Salmon River Riparian Assesment Pilot Planning Project and Conceptual Design for Fisheries and Riparian Vegetation Enhancement

Klamath National Forest, Siskiyou County, California

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Prepared for:
Salmon River Restoration Council
PO Box 1089, Sawyers Bar, CA 96027

Prepared by:
William R. Lew, Professional Geologist #7872
Chris Moore, Riparian Habitat Specialist
Danny K.Hagans, Principal Earth Scientist
Pacific Watershed Associates Inc.
PO Box 4433, Arcata, CA 95518
randyl@pacificwatershed.com / (707) 839-5130

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Left photo: view looking downstream at the Red Bank project area; Right photo: view looking downstream at the Kelly Gulch project area.

1 PROJECT SUMMARY

The Salmon River watershed is one of the most biologically intact subbasins of the Klamath River drainage basin. It provides habitat to salmonids and other at-risk species, and is recognized as one of the largest cold-water contributors to the Klamath River, where recent large-scale fish kills have been attributed to poorly oxygenated warm water. The Salmon River subbasin supports a coldwater resident and anadromous fishery which includes: spring and fall run Chinook salmon (*Oncorhynchus tshawytscha*), summer and winter run steelhead (*O. mykiss*), coho salmon (*O. kisutch*), sea run Pacific lamprey (*Lampreta tridentata*), and green sturgeon (*Acipenser medirostris*).

Increasing the available rearing habitat for juvenile salmonids is of great importance for the future of coho salmon in the Salmon River Watershed. Because coho salmon require slow water refugia and summer cold water temperatures for rearing habitat, increasing side channel habitat as well as riparian forest canopy are especially beneficial to the future health of these important species.

For the Salmon River Riparian Assessment Project several sites were evaluated as potential pilot projects to restore healthy riparian forest conditions and increase rearing habitat for juvenile salmonids. By increasing the duration of floodplain inundation and side channel connectivity we can increase habitat area as well as perennial channel margin required to re-grow a robust riparian forest that will continue to provide materials needed to maintain the natural process of a resilient alluvial system. At the request of the Salmon River Restoration Council (SRRC), Pacific Watershed Associates Inc. (PWA) completed this planning study to assess reasonable alternatives to restore natural processes that provide complex rearing habitat for juvenile salmonids.

For the study, PWA conducted topographic and longitudinal profile surveys, aerial photographic analyses, and geomorphic mapping. After analyzing the data collected, PWA developed conceptual alternatives for the Red Bank and Kelly Gulch sites. The Red Bank conceptual plan recommends side channel modification along the existing alignment, installation of fish habitat structures, construction of willow baffles, and planting of native trees and shrubs. The Kelly Gulch site has two alternatives for restoring side channel habitat. Alternative I recommends modification of the existing side channel alignment, by regrading and excavation, construction of fish habitat structures, willow baffles, planting native trees and shrubs, and the realignment of Kelly Gulch Creek outlet.

The expected benefit of completing the stream channel habitat restoration outlined in this study lies in the return of salmonid populations and long-term sustainability of salmonid habitat in Salmon River watershed. The pilot planning study presented here represents a reasonable solution to increasing rearing habitat for juvenile salmonids and improving riparian conditions, and when implemented in combination with protective land-use practices, can be expected to contribute to the long-term improvement of water quality and salmonid habitat in the watershed. With the findings of this feasibility study, entities interested in the sustainability of the watershed and preservation of salmonid habitat can advance efforts to obtain funding and implement a

habitat restoration plan for the Red Bank and Kelly Gulch study areas.

2 CERTIFICATION AND LIMITATIONS

This report, entitled *Salmon River Riparian Assessment Pilot Planning Project and Conceptual Design for Fisheries and Riparian Vegetation Enhancement* was prepared by or under the direction of a licensed professional geologist at Pacific Watershed Associates Inc. (PWA), and all information herein is based on data and information collected under the supervision of PWA staff. Surface investigations and analysis for the project, were similarly conducted by or under the responsible charge of a California licensed professional geologist at PWA.

The interpretations and conclusions presented in this report are based on a study of inherently limited scope. Observations are qualitative, or semi-quantitative, and confined to surface expressions of limited extent, artificial exposures of subsurface materials and shallow exposures of subsurface earth materials during test pit excavations. Interpretations of problematic geologic and geomorphic features (such as unstable hillslopes) and subsurface stratigraphy are based on the information available at the time of the study and on the nature and distribution of existing features.

The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice, and are valid as of the submittal date. No other warranty, expressed or implied, is made. PWA is not responsible for changes in the conditions of the property with the passage of time, whether due to natural processes or to the works of man, or changing conditions on adjacent areas. Furthermore, to be consistent with existing conditions, information contained in the report should be re-evaluated after a period of no more than three years. It is the responsibility of the landowner and the SRRC to ensure that all recommendations in the report are reviewed and implemented according to the conditions existing at the time of construction. Also, PWA is not responsible for recommendations implemented outside of their professional oversight. Finally, PWA is not responsible for changes in applicable or appropriate standards beyond our control, such as those arising from changes in legislation or the broadening of knowledge, which may invalidate any of our findings.

Certified by:

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William R. Lew, California Professional Geologist #7872
Pacific Watershed Associates Inc.

3 INTRODUCTION

Three important elements of long-term restoration and maintenance of both water quality and fish habitat are: 1) the restoration of riparian vegetation that provides shade and subsequent cooler water temperatures during warm summer/fall months as well as future large woody debris recruitment, 2) the restoration of side channel habitat where migrating smolts can take refuge from strong hydraulics of the mainstem, and 3) restoring large woody debris into barren side channels to provide increased cover and rearing habitat for adult and juvenile salmonids.

The Salmon River watershed is one of the most biologically intact subbasins of the Klamath River drainage basin. It provides habitat to salmonids and other at-risk species, and is recognized as one of the largest cold-water contributors to the Klamath River, where recent large-scale fish kills have been attributed to poorly oxygenated warm water. The Salmon River subbasin supports a coldwater resident and anadromous fishery which includes: spring and fall run Chinook salmon (*Oncorhynchus tshawytscha*), summer and winter run steelhead (*O. mykiss*), coho salmon (*O. kisutch*), sea run Pacific lamprey (*Lampreta tridentata*), and green sturgeon (*Acipenser medirostris*). Non-anadromous species include Klamath speckled dace (*Rhinichthys osculus Klamathensis*), Klamath small scale sucker (*Catostomus rimiculus*), and marbled sculpins (*Cottus klamathensis*). Threespine sticklebacks (*Gasterosteus aculeatus*) may be present, but their use of the habitat is unconfirmed. Resident trout are located throughout the subbasin. Introduced fish stocks include American shad (*Alosa sapidissima*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). Anadromous salmonid habitat is extensive in the subbasin, distributed among tributaries of the Main Stem, Wooley Creek, North Fork and South Fork Salmon River. The Klamath National Forest (KNF) identifies the Salmon River as the watershed with the best anadromous fisheries habitat in the Klamath National Forest (de la Fuente and Haessig, 1994). The basin provides habitat for the largest wild run of spring Chinook salmon in the entire Klamath River system. It is possibly the largest remaining wild spring Chinook run left in California (West, 1991). Problems facing coho salmon and other fish include invasive exotic species, barriers to fish passage, depleted large woody debris (LWD), high sediment loads from the extensive road system, large wildfires, limited riparian function due to mine tailings, unscreened water diversions, unstable spawning gravels, and nutrient and temperature impairment (NCRWQCB, 2005).

In 2010, the Salmon River Restoration Council (SRRC), a non-profit organization committed to restoring ecological function and aquatic habitat in the Salmon River, and educating and empowering local riverine communities, received a grant to conduct an assessment that evaluates riparian conditions and fisheries habitat, and to plan a conceptual design project to restore riparian function and fisheries habitat in the Salmon River watershed. Subsequently, SRRC contracted Pacific Watershed Associates Inc. (PWA) to conduct the assessment and develop conceptual alternatives to restoration of riparian conditions and salmonid habitat in the Salmon River. This involved a variety of tasks that are described in this report.

The general purpose and scope of this planning project is to: (1) develop and evaluate pilot alternatives that will guide future restoration projects in the Salmon River watershed, both to enhance fish habitat and promote healthy riparian conditions; (2) identify potential complications

associated with each alternative; (3) estimate the volume of earth to be moved and develop preliminary cost estimates for each project area; and (4) develop recommendations needed to move these pilot projects towards implementation.

This planning project represents a critical first step in improving riparian conditions and salmonid habitat in the Salmon River watershed. It includes several pilot project areas where preliminary conceptual design alternatives consider not only the need to improve riparian conditions, but also to increase suitable rearing habitat for juvenile salmonids. Upon completion of a review process involving representative stakeholders and additional necessary design components, we believe that these pilot alternatives, if implemented and employed in combination with protective land use practices, will improve and protect riparian conditions and salmonid habitat in the Salmon River watershed.

4 FIELD DESCRIPTION OF THE STUDY AREA

4.1 Location and Travel Directions to the Field Area

The Salmon River Riparian Assessment Project (SRRAP) area consists of 2 potential pilot project areas located in southwestern Siskiyou County, California, approximately 9 and 14 river miles northeast of the town of Forks of Salmon (Figure 1). The SRRAP area is accessed from State Highway 96 by exiting onto Salmon River Road near Somes Bar, and following Salmon River Road southeast for approximately 17 mi to the town of Forks of Salmon. Proceed through Forks of Salmon and stay left on the North Fork Salmon River/Sawyers Bar Road. Continue northeast on the North Fork Salmon River/Sawyers Bar Road for approximately 9 mi to the Red Bank project area, and proceed an additional 5 miles to the Kelly Gulch project area. Red Bank project area is located on the left bank of the North Fork Salmon River while Kelly Gulch Project area is located on the right bank of North Fork Salmon River.

4.2 Regional Climate, Terrain, and Geology

The climate of the central Klamath Mountain region in the Salmon River watershed is characterized by dry, warm summers and cool winters with periods of intense rainfall and snow accumulation during cold storms. Mean annual precipitation ranges from 35 to 85 in., with most of the rainfall occurring between November and April (NCRWQCB, 2005). Elevation ranges from approximately 450 ft to 8,920 ft in the Salmon River basin (USGS, 1979a, b).

The Salmon River watershed is located in steep, mountainous terrain, with hillslope gradients frequently exceeding 70% along inner gorges, headwalls, and upper ridge slopes. Vegetation types are highly variable throughout the watershed and include both conifer and hardwood forests, low level chaparral/brush lands, prairie/grassland, and barren, relatively vegetation free landscape in dominantly rocky areas (de la Fuente and Haessig, 1994).

The geology of the Salmon River watershed is composed of diverse rock groups including

several distinct metamorphic belts, intrusive granitic batholiths, alluvial terrace deposits, colluvial deposits, and recent alluvial deposits. The Salmon River watershed is part of the greater regional physiographic Klamath Mountain province. Poorly consolidated and sheared metamorphic rocks as well as deeply weathered granitic rocks that are particularly susceptible to erosion and mass wasting during periods of sustained or heavy rainfall are exposed throughout the watershed. Large- and small-scale mass wasting is evident and pervasive within the watershed, including a significant historical record of landslides that have had major impacts on the main stem Salmon River (de la Fuente and Haessig, 1994). Hillslope debris slides, earthflows, slumps, cutbank landslides, and road fill landslides have all occurred within the watershed.

