Appendix A

Final Design Technical Memo.

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BOBCAT FLAT RM 43 COARSE SEDIMENT INTRODUCTION

DESIGN DOCUMENT

–TECHNICAL MEMORANDUM–

July 23, 2004

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1 INTRODUCTION

The Tuolumne River Bobcat Flat River Mile 43 Coarse sediment Introduction Project is located within the Dredger Tailing Reach of the lower Tuolumne River (Appendix A: Sheet 1). The project is funded by the Department of Water Resources "Delta Fish Protection Agreement" (formerly 4-Pumps Agreement), and administered by the Turlock Irrigation District. The surrounding 300 acre Bobcat Flat property is owned by Friends of the Tuolumne (FOT).

2 BACKGROUND

Beginning with the Gold Rush in 1848, the Tuolumne River has been extensively modified by land use practices (e.g., agriculture, ranching, and urbanization) and resource extraction (e.g., water for irrigation, gold mining, and aggregate mining). Streamflow regulation began with construction of Wheaton Dam (1871) and La Grange Dam (1893), intensified in the 1920s with the construction of several large reservoirs in the basin, and culminated in 1971 with construction of the New Don Pedro Project (NDPP), which more than tripled the storage capacity of the basin. During the early twentieth century, the Tuolumne River channel and floodplain around RM 43 were dredged for gold. The gold dredges excavated channel and floodplain alluvial deposits to the depth of bedrock (up to 25 feet) and often realigned the river channel. After recovering the gold, the dredges deposited the remaining tailings back onto the floodplain, creating large, cobble-armored windrows that replaced the alluvial deposits and floodplain soils. By the end of the gold mining era, the majority of the floodplain adjacent to the project site had been converted to dredger tailings. In the 1960's, much of the tailings were excavated to provide construction material for New Don Pedro Dam. These areas remain barren, unproductive surfaces with exposed coarse sediment/cobble and little or no soil layer.

Following the removal of the dredger tailings, Davis-Grunsky Act funds were used in the early 1970's to reconstruct a defined channel through the chaos of multiple channels. Unfortunately, only the reach upstream of Basso Bridge (RM 47.5) was completed, leaving Bobcat Flat in a severely damaged condition. The lasting impact of dredge mining was to convert the channel morphology from natural pool-riffle sequences to "lake-cascade" morphology (Figure 1). This conversion greatly reduced low gradient riffles that provided Chinook salmon spawning and rearing habitats, and replaced them with high gradient riffles separated by long pools. Many of these steep riffles have slopes greater than 1% (0.01) during spawning flows (150–300 cfs), creating unsuitably high velocities and coarse substrate over much of the riffle surface.

The conversion to steep riffles by dredge mining has resulted in a dramatic decrease in chinook spawning habitat, and this reach now provides only a small proportion of its total production capacity compared to riffles upstream of Basso Bridge (Figure 2). Additionally, the lack of coarse sediment recruitment below the dam, combined with the reduction of high flows to mobilize sediment and help restore channel morphology, prevent recovery of the natural channel morphology. Within the current physical constraints of flow and sediment regulation, as well as degraded channel conditions, the Bobcat Flat reach will not likely recover natural channel and floodplain features and habitats without mechanical intervention. Restoring a more natural distribution of slope and channel morphology throughout the entire reach would greatly benefit spawning habitat. Replenishing salmonid spawning gravel and coarse sediment supply would also improve rearing habitat and other aquatic habitats in this reach.

3 PROJECT DESCRIPTION

The Bobcat Flat RM 43 Channel Restoration Project is intended to rehabilitate salmonid spawning and rearing habitat by adding coarse sediment at Riffles 20 and 21. Coarse Sediment is defined as gravels and cobbles between 8 mm and 130 mm, which will contribute to spawning habitat, rearing habitat, and geomorphic features active under contemporary flow regime.

This project fits within a broader coarse sediment management objective of balancing the coarse sediment budget, increasing storage, and restoring bedload transport continuity throughout the river corridor (McBain and Trush 2000, 2003). The specific objectives of the project are:

- Add approximately 10,000 yd^3 to 15,000 yd^3 of coarse sediment at several locations within the 2,000 ft project reach, to reduce riffle slope and the particle size distribution within spawning riffles to increase the quantity and quality of a variety of habitat for salmonids;
- Implement different methods (point bars, pool tails, dunes) of coarse sediment placement to evaluate relative use of salmonid spawning, rearing, and holding habitats created by the project, and to compare this project with upstream coarse sediment introduction sites;
- Demonstrate the feasibility, benefits, and potential cost-savings of producing the spawning coarse sediment material on-site by excavating, screening, and washing coarse sediment material either from existing floodplain surfaces or from on-site dredger tailings, then introducing this screened coarse sediment into the river.

The overall restoration approach will attempt to demonstrate effective improvements in spawning habitat by adding coarse sediment suitable for salmonid spawning to adjust the sediment particle size and riffle slope (which partially controls water depth and velocity), thereby increasing usable area of spawning and rearing habitat. The approach assumes that coarse sediment placed in the riffle will be immediately available for salmonid spawning and rearing. The approach also assumes that coarse sediment placed in the channel is subject to mobilization and downstream transport by high flows, and that sediment transport is beneficial to geomorphic conditions and spawning habitat. Spawning gravel transported out of the project reach, however, may need to be replaced in future coarse sediment augmentation projects to maintain the same area of spawning habitat availability.

Existing spawning habitat was quantified in the field in April 2001 by mapping habitat onto air photos, then digitizing the areas. CDFG carcass and redd survey crews identified all habitat that was used during the prior winter spawning season. Within the Bobcat Flat RM 43 project reach, approximately 6,200 ft^2 of spawning habitat was identified, with the majority of the spawning habitat associated with Riffle 20 and the pool-tail of Riffle 21 (Figure 3). Several individual Chinook salmon redds were constructed in the reach between these riffles in winter 2000-01. This habitat density equates to approximately 4 ft^2/ft (square feet of habitat per linear foot of channel). Spawning habitat densities observed in the reaches between Basso Bridge and Old La Grange Bridge range up to 30 ft^2/ft of channel. We predict, based on the existing slope and hydraulic conditions in the Bobcat Flat reach, that spawning densities can approach those found in upstream reaches, and this reach may eventually support as much as 45,000 ft^2 of habitat.

The proposed restoration approach will compare coarse sediment introduction at two different locations – Bobcat Flat and Old La Grange Bridge, and also compare coarse sediment placement methods within the Bobcat Flat site. The first evaluation will allow comparison of spawning use in upstream (RM 50.5) vs. downstream (RM 43.0) spawning gravel introduction sites. The Bobcat Flat project will attempt to use coarse sediment similar in particle size to those used in the CDFG 2003 projects to make the projects comparable. This coarse sediment is projected to be smaller than the coarse sediment used by CDFG in 1999 and 2002.

The second evaluation will compare hydraulic conditions, habitat conditions, and fish use of coarse sediment placed at Bobcat Flat. Fish "use" includes both holding and spawning adult salmonids. This evaluation is in response to suggestions from Carl Mesick and Steve Walser (California Rivers Restoration Fund), and Friends of the Tuolumne to attempt to incorporate steelhead habitat features into the project designs.

The restoration approach also attempts to evaluate on-site spawning gravel processing by excavating either raw, unprocessed dredger tailings or by re-excavating previously dredged and scraped floodplain surfaces, then screening and washing the material to produce a suitable mixture of spawning coarse sediment. This approach is intended to (1) reduce project costs, (2) reclaim floodplain areas to better riparian habitat conditions, and (3) avoid purchasing commercial aggregate for spawning coarse sediment augmentation projects when supplies are available on-site.

The overall project *design* approach is as follows:

(1) survey the project site topography to obtain a DTM of the existing channelbed and floodplain conditions (Appendix A: Sheet 2);

(2) develop a 2-dimensional planform design superimposed over an aerial photograph that specifies existing meso-habitat units and micro-habitat features, locates cross sections, access roads, etc., and then delineate coarse sediment sources and areas where placement is recommended (Figure 3).

(3) submit this 2-dimensional conceptual design along with a technical memorandum to the TRTAC for review;

(4) based on review comments, make necessary revisions and adjustments to the proposed design, until approved by the TRTAC and FOT;

(5) develop the final project design, including floodplain, scour channel, and channel design contours (3-dimensional), coarse sediment placement methods, particle composition

specifications, coarse sediment sources, and access. (Note: the 3-dimensional designs will refine coarse sediment cut and fill estimates.)

Steps 1–5 are complete.

Steps 1–4 of this approach were followed during the CDFG 2001 Coarse Sediment Introduction Project at Riffle A7, and the project was implemented with reasonable success. The primary benefits of developing the final design contours (step 5) is to allow coarse sediment volume estimates to be refined, to identify key design specifications such as grade control elevations that must be strictly followed, and to provide detailed topography for the construction contractor if the project is put out to bid. This design approach also assumes that on-the-ground construction supervision by the project designers is an integral part of the project implementation, allowing refinement of the final topography as the coarse sediment is being placed into the channel.

4 FIELD SURVEYING AND SITE DESCRIPTION

Topographic surveys were conducted on May 21–22 and October 23–25, 2003, using a total station. Of the 2,000 ft in-channel reach, 1,500 ft was surveyed. The lower and upper portions were not surveyed, thus we estimated bathymetry from depth soundings. The active channel was surveyed, extending from top of the banks that confine approximately 1,000 cfs to the wetted channel thalweg. The right bank floodplain was surveyed for the entire 2,000 ft reach to provide better volume estimates for source materials. Discharge was approximately 550 cfs at La Grange (USGS #11-289650) during the May 21-22, 2003 survey. The surveys were used to produce a Digital Terrain Model (DTM) of existing conditions that is the basis for the project design (Appendix A: Sheet 2). A total of seven cross sections were installed and monumented with ½-inch rebar stakes, and additional cross sections were surveyed (not monumented) for use in HEC modeling. Three of the seven cross sections were extended to provide detail of the side channel network. The upper 1,600 ft of the project reach thalweg was surveyed and plotted for use in the design (Appendix A: Sheet 4). Two pebble counts were conducted in areas identified as spawning habitat (Table 1).

Table 1. Particle sizes from pebble counts at the Bobcat Flat project site and other Chinook spawning sites in the coarse sediment-bedded reaches.

LOCATION	CROSS SECTION	D_{84}	D50	D_{31}
Riffle 3B RB Bar	2722+00	83	52	40
Riffle 4A LB Bar	2699+00	70	40	27
Riffle 4B Medial Bar	2690+00	68	43	30
Riffle 5A Pool Tail	2670+00	106	58	43
Riffle 20 RB Margin	2413+00	95	51	36
Riffle 21 Pool Tail	2400+00	111	71	49
RFB Constructed Bar	2214+50	68	38	27
Riffle 29B	2199+20	58	34	26

The project will treat six discrete sections of channel within the 2,000 ft project reach. Currently, the reach has two steep riffles, one at each end of the reach (Riffles 20 and 21) with an 800 ft section of pool-glide-pool in the middle portion and a large pool at the lower end (Appendix A: Sheet 3). Riffle 20 at the upstream project boundary is 400 ft long with 550 cfs water surface slope of 0.0035; Riffle 21 at the downstream project boundary is 250 ft long with 550 cfs water surface slope of 0.0070. The pool-glide section has an additional water surface elevation drop of

0.6 ft over the 800 ft (slope = 0.00075). Riffle slopes are based on rise/run, with a targeted ideal slope of 0.001 to 0.0015. Both riffles contain small amounts of usable chinook spawning habitat (R20 = 1,770 ft^2, R21 = 2,470 ft^2), and chinook redds have been observed in the glide section as well (Figure 3). At the downstream project boundary, Riffle 21 flows into a large pool with depths up to 8-10 ft.

The pool and glide units contain high quality salmonid holding and rearing habitat along the margins (Figure 3) and there is an off-channel backwater area adjacent to Riffle 20 with cattail and other marsh vegetation that may provide good juvenile salmonid rearing habitat. These areas will be preserved when the project is implemented.

The initial project proposal suggested adding coarse sediment to Riffles 20 and 21 to reduce the slope and increase spawning habitat. However, after consulting with FOT, Carl Mesick, and Steve Walser it was determined that we would construct new dune habitats (short riffle and pool as shown in Patch 3 and 6, Figure 3) below Riffle 20 and 21. Sorted coarse sediment will be used to construct two point bars (Patch 2 and 5, Figure 3), enhance the glide unit (referred to as Riffle 20B) by constructing dune habitat (Patch 4, Figure 3) and adding coarse sediment upstream of Riffle 20 (Patch 1, Figure 3) to enhance the pool tail feature as well as provide a long term coarse sediment infusion/source point for this site. Cobbles greater than 128 mm could be spoiled in the bottom of the pool as a foundation for Patch 5 and 6 (Figure 3). Construction within the channel will begin at the upstream end and progress downstream until the initial construction budget is exhausted. Any remaining channel work will be done as funds become available.

