tote barge) in the baseline fish survey of the Demonstration Reach. Therefore, we used three backpack electrofishing units operated adjacent to one another to sample the channel; we made one downstream pass to assess fish populations in the reach. Although our baseline sampling was limited, the information we obtained was sufficient to verify the effects of habitat degradation on fish populations in the reach.

We captured a total of 122 fish in the 4,000-foot section of stream that we sampled during 2002 (Table 11). No bull trout were observed in the area during baseline sampling. Instead, species composition in the Demonstration Reach was dominated by introduced salmonids, especially brown trout (Table 11). Brown trout comprised 63.1 percent (n = 77) of the 122 fish captured, while *Oncorhynchus* spp. made up 33.6 percent of the catch, with most of these fish (approximately 85%; n = 35) classified as rainbow trout x westslope cutthroat trout hybrids. Brook trout were a minor component of the

salmonid assemblage, and represented only 3.3 percent of the trout captured in baseline sampling of the Demonstration Reach.

We were unable to estimate fish numbers in the reach during 2002 because we captured too few individuals to conduct valid mark-recapture population estimates for each species and size class of concern. However, catches-per-unit-effort (CPUE), a measure of relative abundance, were very low compared to other long-term monitoring areas of the main-stem Jocko River, although comparisons with other locations are complicated because of variations in capture efficiencies caused by habitat and gear differences.

Besides overall low numbers of captures, the size composition of fish collected in the Demonstration Reach was another indication of the baseline conditions in the area. The average length of fish captured was relatively small (less than 170 mm total length [TL]), regardless of taxon (Table 11). In contrast, in a downstream monitoring section with better in-channel habitat conditions, the long-term average fish size was larger (200 mm TL; pooled across species) and 50 percent of all fish captured were greater than 185 mm TL. The small size structure of fish in the Demonstration Reach prior to restoration was likely due to habitat simplification, especially loss of deeper pool habitats in the channelized reach of stream.

Table 11. Number and total length (mm) of salmonids captured during 2002 baseline sampling at the Jocko River Demonstration Reach. BRK=brooktrout; BRN=brown trout; ONC=rainbow trout, westslope cutthroat trout, and rainbow x cutthroat trout hybrids.

TAXON	N	MEAN TOTAL LENGTH (mm)	RANGE (mm)
BRK	4	161	93-242
BRN	77	145	72-378
ONC	41	164	87-295

For effectiveness monitoring, we assessed fish populations in the Demonstration Reach during summer 2005, by conducting a mark-recapture population estimate using a modified Petersen estimator. We used a tote barge to sample fish populations over the entire length (approximately 3,200 feet) of the recently restored channel. The tote barge was equipped with multiple anode arrays, which allowed us the flexibility to sample the variety of habitats present in the recently restored reach. We captured and marked fish on July 28, 2005 and conducted a recapture run on August 1, 2005.

We captured 517 fish on the marking run and 373 fish during our recapture effort. We attempted to estimate numbers of each taxon in each of three size classes of fish: 75-150 mm TL; 150-374 mm TL; and, greater than 375 mm TL. However, we were unable to obtain unbiased estimates for all of these size classes for each taxon. This is primarily because we captured too few (n = 4) fish 375 mm TL and longer, regardless of taxon, and because of low numbers of recaptures for the smallest size category (75-150 mm TL) of

brown trout (Table 12). Nonetheless, we obtained good estimates for several categories of fish. We estimated that there was over 1,200 trout between 75 and 375 mm TL in the Phase I section of the Demonstration Reach during late July 2005, less than one year after rehabilitation work was done (Table 12).

Table 12. Estimated numbers of brook trout (BRK), brown trout (BRN), and *Oncorhynchus* species (ONC) in the Demonstration Reach Phase 1 during effectiveness monitoring completed in late July 2005.

MARK DATE	TAXON	SIZE INTERVAL (TL; mm)	# MARKED	SHOCK TIME (S)	ESTIMATE	95% CI
7/28/05	ONC	75-150	95	7,558	282	197-367
7/28/05	ONC	150-375	125	7,558	397	298-496
7/28/05	BRK	75-150	31	7,558	56	42-70
7/28/05	BRK	150-375	71	7,558	118	103-133
7/28/05	BRN	150-375	134	7,558	380	292-468
TOTAL ESTIMATE					1,233	

Species composition, based on unmarked fish from both the mark and recapture runs, was different than prior to restoration. During 2002 baseline monitoring, species composition was dominated by brown trout (63%), whereas *Oncorhynchus* spp. were most abundant (approximately 46%) during 2005 effectiveness monitoring, with about 12 percent of these fish being classified as westslope cutthroat trout, based on phenotypic characteristics. The remainder of the salmonid assemblage was comprised of brown trout (35%) and brook trout (19%). We are uncertain if the shift in species composition between the baseline and effectiveness monitoring periods was because of the timing of sampling and the resulting seasonal shifts in habitat use or if it reflected a true change in the composition of the resident fish assemblage in the Demonstration Reach as a result of restoration actions. Our baseline sampling was done later in the season than the effectiveness monitoring and thus could have reflected seasonal differences in use of the area by different taxa.

The size composition of trout captured during effectiveness monitoring was larger than during baseline monitoring for all three of the primary trout taxa, with the average size of brown trout showing the greatest difference between periods (Table 13). The average total length of brown trout captured during baseline monitoring was 144 mm TL, whereas brown trout sampled during effectiveness monitoring was 176 mm TL. The average sizes of the other two taxa were more similar between the two monitoring periods, with brook trout averaging 161 mm TL and 163 mm TL, during baseline and effectiveness monitoring, respectively, and *Oncorhynchus* spp. averaging 164 mm TL during baseline conditions and 170 mm TL during 2005 effectiveness monitoring. Overall, our first year of effectiveness monitoring suggests that the rehabilitated Demonstration Reach now supports substantially higher numbers of fish and that the average sizes of fish are larger than during baseline monitoring. We will continue out-year effectiveness monitoring to further document the size composition and number of salmonids in the Demonstration Reach.

Table 13. Number and total length (mm, SD) of salmonids captured during 2005 baseline fish sampling at the Jocko River Demonstration Reach. BRK=brook trout; BRN=brown trout, ONC=rainbow trout, westslope cutthroat trout, and rainbow x cutthroat trout hybrids. Number (N)=number of fish captured during marking run and unmarked fish captured from the recapture effort.

TAXON	N	MEAN TOTAL LENGTH (mm)	RANGE
BRK	145	163	67-258
BRN	264	176	53-361
ONC	343	170	47-445

Redd Counts

We conducted baseline redd surveys for brown trout redds during late November or early December from 1999 through 2003 within the Demonstration Reach. The median number of redds in the baseline surveys of the Demonstration Reach was three, with a range of zero to 12 redds, depending upon the year. We observed no evidence of earlier bull trout spawning during these surveys.

We conducted effectiveness monitoring surveys for evidence of bull trout spawning in the Demonstration Reach on October 4, 2005, but did not detect redds in the area. We were unable to conduct effectiveness monitoring of brown trout redds during 2005 because of unseasonably cold weather during late November and through December, which resulted in ice covering most of the near-shore areas of the Demonstration Reach. We attempted surveys on three different occasions, but icing conditions persisted, rendering our brown trout redd surveys ineffective during autumn and early winter 2005. We will continue monitoring the restored reach on an annual basis to determine intensity of use by spawning salmonids. This monitoring will primarily target spawning by bull and brown trout; however, we will additionally monitor spawning by *Oncorhynchus* spp. when conditions are suitable (i.e., when spring flows and turbidities are low).

Macro invertebrate Sampling

We have collected no macro invertebrate data to date.

Habitat Surveys

We completed baseline habitat surveys for the Demonstration Reach in 2003 and implementation monitoring for the project in 2004. Figure 16 shows the percent composition by habitat type for the Demonstration Reach Phase I during baseline, implementation monitoring and at two reference sites. Figure 17 shows the percent primary pools for the Demonstration Reach baseline and implementation monitoring surveys. Primary pools increased in length by 28.5 percent as a result of the restoration project.

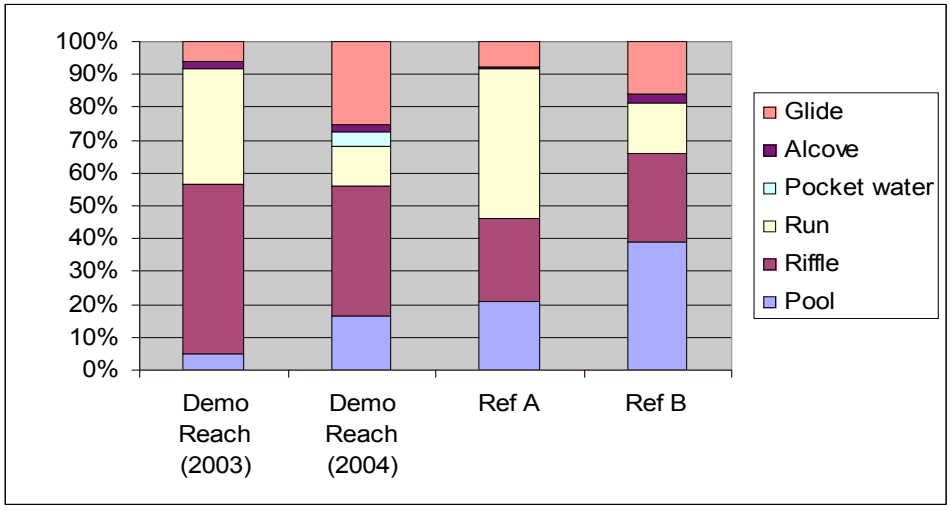


Figure 16. Percent composition by habitat type for the Demonstration Reach project collected for baseline monitoring (Demo Reach 2003), implementation monitoring (Demo Reach 2004) and two reference sites.

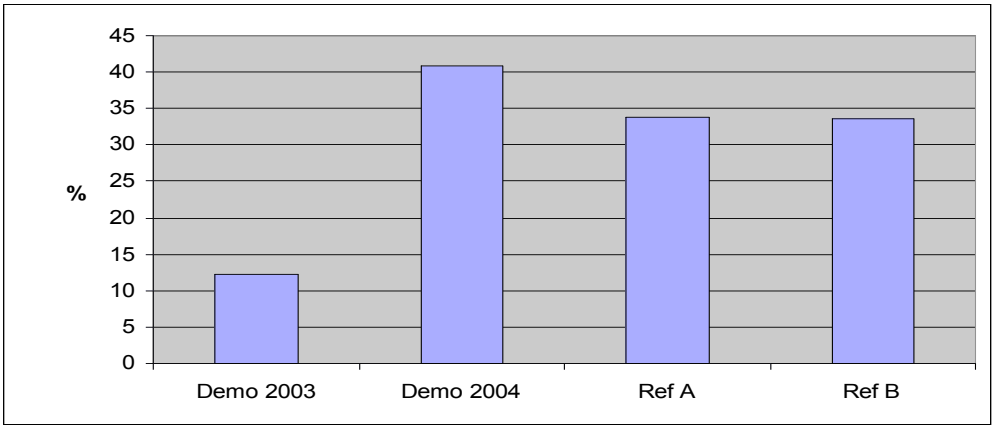


Figure 17. Percent primary pool habitat for the Demonstration Reach project collected for baseline monitoring (Demo Reach 2003), implementation monitoring (Demo Reach 2004) and two reference sites.

Vegetation

HGM Wetland Assessment

We collected baseline monitoring data for vegetation conditions in the floodplain within the project reach prior to project implementation in 2003 using HGM Riverine assessments. The methods and results for conducting HGM assessments are provided in a separate document (HGM Report 2005).