All 4 species of anadromous salmonids as well as the Pacific lamprey and green sturgeon are all present in the Salmon River watershed. Of significance for salmonid habitat, the combination of high rainfall and erodible, potentially unstable geologic substrate results in high rates of erosion and sediment delivery to stream channels. The lower tributaries and main channels alternately traverse gorges with steep and unstable slopes, and low-gradient reaches where sediment deposition and accumulation is amplified, especially as a result of historical mining and road building practices. Whereas salmonid populations have evolved and flourished with the natural processes of rainfall and erosion in the area, the impact of anthropogenically induced habitat fragmentation and erosion (e.g., mining, timber production and road construction) has resulted in a degradation of salmonid habitat, loss of riparian function and accelerated sediment delivery to streams in this important watershed.

4.3 Overview of the SRRAP area

4.3.1 Red Bank project area

Red Bank project area is located approximately 9 river miles up the North Fork Salmon River (NFSR) from its confluence with the South Fork. The project area consists of approximately 20 acres of mostly barren, large alluvial floodplain with several sparsely vegetated high-flow side channels, vegetated alluvial terraces, and is contained on the right side by mainstem NFSR. On the upstream end of the alluvial bar the high-flow side channels are devoid of vegetation and largely dry throughout the late summer and fall. Lower on the alluvial bar these high-flow channels converge and riparian vegetation becomes more prolific, as surface and near surface base flow conditions become perennial. The entire Red Bank project area is located on United States Forest Service (USFS) property.

4.3.2 Kelly Gulch project area

The Kelly Gulch project area is located approximately 14 river miles up the North Fork Salmon River from its confluence with the South Fork. Similar to Red Bank, the Kelly Gulch project area consists of approximately 12 acres of mostly barren, large alluvial floodplain with several sparsely vegetated, discontinuous remnant high-flow side channels, vegetated alluvial terraces,

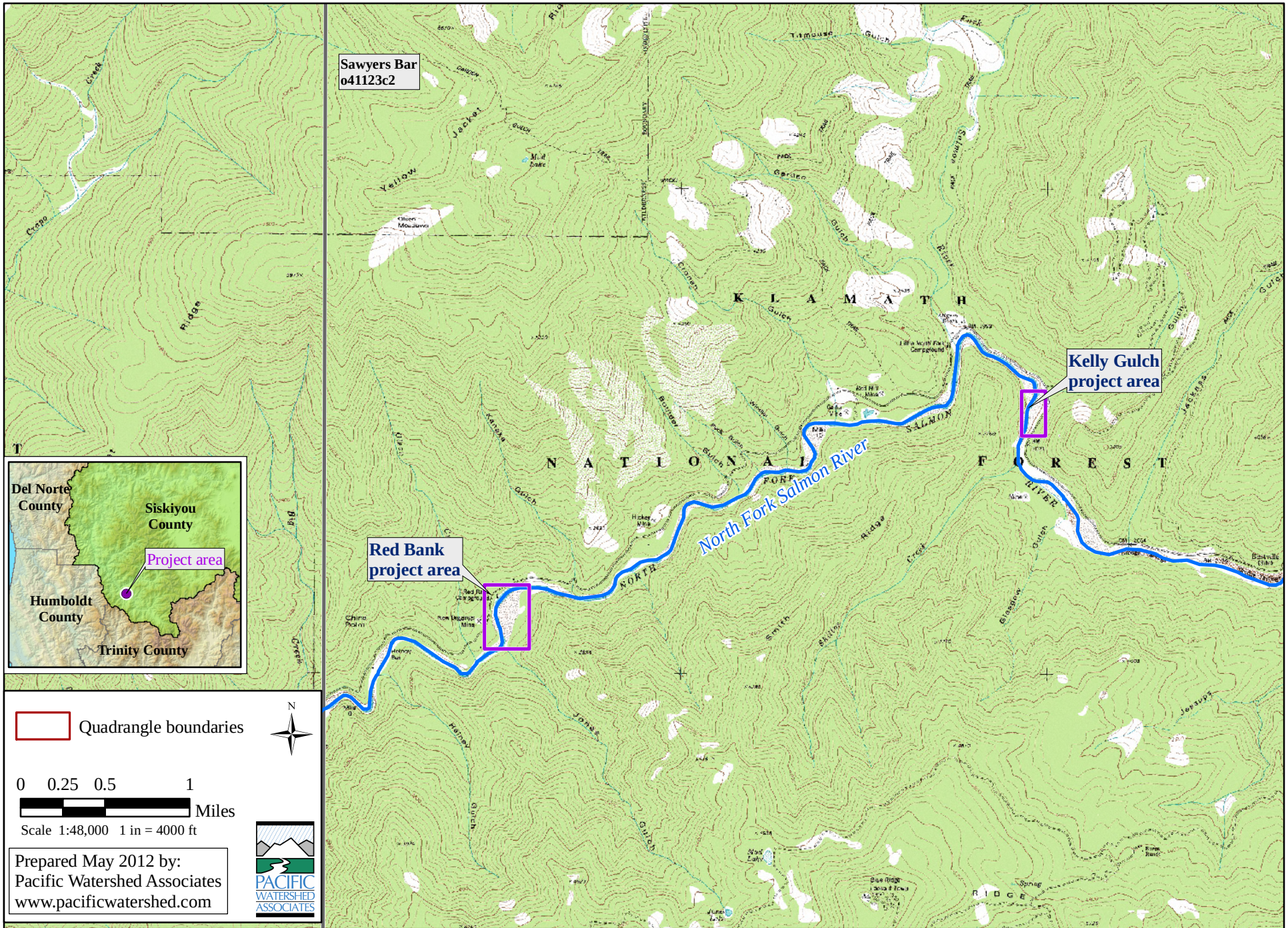

Figure 1. Location of the Salmon River Riparian Assessment Project, Klammath National Forest, Siskiyou County, California.

and is contained on the left side by mainstem NFSR. Much of the alluvial bar has been reworked by historic placer mining activities as well as Kelly Creek stream channel dredging. On the alluvial bar several discontinuous high-flow side channels are mostly devoid of vegetation and are largely dry throughout the late summer and fall. The entire Kelly Gulch project area is located on United States Forest Service (USFS) property.

5 METHODS AND DATA COLLECTION

The SRRAP involved a series of field and office related tasks that were completed in order to develop the analysis, findings and conceptual alternatives. The SRRAP consists of four distinct elements: (1) conducting background studies; (2) developing detailed topographic surveys of the field area, (3) conducting geomorphic field mapping, and (4) compiling findings and developing preliminary conceptual design alternatives. All project elements were completed under the direction of a PWA licensed professional geologist.

During the first element of the SRRAP, PWA staff analyzed sequential historical aerial photographs and a set of digital imagery to document the history of geomorphic changes within the SRRAP area. Six sets of aerial photographs and one set of National Agricultural Imagery Program (NAIP) digital imagery were used in the analysis. The NAIP imagery was for 2005 (CaSIL, 2005), and the aerial photo years and approximate scales were 1944 (1:20,000),1955 (1:24,000), 1965 (1:16,000), 1975 (1:18,000), 1980 (1:12,000), and 1995 (1:12,000).
For the second element of the project, PWA used a total station to complete a detailed topographic landform survey and develop base maps of the project area and immediate surroundings. The resultant base maps (Appendix A) accurately shows a series of features including stream channel locations, side channel alignments and surveyed cross section locations. In addition, alignments, sections and geomorphic features are shown over the 2012 Google GeoEye imagery to depict near current riparian conditions in relation to surveyed features on the map.

The third element of the SRRAP included geomorphic mapping of the project areas. Alluvial terrace/floodplain surfaces of varying elevation, age and extent were mapped over 2005 NAIP imagery. Also, active channels, secondary channels, perennial surface flow and exposed bedrock were mapped spatially. Relevant geomorphic information is depicted on the base maps of the project area. An important aspect of the geomorphic mapping and surveying was identifying existing side channels and the extent of dry seasonal surface water.

The final phase of the project involved summarizing and synthesizing the background information, field data, and results to present preliminary conceptual plans for guiding future restoration efforts and engineering design for the SRRAP.

6 RESULTS

6.1 Aerial Photographic Analysis

PWA staff analyzed sequential historical aerial photographs and a set of digital imagery to document the history of channel and hillslope geomorphic changes within the Red Bank and Kelly Gulch areas. Six sets of aerial photographs and one set of National Agricultural Imagery Program (NAIP) digital imagery were used in the analysis.

Red Bank Project Area

Based on the stereoscopic analysis, the location of the NFSR channel at the Red Bank project area has migrated laterally over time. In the 1944 and 1955 photo sets the mainstem NFSR is located to the east of its current configuration. After the 1965 photo set, the channel migrated several hundred feet westward to its current configuration where it is confined by the steep right bank/native hillslope (Appendix A, Drawing 1). Additionally, the alluvial bar and side channels along the unconfined left bank have evolved significantly over time. The 1944 and 1955 photo sets show the alluvial bar mostly covered in uniform age riparian vegetation with faintly visible side channels proximate to their current location. In the 1965 photos the alluvial bar is largely denuded of vegetation, with a small cluster of trees on the middle of the bar remaining, and the side channel alignments become more prominent. These side channels mostly follow their current configuration. A stereoscopic photo pair was not available for 1975, however surface flows are visible in the side channel in early August for the one photo that is available. In the 1980 photos the side channel has evidence of surface flows in late summer but are becoming less persistent by 1995. By 1980 the riparian vegetation has reoccupied the channel margins and sparse vegetation on the alluvial bar. In the 1995 photos the riparian appears to be well established albeit sparse. The riparian vegetation is predominantly occupying the lower half of the alluvial bar and the channel margins.

Kelly Gulch Project Area

Based on the stereoscopic analysis, the location of the NFSR channel at the Kelly Gulch project area has also migrated laterally over time. In the 1944 and 1955 photo sets the mainstem NFSR is located approximately 200 ft to the southeast of its current configuration. The riparian vegetation is sparse and appears to be recolonizing the right bank bar between the 1944 and 1955 photos. After the 1965 photo set the channel avulsed northwest, significantly eroding the left bank/hillslope and reestablishing a new thalweg (Appendix A, Drawing 2). Mature streambank riparian vegetation previously containing the left bank was left intact but due to significant erosion and channel avulsion, became the seasonal right bank of the NFSR. Much of the alluvial bar vegetation was lost during the 1964 flood. The 1975 photos show the channel occupying nearly the same location of the existing NFSR channel. Riparian vegetation had begun to colonize the low flow channel margins longitudinally along the right bank. The 1980 photos show that the channel appears to be slowly migrating to the east (right bank) at the down stream end of the project reach. The riparian vegetation has continued to mature along the channel margins while still remaining sparse over the greater alluvial bar area along the right side. No photo pair was available for 1995. The Google Earth and NAIP images for 1993 to 2011 confirm that the NFSR channel is occupying nearly the same location as the 1980 photos indicate.

Riparian vegetation continues to slowly mature and expand around the same locations as the 1980 photos.

6.2 Topographic Surveys

In order to evaluate conceptual alternatives for side channel habitat and riparian conditions improvement, a detailed topographic survey was completed. The survey was used to develop a base map showing the location of the NFSR, existing and potential side channel alignments, stream channels, bedrock outcrops, current mid channel and longitudinal bar extent and elevations, extent and types of vegetation, etc., within the immediate project vicinity (Appendix A). Next, longitudinal profile and cross section surveys were completed along the existing and proposed channel alignments to evaluate channel slopes, relative elevations in relation to the thalweg, estimate the length of potential channel disturbance, estimate the volume of earthen material to be excavated and evaluate spoil disposal locations (Appendix B).