The project design should consider how the channel morphology (primarily slope) of the existing and proposed project reach fits within a broader geomorphic context. For example, altering the overall slope within the project reach by changing the upstream or downstream control elevation may have implications for conditions in upstream or downstream riffles. Also, if the existing slope is concentrated within the project reach, then future projects in adjacent reaches may be limited by not having available slope. We evaluated upstream and downstream availability of slope using habitat maps prepared in 2001 at low spawning flows (250 cfs), and level surveys of several riffles in this reach conducted in 1998. Our assessment shows that there is adequate slope in both upstream and downstream reaches such that using the slope locally at Bobcat Flat will not limit future channel rehabilitation projects.

After reviewing coarse sediment source alternatives and consulting with FOT, a recommendation was made to obtain coarse sediment supply by excavating the right bank floodplain. Since then, five staff plates were placed at various open water locations around the floodplain to monitor groundwater elevations and eleven sediment test pits were dug. The portion above the sand coarse sediment division (Figure 4) was sieved to determine quality and quantity of coarse sediment available at the site. Calculations determined that enough spawning gravel would be available after excavating a right bank floodplain and scour channel (Table 2, Appendix A: Sheet 3). This course sediment mix will be sufficient to provide spawning habitat for both Chinook salmon and steelhead trout. Any coarse sediment not used during the project will be stored on-site, off the designated floodway.

Table 2. Recommended coarse sediment composition for spawning habitat.

Percent of Total Composition	*Particle Size Range (mm)*	*Particle Size Range (inches)*
15%	8 to 12.5 mm	1/4 ” to 1/2”
30%	12.5 to 25 mm	1/2” to 1”
35%	25 to 50 mm	1” to 2”
20%	50 to 130 mm	2” to 5”

5 FINAL DESIGN

Coarse Sediment Source: The river mile 43 coarse sediment introduction sources will be obtained by lowering the right (north) bank surface to create a functional floodplain and high flow channel, which will generate a gross volume of approximately 39,500 yd^3 of coarse sediment (Appendix A: Sheet 3 and Table 3). The unprocessed coarse sediment will be sieved and washed to remove everything greater than 128 mm and less than 8 mm. There are four parts to the design and each part and their purpose is described below.

Table 3. Estimated coarse sediment volumes for the three source areas in the project reach.

Coarse sediment source	*Estimated unprocessed coarse sediment volume*	*Estimated coarse sediment between 8 and 128 mm*	*Estimated coarse sediment greater than 128 mm*	*Estimated coarse sediment less than 8 mm*
Floodplain and high flow channel	39,500 yd^3	31,600 yd^3	5,900 yd^3	2,000 yd^3

Floodplain and High Flow Channel: The primary source for coarse sediment will be generated by lowering an 8.8 acre surface, that was previously scraped of its dredge tailings, on average 2.5 ft deep, starting upstream of Riffle 20 and extending approximately 400 ft downstream of Riffle 21 (Appendix A: Sheets 3 through 5). In the conceptual design the floodplain surface was designed to inundate at flows greater than 5,400 cfs. This was based on an analysis done using representative cross sections along the river and choosing the best available data (Table 4). However, once the surface was developed in AutoCAD and compared to the ground water observations recorded during the spring 2004 release (Figure 5-7), it was found that flows of 3,000 cfs may start to inundate the floodplain. Also, the ground water analysis also found a sharp break in groundwater slope at floodplain station 9+50. With this information, we designed the floodplain to follow the groundwater table slope (Appendix A: Sheet 4).

Once the floodplain is built, a high flow channel will be constructed with a top width of approximately 35 ft, depth of 1.5 ft, and slide slope of 2:1 (Appendix A: Sheets 3 through 5). The scour channel starts 100 ft downstream from the upstream-most extent of constructed floodplain and according to groundwater observations, will capture groundwater and begin to flow prior to being completely inundated when the floodplain threshold is met (Figures 5 – 7).

Construction of the floodplain and high flow channel will provide approximately 39,500 yd^3 of unprocessed coarse sediment. This coarse sediment volume will be sieved and washed to remove material finer than 8 mm and coarser than 128 mm, resulting in approximately 31,600 yd^3 of coarse sediment ranging from 8 mm to 128 mm, 2,000 yd^3 of coarse sediment less than 8 mm, and 5,900 yd^3 of coarse sediment greater than 128 mm (Table 3).

Due to the relative proximity of the groundwater and fine sediment to the constructed floodplain surface, the material less than 8 mm does not need to be distributed on the floodplain to provide a better planting medium.

Table 4. Representative cross sections providing difference between low water surface elevation and 5,400 cfs water surface elevation.

Location and site type (cross section, long profile, etc…)	Water surface elevation for Q = 550 cfs (ft)*	Water surface elevation for Q = 5,400 cfs (ft)*	Change in water surface elevation between 550 cfs and 5,400 cfs (ft)	Channel width at 550 cfs (ft)	Channel width at 5,400 cfs (ft)	Qualifying remarks / disqualifying remarks
MJ Ruddy long profile (RM 34.6 to 35.7)	97.76	101.57	3.81	N/A	N/A	Averaging pools and riffles does not reflect the entrance conditions at Bobcat Flat, but may be close as it does provide average over a length of channel.
MJ Ruddy cross section at point A	92.81	97.85	5.04	N/A	N/A	M. J. Ruddy haul road bridge causes confinement at 5,400 cfs resulting in an artificially high water surface.
MJ Ruddy cross section at point B	100.88	104.57	3.69	N/A	N/A	Pre-construction pool tail that best represents the entrance conditions for the floodplain surface at Bobcat Flat. Cross section at this location is not available
Cross section at RM 48.4	160.85	164.36	3.51	148	570	These three cross sections are within Riffle 4B with the cross section at RM 48.6 being at the top of the riffle/pool tail and of these three cross sections best represents the entrance conditions for the floodplain surface at Bobcat Flat.
Cross section at RM 48.5	156.85	160.69	3.84	160	510	
Cross section at RM 48.6	162.47	165.60	3.13	179	528	
Cross section at RM 49.9	169.11	173.35	4.24	162	411	Cross section at New La Grange Bridge, confinement at bridge causes backwater effect at 5,400 cfs
Cross section at RM 50.5	170.00	174.46	4.47	170	268	Cross section at Old Lag Grange Bridge, confinement at bridge causes backwater effect at 5,400 cfs. Channel confined, not a representative cross section for Bobcat Flat
USGS Gage at La Grange	5.11	11.52	6.41	N/A	N/A	Gage is located in canyon downstream of La Grange Dam - Channel confined by bedrock, not a representative cross section for Bobcat Flat
Bobcat Flat 40 ft upstream of cross section 2413+50 at riffle control	131.6	N/A	N/A	188	N/A	
Bobcat Flat cross section 2397+50	127.5	N/A	N/A	110	N/A	
Average of Best Estimates (highlighted in grey)			**3.54**			

Coarse Sediment Stockpile and Processing Area: Approximately 39,500 yd^3 of unprocessed coarse sediment will need to be stored until processing and the coarse sediment augmentation phase can be implemented. Two areas totaling 1.8 acres have been identified as possible storage areas (Appendix A: Sheet 3). These two sites combined can store 39,500 yd^3 if piled approximately 13 ft high.

Coarse Sediment Augmentation: The design for the coarse sediment augmentation phase includes placement of approximately 12,000 yd^3 with a contingency of 1,800 yd^3 of coarse sediment in six discrete patches within the project reach (Table 5). Actual implementation volumes will depend on the costs and available funds. Different coarse sediment placement methods were developed and presented in the Tuolumne River Coarse Sediment Management Plan, and include high flow recruitment pile, riffle supplementation, and channel contouring to mimic alluvial features. The design for the RM 43 project contains examples of each of these coarse sediment placement methods, as well as those used by Mesick (2003) on the Stanislaus River. These volumes summarized in Table 5 are based on the best available topographic information.

Table 5. Estimated coarse sediment volumes for six introduction locations in the project reach.

Coarse sediment Patch	*Estimated coarse sediment volume*
Pool tail at stn. 21+00	400 yd^3
Point bar at stn. 19+00	800 yd^3
Pool tail / riffle sequence at stn. 15+00	1,000 yd^3
Pool tail / riffle sequence at stn. 10+50	1,500 yd^3
Point bar at stn. 3+00	5,000 yd^3
Pool tail at stn. 1+00	3,300 yd^3
TOTAL	**12,000 yd^3**

Pool Tail at Station 21+00: The pool-tail upstream of Riffle 20 currently provides only a narrow strip of spawning habitat. The area surrounding this habitat is highly embedded, with depths and velocities, and substrate unsuitable for spawning. The pool-tail can be supplemented with coarse sediment to increase the usable spawning area. Coarse sediment should be added to preserve the riffle crest elevation, and gradually slope down into the upstream pool. Water depths should be maintained between 1-3 ft above the introduced coarse sediment. The estimated coarse sediment volume needed = 400 yd^3

Point Bar at Station 19+00: Coarse sediment will be placed along the right bank as a point bar to allow future coarse sediment recruitment during high flows. Coarse sediment can be placed with average depth of 2-3 ft to supplement the existing coarse subtle point bar. The bar should be constructed to grade into the existing channelbed and maintain the existing spawning habitat that extends longitudinally along the right bank. The margin of the coarse sediment bar may provide additional spawning and rearing habitat. Estimated coarse sediment volume needed = 800 yd^3.

Pool Tail / Riffle Sequence at Station 15+00: This area was originally intended to enhance Riffle 20 by extending the riffle downstream, but after further consideration and a field visit with Carl Mesick and Steve Walser, Patch-3 has been moved slightly downstream of Riffle 20

(Appendix A: Sheet 3). The design for the new riffle will be similar to the approach used by Carl Mesick on several Stanislaus River coarse sediment introduction projects intended to benefit multiple salmonid species and life-stages. Given the overall slope, one dune (pool tail, and short riffle) with an overall length of 150 to 200 ft was recommended during our field review. The riffle crest will be built to an elevation that will cause a small amount of water to back into the riffle just upstream, which will slow velocities, and should provide better rearing and holding habitat. This dune will extend from left to right bank. The estimated coarse sediment volume needed = 1,000 yd^3.

Pool Tail / Riffle Sequence at Station 10+50: This coarse sediment placement volume will significantly increase spawning habitat availability. The existing channel at this location offers limited spawning habitat availability, but excellent potential for increasing suitable habitat by adding coarse sediment and reducing the slope. The overall elevation change of 0.6 ft over the 800 ft reach can be redistributed by constructing two 200 ft long pool tail / riffle sequences with slope of approximately 0.0013 (Appendix A: Sheet 3 and 4). Coarse sediment placement at this riffle will also evaluate the design and construction of the "dune" micro-topography constructed within spawning riffles. In contrast to recent coarse sediment introductions at Riffles A7, 1A, and 1B that constructed relatively flat spawning coarse sediment beds, this riffle will be constructed in the form of a succession of dunes with morphology similar to a pool-tail, with a gently upward-sloping channel bed, cresting, and then falling rapidly into a short pool. The riffle crest should ideally create accelerated water velocities and surface turbulence that is intended to provide pockets of eddy water, cover, and feeding stations for adult salmonids.

The design should be implemented by placing the bulk of the coarse sediment into the channel as a flat, gently-sloped feature (Appendix A: Sheet 4), then contouring the dune features with a front-end loader after the entire volume has been placed. The design should also integrate existing high quality holding and rearing habitat along the banks into the design. Stanislaus River "dunes" had an overall coarse sediment dune length of 50-80 ft and intermediary trough (pool) with length of 60-100 ft. Given the overall slope space, we propose lengths of 40 ft and 60 ft for the dune and trough, respectively. Riffle crest depths should approach 1.0 ft minimum depth and the trough should range up to 4-5 ft deep. Any remaining coarse sediment at this site can be placed at the downstream end of the reconstructed riffle along the left bank as a coarse sediment bar. The estimated coarse sediment volume needed = 1,500 yd^3.

Point Bar at Station 3+00: This area along the right bank is potentially the largest coarse sediment placement volume and is suitable for constructing a point bar (Appendix A: Sheet 3). Coarse sediment will be placed with average depth of approximately 6 ft. The constructed point bar will provide better cannel confinement, provide rearing and additional spawning habitat, as well as reduce existing salmonid predator habitat. The point bar will be constructed approximately 2 ft above the low flow water surface along the north bank and daylight into the existing channelbed approximately half way across the existing channel. Estimated coarse sediment volume needed = 5,000 yd^3. Cobbles greater than 128 mm generated from the screening process can be used as the foundation for this point bar construction.

Pool Tail at Station 1+00: The design for the new riffle will be similar to the approach used in Patch-3. We propose one dune (pool tail and riffle) with an overall length of 100 to 150 ft. The riffle crest will be built to an elevation that will not exceed 126.0 ft in elevation and will backwater into Riffle 21. This will slow velocities, and should provide better rearing and holding habitat. This patch will begin at the downstream end of the new point bar and extend across the channel. The estimated coarse sediment volume needed = 3,300 yd^3. Cobbles greater than 128 mm generated from the screening process can be used as the foundation for this construction.