In general, we concluded that vegetative manipulation in the floodplain and directly on the river banks, either through removal of riparian canopy or through concentrated livestock grazing, has led to significant conversion of ponderosa pine overstory and black cottonwood/red osier dogwood and other native plant community types to an agricultural herbaceous cover. This is illustrated in Figure 18, which shows the HGM cover types, and the high occurrence of agricultural land, in the Demonstration Reach vicinity.

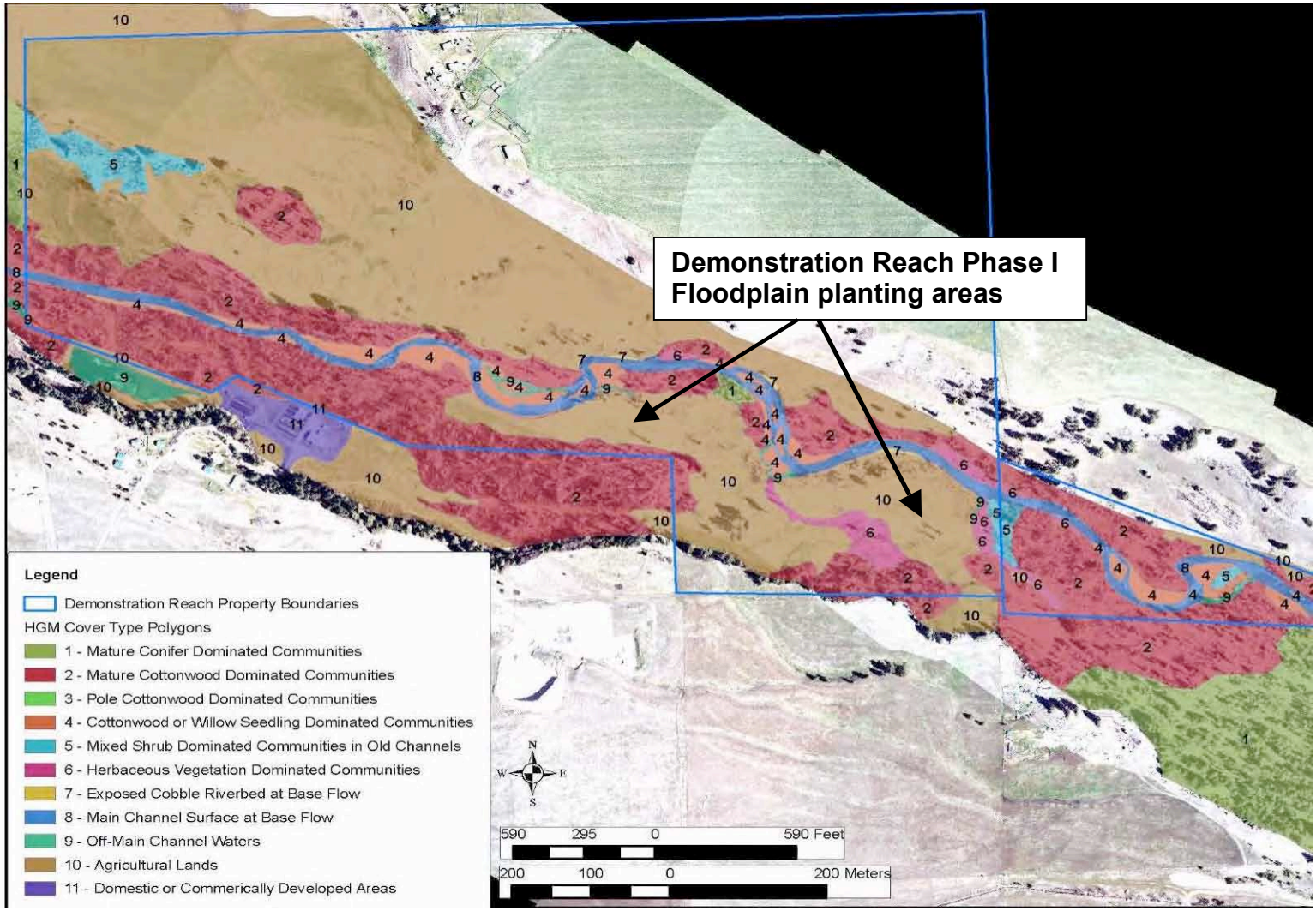


Figure 18. Demonstration Reach results of baseline HGM wetland assessment showing vegetation cover types. Cover type 10 indicates agriculture lands.

Implementation Monitoring Data

Tables 14 through 17 summarize the revegetation-related implementation data collected for the Demonstration Reach Phase I project. These data document the as-built conditions for the revegetation portion of the project. Table 14 is a summary of the bioengineering structures installed during the project. Table 15 provides species, quantities, salvaged and transplant locations for all shrubs and trees salvaged from within construction limits of the restoration project. We did not record all salvaged and transplanted materials. Table 16 summarizes the containerized plantings we installed during the project. Table 17 describes the experimental weed treatment plots.

Table 14. Description and location of bioengineering structures installed at the Jocko River Demonstration Reach phase I project. Station numbers correspond to river design stations.

Structure	Location (Stations)	Bank location	Layers (Height)	Notes
Soil lift 1	84+70 to 84+30	Right bank	2	Bottom layer reinforced with excelsior logs
Soil lift 2	83+50 to 83+75	Right bank	1	Reinforced with excelsior logs
Soil lift 3	83+25 to 83+00	Right bank	1	Reinforced with excelsior log
Soil lift 4	80+50 to 80+00	Left bank	3	Bottom layer not reinforced
Soil lift 5	Double layer: 79+50 to 79+30 Single layer: 79+30 to 78+70	Left bank	2, 1	Bottom layer reinforced with salvaged 12” coir log
Soil lift 6	77+25 to 77+50	Right bank	3	Bottom layer reinforced with willow bundles
Soil lift 7	76+65 to 76+00	Right bank	2	Bottom layer reinforced with excelsior logs
Soil lift 8	71+75 to 72+75	Left bank	3	Bottom layer reinforced with willow fascines
Soil lift 9	69+00 to 68+50	Left bank	1	Bottom layer reinforced with willow fascines
Soil lift 10	63+00 to 62+40	Right bank		
Soil lift 11	59+75 to 58+25	Left bank	3	Bottom layer reinforced with excelsior logs
Coir fascine 1	82+67 to 82+12	Right bank	2	Willow cuttings
Coir fascine 2	81+50 to 82+10	Left bank	2	Willow cuttings
Coir fascine 3	70+10 to 69+90	Left bank	1	Willow cuttings
Coir fascine 4	67+00 to 66+50	Right bank	2	Willow cuttings
Coir fascine 5	62+00 to 61+40	Right bank	2	Willow cuttings

Table 12. Log of salvage and transplant areas for the Jocko River Demonstration Reach restoration project. Station numbers correspond to river design stations.

SALVAGED FROM LOCATION (STATION)	SPECIES	QUANTITY (# PLANTS OR AREA FT^2)	TRANSPLANT LOCATION
83+40	Willow species	175	Cuttings used in bioengineering structures
83+50 to 81+75	Willow species	Approx. 400 ft^2	Cuttings used in bioengineering structures
	Willow species	Approx. 400 ft^2	Willow clumps transplanted to new floodplain south of 81+00
81+00 to 79+00	Willow species	Approx. 6,000 ft^2	Cuttings used in bioengineering structures; clumps transplanted to large disturbed area near 78+75
80+50	Ponderosa pine	2	Terrace north of material staging area
78+00 to 80+00	Willow species	Approx. 4,000 ft^2	Right floodplain near 81+00
76+00 to 74+-00	birch	15	Left floodplain 67+00 to 66+00
	alder	15	Left floodplain 67+00 to 66+00
	chokecherry	3	Southeast part of floodplain planting area
	mock orange	4	Southeast part of floodplain planting area
	snowberry/rose mix	80	Southeast part of floodplain planting area
	chokecherry	5	Southeast part of floodplain planting area
	maple	5	Southeast part of floodplain planting area
	dogwood	3	Southeast part of floodplain planting area
	alder	4	Left floodplain 67+00 to 66+00
	maple	3	Southeast part of floodplain planting area
	chokecherry	5	Southeast part of floodplain planting area
	mock orange	2	Southeast part of floodplain planting area
	chokecherry	3	Mid/north part of floodplain planting area
	aspen	1	Mid/north part of floodplain planting area

SALVAGED FROM LOCATION (STATION)	SPECIES	QUANTITY (# PLANTS OR AREA FT^2)	TRANSPLANT LOCATION
	rose	13	Mid/north part of floodplain planting area
	snowberry	16	Mid/north part of floodplain planting area
73+00 to 72+00	alder	8	Plug and left floodplain near 73+00
	cottonwood	3	Left floodplain near 73+00
	willow	1	Plug near 73+00
	chokecherry	1	Southeast part of floodplain planting area
	mock orange	1	Southeast part of floodplain planting area
	wetland sedge/herb. sod	1000 ft^2	Plug near 73+00
71+00	Wetland sedge/willow/sod	300 ft^2	79+00 log cross vein
70+00	birch	9	Southeast of 73+00 above plugs
	birch	4	Left floodplain near 72+00
	alder	11	79+00 log cross vein
	willow	5	Southeast of 73+00 above plugs
	rose	5	Southeast of 73+00 above plugs
	cottonwood	3	Southeast of 73+00 above plugs
	birch	3	Southeast of 73+00 above plugs
	juniper	1	Southeast of 73+00 above plugs
	ponderosa pine	1	Southeast of 73+00 above plugs
68+00	ponderosa pine	1	Mid/north part of floodplain planting area
	cottonwood	4	Mid/north part of floodplain planting area
	birch	3	Mid/north part of floodplain planting area
	rose	4	79+00 log cross vein
	willow	8	79+00 log cross vein
66+50 to 64+00	ponderosa pine	17	Terrace north of material staging area
62+00 to 59+00	birch	14	Upland area north of 62+00
	alder	5	Upland area north of 62+00
60+100 to 60+00	birch	7	Mid/north part of floodplain planting area
	willow	2	Mid/north part of floodplain planting area
	snowberry	16	Mid/north part of floodplain planting area

SALVAGED FROM LOCATION (STATION)	SPECIES	QUANTITY (# PLANTS OR AREA FT^2)	TRANSPLANT LOCATION
	rose	10	Mid/north part of floodplain planting area
	dogwood	5	Mid/north part of floodplain planting area
	cottonwood	4	Mid/north part of floodplain planting area
	ponderosa pine	17	Mid/north part of floodplain planting area
	ponderosa pine	4	Southwest corner floodplain planting area
	douglas fir	6	Mid/north part of floodplain planting area
	birch	3	Mid/north part of floodplain planting area
	juniper	1	Mid/north part of floodplain planting area

Figure A-2 in Appendix A shows the location of planting polygons within the floodplain planting area. In addition to floodplain planting polygons, we also planted streambanks and wetland areas along the newly constructed channel. Table 15 provides the species and numbers of each species we planted within each floodplain polygon and within streambank and wetland planting areas.

Table 15. Summary of plants installed in floodplain, streambank and wetland planting polygons at the Demonstration Reach Phase I restoration project.