Using a total station, control network traverse loops were established around the project areas. Wooden lath and rebar or galvanized nail spikes were set into the ground to be used and reoccupied as instrument stations or back sites for the topographic surveys. From these control networks, over 500 points were shot along strategic transects, to document slope breaks and other relevant topographic features, in order to develop the base map. During the longitudinal profile and cross section transect surveys, the total station was set up on control network stations with the best visibility to the stream, and points were shot at slope breaks within the thalweg or perpendicular to profiles at cross section transects. The thalweg surveys initiated and terminated in/at stable geomorphic channel features located upstream and downstream of the potential project areas.

Northing, easting, and elevation (NEZ) coordinates were developed for all points. These coordinates were imported into ArcGIS software in order to construct the base map and conceptual plan. During the survey, no horizontal or vertical benchmarks were tied to, therefore, all coordinates generated for the survey are relative.

6.3 Geomorphic Mapping

To evaluate the surficial constraints of existing and alternative side channel locations, a geomorphic field reconnaissance of the project area was completed. Surficially exposed bedrock, nearby hydraulically mined hillslopes, engineered structures (i.e., roads, crossings), stream channel locations, aerial extent of various bar surfaces, vegetation types and density, alluvial terrace surfaces, etc., were all identified in the field. Relevant geomorphic features are illustrated on Appendix A Plan View Maps.

7 DISCUSSION

This section describes the conceptual alternatives for improving fish rearing and riparian conditions at both the Red Bank and Kelly Gulch project locations. The Red Bank conceptual plan involves channel modification along the existing side channel alignments as well as replanting/reestablishment of native riparian plants. Similarly, the Kelly Gulch conceptual plan involves channel modification along discontinuous existing side channel alignments and Kelly Gulch channel between Sawyers Bar road and its confluence with the NFSR. Also, the replanting/reestablishment of native riparian plants are proposed. Each conceptual plan exhibits benefits to fish habitat, however there are potential complications and constraints that must be considered to promote long-term success for fish habitat and riparian function improvement.

7.1 Red Bank Conceptual Plan

7.1.1 Existing conditions

Currently the NFSR flows in a broad sweeping leftward bend with a steep confining bank to the right and a large alluvial floodplain/terrace to the left. Within the large (~20 acres) floodplain/terrace several high flow side channels convey flow during moderate to high water flow conditions. In the summer and fall, depending on antecedent moisture conditions and streamflow in the NFSR, much of the flow goes subsurface though coarse alluvial deposits. However, surface flow again reemerges where the two primary side channels converge before reaching the NFSR (Appendix A, Drawing 1). Riparian conditions vary from dense hardwoods and conifers along the NFSR streambanks, terrace and floodplain surfaces to barren or sparsely vegetated ground on the alluvial bar surfaces.

7.1.2 Proposed modifications

The Red Bank conceptual plan alternative primarily involves side channel modification along the existing alignment, construction of fish habitat and hydraulic structures, willow baffles with large woody debris buried for moisture retention, and planting native trees and shrubs along newly excavated areas. The plan includes reconfiguring (grading and excavation) the existing channel profile and cross section along the existing side channel alignment to allow for a “self-maintaining” perennial watercourse that supports salmonid refugia and riparian conditions improvement. Through the channel regrade section, it is proposed that the banks are sloped back to a 2:1 (H:V) grade with a 12.5 ft final channel width. The final channel, with an approximate 1,200 ft regraded length, is proposed to have ~1.1% average slope gradient (Appendix A, Drawing 1; Appendix B Drawings 1&2).

7.1.3 Fish and riparian habitat benefits

The proposed modifications to the existing side channels are intended to increase slow water refugia for juvenile salmonids during a wide range of flows; where as the current channel configurations are only providing habitat during high flow conditions. The proposed modifications will also increase perennial flows along side channel margins and thereby habitat available for riparian vegetation to become established. The proposed plan is intended to

reestablish natural geomorphic and hydraulic processes that will enhance channel complexity for all salmonid life stages.

The existing side channel complex is currently active during moderate to high flows and is lacking habitat complexity for juvenile salmonids. The upper to middle portions of the existing side channel has minimal surface flows and does not currently provide adequate habitat for salmonids during summer low flow conditions. The existing alluvial bar and side channel complex has signs that the riparian is slowly regenerating and becoming a stable feature. The side channel modification and large woody debris structures would increase stability and resilience to the riparian, preventing loss of riparian habitat during large flood events (Abbe and Montgomery 1996) as well as providing complex habitat for salmonid rearing.

7.1.4 Conceptual plan constraints and limitations

The existing side channel is currently inundated during moderate to high flows which provide limited seasonal habitat value. There are currently a few pools that become isolated as flows recede, resulting in juvenile salmonids becoming stranded. The lack of complex cover in the side channel limits the available habitat for salmonids to escape predation and provide cool water in the summer months. By creating a perennial side channel and installing complex wood jams there will be an increase in the available habitat for salmonids spawning and rearing. The lack of existing LWD in the side channel limits the amount of available habitat for juveniles and adults. The designs for the side channel are preliminary and have not had hydraulic or sediment transport modeling completed. Further analysis will need to be conducted to verify the channels ability to transport bedload and continue to be self maintaining through a wide range of flow events. This will require further field investigations, including but not limited to pebble counts and potentially more topographical surveys.

Given that the availability of money will ultimately become a constraint to design and construction costs, it should be considered that modifications of the proposed design may be necessary to conform within these monetary constraints. Several additional alternatives that do not include channel regrade earthwork may be considered due to monetary constraints. These are: (1) constructing fish habitat structures, willow baffles and native tree and shrub planting; (2) construction of floodplain fencing (cottonwood poles placed vertically in the floodplain designed to rack woody debris, mimicking a forested island) with willow baffles and native tree planting; and (3) placement of willow baffles and native tree planting alone. These alternatives may be valid suggestions for lowering the cost of design and/or construction; however they have not been evaluated during this initial feasibility study.

7.1.5 Potential complications

In general, complications may include but may not be limited to: downcutting, lateral migration, headcut development, and excessive aggradation, all of which have the potential to reduce or negate rearing conditions and riparian vegetation enhancement goals. These potential complications will need to be addressed during final engineering design.

7.1.6 Earthwork and vegetation disturbance

Excavation of the existing side channel will be conducted in a manner that will limit disturbance to existing vegetation. The entire ~2,000 feet of side channel will not need to be excavated due to the lower extent of the channel exhibiting surface flow during summer low flow conditions (Appendix B, Table 1). Within this lower reach perennial surface flow conditions were observed while conducting the field surveys in August of 2011. The construction of LWD structures in the downstream extent of the project will improve the depth of the channel, help to sort substrate and provide habitat for salmonids. All brush and trees that are removed on-site will be used in addition to imported materials for the construction of LWD structures.

Table 1. Estimates for earthmoving and tree removal during construction, Red Bank project area.

Construction element	**Volume of earthen material moved (yd^3)**	**Trees removed (# > 4 in. DBH)**
Regrading of side channel	3,625	5
Hydraulic structures	30	2
Fish habitat structures	15	0
Willow baffles	170	0
Totals	3,840	7

7.1.7 Preliminary cost estimates

The major costs associated with the implementation of Red Bank project area are outlined in Table 2. Specific work tasks include, but may not be limited to: (1) physical earthwork related to regrading the side channel and the construction of hydraulic structures, fish habitat structures and willow baffles; (2) riparian planting; (3) final engineering design including hydraulic/sediment transport and geotechnical analysis; and (4) final planning for permitting approval through State, federal, and local agencies. Contingency funds (estimated @ 25%) have been included to account for variations or increases in material and equipment costs, as well as unforeseen problems or additional project elements. The costs outlined are preliminary, subject to revision, and are to be used for planning purposes only. The estimated cost to implement Red Bank project area is approximately $223,000.

Table 2. Preliminary estimated costs for side channel and riparian habitat improvements, Red Bank project area.

Cost category	Work product / action	Estimated cost ($)
Side channel regrade[1]	Excavate and regrade existing middle side channel to specified profile and cross section	24,600
Installation of willow baffles, hydraulic, fish habitat structures and riparian planting[2]	Construct instream components and plant riparian	65,900
Material costs[3]	Purchase materials for willow baffles, hydraulic and fish habitat structures.	28,100
Engineering and geotechnical	Civil design, hydraulic/sediment transport and geotechnical analysis	45,000
Permitting	CEQA / NEPA compliance, USFS permits, etc.	15,000
	Subtotal	178,600
	Contingencies ~ 25% of Subtotal	44,650
	Totals	**223,250**

[1] Side channel regrade/excavation costs are based on excavation production rates and prevailing wage equipment costs derived from several recently completed projects of a similar nature. Costs assume 40 yd^3/hr production rate using an excavator ($190/hr), and a laborer ($80/hr) for dewatering and vegetation stockpiling activities.
[2] Costs assume using an excavator ($190/hr), and a laborer ($80/hr) for construction activities.
[3] Materials necessary for constructing fish habitat and hydraulic structures, willow baffles and riparian planting.

7.2 Kelly Gulch Conceptual Plan

7.2.1 Existing conditions

Currently the NFSR flows in a relatively straight reach with a steep confining bank to the left at the up stream end of the project and transitioning to a large alluvial floodplain/gravel bar complex on the left and right banks. The project area focus is on the right bank floodplain/gravel bars. Within the large (~12 acres) floodplain/gravel bar one partially defined high flow side channel conveys flow during moderate to high water flow conditions. In the summer and fall, depending on antecedent moisture conditions and streamflow in the NFSR, flow in the side channels goes subsurface though coarse alluvial deposits. Kelly Gulch enters the floodplain/bar complex and NFSR~300 ft upstream from where the NFSR makes a sharp left hand turn at prominent bedrock formed pool. Kelly Gulch Creek flow also goes subsurface once it reaches the gravel bar of NFSR during the summer and fall low flow conditions. Kelly Gulch Riparian

conditions vary from dense hardwoods and conifers along the NFSM streambank to barren or sparsely vegetated ground on the alluvial gravel bar surface.

7.2.2 Proposed modifications

The Kelly Gulch conceptual plan has two alternative channel alignments. One alternative primarily involves side channel modification along the existing alignments as well as realigning Kelly Gulch Creek outlet (short alternative). Another alternative would modify the existing side channel inlet, connecting the inlet to a newly excavated side channel that will extend the full length of the floodplain, capturing Kelly Gulch Creek at the down stream end of the excavation before reconnecting the NFSR (long alternative). Both options consist of excavation and regrade of the floodplain/gravel bar surface, construction of hydraulic and fish habitat structures, and planting native trees and shrubs along newly excavated areas. The plan includes reconfiguring (grading and excavation) the existing channel profile and cross section along the existing side channel alignment to allow for a "self-maintaining" perennial watercourse that supports salmonid refugia and riparian conditions improvement.

The short alternative involves excavating the existing side channel and realigning the outlet of Kelly Gulch Creek. It is proposed that the side channel banks are sloped back to a 2:1 (H:V) grade with a 12.5 ft final channel width and a total of approximately 800 ft of regraded length. The preliminary design grade for the short alternative is approximately 0.7%, however the exact alignment, cross section, sinuosity, and slope grade may vary based on the final hydraulic analysis and engineered channel design (Appendix A, Drawing 2; Appendix B Drawings 5&6).