6 REVEGETATION PLANTING DESCRIPTION AND PLANT LIST

Planting plans at Bobcat Flat calls for slightly over 2,000 plants. Of the total plants, approximately 1,000 will be trees, 300 will be shrubs, and the remaining 700 will be herbaceous. The revegetation will be implemented as part of the larger Bobcat Flat floodplain restoration project overseen by Friends of the Tuolumne, but the revegetation planting description is included here to show compliance with Reclamation Board permit requirements on planting layouts. The trees will be planted to conform to Reclamation Board spacing requirements. Trees will be aligned with the direction of possible flood flowage in rows spaced 20 feet apart and planted approximately 15 feet on center (Appendix A: Sheet 6). Plants will be placed in areas where conditions are appropriate for the species and in groupings to form plant communities. No planting will be done in the high flow scour channel or on its slopes such that overall flood conveyance should be improved. Herbaceous plants will be in isolated patches as well as interspersed among the tree planting rows.

Plant list

Trees:	Approximate Number
Arroyo Willow (Salix lasiolepis)	100
Goodings willow (Salix gooddingii var. variabilis)	100
Button Willow (Cephalanthus occidentalis var. californicus)	10
Fremont Cottonwood (Populus Fremontii)	200
Oregon Ash (Fraxinus latifolia)	10
Red Willow (Salix laevigata)	100
Valley Oak (Quercus lombata)	400
White Alder (Alnus oregano)	10
Yellow Tree Willow (Salix lasiandra)	100
California Black Walnut (Juglans hindsii)	10
Shrubs:	
Bush Lupin (Lupinus latifolius)	50
Cascara (Rhamnus purshiana)	50
Coffee Berry (Rhamnus californica)	50
Coyote Bush (Baccharis pilularis)	50
Mule Fat (Baccharis viminea)	50
California Wild Rose (Rosa californica)	50
Herbaceous:	
Gum Weed (Grindelia camporum)	300
Milkweed (Asclepias fascicularis)	100
Mugwort (Artemesia douglasiana)	300
California Nettle (Urtica californica)	50

7 COST ESTIMATES

Phase-I: Construct floodplain, high flow channel. Total estimated material to be moved and stockpiled is 39,500 yd^3. Cost for earthwork is \$5.10 yd^3 for a total of \$201,000 (Table 6).

Phase-II: Sieve necessary material to achieve 12,000 yd^3 of coarse sediment at an estimated cost of \$6.50 yd^3 for a total of \$98,000 (Table 6).

Phase-III: Distribute approximately 1,300 yd^3 of fine sediment (< 8 mm) over the terrace (Appendix A: Sheets 3 and 5) to a depth of 1.0 to 1.25 ft. Cost for earthwork is included in Phase III (Table 6).

Phase-IV: Construct temporary access, in-channel point bars, riffles, and pool tails. Estimated coarse sediment (8 mm to 128 mm) need for construction, 12,000 yd^3. Cost for earthwork is \$12.90 per cubic yard for a total of \$155,000 (Table 6).

Phase-V: Stockpile remaining coarse sediment (8 mm to 128 mm) in identified areas (areas must be off designated floodway) for future coarse sediment augmentation projects.

Phase-VI: Revegetation of floodplain with native woody riparian vegetation as described in Section 6. Cost estimate has not been completed.

The cost estimates for earthwork is based on a bid by Esquivel Grading and Paving, Inc. There is \$220,000 available in the TID-DWR contract for construction, with a \$27,000 contingency. CALFED funding provided to Friends of the Tuolumne will implement all of Phase I and Phase VI, and a small portion of Phase II. The TID-DWR budget of \$220,000 budget (plus contingency as available) will be used for implementing Phase IV, and a majority of Phase II.

Table 6. Estimated cost for each phase of construction.

Phase	*Description*	*Estimated earthwork volume (yd^3)*	*Estimated unit cost*	*Total*
I	Construct floodplain, high water scour channel, and low water side channel	39,500	\$5.10/ yd^3	\$201,000[1]
II	Sieve stockpiled coarse sediment to achieve 12,000 yd^3 of material	15,000	\$6.50/ yd^3	\$92,000[2] \$6,000[1]
III	Distribute fine sediment over terrace	1,300	Cost included in Phase I	
IV	Construct temporary access roads, point bars, riffles, and pool tails.	12,000	\$12.90/ yd^3	\$155,000[2]
V	Stockpiling of remaining coarse sediment	24,500	Cost included in Phase I	
VI	Revegetation of constructed floodplain	N/A	To be determined	To be determined[1]
			TOTAL	**\$454,000**

[1]Approximate cost covered by CALFED funding provided to Friends of the Tuolumne.
[2]Approximate cost covered by DWR funding provided to Turlock Irrigation District.
Notes: Volume estimates assume no expansion or contraction, and are based on the best existing topography available and 3-dimensional designs. Total cost rounded to nearest \$1,000.

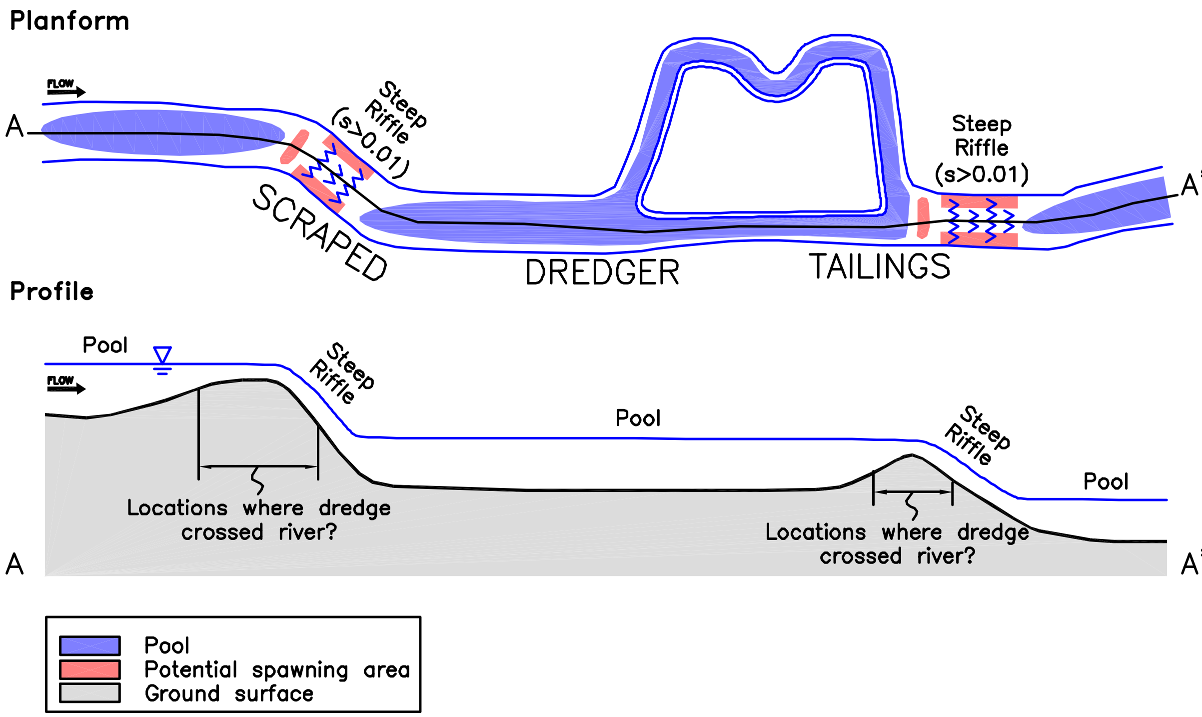


Figure 1. Post dredger mining planform and longitudinal profile showing the impacts of mining on the channel.

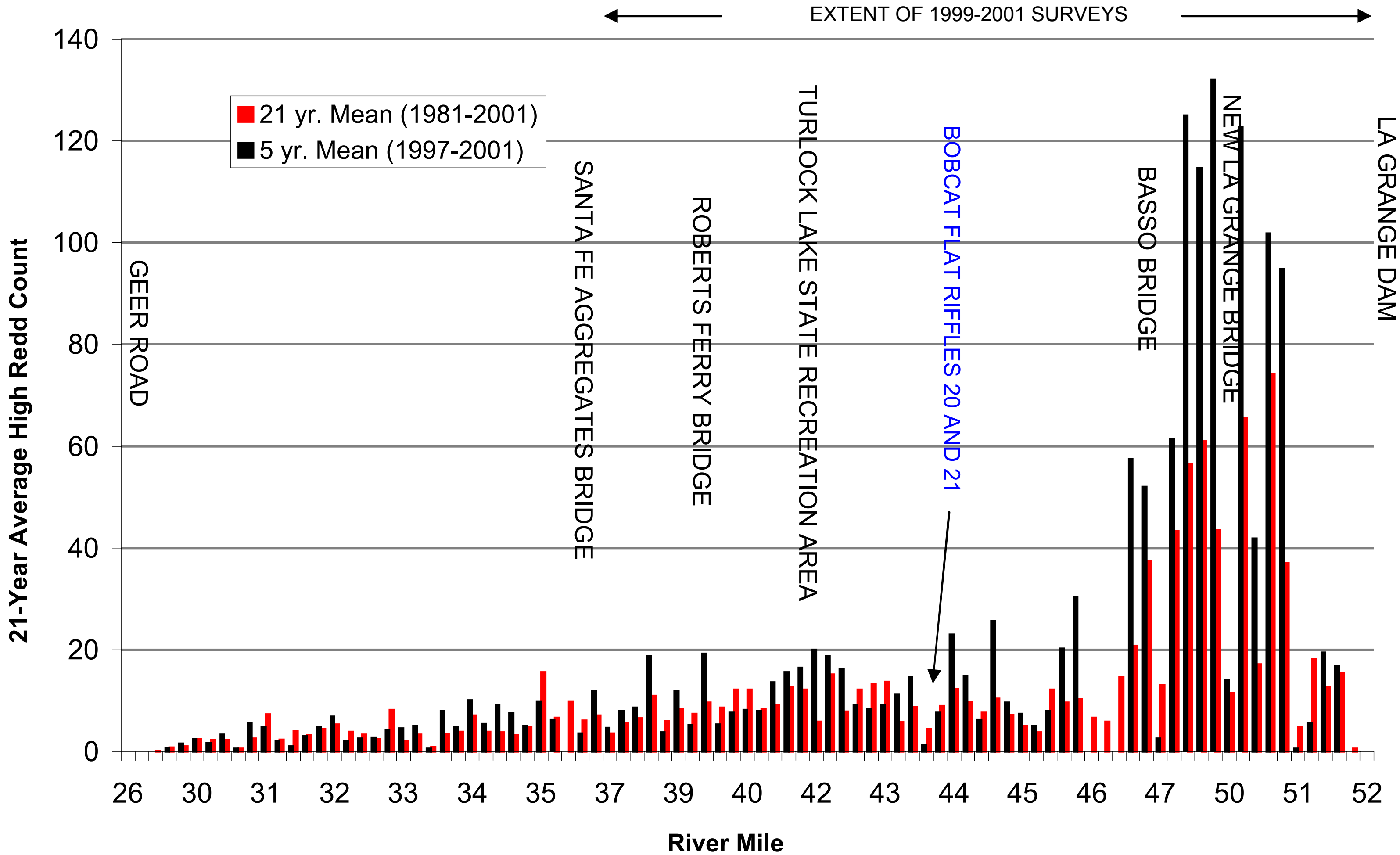


Figure 2. Distribution of fall-run Chinook spawning along the entire spawning reaches, as indicated by the CDFG annual "high redd count data", which is the annual maximum number of redds counted at each riffle during weekly carcass surveys.