Common Name	Container Size[1]	Jocko (Demo Reach) Polygon sub-units												Total Planted
		1a	1b	1c	2a	2b	3	5a	5b	5c	6	Banks	Wetland	
Apocynum cannabium	5.5 ci				50	16				107	78	0	0	251
Artemesia ludoviciana	5.5 ci				224	71		51	10	417	346	0	0	1,120
Carex bebbii	5.5 ci											525	655	1,180
Carex flava	5.5 ci											675	1,078	1,753
Carex nebrascensis	5.5 ci											1,025	1,656	2,681
Carex utriculata	5.5 ci											1,800	2,881	4,681
Eleocharis palustris	5.5 ci											825	1,317	2,142
Epilobium angustifolium	5.5 ci				320	102		73	15	596	495	0	0	1,600
Geum macrophyllum	5.5 ci											2,000	600	2,600
Juncus balticus	5.5 ci											575	900	1,475
Juncus ensifolius	5.5 ci											315	501	816
Juncus tenuis	5.5 ci											290	459	749
Monarda fistulosa	5.5 ci											430	690	1,120
Scirpus acutus	5.5 ci											100	550	660
Scirpus microcarpus	5.5 ci											975	1,535	2,510
TOTAL HERBACEOUS		0	0	0	594	189	0	124	25	1,121	918	9,535	12,822	**25,328**
Acer glabrum	10 ci				70	22		16	3	131	109	0	0	352
Alnus incana	10 ci	38	5	5	60	19	27	14	3	112	93	0	212	588
Alnus incana	99 ci											193	0	193
Betula occidentalis	10 ci	82	12	12	128	41	58	29	6	239	198	0	319	1,123
Betula occidentalis	99 ci											193	0	193
Cornus stolonifera	10 ci	144	21	21	226	72	103	51	10	422	350	0	300	1,720
Cornus stolonifera	99 ci											387	0	387
Crataegus douglasii	10 ci				118	37		27	5	219	182	0	0	588
Philadelphus lewisii	10 ci				69	22		16	3	129	107	0	0	347

Common Name	Container Size[1]	Jocko (Demo Reach) Polygon sub-units												Total Planted
		1a	1b	1c	2a	2b	3	5a	5b	5c	6	Banks	Wetland	
Prunus viriginiana	10 ci				96	31		22	4	180	149	0	120	602
Prunus viriginiana	99 ci				47	15		11	2	88	73	200	0	437
Rosa woodsii	10 ci	80	11	11	126	40	57	29	6	234	194	0	207	996
Rosa woodsii	99 ci											150	93	243
Rubus idaeus	10 ci	23	3	3	36	11	16	8	2	67	55	0	120	344
Salix bebbiana	10 ci	91	13	13	143	45	65	32	6	266	221	0	300	1,195
Salix bebbiana	99 ci											100	287	387
Salix drummondiana	10 ci				115	37		26	5	214	177	0	350	924
Salix geyeriana	10 ci	30	4	4			21					0	38	98
Salix geyeriana	99 ci				20	6		5	1	37	31	325	425	850
Salix exigua	10 ci				269	85		61	12	501	415	0	350	1,693
Salix exigua	99 ci											800	417	1,217
Sambucus cerulea	10 ci				47	15		11	2	88	73	0	0	235
Sambucus cerulean	99 ci											100	143	243
Shepherdia canadensis	99 ci				49	15		11	2	91	75	0	0	243
Symphoricarpos occidentalis	10 ci	78	11	11	123	39	56	28	6	228	189	0	200	1,049
TOTAL SHRUBS		565	81	81	1,741	554	404	396	79	3,245	2,691	2,448	3,881	**16,167**
Pinus ponderosa	99 ci				83	27		19	4	155	129	0	0	417
Populus tremuloides	27 ci				128	41		29	6	238	197	0	0	638
Populus trichocarpa	27ci				241	77		55	11	450	373	0	600	1,856
Populus trichocrapa	99 ci				83	27		19	4	155	129	600	200	2,217
TOTAL TREES		0	0	0	536	170	3	122	24	998	834	600	800	**4,087**
TOTAL PLANTS INSTALLED AT DEMONSTRATION REACH PHASE I														**45,582**

[1] Container size descriptions are as follows:5.5 ci (cubic inches) – Beaver Plastics Styroblock 160/90 container (1.2 inch diameter, 6 inch depth),
10 ci – Ray Leach Super Cell container (1.5 inch diameter, 8.25 inch depth), 27 ci – Beaver Plastics Styroblock 45/450 container (2.4 inch diameter, 8 inch depth)
99 ci – Custom PVC container (3 inch diameter, 14 inch depth)

In addition to the revegetation treatments described above, we implemented the following treatments in floodplain planting polygons and list them below to document "as-built" conditions for implementation monitoring purposes:

Soil Amendments. We added a fertilizer pack to each planting hole at a depth of approximately 6 inches.

Browse Protection. We placed a browse protector around each woody plant. We used two types of browse protectors: a four-foot tall rigid mesh browse protector (custom made) and a two-foot tall Rigid Seedling Protection Tubes (manufactured by Quadel Industries, Inc). We installed the four-foot tall browse protectors predominantly around tree species, and the two-foot tall protectors around shrub species. We did not install browse protectors around herbaceous species.

Irrigation. We installed an irrigation system on the site to provide water to all floodplain-planting polygons. Crews installed drip irrigation to approximately 4,000 plants in the floodplain planting polygons (1,2,3,5, and 6). Additionally, we installed overhead irrigation to all plants installed in the experimental weed plots. Plants in wetland and streambank polygons did not receive any supplemental irrigation.

Weed Removal and Control Methods. We scalped the soil around each planting hole to a depth of approximately six inches to remove existing vegetation and installed three- by three-foot or two- by two-foot Coolmat® weed mats around each plant.

We installed four experimental treatments in the floodplain to evaluate their effectiveness for controlling weeds and invasive grasses. Each treatment plot is fifty- by one hundred-foot and replicated once each for a total of eight treatment plots. Experimental weed control treatments include:

- Continuous cardboard topped with a four-inch layer of wood mulch;
- Continuous black polyethylene weed mat;
- Six inch layer of wood mulch; and
- Three- by three-foot weed mats.

The location of the eight experimental weed treatment plots is shown in Figure A-1 in Appendix A.

Green line Photo Documentation

We completed photo point documentation for implementation monitoring purposes after channel construction and during annual effectiveness monitoring. The locations of photo points along the newly constructed channel are shown in Figure A-3 in Appendix A. Photos, with accompanying notes on green line composition and revegetation treatments, collected for baseline monitoring are provided in Appendix B.

Implementation Monitoring Data

Summary of Revegetation Effectiveness Monitoring Results

In order to provide a context for revegetation effectiveness monitoring results, this section provides an integrated discussion that outlines how revegetation strategies evolved for the Demonstration Reach project and discusses results in terms of ecological processes at the site.

During 2002 and 2003, a large-scale seed collection and plant-growing program was implemented in anticipation of the Demonstration Reach project. The CSKT Forestry Nursery grew approximately 25,000 plants, most of which were grown as part of the Demonstration project. By fall of 2004, when the project was being implemented, most of these plants were ready for out planting.

At the same time, the ARCO restoration team was realizing, based on early results from projects planted during 2003, that many restoration sites would need a period of site preparation before they were ready to be planted at a large scale. By eliminating livestock grazing and agricultural uses from these sites, we had changed the land management without addressing the fact that sites were still adapted to the frequent disturbance cycles that characterize agriculture. Sites had actually become adapted (in a sense addicted) to agriculture. Responses to this abrupt change in land management included a dramatic expression of weed populations, and vigorous growth of agricultural grasses. The ecological reasons for this response are discussed at length in the Jocko River Master Plan—in summary, while these sites once supported diverse, multi-storied riparian plant communities, they were now best suited to support weeds and agricultural grasses. In other words, the site potential had shifted.

In most cases, where shrub seedlings were out planted on other sites in 2003, they were overwhelmed by competition from weeds and grasses. Insects that use agricultural grasses and weeds for a food source also fed on shrub leaves. Voles, whose ideal habitat is grasslands, girdled the stems of many shrubs. Wide-open areas with minimal shade resulted in extreme temperature variations. In summary, the agricultural sites proved hostile to out-planted shrubs, resulting in high mortality.

At the start of the Demonstration Reach project in 2004, we were aware of what was happening at the 2003 sites, and decided that future projects would need to address site conditions before large-scale out planting would be feasible. However, we were faced with a greenhouse full of native plants that either needed to be out planted, moved into larger containers, or disposed of as they were starting to become root-bound. Faced with these choices, we decided to move some plants into larger containers and out-plant the rest so as to not waste plant material. We decided to invest in browse protectors, mulch mats, and an aggressive irrigation program, to maximize survival of these plants that we knew were being out planted onto a potentially hostile site. As shown below, overall survival of this large scale planting as of late summer 2005 was 54 percent.

Meanwhile, we also began systematically experimenting with site preparation treatments at the Demonstration Reach site. Three different aggressive mulch treatments were applied with the goal of suppressing native grasses and weeds. These treatments, described below, resulted in overall survival between 70 percent and 95 percent depending on the treatment used. In addition, these mulch treatments resulted in significantly greater height and caliper growth.

Plant Survival

In 2005, we established twelve 3,600 foot-square plots in floodplain planting polygons and eleven 900 foot-square plots in streambank and wetland planting areas. The locations of plant survival planting plots are shown in Figure A-2, Appendix A. In September 2005, we collected survival data, invasive species presence, and natural recruitment data in each plot. In addition to plots, we established thirty-foot transects along the riverside of each streambank-monitoring plot for monitoring woody species regeneration. We recorded the species and number of plants occurring in a two- by two-foot square placed every other two feet on the transect (i.e. the square was placed from two to four feet on the transect, then six to eight feet, ten to twelve feet, etc.).

We sampled a total of 1,423 plants in floodplain planting polygon plots and a total of 593 plants in streambank and wetland sampling plots. Table 16 is a summary of survival by species within floodplain planting polygon-monitoring plots. Table 17 is a summary of survival by species within streambank and wetland planting area-monitoring plots.

Overall survival for floodplain planting plots was 54 percent. Percent survival was lowest for dogbane (*Apocynum cannabium*) and sandbar willow (*Salix exigua*). However, many of the dead plants (355) could not be identified at the time of monitoring, in many cases because no above-ground plant parts were present.

A comparison between survival of plants grown in different containers showed that 70 percent of plants cultivated in PVC containers survived and 47 percent of those cultivated in ten cubic-inch planters survived.

Overall survival for streambank and wetland plots was 89 percent. Survival of woody species within these plots was 82 percent.

The dominant invasive species recorded in six or more floodplain planting plots included: quack grass (*Agropyron repens*), smooth brome (*Bromus inermis*), spotted knapweed (*Centaurea maculosa*), hounds tongue (*Cynoglossum officinale*), orchardgrass (*Dactylis glomerata*), common timothy (*Phleum pratense*), and sulfur cinquefoil (*Potentilla recta*).

Other invasive or non-native species included: cheatgrass (*Bromus tectorum*), reed canarygrass (*Phalaris arundinacea*), bladderwort (*Silene alba*), red-top (*Agrostis stolonifera*), Canada thistle (*Cirsium arvense*), and bull thistle (*Cirsium vulgare*).

The only naturally colonizing dominant native shrub species found at six or more sites were Wood's rose (*Rosa woodsii*) and snowberry (*Symphoricarpos spp.*).

Black cottonwood (*Populus trichocarpa*) regeneration was abundant along streambank plots. Table 18 provides seedling numbers recorded by plot. The high flows during the spring of 2005, followed by a gradual declining limb of the hydrograph between late June and mid-July, provided ideal conditions for cottonwood germination.