The new outlet for Kelly Gulch Creek would be excavated for approximately 200 ft with 2:1 (H:V) sideslopes, a 10 ft wide channel and with a sweeping right hand bend at the transition with the existing channel to create parallel flow with the NFSR. The outer bend will be armored with a redirective LWD structure (Appendix A, Drawing 2; Appendix B Drawings 7&8).

The long alternative would require approximately 1,200 ft of excavated channel on the floodplain, with 2:1 (H:V) sideslopes, 12.5 ft final channel width and several broad channel bends that will have LWD structures installed to redirect flow, prevent bank scour and excessive lateral channel migration. This excavated side channel will converge with Kelly Creek channel and continue along the same Kelly Creek alignment proposed in the short alternative (Appendix A, Drawing 2; Appendix B Drawings 3&4). The preliminary design grade for the long alternative is approximately 0.6%, however the exact alignment, cross section, sinuosity, and slope grade may vary based on the final hydraulic analysis and engineered channel design.

7.2.3 Fish and riparian habitat benefits

The proposed modifications to the existing side channels are intended to increase slow water refugia for juvenile salmonids during a wide range of flows; where as the current channel configurations are only providing habitat during high flow conditions. The proposed modifications will also increase perennial flows along side channel margins and thereby habitat available for riparian vegetation to become established. The proposed plan is intended to

reestablish natural geomorphic and hydraulic processes that will enhance channel complexity for all salmonid life stages.

The existing side channel complex is currently active during moderate to high flows and is lacking habitat complexity for juvenile salmonids. The lower end of the existing side channel has minimal surface flows and does not currently provide adequate habitat for salmonids during summer low flow conditions. The existing alluvial bar and side channel complex shows signs that the riparian is slowly regenerating and becoming a stable feature. The side channel modification and large woody debris structures would increase stability and resilience to the riparian, preventing loss of riparian habitat during large flood events (Abbe and Montgomery 1996) as well as providing complex habitat for salmonid rearing.

7.2.4 Conceptual plan constraints and limitations

The existing side channel is currently inundated during moderate to high flows which provide limited seasonal habitat value. There are currently a few pools that become isolated as flows recede, resulting in juvenile salmonids becoming stranded. There is very little cover in these existing pools and though out the length of the existing side channel. By creating a perennial side channel at the Kelly Gulch site there will be an increase in the available habitat for adult and juvenile salmonids for spawning and rearing. The lack of existing LWD in the side channel limits the amount of available habitat for juveniles and adults. The designs for the side channel are preliminary and have not had hydraulic or sediment transport modeling completed. Further analysis will need to be conducted to verify the channels ability to transport bedload and continue to be self maintaining through a wide range of flow events. This will require further field investigations, including but not limited to pebble counts and potentially more topographical surveys.

Given that the availability of money will ultimately become a constraint to design and construction costs, it should be considered that modifications of the proposed design may be necessary to conform within these monetary constraints. Several additional alternatives may be considered due to monetary constraints: (1) constructing fish habitat structures, willow baffles and native tree and shrub planting; (2) construction of floodplain fencing (cottonwood polls placed vertically in the floodplain designed to rack woody debris, mimicking a forested island) with willow baffles and native tree planting; and (3) placement of willow baffles and native tree planting alone. These alternatives may be valid suggestions for lowering the cost of design and/or construction; however they have not been evaluated during this initial feasibility study.

7.2.5 Potential complications

The preliminary design has not undergone hydraulic modeling that will be necessary to confirm the stability and long term sustainability of the design under a range of flow events.

In general, complications may include but may not be limited to: downcutting, lateral migration, headcut development, and excessive aggradation, all of which have the potential to reduce or negate rearing conditions and riparian vegetation enhancement goals. These potential complications will need to be addressed during final engineering design.

7.2.6 Earthwork and vegetation disturbance

Excavation of the side channel and Kelly Creek will be conducted in a manner that will limit disturbance to existing vegetation. Approximately 1,200 feet of side channel and Kelly Creek channel will be excavated to increase favorable rearing conditions. Additionally, the construction of LWD structures will improve cover, complexity, help to sort substrate and provide habitat for salmonids. All brush and trees that are removed will be used in the construction of LWD structures.

Table 3. Estimates for earthmoving and tree removal during construction, Kelly Gulch project area (long alternative + Kelly Gulch realignment).

Construction element	**Volume of earthen material moved (yd^3)**	**Trees removed (# > 4 in. DBH)**
Regrading/excavating side channel and realignment of Kelly Gulch	4,924	5
Hydraulic structures	80	2
Fish habitat structures	10	2
Willow baffles	260	0
Totals	5,274	9

7.2.7 Preliminary cost estimates

The major costs associated with the implementation of Kelly Gulch project area are outlined in Table 4. Specific work tasks include, but may not be limited to: (1) physical earthwork related to regrading the side channel, Kelly Creek channel and the construction of hydraulic structures, fish habitat structures and willow baffles; (2) riparian planting; (3) final engineering design including hydraulic/sediment transport and geotechnical analysis; and (4) final planning for permitting approval through State, federal, and local agencies. Contingency funds (estimated @ 25%) have been included to account for variations or increases in material and equipment costs, as well as unforeseen problems or additional project elements. The costs outlined are preliminary, subject to revision, and are to be used for planning purposes only. The estimated cost to implement Kelly Creek project area is approximately $272,000.

Table 4. Preliminary estimated costs for side channel and riparian habitat improvements, Kelly Gulch project area.

Cost category	Work product / action	Estimated cost ($)
Long side channel and Kelly Creek regrade[1]	Excavate and regrade existing long side channel and Kelly Creek to specified profile and cross section	33,200
Installation of willow baffles, hydraulic, fish habitat structures and riparian planting[2]	Construct instream components and plant riparian	85,300
Material costs[3]	Purchase materials for willow baffles, hydraulic and fish habitat structures.	39,600
Engineering and geotechnical	Civil design, hydraulic/sediment transport and geotechnical analysis	45,000
Permitting	CEQA / NEPA compliance, USFS permits, etc.	15,000
	Subtotal	218,100
	Contingencies ~ 25% of Subtotal	54,525
	Totals	**272,625**

[1] Side channel regrade/excavation costs are based on excavation production rates and prevailing wage equipment costs derived from several recently completed projects of a similar nature. Costs assume 40 yd^3/hr production rate using an excavator ($190/hr), and a laborer ($80/hr) for dewatering and vegetation stockpiling activities.
[2] Costs assume using an excavator ($190/hr), and a laborer ($80/hr) for construction activities.
[3] Materials necessary for constructing fish habitat and hydraulic structures, willow baffles and riparian planting.

8 RECOMMENDATIONS

This study provides important information and guidance for decision making regarding pilot implementation alternatives. It is not a substitute for detailed engineering, hydraulic/sediment transport analysis and geotechnical studies that will be required prior to final design or before any on-the-ground improvement activities take place. As described above, both Red Bank and Kelly Gulch planning areas include development of side channel rearing habitat through the physical excavation of channels and/or enhancement of existing side channel alignments. Prior to these restoration activities taking place, it is recommended that a final hydraulic and sediment transport analysis, geotechnical, and civil engineering design are completed for the project. In addition, no consideration regarding recreational river user's safety has been evaluated for this planning study. It is recommended that an evaluation of recreational river user's safety be considered in the final design.

9 REFERENCES

CaSIL, 2005, NAIP county mosaics [Internet]: Sacramento, CA, California Spatial Information Library [cited December 2008]. Available from: http://gis.ca.gov/

CH2M Hill, 1985, Klamath River Basin Fisheries Resource Plan, Prepared for the Bureau of Indian Affairs, Department of Interior.

de la Fuente, J., and Haessig, P. A., 1994, Salmon Sub-Basin Sediment Analysis: Yreka, CA, USDA Forest Service, Klamath National Forest.

Dunne, T., and L.B. Leopold, 1978, Water in Environmental Planning: New York, W.H. Freeman, 818p.

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B., eds., 1998, California salmonid stream habitat restoration manual, 3d. ed.: Sacramento, CA, California Department of Fish and Game, 497 p. Available from: http://www.dfg.ca.gov/fish/Resources/HabitatManual.asp

NCRWQCB, 2005, Salmon River, Siskiyou County, California, total maximum daily load for temperature and implementation plan: Santa Rosa, CA, North Coast Regional Water Quality Control Board, 51 p. Available from: http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/salmon_river/062405/part_1_salmon_temperature_tmdl_report_adopted.pdf

Taylor, R.N., and Love, M., 2003, Part IX, Fish Passage Evaluation at Stream Crossings, *in* Flosi,G., Downie, S., et al., eds., California salmonid stream habitat restoration manual, 3d. ed.: Sacramento, CA, California Department of Fish and Game, 177 p. Available from: http://www.dfg.ca.gov/nafwb/pubs/2003/FishPassage.pdf

USDA Forest Service; USDI, Bureau of Land Management, 1994, Record Of Decision For Amendments To Forest Service And Bureau Of Land Management Planning Documents Within The Range Of The Northern Spotted Owl, Standards And Guidelines For Management Of Habitat For Late-Successional And Old-Growth Forest Related Species Within The Range Of The Northern Spotted Owl. Portland, OR.

USGS, 1979a, Somes Bar, California [map]: Washington, D.C., U.S. Geological Survey, 7.5 Minute Map 41123D4, scale 1:24,000.

USGS, 1979b, Thompson Peak, California [map]: Washington, D.C., U.S. Geological Survey, 7.5 Minute Map 41123A1, scale 1:24,000.

USGS, 2001, Youngs Peak, California [map]: Washington, D.C., U.S. Geological Survey, 7.5 Minute Map 41123B3, scale 1:24,000.

Wagner, D.L., and Saucedo G. J., 1987, Geologic Map of the Weed Quadrangle, California., State of California, Division of Mines and Geology, scale 1:250,000.

Waananen, A.O., and Crippen, J.R., 1977, Magnitude and frequency of floods in California: U.S. Geological Survey Water-Resources Investigations 77-21, 96 p.

West, J.R., 1991, A proposed strategy to recover endemic spring-run chinook salmon populations and their habitats in the Klamath River Basin: Yreka, CA, USDA Forest Service, Klamath National Forest, 27 pp.

Wolman, M.G., 1954, A method of sampling coarse river bed material: Transactions of the American Geophysical Union, v. 35, p. 951-956.

10 AERIAL PHOTOGRAPHY REVIEWED

1944, Salmon River Restoration Council digital catalog, origin unknown, flight DDD, frames 32-12&13 and 33-28&29, approximate scale 1: 20,000.

1955, Salmon River Restoration Council digital catalog, origin unknown, flight DDC, frames 16P-93&94 and 20P-47&48, approximate scale 1: 24,000.

1965, Salmon River Restoration Council digital catalog, origin unknown, flight DDC, frames 17FF-256&257 and 18FF-135&136, approximate scale 1: 16,000.

1975, Salmon River Restoration Council digital catalog, origin unknown, flight 06093, frames 2075-232 and 4675-153&154, approximate scale 1: 18,000.

1980, Salmon River Restoration Council digital catalog, U.S.D.A., flight 625050, frames 180-149&150 and 280-150&151, approximate scale 1: 12,000.

1995, Salmon River Restoration Council digital catalog, U.S.D.A., flight 615050, frames 295-121&123, approximate scale 1: 12,000.