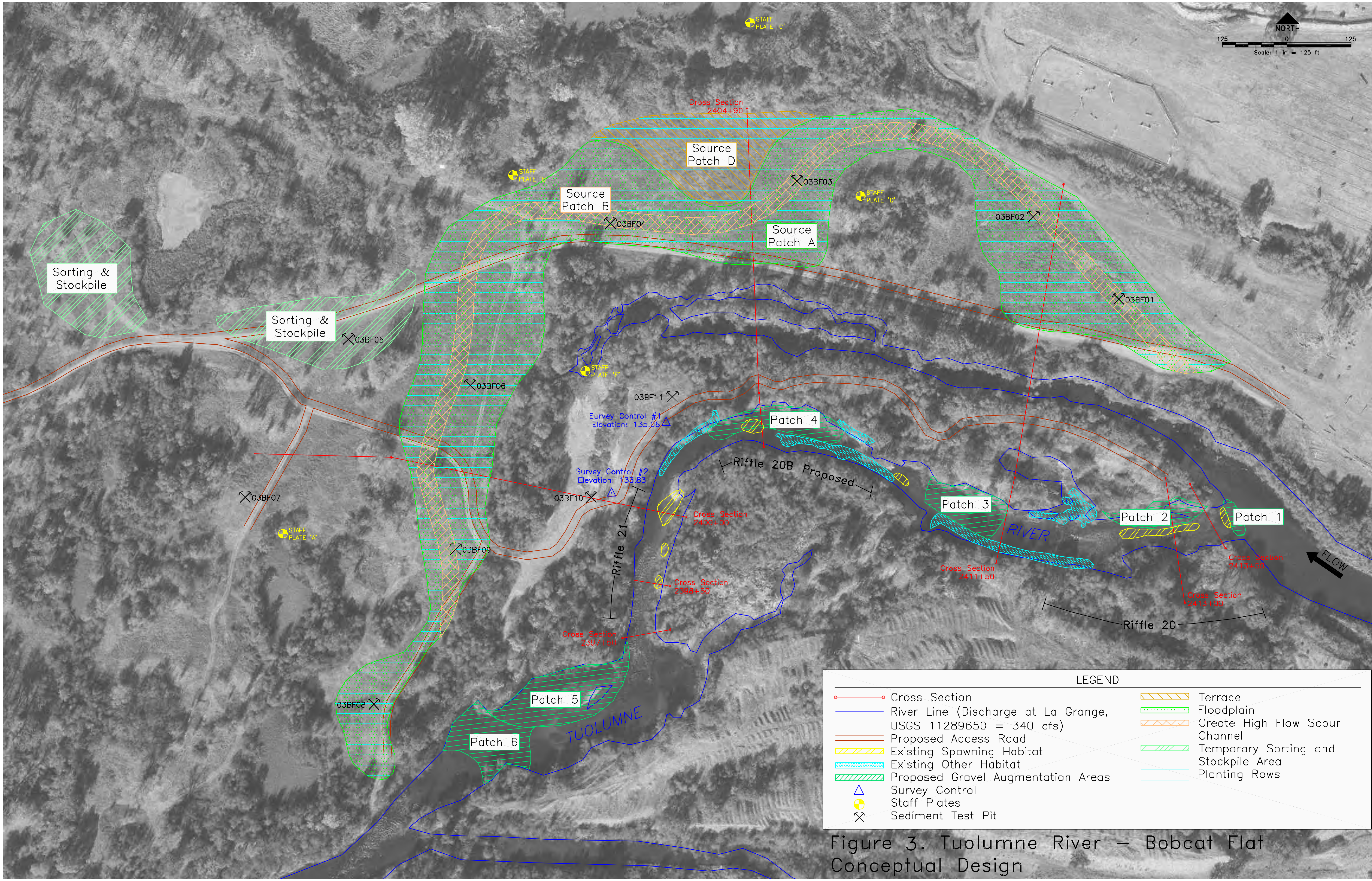


Figure 3. Tuolumne River – Bobcat Flat Conceptual Design

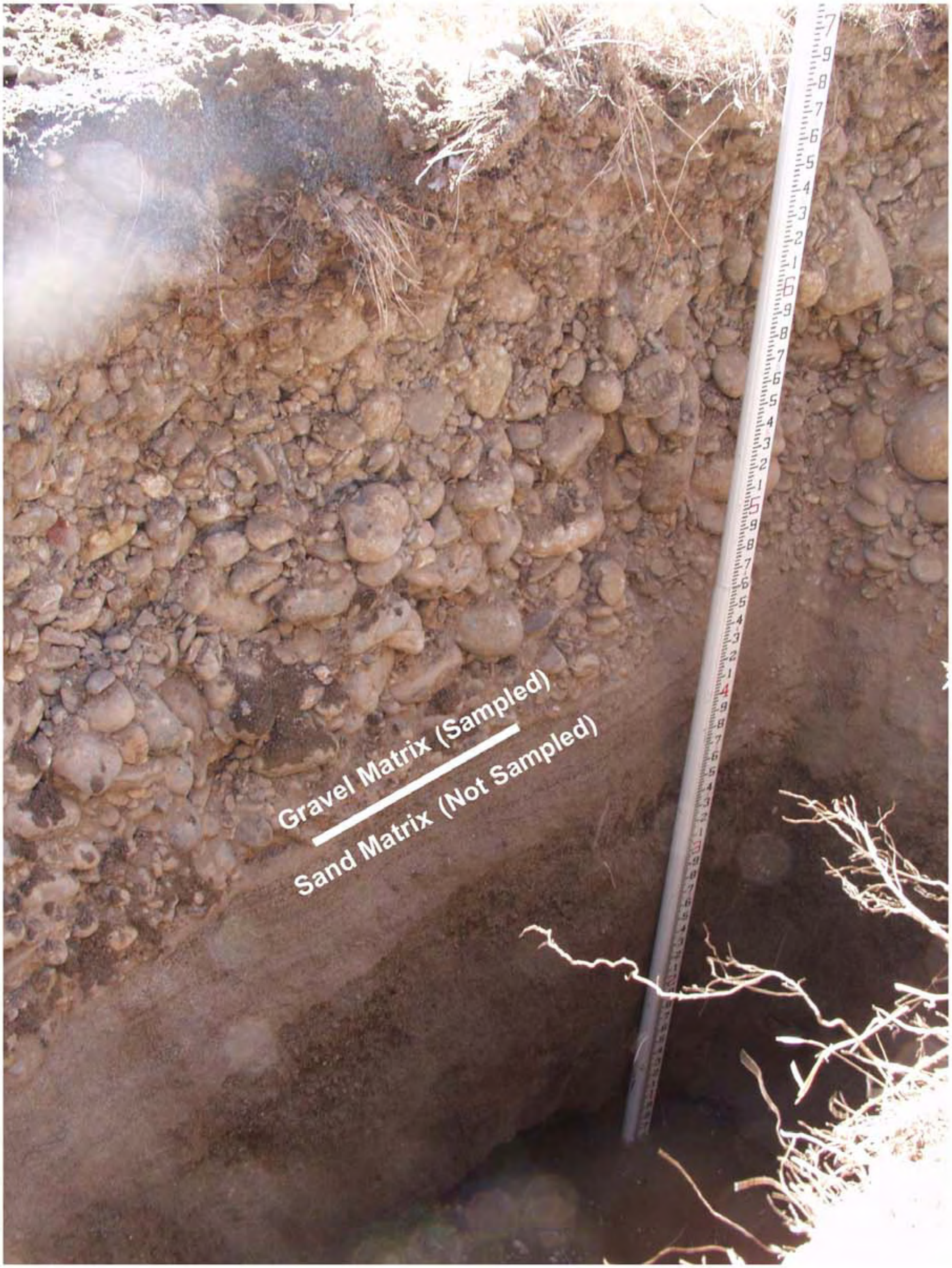


Figure 4. Bobcat Flat sediment test pit showing gravel / sand matrix separation. Only the coarse sediment portion will be removed for processing and coarse sediment introduction.

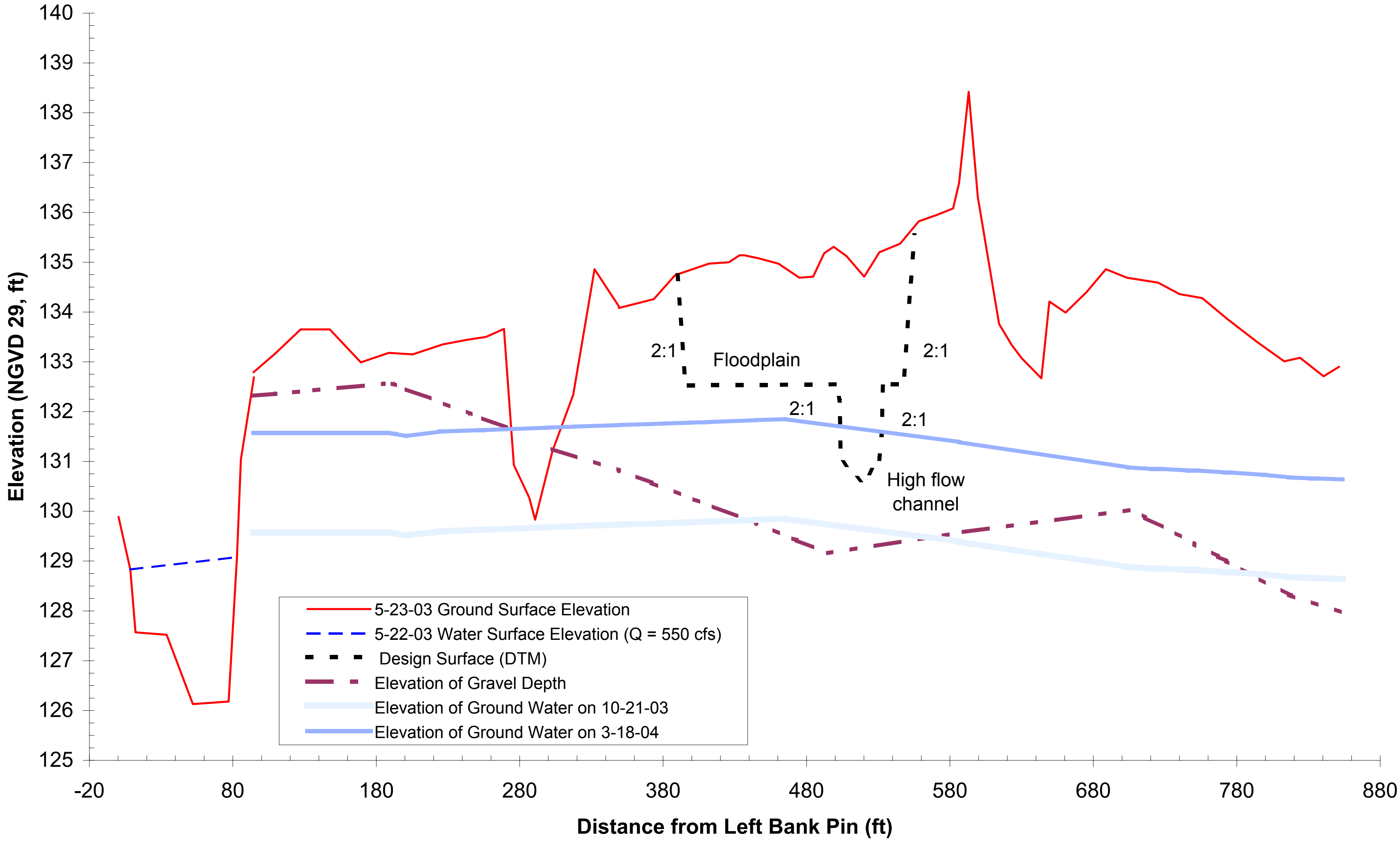


Figure 5. Bobcat Flat (RM 43) cross section 2400+00 showing constructed floodplain, high flow channel.

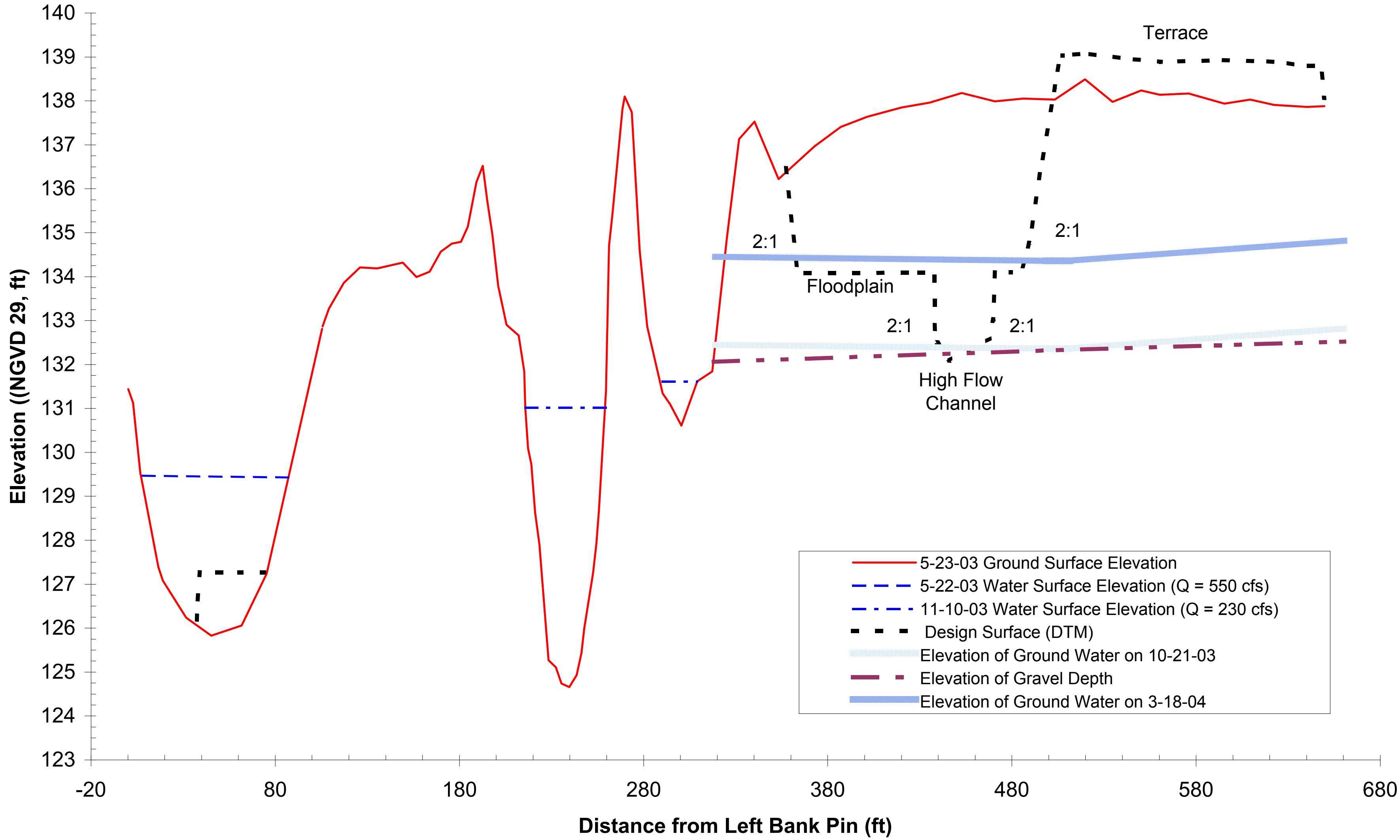


Figure 6. Bobcat Flat (RM 43) cross section 2404+90 showing constructed floodplain, high flow scour channel, and terrace.