Experimental Weed Treatments

The results of the experimental weed treatment monitoring showed that all experimental plots had greater survival compared to the control plot (Table 18). The cardboard with mulch and black polyethylene fabric treatments had greater survival (Figure 20) and greater diameter/stem growth metric values (Figure 21) compared to control and mulch only plots (Figures 20 and 21). For the growth data, Wood's rose and snowberry are reported separately. Because chokecherry growth in the Black Plastic 2 treatment was considerably higher than other species, a bar excluding chokecherry is included to evaluate the influence of chokecherry on overall growth. The mulch only treatment plots had slightly lower growth metric values compared to control plots (Figure 19). The black polyethylene fabric and cardboard treatments also had very low exotic plant species coverage compared to control plots (Table 17). Figure 19 shows photos comparing the four treatment plots.

Valley-wide Transects

We collected valley-wide transect data in the fall of 2005. We established a total of three valley-wide transects which tie in with monumented channel cross sections described in the geomorphic section above. The location of these transects is shown in Figure A-1 in Appendix A. Figure 22 shows the results of valley-wide transect #3. Valley-wide transects will be a very useful tool in monitoring long-term changes in plant communities within the floodplain for the Demonstration Reach Phase I project.

Table 16. Summary of plant survival by species for floodplain planting polygon plots. Numbers do not reflect the unknown species.

Species	Total Survived BY INDIVIDUAL PLANT	Percent Survival
Acer glabrum	31	82%
Alnus incana	24	57%
Amelianchier alnifolia	1	100%
Apocynum cannabium	8	30%
Artemesia ludoviciana	12	86%
Betula occidentalis	58	73%
Crataegus douglasii	87	67%
Epilobium angustifolium	60	95%
Philadelphus lewisii	1	100%
Pinus ponderosa[1]	13	72%
Populus tremuloides[1]	35	78%
Populus trichocarpa	27	73%
Prunus virginiana[1]	57	51%
Rosa woodsii[1]	59	92%
Ribes lacustre	1	100%
Rosa woodsii	113	95%
Rubus idaeus	24	92%
Salix bebbiana	38	93%
Salix drummondiana	1	100%
Salix exigua	18	42%
Salix geyeriana	4	80%
Salix species (unidentified)	27	40%
Sambucus cerulea[1]	11	65%
Shepherdia canadensis[1]	20	80%
Symphoricarpos occidentalis[1]	71	88%

[1] Indicate those plants that were cultivated in both 99 cubic inch PVC and 10 cubic inch Styroblock containers.

Table 17. Summary of plant survival by species for streambank and wetland planting plots.

Species	Total Survived (total sampled)	Percent Suvival
Acer glabrum	3	100%
Alnus incana	22	76%
Betula occidentalis	27	82%
Carex bebbii	19	100%
Carex flava	22	100%
Carex nebrascensis	9	100%
Carex utriculata	61	100%
Cornus stolonifera[1]	56	85%
Crateagus douglasii	1	100%
Eleocharis palustris	5	100%
Geum macrophyllum	49	100%
Juncus balticus	39	100%
Juncus ensifolius	12	100%
Juncus tenuis	16	100%
Mentha arvensis	37	100%
Monarda fistulosa	4	100%
Pinus ponderosa[1]	4	100%
Populus tremuloides[1]	1	100%
Rosa woodsii	11	100%
Rubus idaeus	5	83%
Salix bebbiana	33	83%
Salix drummondia	3	100%
Salix exigua	22	71%
Salix species (unidentified)	9	75%
Sambucus cerulea	3	60%
Scirpus acutus	4	100%
Scirpus microcarpus	2	100%
Shepherdia canadensis	2	100%
Symphoricarpos occidentalis	1	50%

[1] Indicate those plants that were cultivated in both 99 cubic inch PVC and 10 cubic inch Styroblock containers.

Table 18. Summary of seedling recruitment by species for streambank planting plots. The number of seedlings is the number recorded along a one meter by one meter transect located parallel to the streambank along the edge of the cottonwood and willow recruitment zone.

Streambank Survival Plot ID	Species	Number of seedlings
SB-01	*Populus trichocarpa*	73
SB-02	*Populus trichocarpa*	70
SB-03	*Populus trichocarpa*	20
SB-04	*Populus trichocarpa*	288
SB-05	*Populus trichocarpa*	56
SB-06	*Populus trichocarpa*	17
SB-07	*Populus trichocarpa*	76
SB-08	*Populus trichocarpa*	125
SB-09	*Populus trichocarpa*	118
SB-10	*Populus trichocarpa*	0
SB-11	*Populus trichocarpa*	12
	TOTAL *Populus trichocarpa*	855
SB-07	*Salix exigua*	69

Figure 19. Photographs of experimental weed treatments implemented at the Demonstration Reach Phase I.

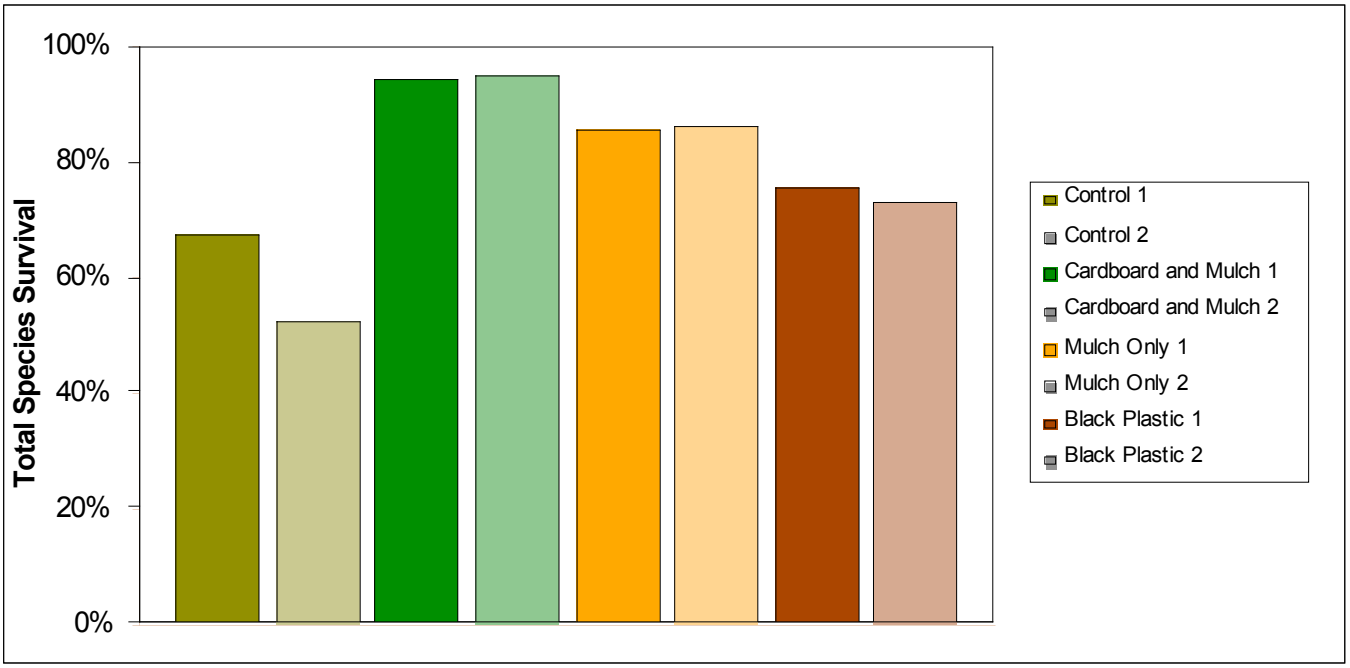


Figure 20. Percent survival for species planted in experimental weed treatment plots by treatment.

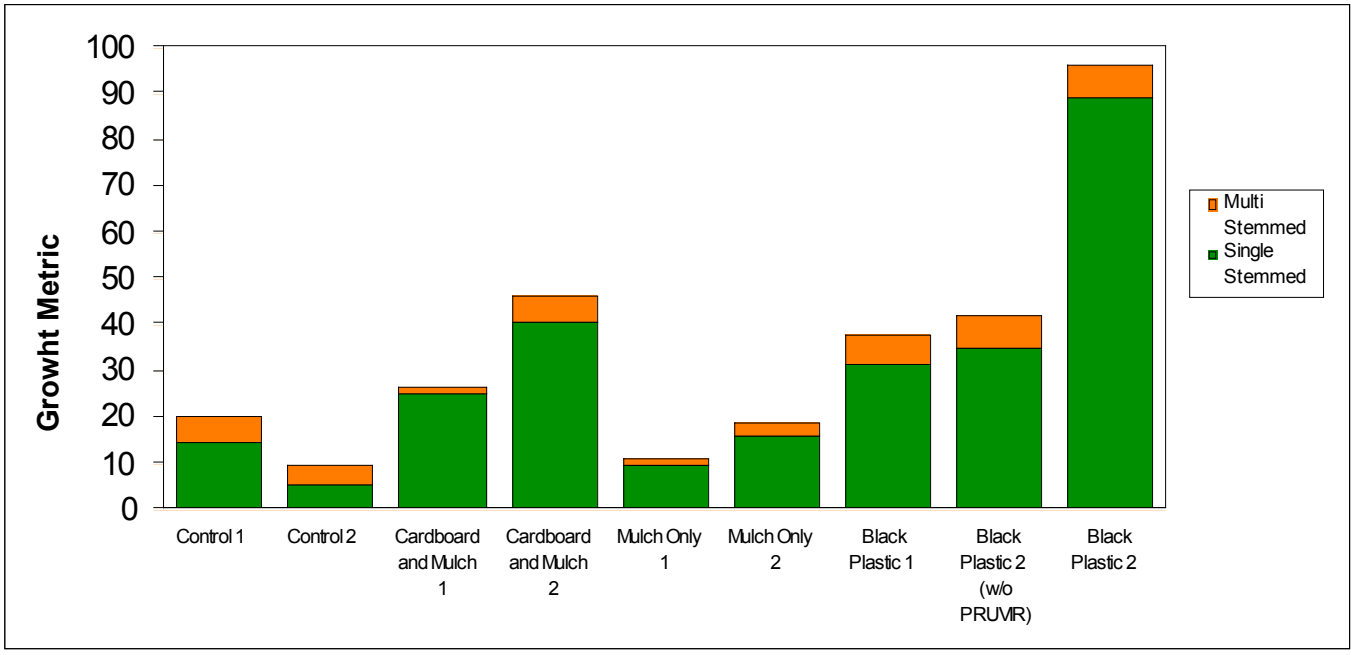


Figure 21. Total plant growth (all species) using the growth metric for experimental weed treatment plots.

Table 19. Total species survival and percent survival for each of the experimental weed treatment plots.