2005, NAIP county mosaics [Internet]: Sacramento, CA, California Spatial Information Library [cited December 2008]. Available from: http://gis.ca.gov/

Appendix A

Salmon River Riparian Assessment Area Conceptual Plans/Plan View Diagrams, Klamath National Forest, Siskiyou County, California.

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P.O. Box 4433 Arcata, CA 95518
PH (707) 839-5130 FX (707) 839-8168

Appendix A, Drawing 1 - Red Bank Conceptual Plan Plan View Diagram

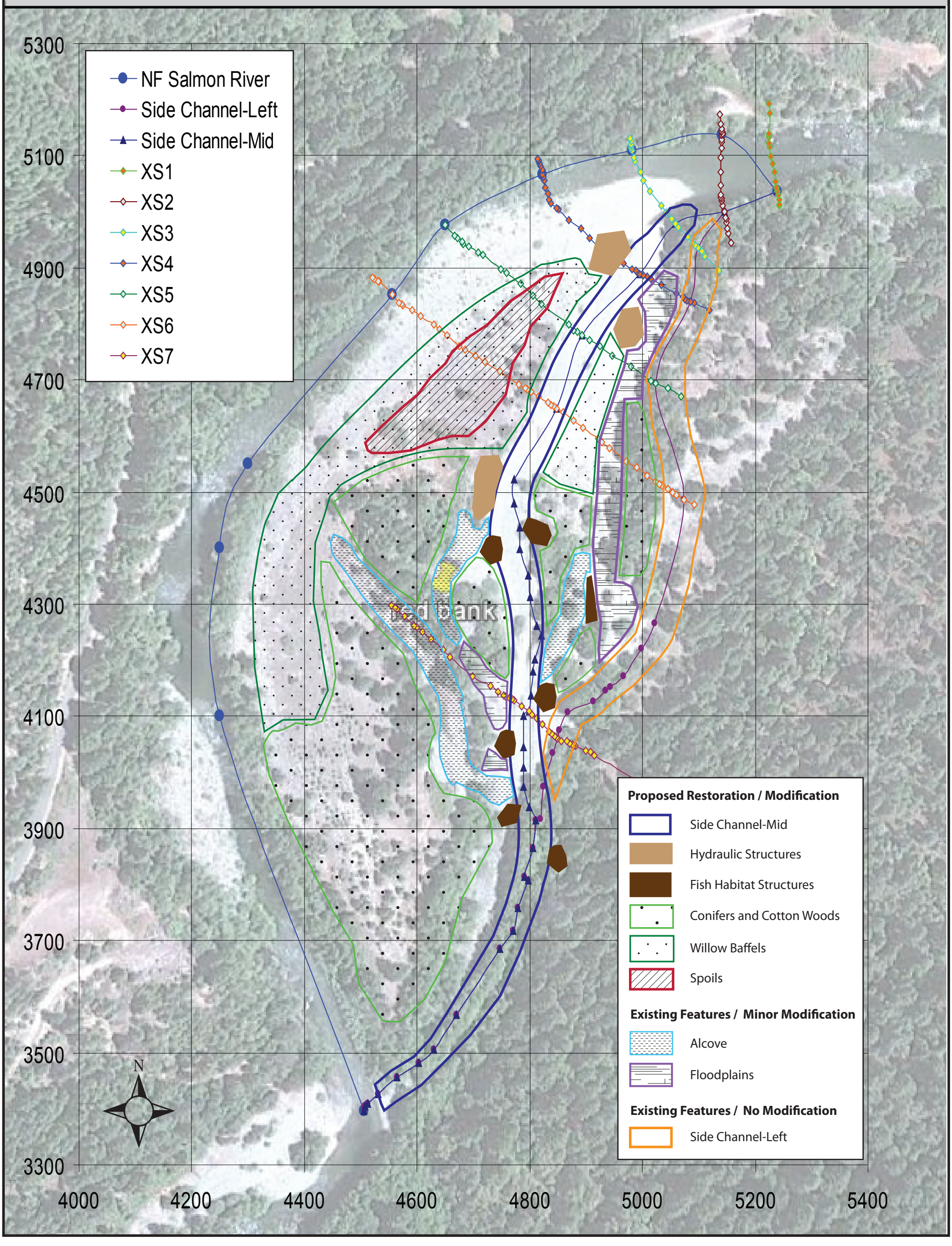
Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

Developed for Salmon River Restoration Council, May 2012

Site - Red Bank
Road: Sawyers Bar
Milepost: 9

Sheet 1 of 2
Phase: Draft
Drawings: RL

Notes:
(1) Drawings are preliminary and subject to revision
(2) Northing and easting scales are in feet
(3) Imagery from 2011 Google Earth, 2012 GeoEye
(4) Survey is relative and not tied to a geodetic datum



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Appendix A, Drawing 2 - Kelly Gulch Conceptual Plan
Plan View Diagram

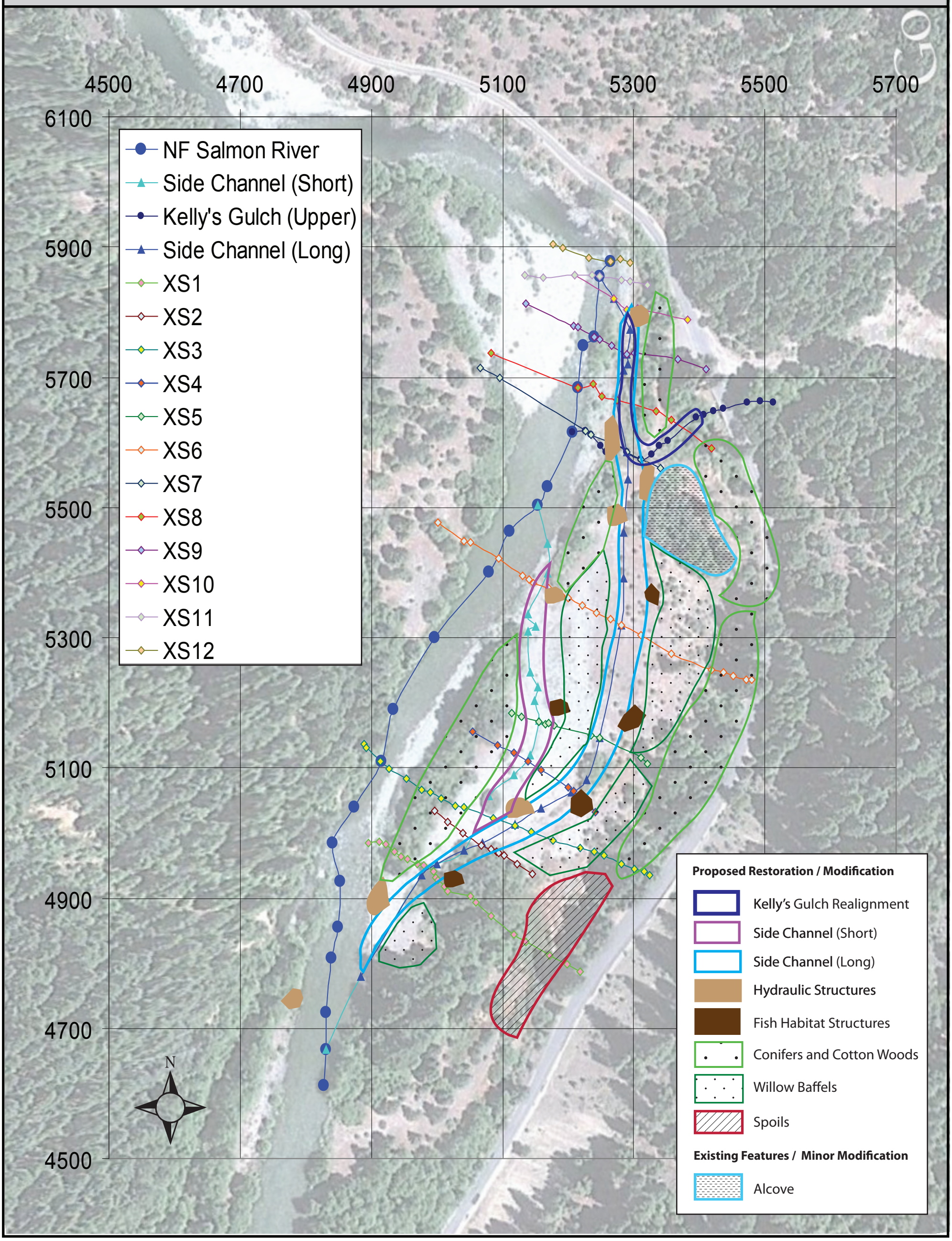
Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 2 of 2
Phase: Draft
Drawings: RL

Notes:
(1) Drawings are preliminary and subject to revision
(2) Northing and easting scales are in feet
(3) Imagery from 2011 Google Earth, 2012 GeoEye
(4) Survey is relative and not tied to a geodetic datum



Appendix B

Salmon River Riparian Assessment Area Channel Profile and Cross Section Drawings
Showing Existing and Proposed Conditions,
Klamath National Forest, Siskiyou County, California.

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Appendix B, Drawing 1 - Red Bank Side Channel (Mid Channel)
Channel profiles pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

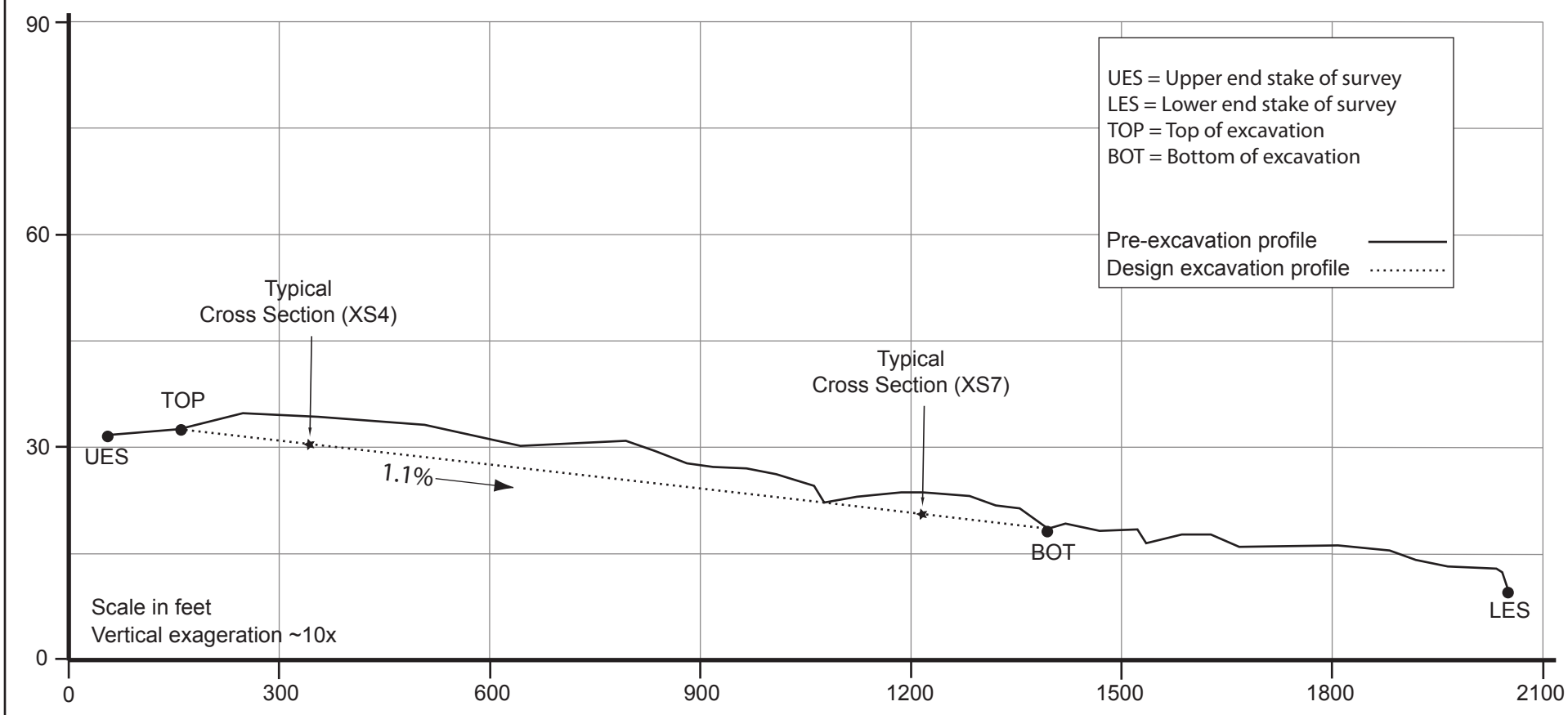
Developed for Salmon River Restoration Council, May 2012