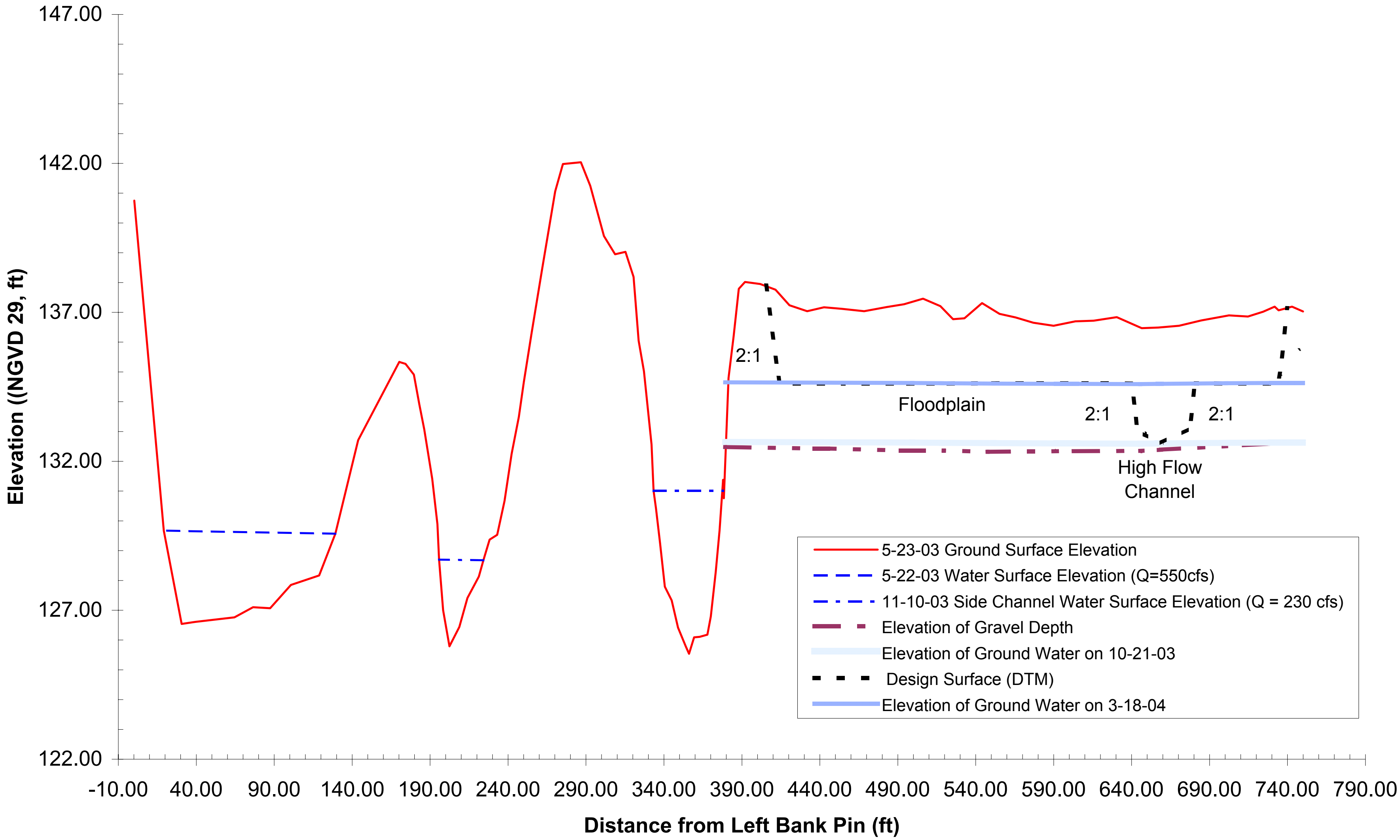
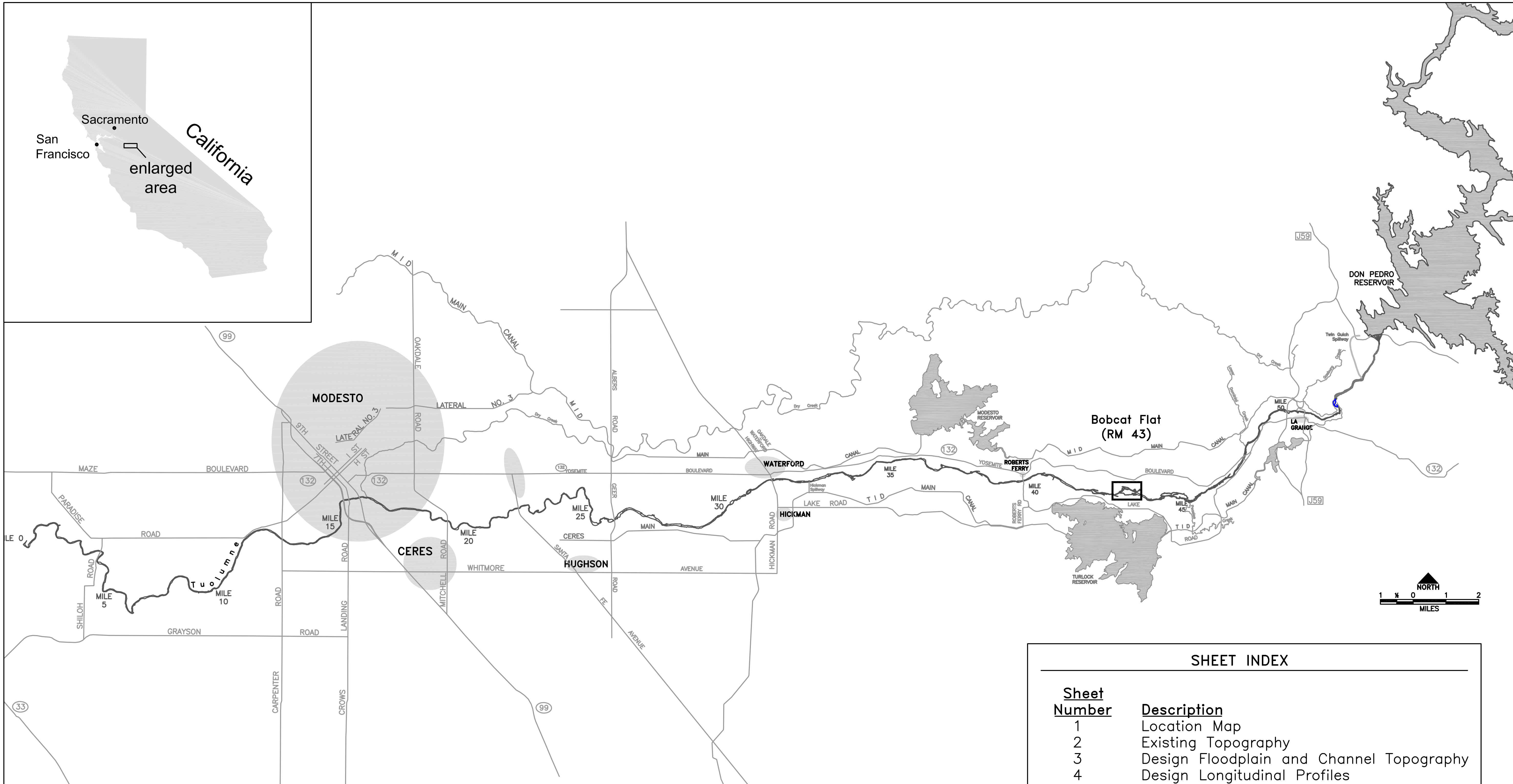


Figure 7. Bobcat Flat (RM 43) Cross Section 2411+50 showing constructed floodplain, high flow channel.



SHEET INDEX

Sheet Number	Description
1	Location Map
2	Existing Topography
3	Design Floodplain and Channel Topography
4	Design Longitudinal Profiles
5	Design Cross Sections
6	Floodplain Revegetation Area

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HYDROLOGY
STREAM RESTORATION
FLUVIAL GEOMORPHOLOGY
P.O. BOX 663, ARCATA, CALIFORNIA 95518

TUOLUMNE RIVER
Bobcat Flat (RM 43)
Location Map

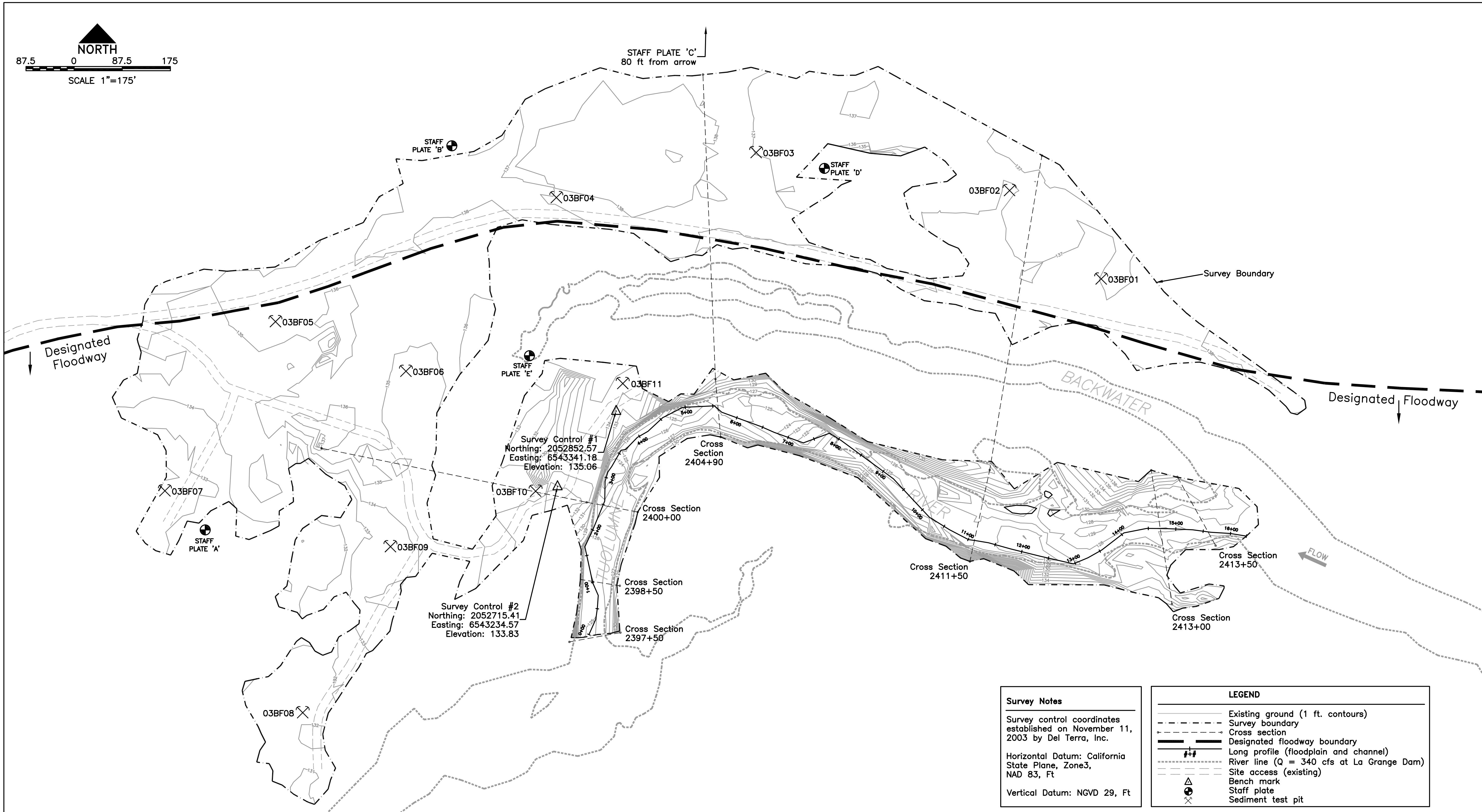
PREPARED FOR:

TURLOCK IRRIGATION DISTRICT
P.O. Box 949
Turlock, CA 95381

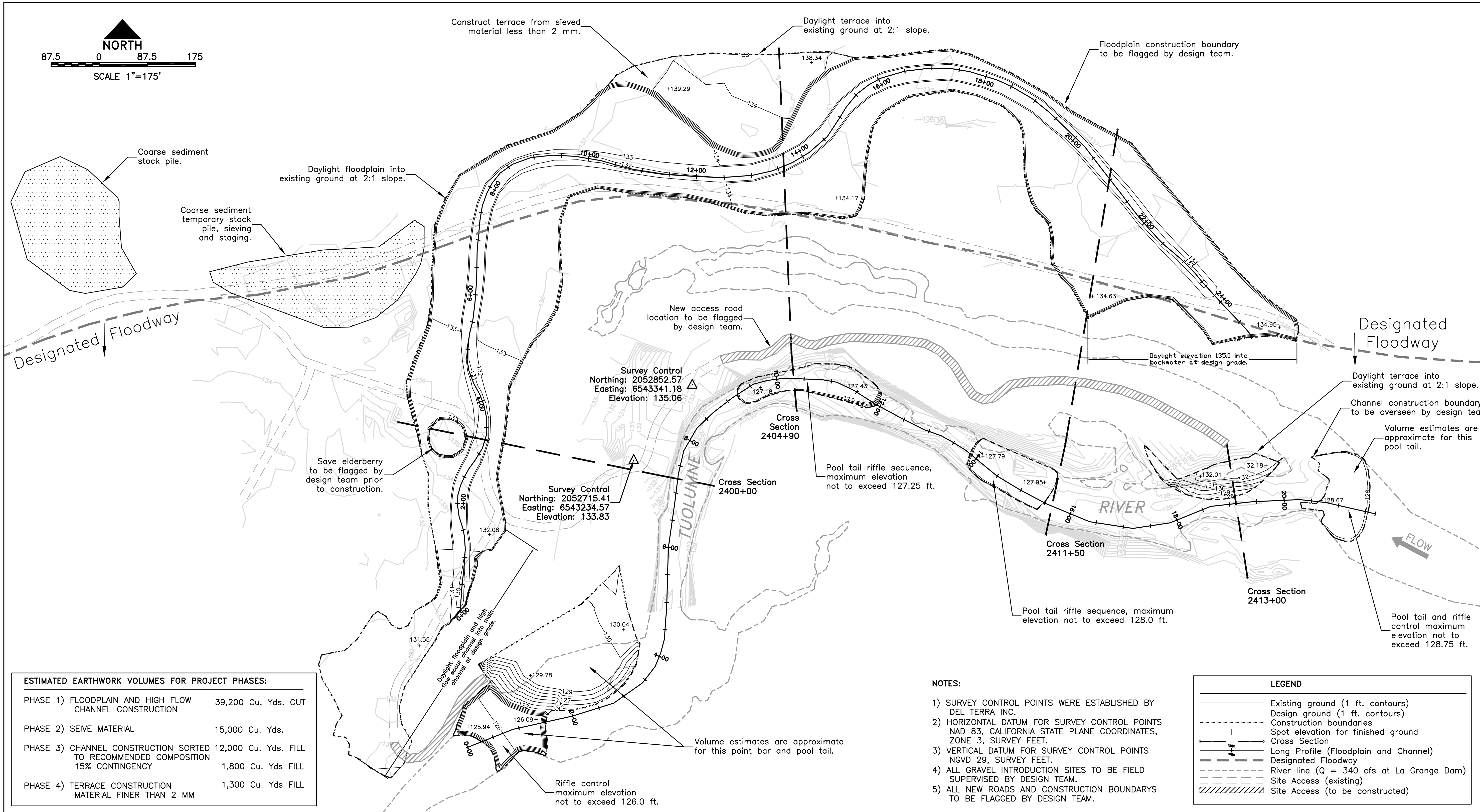
DRAWN BY	FM
CHECKED BY	SM
DATE	July 23, 2004
Location Map.dwg	
REVISION	A

SHEET NUMBER

1 OF 6



McBain & Trush — FISHERIES, HYDROLOGY, STREAM RESTORATION, FLUVIAL GEOMORPHOLOGY P.O. BOX 663, ARCATA, CALIFORNIA 95518	TUOLUMNE RIVER Bobcat Flat (RM 43) Existing Topography	PREPARED FOR: TURLOCK IRRIGATION DISTRICT P. O. Box 949 Turlock, CA 95381	DRAWN BY: FM CHECKED BY: SM DATE: July 23, 2004 BF Exist Gnd.dwg REVISION: A	SHEET NUMBER 2 OF 6



ESTIMATED EARTHWORK VOLUMES FOR PROJECT PHASES:

PHASE 1) FLOODPLAIN AND HIGH FLOW CHANNEL CONSTRUCTION	39,200 Cu. Yds. CUT
PHASE 2) SEIVE MATERIAL	15,000 Cu. Yds.
PHASE 3) CHANNEL CONSTRUCTION SORTED TO RECOMMENDED COMPOSITION	12,000 Cu. Yds. FILL
15% CONTINGENCY	1,800 Cu. Yds FILL
PHASE 4) TERRACE CONSTRUCTION MATERIAL FINER THAN 2 MM	1,300 Cu. Yds FILL

NOTES:

1) SURVEY CONTROL POINTS WERE ESTABLISHED BY DEL TERRA INC.
2) HORIZONTAL DATUM FOR SURVEY CONTROL POINTS NAD 83, CALIFORNIA STATE PLANE COORDINATES, ZONE 3, SURVEY FEET.
3) VERTICAL DATUM FOR SURVEY CONTROL POINTS NGVD 29, SURVEY FEET.
4) ALL GRAVEL INTRODUCTION SITES TO BE FIELD SUPERVISED BY DESIGN TEAM.
5) ALL NEW ROADS AND CONSTRUCTION BOUNDARYS TO BE FLAGGED BY DESIGN TEAM.

LEGEND

- Existing ground (1 ft. contours)
- Design ground (1 ft. contours)
- Construction boundaries
- Spot elevation for finished ground
- Cross Section
- Long Profile (Floodplain and Channel)
- Designated Floodway
- River line (Q = 340 cfs at La Grange Dam)
- Site Access (existing)
- Site Access (to be constructed)

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P.O. BOX 663, ARCATA, CALIFORNIA 95518

TUOLUMNE RIVER
Bobcat Flat (RM 43) Design
Floodplain & Channel Topography

PREPARED FOR:

TURLOCK IRRIGATION DISTRICT
P. O. Box 949
Turlock, CA 95381

DRAWN BY	FM
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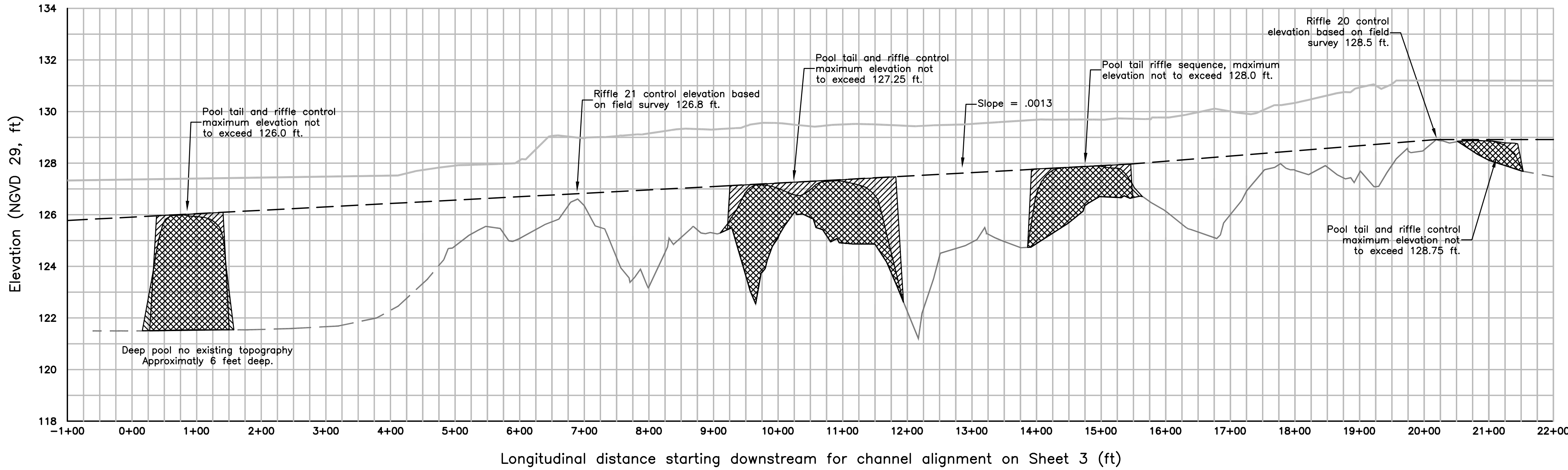
DATE	Jan 6, 2005
Final DesignV4.dwg	
REVISION	B

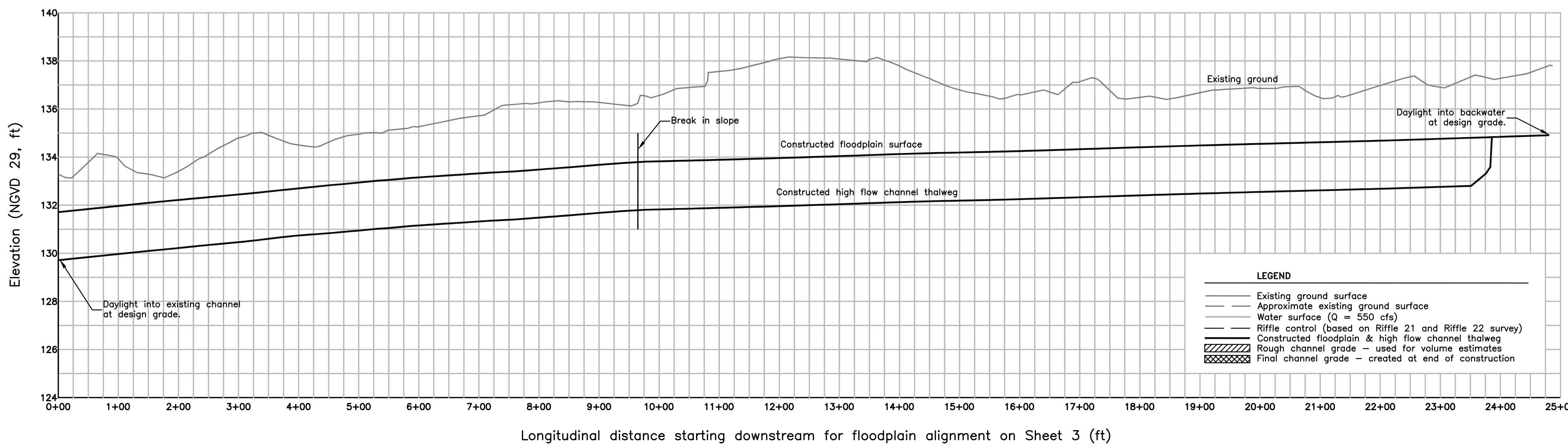
SHEET NUMBER

3 OF 6

Existing channel thalweg and design channel thalweg for Bobcat Flat (RM 43) gravel introduction design



Existing ground, design floodplain, and high flow channel thalweg for Bobcat Flat (RM 43) floodplain design



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TUOLUMNE RIVER
Bobcat Flat (RM 43)
Design Longitudinal Profiles

PREPARED FOR:

TURLOCK IRRIGATION DISTRICT
P. O. Box 949
Turlock, CA 95381

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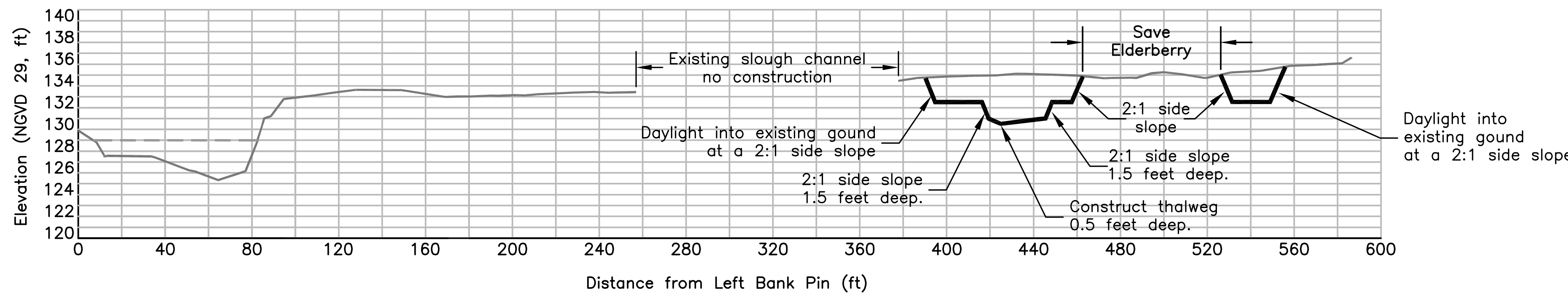
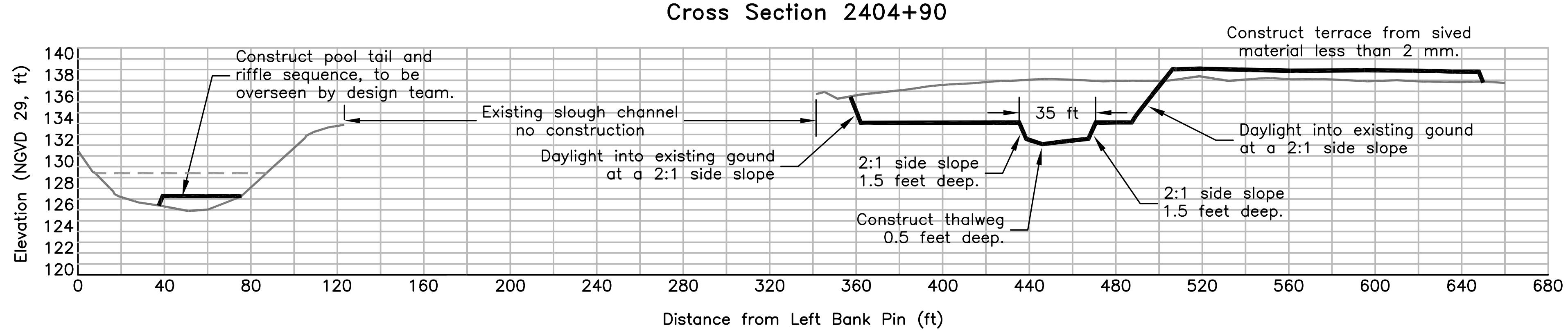
Cross Section 2400+00