SPECIES	Control 1		Control 2		Cardboard-Mulch 1		Cardboard-Mulch 2	
	Total number surviving	Percent survival	Total number surviving	Percent survival	Total number surviving	Percent survival	Total number surviving	Percent survival
ACEGLA	7	78%	4	67%	10	100%	9	100%
ALNINC	3	25%	1	9%	8	89%	9	100%
BETOCC	2	29%	1	25%	7	88%	8	89%
CRADOU	9	100%	11	85%	13	93%	9	100%
PHILEW	9	90%	7	100%	0	0%	9	100%
PINPON	2	40%	3	60%	5	100%	5	100%
POPTRE	6	75%	3	27%	10	100%	10	100%
POPTRI	2	20%	0	0%	8	100%	8	73%
PRUVIR	8	100%	6	75%	9	100%	10	100%
ROSWOO	10	100%	10	100%	10	100%	11	100%
SYMOCC	11	92%	8	80%	18	95%	11	85%
SPECIES	**Mulch Only 1**		**Mulch Only 2**		**Black Plastic 1**		**Black Plastic 2**	
	Total number surviving	Percent survival	Total number surviving	Percent survival	Total number surviving	Percent survival	Total number surviving	Percent survival
ACEGLA	10	100%	8	100%	6	67%	6	86%
ALNINC	6	86%	9	100%	10	91%	6	75%
BETOCC	4	44%	7	78%	4	50%	4	44%
CRADOU	11	92%	12	100%	9	100%	9	100%
PHILEW	5	100%	3	100%	5	83%	2	50%
PINPON	7	70%	5	100%	5	100%	5	100%
POPTRE	8	80%	10	100%	7	70%	5	56%
POPTRI	10	100%	7	70%	4	44%	9	90%
PRUVIR	9	90%	8	100%	10	100%	8	89%
ROSWOO	18	90%	11	100%	9	100%	8	100%
SYMOCC	0	0%	9	47%	10	77%	11	100%

Table 20. Number of exotic species with greater than 5% canopy cover within experimental weed treatment plots.

PLOT ID	NUMBER OF EXOTIC SPECIES WITH >5% COVER
Control 1	6
Control 2	7
Cardboard and Mulch 1	0
Cardboard and Mulch 2	0
Mulch Only 1	5
Mulch Only 2	4
Black Plastic 1	0
Black Plastic 2	0

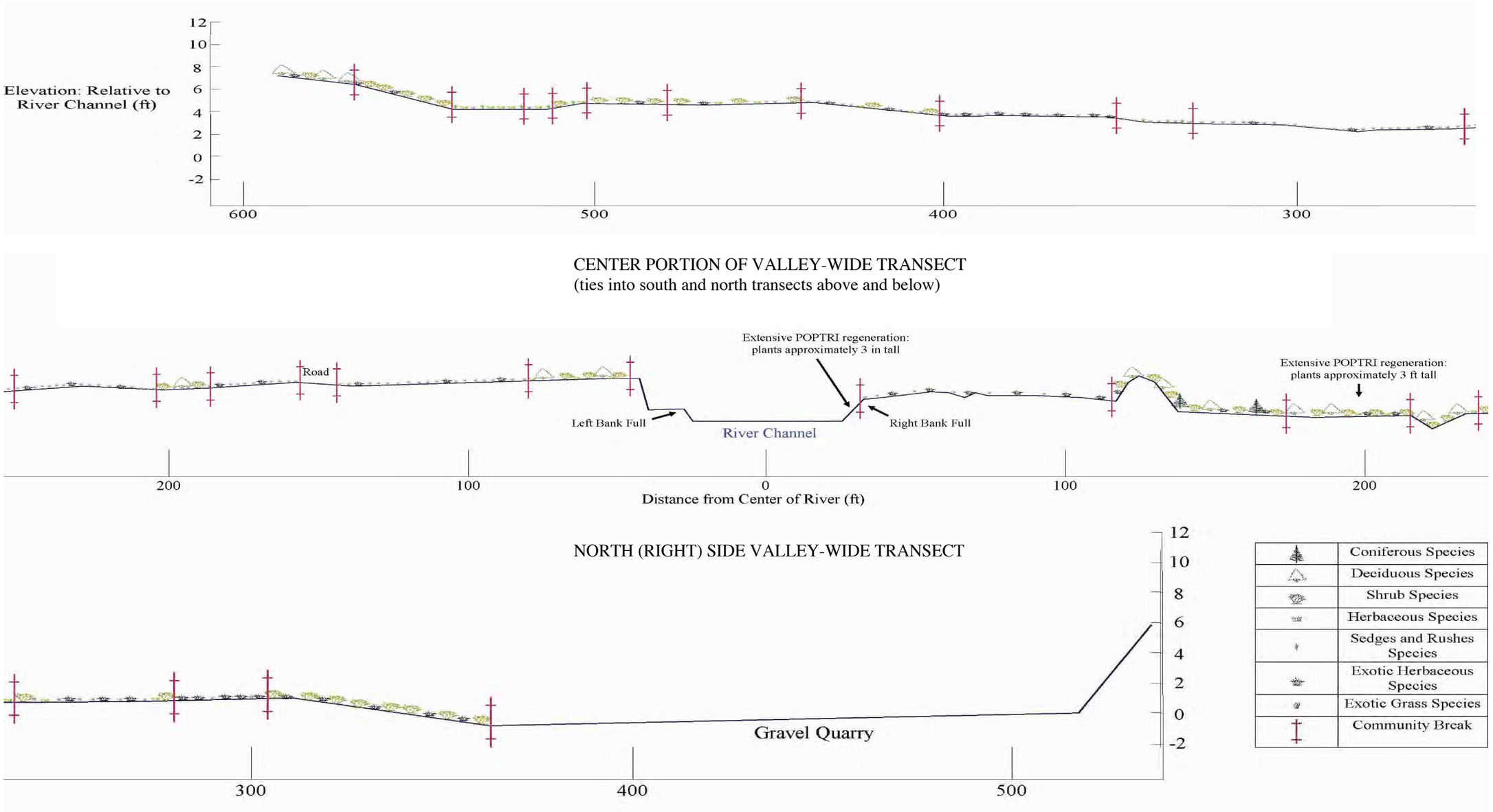


Figure 22. Jocko River Demonstration Reach Phase I valley-wide transect #3 for use in long-term effectiveness monitoring.

Bioengineering Structures

We monitored bioengineering structures, described in Table 11, for percent cover of vegetation, number of living willow cuttings and maintenance needs. Figure A-1 in Appendix A shows the locations of bioengineering structures. During the Spring 2005 flood, only one bioengineering structure, coir fascine 1, was lost.

Table 21. Summary of bioengineering structures willow cutting stems alive and percent cover by vegetation.

Structure Number	Number of living cuttings	average % cover
Soil Lift 1	74	6.8%
Soil Lift 2	99	4.6
Soil Lift 3	31	1.0%
Soil Lift 4	36	0.6%
Soil Lift 5	107	2.4%
Soil Lift 6	73	9.6%
Soil Lift 7	99	5.3%
Soil Lift 8	48	0.1%
Soil Lift 9	157	10.8%
Soil Lift 10	124	3.3%
Soil Lift 11	95	2.7%
Coir fascine 1*	N/A	N/A
Coir fascine 2	47	1.4%
Coir fascine 3	28	10%
Coir fascine 4	107	19.2%
Coir fascine 5	201	12.7%

*Coir fascine #1 was lost during the Spring 2005 flood event.

Transplanted Shrub and Tree Survival

We recorded general notes on transplant survival during 2005 green line photo documentation. In general, of the species salvaged, alder and birch appeared to have the highest survival rate. Smaller transplants also appeared to be thriving compared with larger shrub transplants; however, new growth is present on many large shrubs. A number of large (five to eight-foot) pines transplanted to an upland terrace did not survive. Shrubs transplanted nearest to the newly construction channel appeared to have higher survival than transplants placed in floodplain planting polygons.

Use of Data in Adaptive Management

Adaptive management, as it relates to the CSKT Jocko River restoration effort, is described in the Jocko River Master Plan (JRMP). Data collected during annual effectiveness monitoring is used to determine if the Demonstration Project is achieving near-term goals and objectives, and moving the river and floodplain environment toward longer term ecological objectives. This learning base has been, and will continue to be integrated into future restoration effort in the Jocko Drainage.

Adaptive Management Recommendations

Based on the monitoring data collected to date, the following adaptive management actions were enacted during autumn 2005.:

- Repair of some damages to structures and channel that occurred during the Spring 2005 flood event;
- Minor repair of two bioengineered soil lifts that occurred during the Spring 2005 flood event; and
- Construction of an additional bioengineered soil lift to vegetate a high priority stream bank.

Based on the monitoring data collected to date, the following adaptive management recommendations may be made for future restoration projects:

- Mulch alone may not be effective in controlling invasive grasses and other invasive species. The use of cardboard or other treatments not tested at the Demonstration Reach (e.g., herbicide or soil tillage treatments prior to mulch placement), in combination with mulch, should prove more effective;
- Planting containerized shrubs should be done in select areas using a phased, multi-year approach that includes two or three years of site preparation before out planting;
- Larger container-grown nursery stock should be used on future projects. Examples of larger sizes include Deepot D40 (40 ci), custom made PVC (99 ci), and Tall One Treepot (224 ci) containers for woody plants, and Ray Leach Super Cell (10 ci) and Deepot D40 containers for herbaceous species. The larger planting stock and deeper rooting depths should allow planted stock to compete more effectively with weedy species and become established more quickly; and,
- Bioengineered soil lifts are a more effective revegetation technique for high priority streambanks compared to coir fascines.

Adaptive management recommendations will be added to as effectiveness monitoring for the project continues.

References

Driscoll, F., 1986. Groundwater and Wells 2nd Edition. Johnson Filtration Systems. 1,089 p.

CSKT. 2005. HGM Report. Prepared by Geum Environmental Consulting, Inc. Hamilton, MT.

CSKT. Unpublished. Work Plan for Stream Stock Assessments. Unpublished internal document. Confederated Salish and Kootenai Tribes, Natural Resources Division, Pablo, Montana.

CSKT. Unpublished. Field Operating Procedures: Salmonid Redd Determination. Unpublished internal document. Confederated Salish and Kootenai Tribes, Natural Resources Division, Pablo, Montana.

Harrelson, C. C., C. L. Rawlins, and J. P. Potyondy. Stream channel reference sites: an illustrated guide to field technique. General Technical Report RM-245. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Hauer, F.R., Cook, B.J., Gilbert, M.C., Clairain, E.Jl, Jr., and Smith, R.D. 2002. "A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of riverine floodplains in the northern Rocky Mountains," ERDC/EL TR-02-21, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Huntington, C. 2003. unpublished. Transect-Based Habitat Survey of the mainstem Jocko River and primary tributaries. Prepared for CSKT Fisheries Program.

Platts, W., W. Megahan, and G. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. Gen. Tech. Rep. INT-138. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah. 70 p.

Robson, D. S. and H. A. Reiger. 1964. Sample size in Petersen mark-recapture experiments. Transactions of the American Fisheries Society 93(3):215-232.

Shepard, B. B. and P. J. Graham. 1983. Fish resource monitoring program for the upper Flathead Basin. Prepared for the Environmental Protection Agency, contract number R008224-01-4. Montana Fish, Wildlife & Parks, Kalispell, Montana.

Thurow, R. F. 1994. Underwater methods for study of salmonids in the intermountain west. General Technical Report INT-GTR-307. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah.