Site - Red Bank
Road: Sawyers Bar
Milepost: 9

Sheet 1 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
TOP to BOT slope distance (ft)	1,235
XS 4 depth (ft)	3.6
XS 7 depth (ft)	3.2
Estimated volume removed (yd^3)	3,625

Notes: (1) Drawings are preliminary and subject to revision



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PH (707) 839-5130 FX (707) 839-8168

Appendix B, Drawing 2 - Red Bank Side Channel (Mid Channel)
Channel cross sections pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

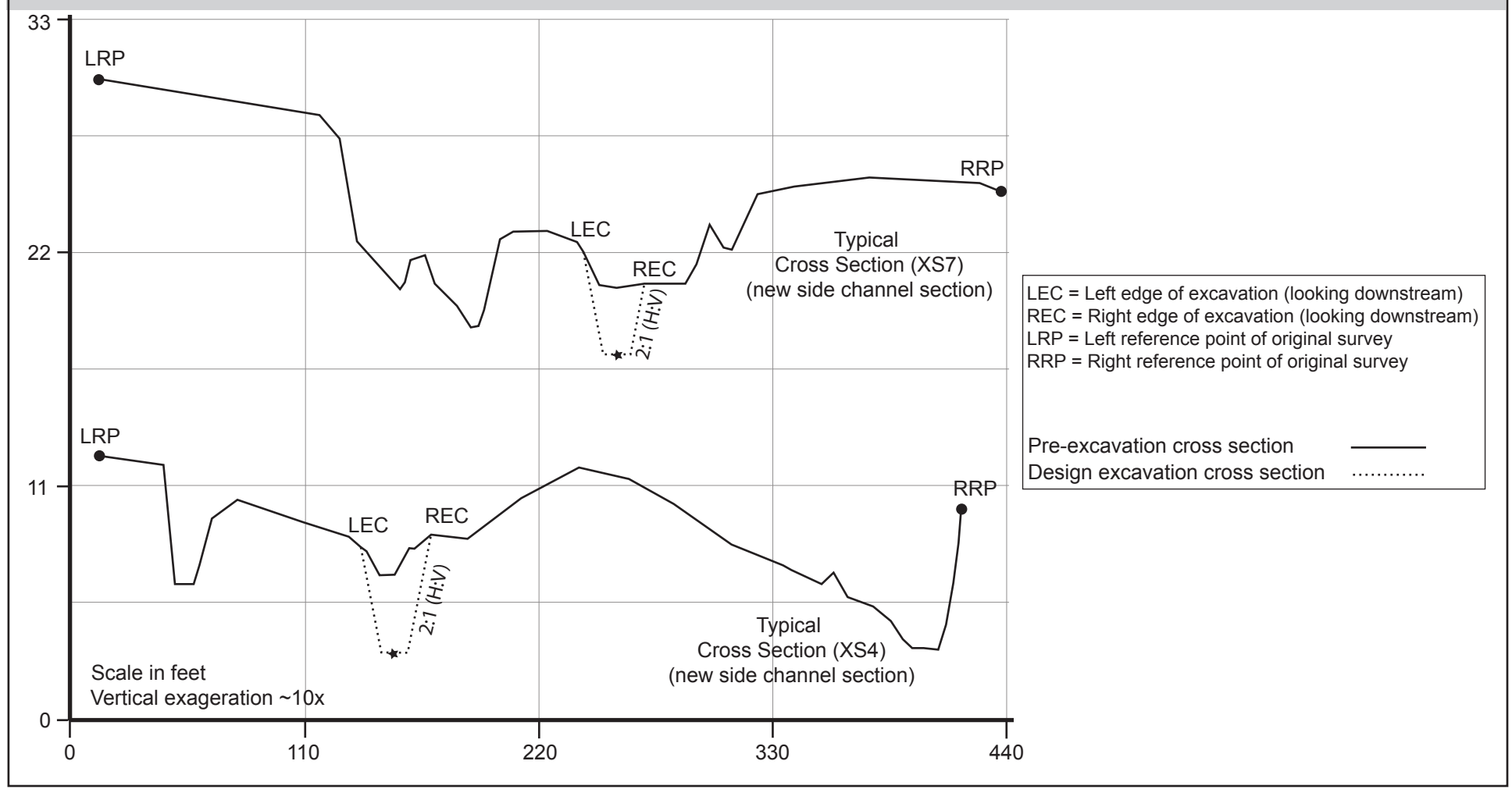
Developed for Salmon River Restoration Council, May 2012

Site - Red Bank
Road: Sawyers Bar
Milepost: 9

Sheet 1 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
XS 4 LEC to REC distance (ft)	33.3
XS 4 depth (ft)	3.6
XS 7 LEC to REC distance (ft)	29.0
XS 7 depth (ft)	3.2

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 3 - Kelly Side Channel (Long Alternative)
Channel profiles pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

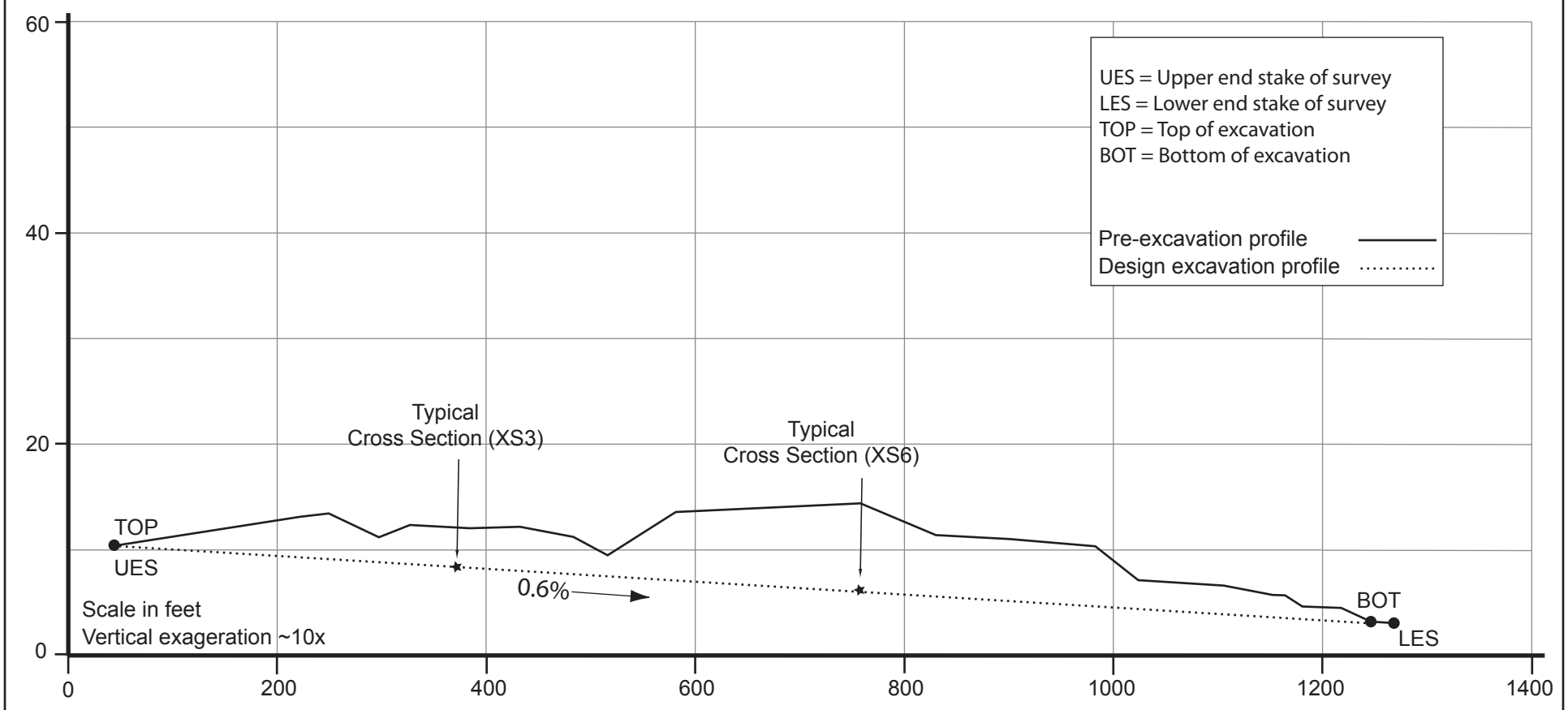
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 2 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
TOP to BOT slope distance (ft)	1,210
XS 3 depth (ft)	3.9
XS 6 depth (ft)	8.4
Estimated volume removed (yd^3)	4,720

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 4 - Kelly Side Channel (Long Alternative)
Channel cross sections pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