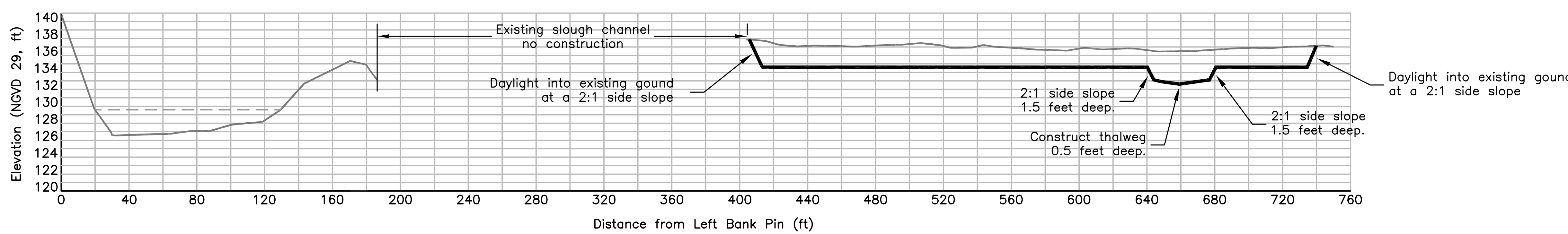
Cross Section 2413+00

Cross Section 2404+90



LEGEND	
———	Existing ground surface
– – – –	Water surface (Q = 550 cfs)
━━━	Constructed surface

Cross Section 2411+50



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TUOLUMNE RIVER
Bobcat Flat (RM 43)
Design Cross Sections

PREPARED FOR:

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DATE	Jan 6, 2005
Final DesignV4.dwg	
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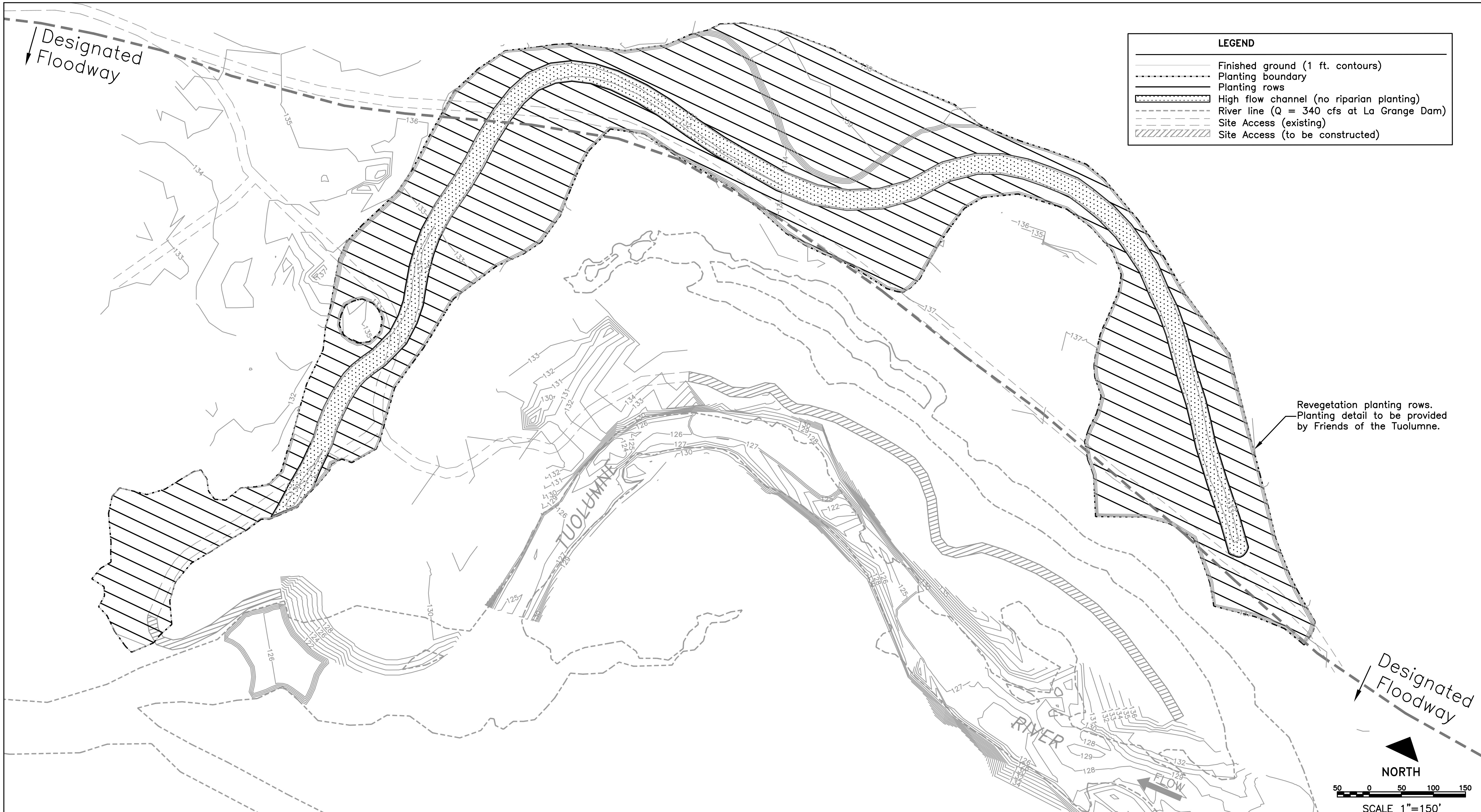
SHEET NUMBER



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FLUVIAL GEOMORPHOLOGY
P.O. BOX 663, ARCATA, CALIFORNIA 95518

TUOLUMNE RIVER
Bobcat Flat (RM 43)
Floodplain Revegetation Area

PREPARED FOR:

TURLOCK IRRIGATION DISTRICT
P. O. Box 949
Turlock, CA 95381

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Final DesignV4.dwg	
REVISION	B

SHEET NUMBER

6 OF 6

Appendix B

Bobcat Flat RM43 Phase I
Monitoring Plan.

McBain & Trush
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RIPARIAN ECOLOGY
STREAM RESTORATION
FLUVIAL GEOMORPHOLOGY
P.O. Box 663, Arcata, CA 95518 • 824 L Street, Studio 5, Arcata, CA 95521
Phone: (707)826-7794 • Fax: (707)826-7795

November 16, 2004

Brief Monitoring Plan for Bobcat Flat RM 43 Sediment Transfusion Project

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The Bobcat Flat RM 43 Sediment Transfusion Project proposes to place up to 15,000 yd^3 of coarse sediment in the channel to replenish alluvial features (bars, riffles) and to resupply spawning gravel for Chinook salmon and *O. mykiss*. The Project is located within the Dredger Tailing Reach of the lower Tuolumne River (Figure 1). The design and implementation of this project is described in detail in *Bobcat Flat RM 43 Coarse Sediment Introduction Design Document–Technical Memorandum*, dated July 23, 2004 (McBain and Trush 2004), and the conceptual design features are shown in Figure 2. The project is funded by the Department of Water Resources "Delta Fish Protection Agreement" (formerly 4-Pumps Agreement), and administered by the Turlock Irrigation District. The surrounding 300 acre Bobcat Flat property is owned by Friends of the Tuolumne (FOT). The specific objectives of the project are:

- Add up to 15,000 yd^3 of coarse sediment at several locations within the 2,200 ft project reach, to reduce riffle slope and the particle size distribution within spawning riffles to increase the quantity and quality of a variety of habitats for salmonids;
- Implement different methods of coarse sediment placement (point bars, pool tails, dunes) to evaluate the relative use of salmonid spawning, rearing, and holding habitats created by the project;
- Demonstrate the feasibility, benefits, and potential cost-savings of producing the coarse sediment material on-site by excavating, screening, and washing coarse sediment material either from existing floodplain surfaces or from on-site dredger tailings, then introducing this screened coarse sediment into the river.

This brief technical memorandum describes monitoring measures being proposed to evaluate **pre-project baseline conditions**. Subsequent proposals will seek funding to conduct post-project monitoring to evaluate the project's performance The Coarse Sediment Management Plan for the Lower Tuolumne River (CSMP) developed quantitative objectives and monitoring hypotheses to be implemented river-wide in association with coarse sediment transfusion projects. This monitoring plan proposed for RM 43 tiers off the CSMP and recommends implementing several of these monitoring hypotheses, including:

(1) Increasing sediment supply (in conjunction with periodic high flows) will increase salmonid spawning habitat availability in the gravel-bedded zone to habitat quantities approaching the density in the reach between New La Grange Bridge and Basso Bridge (approximately 30 ft^2 per linear foot of channel).

(2) Chinook salmon and *O. mykiss* will utilize introduced coarse sediment immediately following insertion (i.e., in the first spawning season following insertion) and will continue to use inserted and mobilized coarse sediment in the years following insertion.

(3) Coarse sediment added to the channel conforming to the particle size range considered suitable for salmonid spawning gravel (approximately 13–150 mm), but without fine

sediment (sand and silt smaller than 2 mm), will increase intragravel flow of water in redds (from CMC 2001).

(4) Increasing spawning habitat availability in the gravel-bedded zone will increase the average high redd count in proportion to the annual escapement level (i.e., will allow broader distribution of spawning and reduce redd superimposition, assuming other habitat suitability requirements are similar).

Proposed monitoring methods

To test the above hypotheses, the proposed monitoring program will include the following tasks:

Task 1. Develop a monitoring plan, coordinate field tasks, and prepare a technical memorandum presenting results of the pre-project baseline monitoring. The monitoring plan will be circulated to the TRTAC Monitoring Subcommittee for review.

Task 2. Conduct detailed surveys of pre-project channel and floodplain topography with a total station, develop a digital terrain model (DTM) of existing topography with accuracy to 1 ft contour intervals, and establish seven cross sections traversing the channel and floodplains, with rebar pins to monument cross section endpoints. Real coordinates have been established at the project site, using Horizontal Datum: California State Plane, Zone 3, NAD 83, US Foot. Vertical Datum: NGVD 29, US Foot. This task was largely completed during the conceptual design phase of the project. Additional cross sections may be established during or after project implementation as needed.

Task 3. Prepare a planform map showing particle facies (patches of the riverbed with relatively homogenous particle size distribution), and collect pebble counts and bulk sediment samples within selected representative facies to quantify the sediment composition. This task will establish baseline physical conditions within the reach to allow modeling of sediment mobility thresholds and sediment transport rates, as well as describe the quality of salmonid spawning gravels.

Task 4. Collect permeability measurements within salmonid spawning gravels to document the quality of Chinook and *O. mykiss* spawning and incubation habitat. Permeability data will be analyzed along with sediment composition data from Task 3 to assess the quality of salmonid spawning gravels. This task will test Hypothesis–3 above.

Task 5. Prepare a planform map showing existing Chinook spawning and rearing habitats, and *O. mykiss* adult holding, spawning, and rearing habitats using aerial photographs from November 2000 and habitat criteria (depth, velocity, substrate, cover) developed for the Gravel Mining Reach projects. Mapping of Chinook salmon habitat will be conducted by the Districts' consultants; mapping of *O. mykiss* habitat will be conducted by the landowners, Friends of the Tuolumne. This task will test Hypothesis–1 above. The targeted Chinook spawning habitat area predicted for this 2,200 ft reach is approximately 66,000 ft^2. This target may require several high flow events to mobilize and redistribute coarse sediment to rebuild natural channel and spawning habitat features.