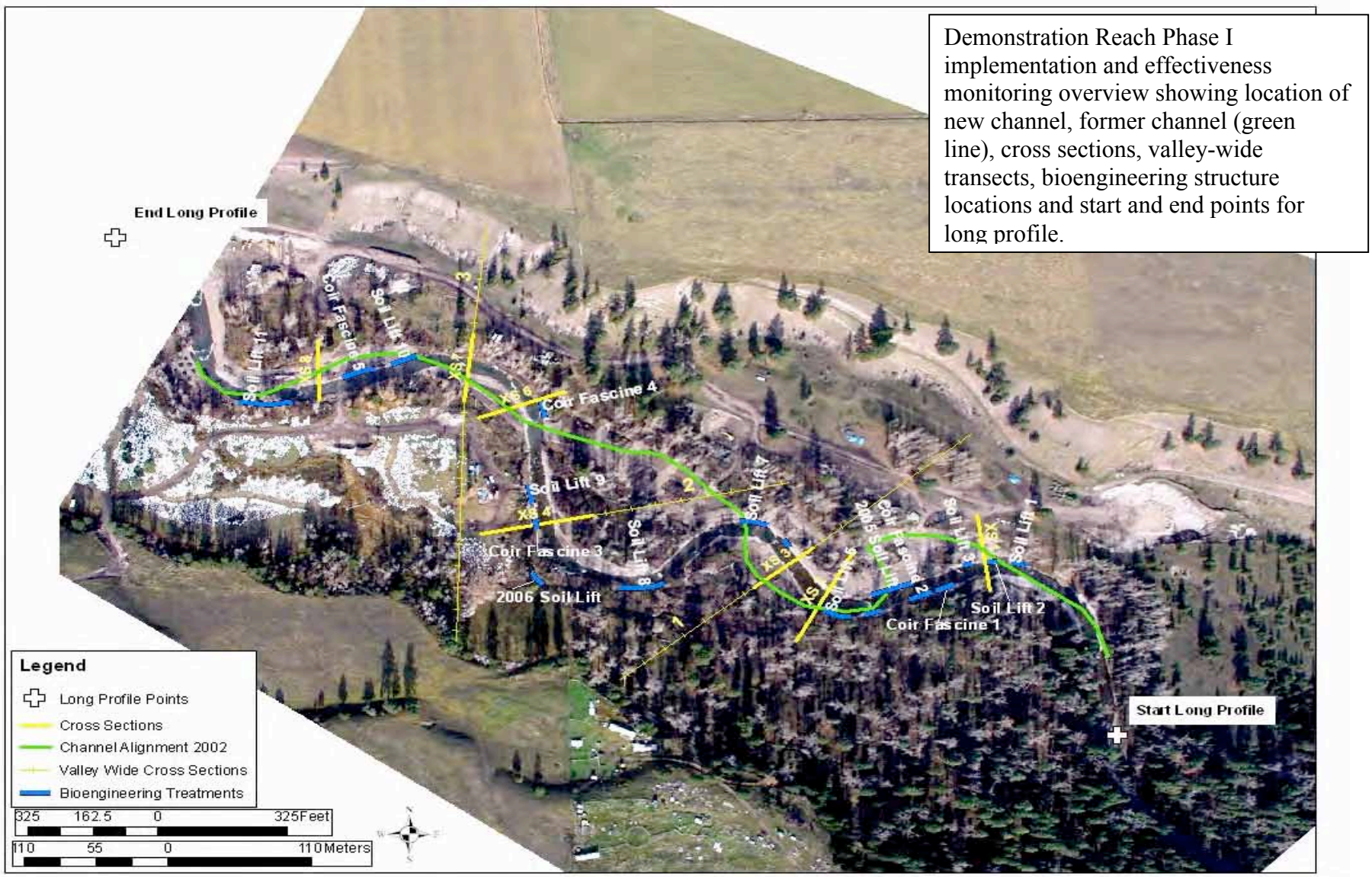
U.S. Agricultural Research Service. 1937. Aerial photographs of the lower Jocko River, 1:18,000 scale.

USDA Forest Service. 1989. Ecosystem Classification Handbook: ECODATA. USDA Forest Service, Northern Region, Missoula, Montana.

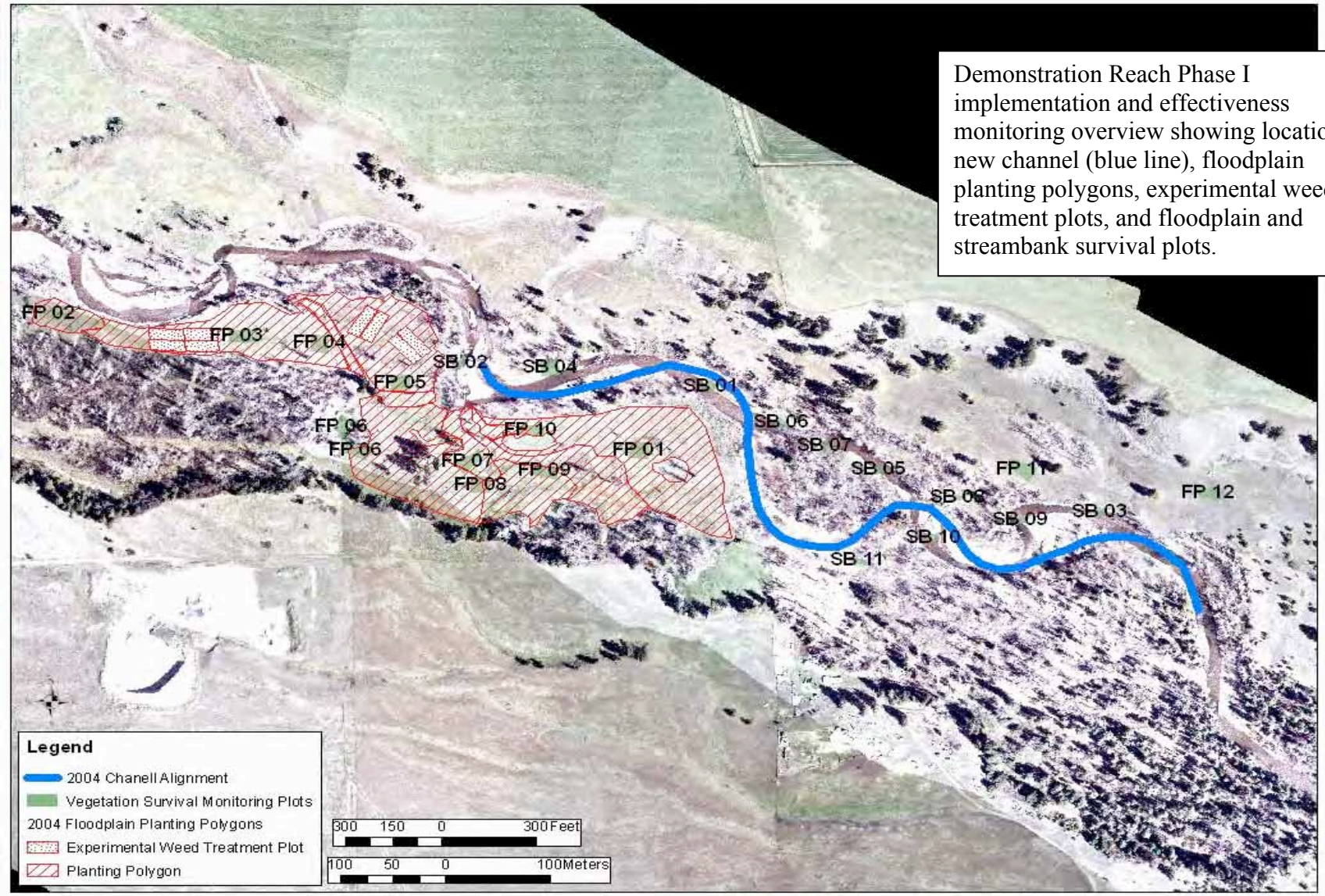
USEPA. 2004. Wadeable Stream Assessment: Field Operations Manual. EPA841-B-04-004. U.S. Environmental Protection Agency, Office of Water and Office of Research and Development, Washington, DC.

Vincent, R. 1971. River electrofishing and fish population estimates. The Progressive Fish Culturist 33(3): 163-169.

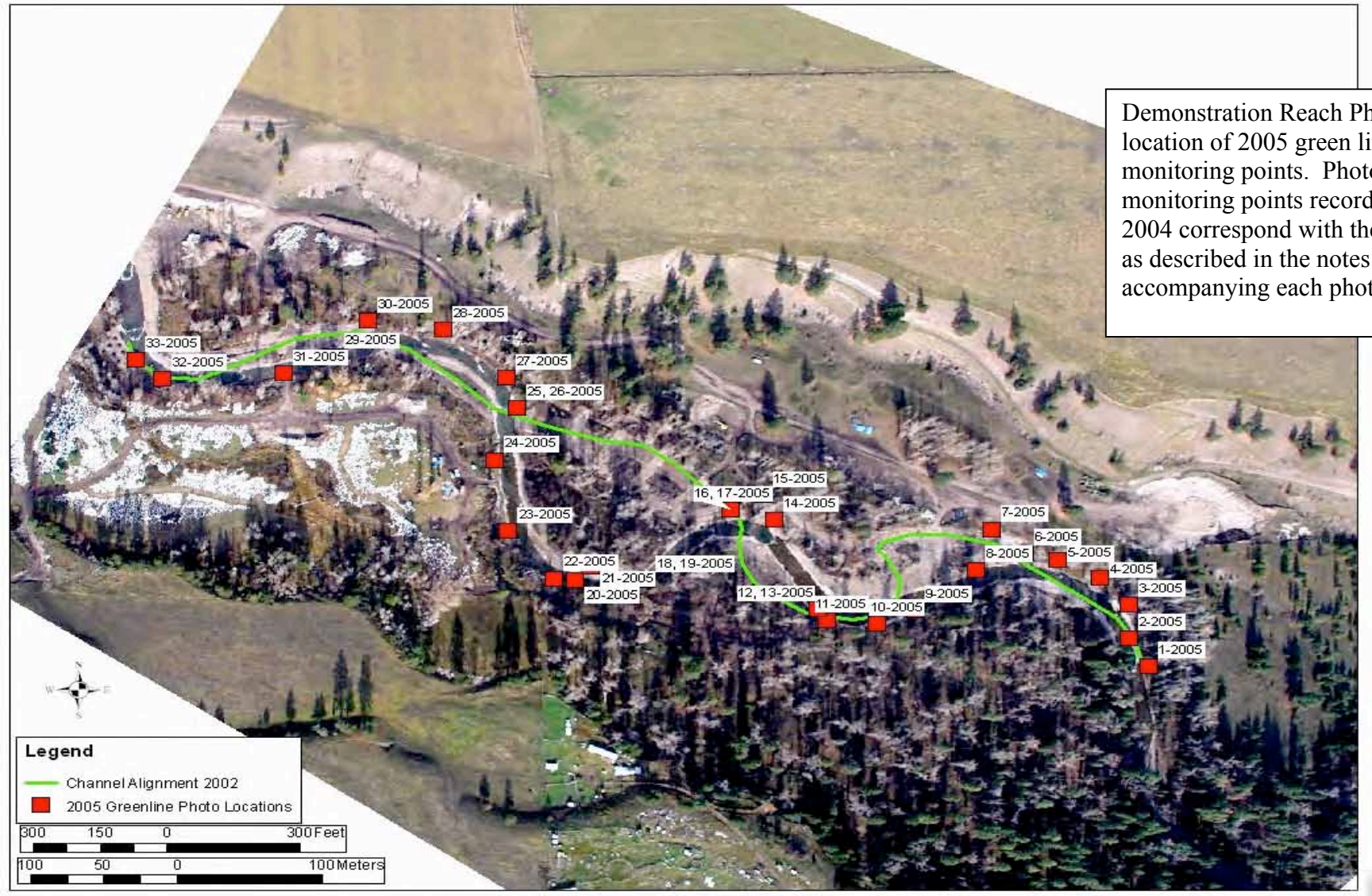
Appendix A: Monitoring Site Locations



Demonstration Reach Phase I implementation and effectiveness monitoring overview showing location of new channel, former channel (green line), cross sections, valley-wide transects, bioengineering structure locations and start and end points for long profile.