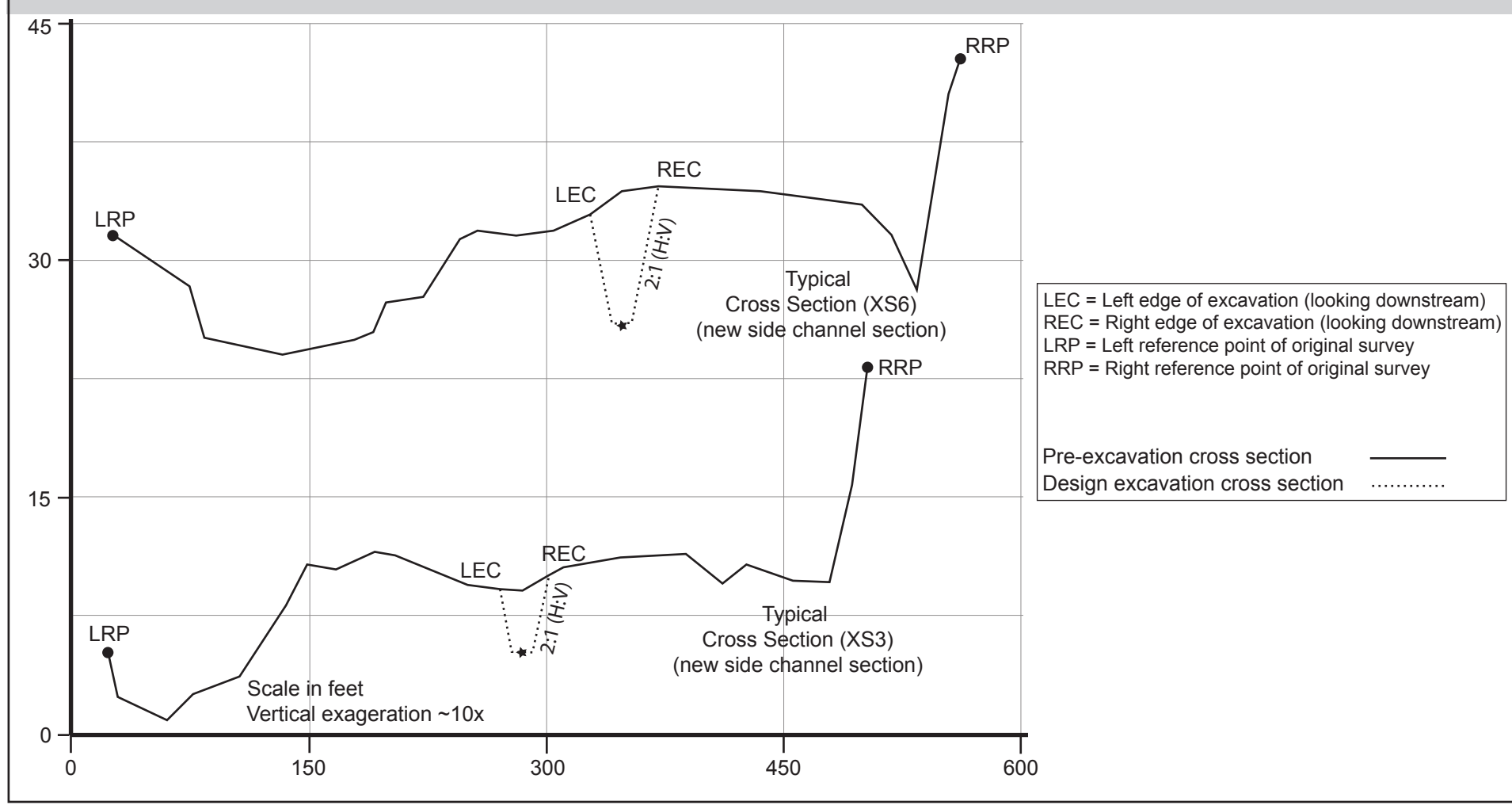
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 2 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
XS 3 LEC to REC distance (ft)	30.5
XS 3 depth (ft)	3.9
XS 6 LEC to REC distance (ft)	43.8
XS 6 depth (ft)	8.4

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 5 - Kelly Side Channel (Short Alternative)
Channel profiles pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

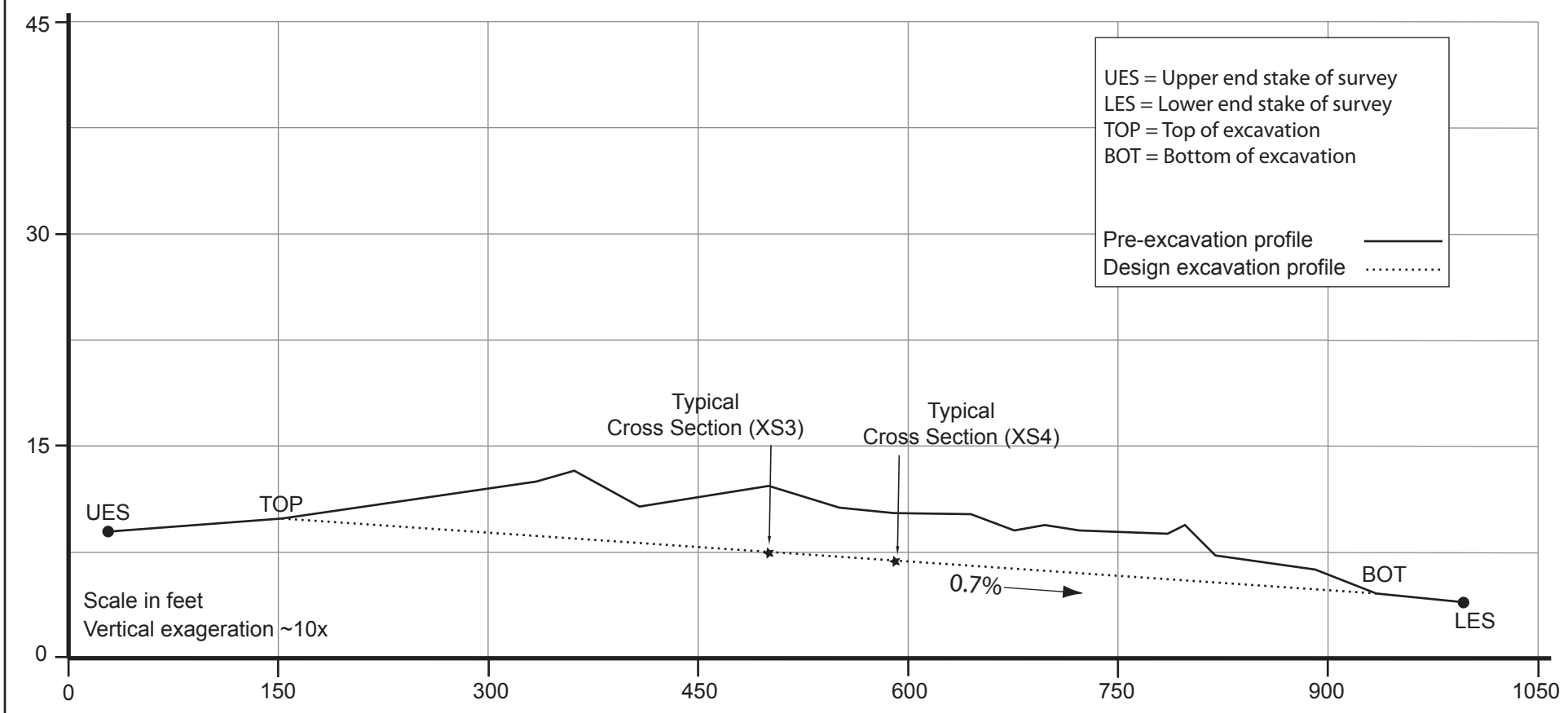
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 3 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
TOP to BOT slope distance (ft)	782
XS 3 depth (ft)	4.6
XS 4 depth (ft)	3.3
Estimated volume removed (yd^3)	1,863

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 6 - Kelly Side Channel (Short Alternative)
Channel cross sections pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

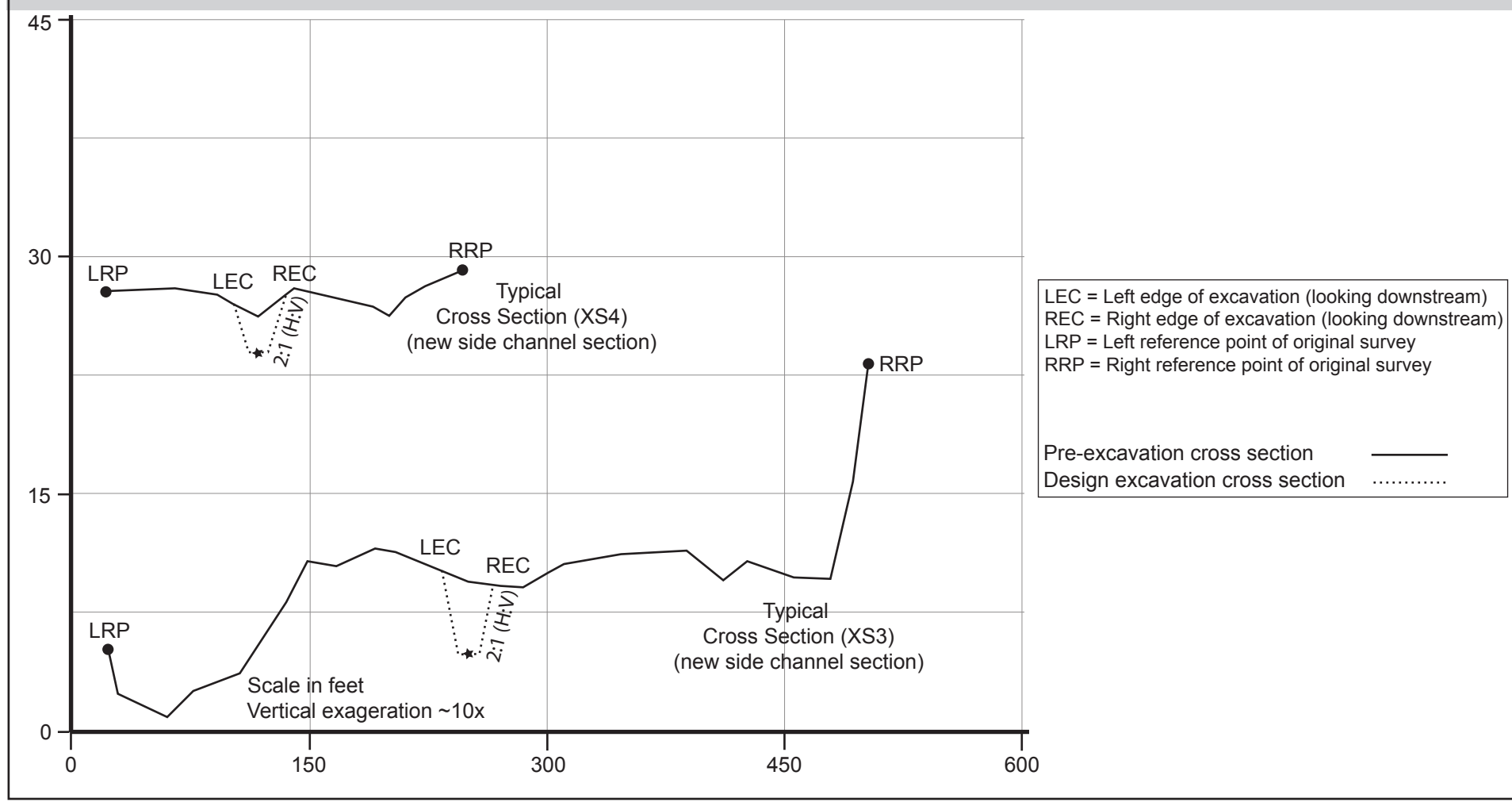
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 3 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
XS 3 LEC to REC distance (ft)	32.2
XS 3 depth (ft)	4.6
XS 4 LEC to REC distance (ft)	32.2
XS 4 depth (ft)	3.3

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 7 - Kelly Gulch Channel (New Alignment)
Channel profiles pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