Demonstration Reach Phase I implementation and effectiveness monitoring overview showing location of new channel (blue line), floodplain planting polygons, experimental weed treatment plots, and floodplain and streambank survival plots.



Demonstration Reach Phase I location of 2005 green line photo monitoring points. Photo monitoring points recorded in 2004 correspond with these points as described in the notes accompanying each photo.

Appendix B: Green line Photo Documentation

Implementation Monitoring: October, 2004

PHOTO MONITORING POINT 1-2004

Photo was taken from right bank at Station 91+54 looking NNW (337.5°). Photo and notes extend to Station 88+50. The existing green line along the right bank is located at bankfull and consists of predominantly reed canarygrass and knapweed (approx. 50 feet wide). Community type transitions to cottonwood, pines, and shrub riparian vegetation beyond this. No vegetation treatments were implemented in this area.

PHOTO MONITORING POINT 2-2004

Photo was taken from left bank at station 90+00 looking N (0°) to station 88+50. The existing green line is at bankfull reed canarygrass and knapweed on the left bank (approx. 20 feet wide). Community type transitions to pine and rose upland community. No vegetation treatments were implemented in this area. Structure in channel is rock cross vane (most upstream structure).

PHOTO MONITORING POINT 3-2004

Photo was taken from right bank at station 85+50 looking NW (315°). The existing green line along the right bank is located at bankfull and consists of knapweed and red top (approx. 10 feet wide). Community type transitions to pine and cottonwood with a shrub understory. No vegetation treatments were implemented in this area. Left bank is newly created cobble point bar. Green line is approx. 15 feet from high water mark and consists of existing vegetation-cottonwood and pine with a shrub understory. Herbaceous plugs and native shrubs were planted along left bank.

PHOTO MONITORING POINT 4-2004

Photo was taken from right bank at Station 84+00 looking NNW (337.5°) into abandoned channel area filled with cobble and top soil. The existing green line is located 75 feet from the right edge of the newly constructed channel. The existing green line corresponds to the former right channel bank consists of predominantly of knapweed and scattered shrubs (approx. 50 feet wide). Native shrubs, trees and herbaceous wetland species were planted in the bare floodplain area.

PHOTO MONITORING POINT 5-2004

Photo was taken from right bank at Station 84+00 looking WSW (247.5°). The existing green line is located approximately 10 feet from bankfull and consists of knapweed, shrubs and cottonwood. Vegetation width is approximately 50 feet. Beyond this is bare floodplain area created during fill of the abandoned channel. Channel banks treated with bioengineered soil lifts and coir fascines incorporating willow cuttings. Native shrubs, trees herbaceous species were planted, transplanted, sodded and seeded in this area. Green line along left bank is located approximately 10 feet above bankfull (below this is cobble placed to create the new channel). Green line is approx. 15 feet wide and consists of reed canarygrass, knapweed, red top and scattered shrubs (alder). Community type transitions to pine with shrub and herbaceous understory.

PHOTO MONITORING POINT 6-2004

Photo was taken from right bank at Station 81+75 looking WSW (247.5°). The existing green line is located approximately 75 feet from the new right bank and consists of predominantly cottonwood with a shrub understory (approx. 50 feet wide). Community type transitions to cottonwood, pines, and shrub vegetation beyond this. Newly constructed floodplain was seeded and planted with native shrubs, trees and herbaceous wetland plants.

PHOTO MONITORING POINT 7-2004

Photo was taken from left bank at Station 80+00 looking NW (315°). The existing green line is located at bankfull and consists of predominantly knapweed (approx. 10 feet wide). Community type transitions to cottonwood, pines, and shrub riparian vegetation beyond this. No vegetation treatments were implemented in this area along the new channel. Area will be monitored to see if raised channel will reduce knapweed along the channel.

PHOTO MONITORING POINT 8-2004

Photo was taken from left bank at Station 79+00 looking NW (315°). The existing green line is located approximately 50 feet from the newly constructed left bank and consists of predominantly reed cottonwood, upland shrubs, and knapweed (approx. 50 feet wide). Community type transitions to cottonwood, wetland shrubs and herbaceous wetland species. The newly constructed floodplain was planted and seeded with native trees, shrubs, and herbaceous wetland plants.

PHOTO MONITORING POINT 9-2004

Photo was taken from left bank at Station 79+00 looking NNW (337.5°). Existing green line for left bank is described in Photo 8. The existing green line for the right bank is located approximately 15 feet above bankfull and consists of predominantly cottonwoods, upland shrub understory and knapweed. Herbaceous wetland plugs were planted along the channel.

PHOTO MONITORING POINT 10-2004

Photo was taken from right bank at Station 76+50 looking NW (315°). Photo is of abandoned channel area filled to create wetlands. The existing green line along the right side of the filled channel consists of predominantly shrubs (alder) for 20 feet and transitions to pines and upland shrubs and herbaceous species. The existing green line along the left side of the filled channel consists of cottonwoods, upland and wetland shrubs and upland herbaceous species (100 feet) and community type transitions to wetland shrubs with a wetland herbaceous species understory. Area was seeded and planted with native shrubs, trees and wetland herbaceous species.

PHOTO MONITORING POINT 11-2004

Photo was taken from right bank at Station 76+50 looking WSW (247.5°). The existing green line for both left and right banks is located approximately 10 feet above bankfull and consists of cottonwoods, pines and wetland and upland shrubs and herbaceous understory. Newly created channel banks were seeded and planted with native trees, shrubs and herbaceous wetland species.

PHOTO MONITORING POINT 12-2004

Photo was taken from left bank at Station 73+00 looking SE (135°). Photo is of plugged side channel area. The existing green line is located at bankfull and consists of transplanted wetland sod and shrubs. Area was seeded and planted with herbaceous wetland plugs, planted with transplanted wetland shrubs and wetland sod.

PHOTO MONITORING POINT 13-2004

Photo was taken from left bank at Station 72+00 looking NW (315°). The existing green line on the right bank is located approximately 10 feet above bankfull and consists of predominantly cottonwoods with an understory of wetland shrubs and herbaceous vegetation. The existing green line on the left bank is located at bankfull and consists of existing vegetation including wetland shrubs and herbaceous vegetation and knapweed. Newly created banks were planted with herbaceous plugs and seeded.

PHOTO MONITORING POINT 14-2004

Photo was taken from left bank at Station 69+75 looking N (0°). The existing green line on the right bank is located approximately 2 feet above bankfull and consists of wetland shrubs and wetland herbaceous species. The existing green line on the left bank is located approximately 5 feet above bankfull and consists of wetland and upland shrubs and wetland and upland herbaceous species and knapweed. Vegetation treatments include seeding and planting of wetland herbaceous species and soil bioengineering incorporating willow cuttings.

PHOTO MONITORING 15-2004

Photo was taken from left bank at Station 68+00 looking NNE (22.5°). The existing green line along the right bank is located at bankfull and consists of wetland shrubs and wetland herbaceous species. The existing green line along the left bank is located approximately 5 feet above bankfull and consists of wetland and upland shrubs and wetland and herbaceous species for approximately 50 feet. Community type transitions to floodplain dominated by upland herbaceous species and knapweed with scattered upland shrubs. Vegetation treatments include seeding and planting of wetland herbaceous species.

PHOTO MONITORING POINT 16-2004

Photo was taken from right bank at Station 67+00 looking NW (315°). The existing green line along the right bank consists of transplanted sod placed at downstream end of wetland plug and transitions to pine, cottonwood and wetland and upland shrubs. Green line along the left bank is approximately 50 feet from the edge of the newly constructed channel and consists of pines, cottonwood, upland shrubs and herbaceous species and knapweed for approx. 50 feet and then transitions to open floodplain dominated by upland herbaceous species and knapweed. No planting or seeding was done in Fall 2004.

PHOTO MONITORING POINT 17-2004

Photo was taken from right bank at Station 65+50 looking SW (225°). The existing green line along the right bank is located approximately 15 feet from bankfull and consists of pines, cottonwoods and upland shrubs and herbaceous species (50 feet). Community type transitions to upland dominated by pines and upland herbaceous species and knapweed. The existing green line along the left bank is located approximately 10 feet above bankfull (downstream of point bar) and consists of cottonwoods, pines and wetland and upland shrubs and herbaceous species (50 feet). Community type transitions to open floodplain area dominated by upland herbaceous species and knapweed and then to herbaceous wetlands. No vegetation treatments were implemented in this area in Fall 2004.

PHOTO MONITORING POINT 18-2004

Photo was taken from left bank at Station 61+00 looking WSW (247.5°). The existing green line along the right bank is located approximately 50 feet from the new right bank and consists of cottonwood, pines and upland shrubs and herbaceous species and knapweed (approx. 100 feet wide). Beyond this is a large unvegetated borrow site. The existing green line along the left bank is located at bankfull and consists of existing vegetation including cottonwoods, pines and wetland and upland shrubs and herbaceous species (50 feet). Community type transitions to open floodplain area dominated by upland herbaceous species and knapweed and then to herbaceous wetlands. No vegetation treatments were implemented in this area in Fall 2004.

PHOTO MONITORING POINT 19-2004

Photo was taken from left bank at Station 57+50 NNW (337.5°). The existing green line along the right bank is located approximately 20 feet from bankfull and consists of wetland and upland shrubs and herbaceous species and knapweed (approx. 20 feet wide). Beyond this is a large unvegetated borrow site. Existing green line along the left bank is located at bankfull and consists of pines, cottonwoods and upland shrubs (150 feet). Community type transitions to open floodplain area dominated by upland herbaceous species and knapweed. No vegetation treatments were implemented in this area in Fall 2004.

Green line Photo Effectiveness Monitoring: August, 2005

PHOTO MONITORING POINT 1-2005

Photo was taken from right bank looking NNW (337.5°). Location corresponds with Photo point 1-2004. The existing green line along the right bank is located at bankfull and consists of predominantly reed canarygrass and knapweed (approx. 50 feet wide). Community type transitions to cottonwood, pines, and shrub riparian vegetation away from the channel. Downstream green line transitions to shrubs, predominantly alder with an understory of grasses and fireweed and an overstory of pine and cottonwood.

PHOTO MONITORING POINT 2-2005

Photo was taken from left bank looking N (0°). Photo corresponds with photo point 2-2004. The existing green line is at bankfull and dominated by reed canarygrass and sandbar willow regeneration on the left bank. The right bank has eroded with pines fallen into the channel. Away from the channel, the community type transitions to cottonwood, pine, juniper, rose and snowberry. No vegetation treatments were implemented in this area. Structure in channel in photo center is rock cross vane (most upstream structure).

PHOTO MONITORING POINT 3-2005

Photo was taken from right bank looking NW (315°). This photo point does not correspond with a 2004 monitoring point. The existing green line along the right bank is located at bankfull and consists of shrubs including snowberry, red-osier dogwood and wood's rose with a pine and cottonwood with a shrub understory. No vegetation treatments were implemented in this area. Left bank is newly created cobble point bar. Green line is approx. 15 feet from high water mark and consists of existing vegetation-cottonwood and pine with a shrub understory. Herbaceous plugs and native shrubs were planted along left bank. Wood in channel was recruited during the spring 2005 flood event.

PHOTO MONITORING POINT 4-2005

Photo was taken from right bank looking NW (315°). Photo corresponds with Photo Monitoring Point 3-2004. The existing green line along the right bank is located at bankfull and consists of cottonwood with knapweed and red top in the understory (approx. 10 feet wide). Terrace located to the north and community type transitions to dry upland grasses and invasive species. Green line on left bank is at bankfull and consists of knapweed and grasses. Community type transitions to cottonwood and pine overstory with dry shrubs such as Wood's rose and snowberry in the understory.