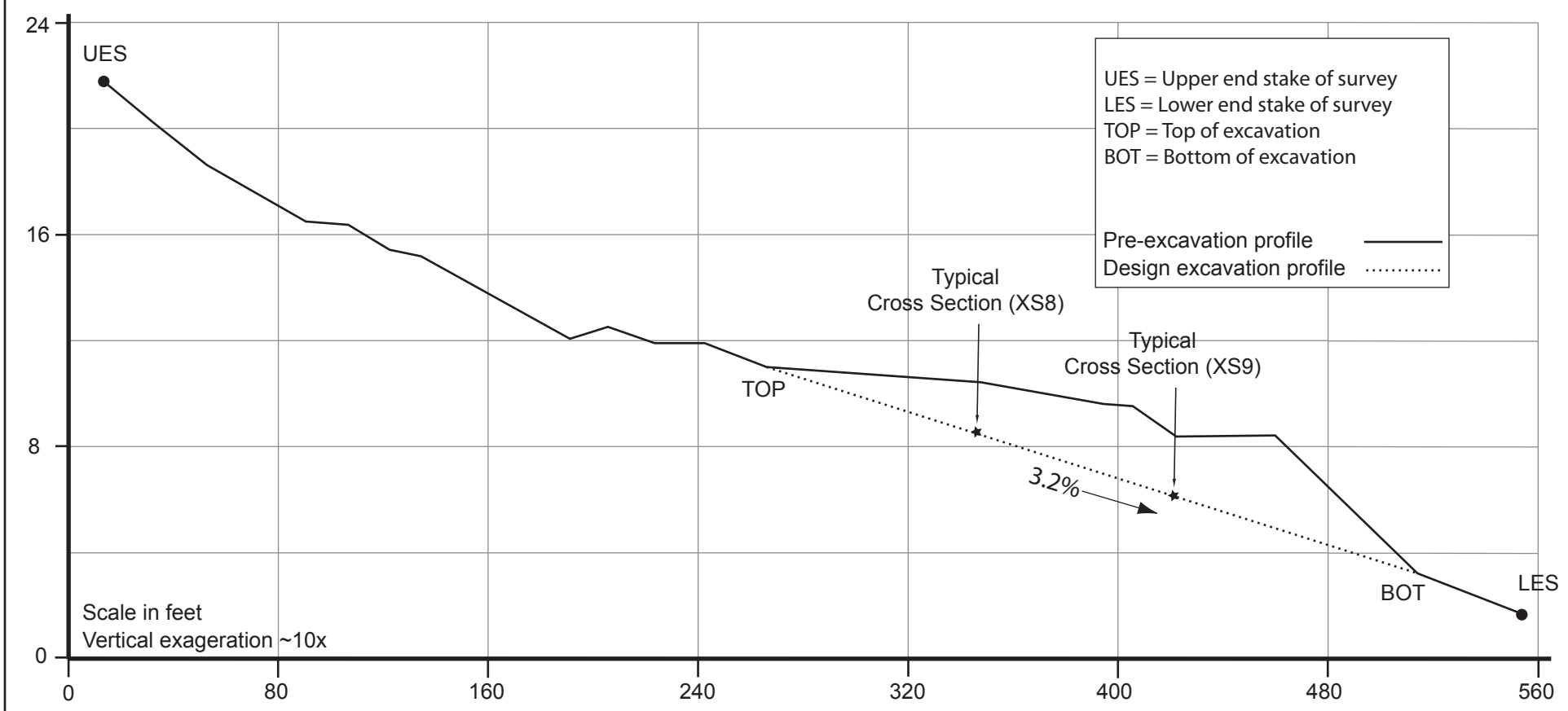
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 4 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
TOP to BOT slope distance (ft)	248
XS 8 depth (ft)	2.0
XS 9 depth (ft)	2.4
Estimated volume removed (yd^3)	204

Notes: (1) Drawings are preliminary and subject to revision



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Appendix B, Drawing 8 - Kelly Gulch Channel (New Alignment)
Channel cross sections pre and post excavation specifications

Salmon River Riparain Assesment Pilot Planning Project, Siskiyou County
Project # 913 United States Forest Service property

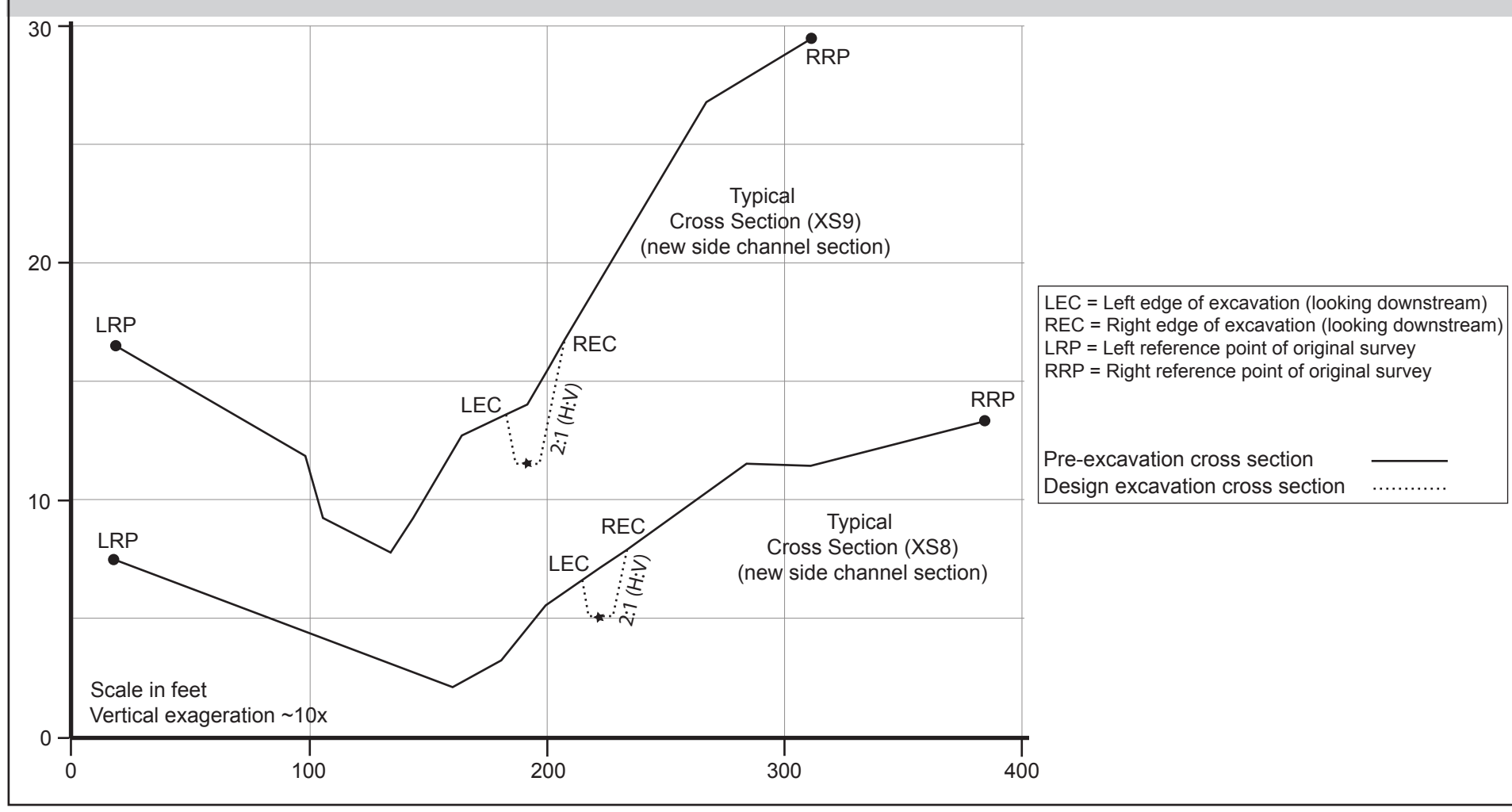
Developed for Salmon River Restoration Council, May 2012

Site - Kelly Gulch
Road: Sawyers Bar
Milepost: 14

Sheet 4 of 4
Phase: Draft
Drawings: RL

Post-excavation specifications	
XS 8 LEC to REC distance (ft)	18.4
XS 8 depth (ft)	2.0
XS 9 LEC to REC distance (ft)	24.2
XS 9 depth (ft)	2.4

Notes: (1) Drawings are preliminary and subject to revision



Appendix C

Salmon River Riparian Assessment Area Photographs,
Klamath National Forest, Siskiyou County, California.

Photo 1. View looking downstream to the Red Bank alluvial bar with the side channel inlet on the left edge of the gravel bar.

Photo 2. Current view of the Red Bank side channel looking downstream from the proposed inlet. Note the mature conifers in the upper right frame growing on the highest portion of the bar.

Photo 3. The current view of the Red Bank side channel looking upstream. Note the mature conifers in the upper center frame are growing on the highest portion of the bar and are the same conifers from the previous photo.

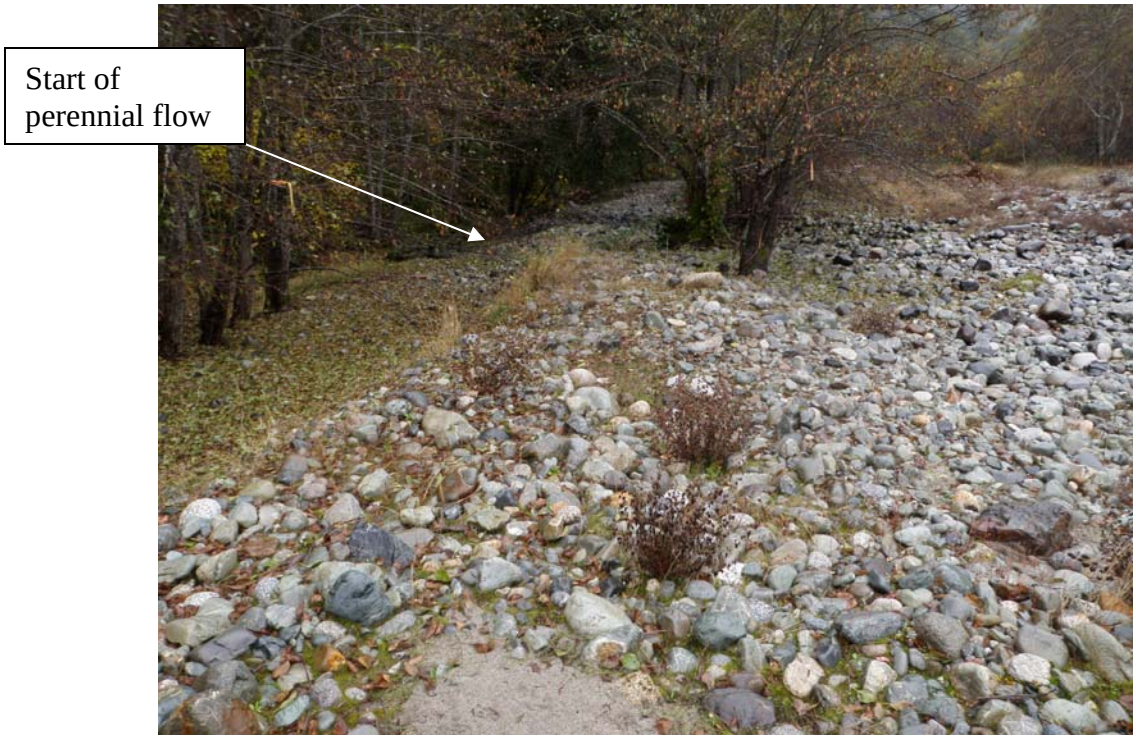


Photo 4. View looking downstream at the confluence of the Red Bank side channels. Perennial flow was observed from this point down stream to the confluence with NFSR.

Photo 5. View looking downstream at the current high flow side channel inlet at Kelly Gulch bar.

Photo 6. View looking upstream at the current inlet to the high flow side channel at Kelly Gulch bar.

Photo 7. View looking upstream at the current alignment of Kelly Gulch high flow side channel.

Photo 8. A second view looking upstream at the current alignment of Kelly Gulch high flow side channel, taken from the right bank.

Photo 9. View looking downstream at the proposed short side channel excavation alignment and outlet to NFSR.

Photo 10. View looking upstream at proposed excavation of Kelly Gulch Creek alignment and outlet.