PHOTO MONITORING POINT 5-2005

Photo was taken from right bank looking NNW (337.5°). Photo corresponds with Photo Monitoring Point 4-2004. Photo is looking into abandoned channel area filled with cobble and top soil and planted with containerized shrubs during Fall 2004. Soil lift 1 is located in the bottom left of the photo. Grasses are from seeding done during construction of the lift. Green line is at approximately bankfull and consists of seeded native grasses and recruited native forbs. Knapweed was present in small amounts.

PHOTO MONITORING POINT 6-2005

Photo was taken from right bank looking W. Photo corresponds approximately with Photo Monitoring Point 5-2004. Right bank green line is at bankfull and consists of grasses from bare surfaces soil lift during construction. Soil lift 2 is located in lower right corner of photo. Left bank green line is at bankfull and consists of native riparian shrubs such as alder and dogwood. Community type transitions to cottonwood, pines, and drier shrub vegetation beyond this. Newly constructed floodplain was seeded and planted with native shrubs, trees and herbaceous wetland plants.

PHOTO MONITORING POINT 7-2005

Photo was taken from left bank at same location as Photo Monitoring Point 6-2005 looking NNW (337.5°). Photo point does not correspond with 2004 monitoring point. Photo is looking into filled channel area that was seeded and planted with containerized native shrubs, trees and herbaceous species. Existing vegetation on photo right is reed canarygrass and sandbar willow. Existing vegetation on photo left is cottonwood, alder and birch. Some knapweed is present.

PHOTO MONITORING POINT 8-2005

Photo was taken from right bank looking W. Corresponds approximately with Photo Monitoring Point 6-2004. Photo looking downstream towards section of channel that widened and braided during the spring 2005 flood. Right bank green line is located at bankfull and consists of seeded grasses. Native shrubs and herbaceous species planted in constructed floodplain.

PHOTO MONITORING POINT 9-2005

Photo was taken from left bank looking NW (315°). Photo shows a section of the channel that braided during spring 2005 flood event. Existing green line on left bank consists of knapweed and timothy at bankfull and transitions to cottonwood and pine with understory of dry shrubs and grasses. This photo point was not recorded in 2004. Photo was taken to document changes in channel as a result of the 2005 flood event and prior to repairing channel structures that were damaged during the flood.

PHOTO MONITORING POINT 10-2005

Photo was taken from left bank at looking NNW (337.5°). Photo corresponds with Photo Monitoring Point 7-2004. Cobble accumulation behind vane arm at bottom of photo is a result of the spring 2005 flood event. Pine on bar is also recruited from flood event. Left bank green line is located approximately 1 foot above bankfull and consists of knapweed and grasses. Green line transitions to cottonwood and pine with understory of dry shrubs and grasses. Transplanted shrubs around structure are alive and consist of alder and birch. Salvaged shrubs also located at soil lift 3, which is located on photo left center. In general, smaller shrubs had more new growth.

PHOTO MONITORING POINT 11-2005

Photo was taken from left bank looking NW (315°). Photo corresponds approximately with Photo Monitoring Point 9-2004. The left bank green line is located at bankfull and consists of seeded grasses and planted shrubs, trees and herbaceous species. Vegetation is described more in Photo Monitoring Point 12-2005 notes. The existing green line for the right bank is located approximately 15 feet above bankfull and consists of predominantly cottonwoods, upland shrub understory and knapweed. Herbaceous wetland plugs were planted along the channel. No survival plots are located here, but survival appears to be high.

PHOTO MONITORING POINT 12-2005

Photo was taken from right bank looking upstream (E) from same spot as Photo Monitoring Point 11-2005. This photo was taken to show how the channel braided during the Spring 2005 flood event.

PHOTO MONITORING POINT 13-2005

Photo was taken from left bank looking NW (315°). The green line was previously located approximately 50 feet from the newly constructed channel. Community type transitions to cottonwood, wetland shrubs and herbaceous wetland species. Numerous shrubs were transplanted to the constructed floodplain. In general, the smaller shrubs had more new growth compared with the larger shrubs. Birch appeared to have more growth compared with alder. Approximately 50% of transplanted shrubs in this location appeared to be alive. One vegetation survival plot is located in this area. Birch that is at photo right center was formerly located along the channel and was filled around that is dead.

PHOTO MONITORING POINT 14-2005

Photo was taken from right bank looking. The existing green line on the right bank is located approximately 2 feet above bankfull and consists of wetland shrubs and wetland herbaceous species. The existing green line on the left bank is located approximately 5 feet above bankfull and consists of wetland and upland shrubs and wetland and upland herbaceous species and knapweed. Vegetation treatments include seeding and planting of wetland herbaceous species and soil bioengineering incorporating willow cuttings.

PHOTO MONITORING POINT 15-2005

Photo was taken looking NNE (22.5°). Photo is looking into area where clearwater diversion was dug during channel construction. Area was seeded and planted with native shrubs and trees. One vegetation survival plot is located in this area.

PHOTO MONITORING POINT 16-2005

Photo was taken from right bank looking NW (315°). Photo is looking into plugged channel area. Area was seeded and planted with native tree, shrub and herbaceous species. Surface was complete bare post-construction. Two survival plots are located within plugged area. Herbaceous species in photo are a mix of seeded and recruited species including wetland forbs and some knapweed.

PHOTO MONITORING POINT 17-2005

Photo was taken from right bank looking WSW (247.5°). Photo is from same location as Photo Monitoring Point 11-2004. Right bank green line is located at bankfull and consists of seeded grass species. Transitions to cottonwood with a shrub understory along right and left banks at bankfull downstream. Soil lift 7 is located at photo right where grasses are coming in.

PHOTO MONITORING POINT 18-2005

Photo was taken from left bank looking NW (315°). The existing green line on the right bank is located approximately 10 feet above bankfull and consists of predominantly cottonwoods with an understory of wetland shrubs and herbaceous vegetation. The existing green line on the left bank is located at bankfull and consists of existing vegetation including wetland shrubs and herbaceous vegetation and knapweed. Newly created banks were planted with herbaceous plugs and seeded. Most of the planted plugs were lost during the Spring 2005 flood event. Soil lift 8 is located at photo left center.

PHOTO MONITORING POINT 19-2005

Photo was taken from left bank looking SE (135°). Photo is from same point as Photo Monitoring Point 12-2004. This was a former side channel area that was plugged and a portion of the channel re-aligned through it. Most of the shrubs in the photo were transplanted during construction. Shrub transplant survival appears to be 100% with many having vigorous growth. Area is very wet with diverse wetland species including sedges, rushes and forbs. Lots of fresh sand deposition in this area from spring 2005 flood event.

PHOTO MONITORING POINT 20-2005

Photo does not correspond with 2004 monitoring point. Photo taken to show changes that occurred to channel during Spring 2005 flood event. Right green line consists of native shrubs including willow, alder and birch at bankfull. Community type transitions to cottonwoods with drier shrub understory. Left green line consists of native shrubs including alder, birch and dogwood at bankfull. Community type transitions to an upland terrace.

PHOTO MONITORING POINT 21-2005

Photo does not correspond with 2004 monitoring point. Photo taken to show changes that occurred to channel during Spring 2005 flood event. Photo shows channel deposition and widening.

PHOTO MONITORING POINT 22-2005

Photo does not correspond with 2004 monitoring point. Photo taken to show changes that occurred to channel during Spring 2005 flood event. Photo shows channel deposition and braiding.

PHOTO MONITORING POINT 23-2005

Photo was taken from left bank looking N (0°). Photo corresponds with Photo Monitoring Point 14-2004. The existing green line on the right bank is located at bankfull and consists of wetland shrubs including birch and willows and wetland herbaceous species including sedges and rushes. The existing green line on the left bank is located at bankfull and consists of reed canarygrass and grasses and transitions to native shrubs mostly alder and birch and then transitioning to an upland terrace. Coir fascine 3 is located at photo left center.

PHOTO MONITORING POINT 24-2005

Photo was taken from left bank looking NNE (22.5°). Photo corresponds with Photo Monitoring Point 15-2004. Photo looks downstream to coir fascine 4 on right bank, which marks the downstream end of plugged channel (Photo point 16-2005). The green line along the right bank is located at bankfull and consists of wetland shrubs and wetland herbaceous species. The existing green line along the left bank is located at bankfull and consists of red top and timothy. Herbaceous plugs planted along the channel here were lost during the 2005 flood.

PHOTO MONITORING POINT 25-2005

Photo was taken from right bank looking NW (315°). The existing green line along the right bank consists of transplanted sod placed at downstream end of wetland plug and transitions to pine, cottonwood and wetland and upland shrubs. Green line along the left bank is approximately 15 feet above bankfull and consists of planted shrubs and forbs and seeded grass and forb species. Photo shows point bar formation on left bank from Spring 2005 flood event.

PHOTO MONITORING POINT 26-2005

Photo does not correspond with 2004 monitoring photo. Taken from coir fascine 4 looking SE into plugged channel area. Two survival plots are located here. Vegetation consists of planted herbaceous and shrub species and seeded herbaceous species. Some weedy species present including knapweed and mustard.

PHOTO MONITORING POINT 27-2005

Photo was taken from right bank looking NW (315°). Photo corresponds with Photo Monitoring Point 16-2004. The existing green line along the right bank consists of transplanted sod placed at downstream end of wetland plug and transitions to pine, cottonwood and wetland and upland shrubs. Green line along the left bank is located at bankfull and consists of seeded grass and forb species. Survival monitoring plot is located here. Community types transitions to pines, cottonwood, upland shrubs and herbaceous species and knapweed for approx. 50 feet and then transitions to open floodplain dominated by upland herbaceous species and knapweed.

PHOTO MONITORING POINT 28-2005

Photo was taken from right bank looking W. Photo is just downstream of Photo Monitoring Point 27-2005. Photo taken to document changes in channel conditions resulting from Spring 2005 flood event.

PHOTO MONITORING POINT 29-2005

Photo was taken from left bank looking WSW (247.5°). Right bank green line is located at bankfull and consists of shrubs and cottonwoods. Floodplain was planted with native shrub and herbaceous species. Community type transitions to cottonwood, pines and upland shrubs, herbaceous species and knapweed (approx. 100 feet wide). Beyond this is a large unvegetated borrow site. The existing green line along the left bank is located at bankfull and consists of existing vegetation including cottonwoods, pines and wetland and upland shrubs and herbaceous species (50 feet). Community type transitions to open floodplain area dominated by upland herbaceous species and knapweed and then to herbaceous wetlands.

PHOTO MONITORING POINT 30-2005

Photo does not correspond with a 2004 monitoring point. Photo shows sediment deposition in floodplain in constructed floodplain resulting from Spring 2005 flood event.

PHOTO MONITORING POINT 31-2005

Photo does not correspond with 2004 monitoring point.

PHOTO MONITORING POINT 32-2005

Photo was taken from left bank at approximately the same location as Photo Monitoring Point 19-2004 looking NNW (337.5°). Soil lift is located lower left hand corner of photo showing growth of seeded grass species.

PHOTO MONITORING POINT 33-2005

Photo was taken from left bank looking north (0°). Photo taken from soil lift 11 looking downstream to downstream end of Phase I project reach. The green line on the right bank is located approximately 2 feet above bankfull and consists of wetland shrubs and wetland herbaceous species. The existing green line on the left bank is located approximately 5 feet above bankfull and consists of wetland and upland shrubs and wetland and upland herbaceous species and knapweed.