Task 6. Prepare planform maps showing Chinook and *O. mykiss* spawning redds distributed spatially within the project reach and temporally throughout the spawning season. Synoptic depth and velocity measurements will be collected at representative redds. Redds will be mapped in enough detail to evaluate superimposition throughout the spawning season. This task will test Hypothesis–2 above. Data will be evaluated in conjunction with the CDFG annual redd count and escapement data to adjust for year-to-year variations in escapement. As with Task 5 habitat mapping, the Chinook salmon redd mapping will be conducted by the Districts' consultants; *O. mykiss* redd mapping will be conducted by the landowners, Friends of the Tuolumne.

In addition to these tasks, the project design phase included excavation of 11 test pits across 8.8 acres of floodplain to estimate sediment composition, installation of staff plates to monitor groundwater elevations, and mapping of existing vegetation within the project boundary to designate "save" areas to be protected during excavation and on-site processing of coarse sediment. Additional recommended monitoring tasks not proposed here include monitoring survival of riparian vegetation planted on floodplains, and seasonal fluctuations in groundwater elevations.

Deliverables. The monitoring plan will be circulated to the TRTAC Monitoring Subcommittee for review. The pre-project monitoring technical memorandum will report the data and results of the baseline monitoring and will be completed by June 2005 with the assumption that the project will be implemented in summer 2005. Post project monitoring will be implemented beginning in summer and fall of 2005 (assuming funding is available).

The total budget for the pre-implementation monitoring tasks is $20,000 (not including tasks 2 and 5 which were completed during the conceptual design phase). Table 1 shows the budget for each monitoring task.

Table 1. Budget for pre-project monitoring tasks.

Task 1	**Monitoring Plan, Project Management, Final Report**	**$5,685**
Task 2	**Topographic and Cross Section Surveys** [COMPLETED DURING DESIGN PHASE]	**$0**
Task 3	**Facies Map, Pebble Counts, Bulk Samples**	**$5,640**
Task 4	**Permeability Measurements**	**$1,270**
Task 5	**Salmonid Habitat Maps** [COMPLETED DURING DESIGN PHASE]	**$0**
Task 6	**Chinook Salmon Redd Mapping**	**$7,405**
	TOTAL BUDGET	**$20,000**

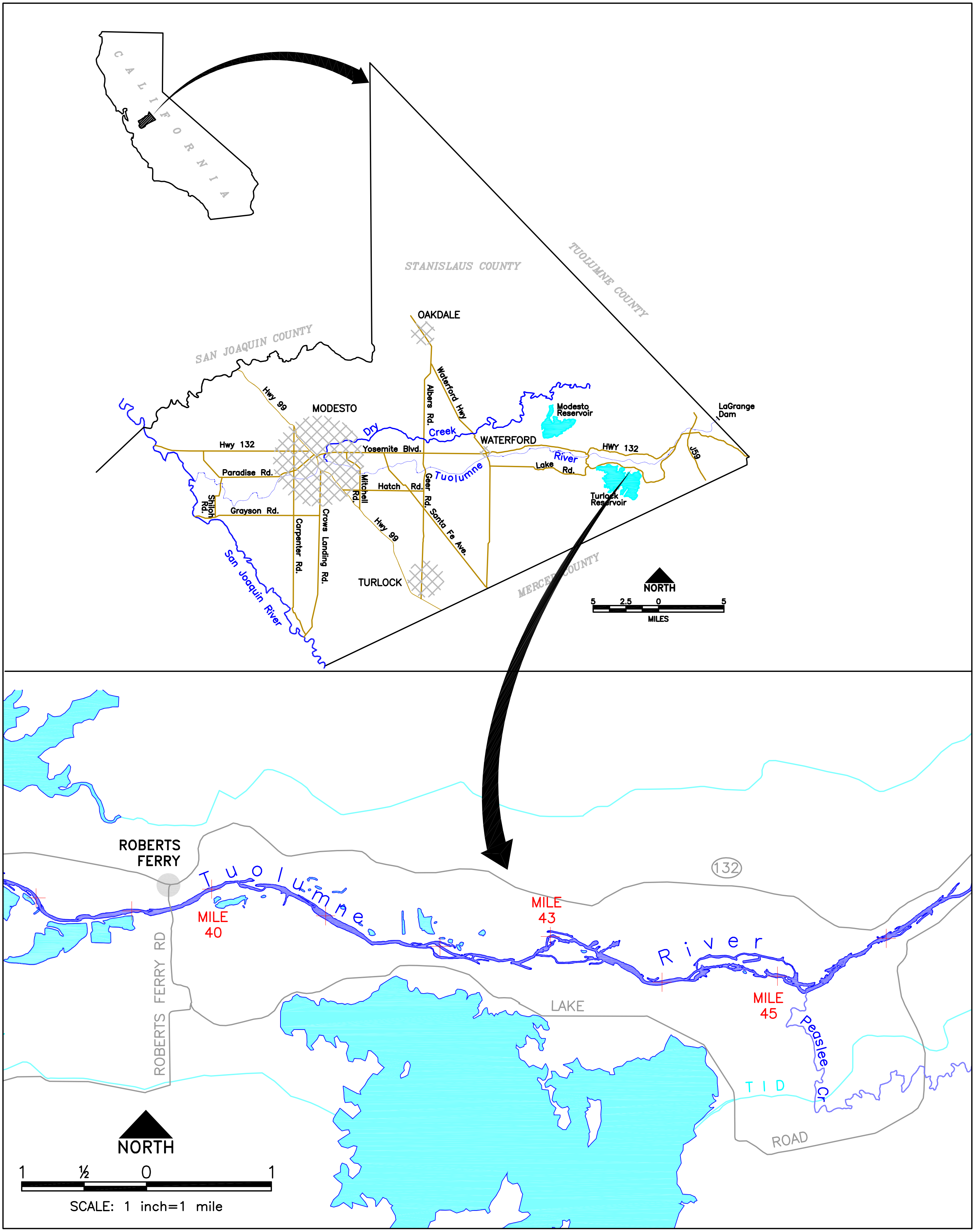


Figure 1. Location of the Bobcat Flat RM 43 Channel Restoration Project

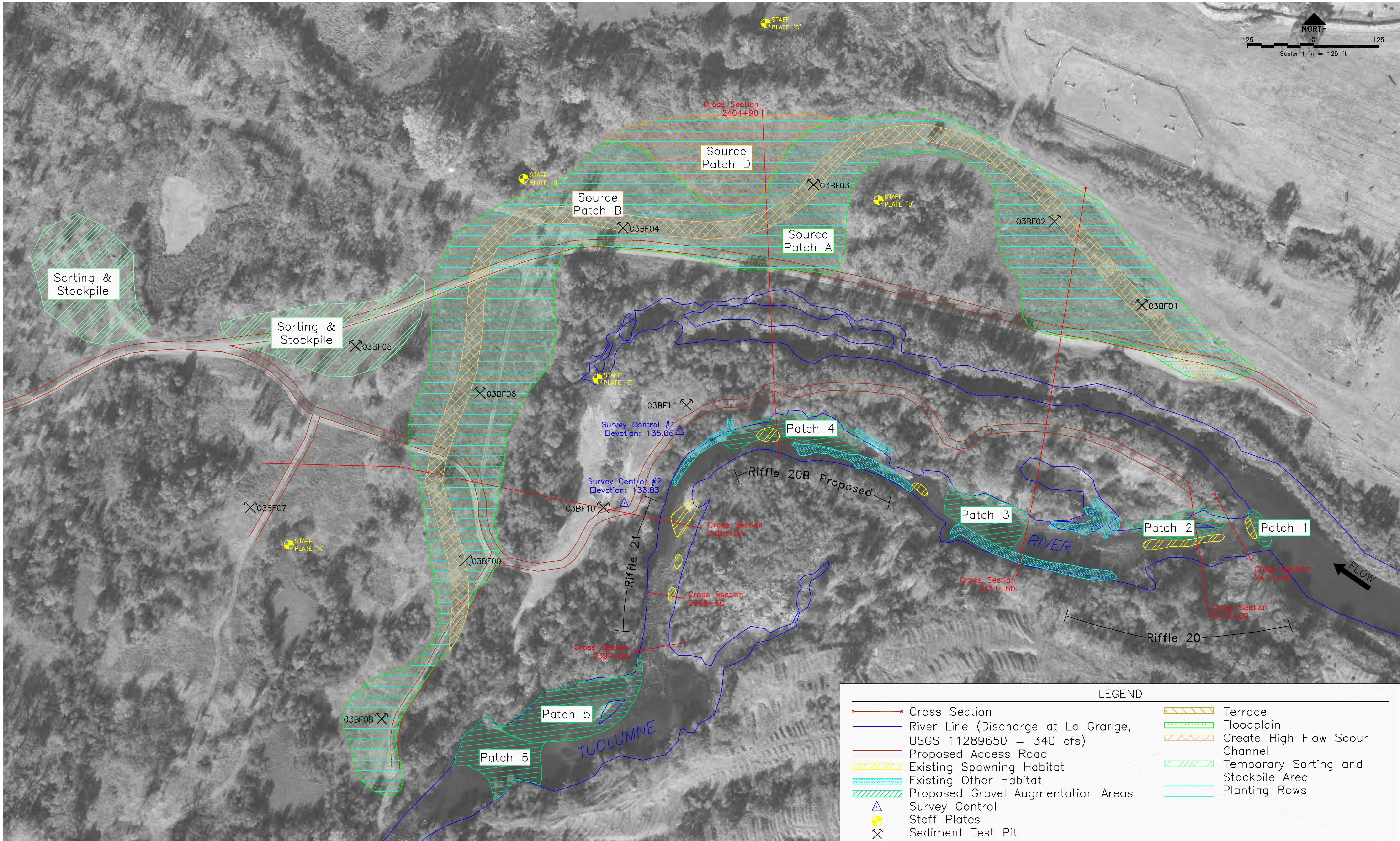


Figure 3. Tuolumne River – Bobcat Flat Conceptual Design

Appendix C

Post-Construction Completed Data Sheets.

CHINOOK SALMON REDD MAPPING DATA SHEET
CONTROL PIN SUMMARY (ESTAB NOV 2004)
[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

pg 1 of ____

Stream: Tuolumne **Reach:** Bobcat Flat (RM 43)

*LB = river left; RB = river right

PIN ID	STA (ft)	BANK*	TYPE		DESCRIPTION
			rebar	nail	
21+25	21+25	LB	X		Elevation of R.B. too low for pin so set on LB. Just up from small island & backwater
18+75	18+75	LB	X		Elev. of R.B. too low for pin so set on LB. Across from island.
2400+00	10+75	RB	X		Cross section marker just above head of riffle & d/s of raft access.
8+75	8+75	RB	X		Could not locate X-sect indicated on map so set pin. PIN SET IN CLEARING ON STEEP BANK
1+50	1+50	RB	X		TO RIGHT SIDE OF BOAT LAUNCH WHEN LOOKING AT RIVER, 5 FT. FROM RIVER CHANNEL @ LOW FLOW, NEXT TO NON-PERMANENT FIRE PIT
2+25	2+25	RB	X		SMALL TRAIL UPSTREAM OF BOAT LAUNCH, JUST TO THE RIGHT OF THE TRAIL WHEN LOOKING AT THE RIVER.
23+50	23+50	LB	X		ELEVATION OF R.B. TOO LOW FOR PIN SET PIN-SET ON L.B. JUST AS RIVER BENDS AROUND A CORNER.
18+25	18+25	LB		X	SET NAIL IN LARGE STURDY OAK TREE ON LEFT BANK
6+00	6+00	LB	X		REBAR SET NEXT TO ALDER TREE ABOUT 10 FT. FROM RIVER CHANNEL.
5+25	5+25	LB	X		REBAR SET BETWEEN TWO SMALL ALDER TREES.
20+50	20+50	LB	X		REBAR SET IN SMALL CLEARING OF OVERHANGING TREES ABOUT 3 FT. FROM RIVER CHANNEL.

CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 11-16-2004

Weather: CLR/OVC
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 1330

Start Water Temp (°C): 12.5

End Time: 1545

End Water Temp (°C): 12

Turbidity: 0.65 ✓

Visibility (ft): Good

Crew: A. Fuller, R. Cuthbert

Comments:

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*
1	20+50	A	21+25	134'4"	18+25	196'6"	/	/	/	/	/	N/A	NONE
1	10+75	A	2400+00	52'7"	8+75	202'9"	/	/	/	/	/	N/A	NONE

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne **Reach:** Bobcat Flat (RM 43)

Date: 11-16-2004

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			COMMENT
Week No.	STA (ft)	Alpha	
1	20+50	A	Digging activity but not completed redd. No fish present.
1	10+75	A	Digging activity, but not completed redd. A small fish was present earlier in the day, but absent during survey.

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 11-23-04

Weather: CLR
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 0930

Start Water Temp (°C): 7

End Time: 1200

End Water Temp (°C): 9

Turbidity: 0.72 ✓

Visibility (ft): GOOD

Crew: R. CUTHBERT, R. FULLER

Comments: PIN ID 23+00 IS THE LEFT BANK CROSS SECTION PIN LABELED (2413 +50) ON MAP. PIN ID 19+25 WAS ID'd WRONG ON WEEK 1 (PIN ID IS 18+75)

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*
2	23+25	B	23+50	49.0	23+00	55.0	7.8	5.1	SW 266°	2.7	1.5	2.0	LWD
2	20+50	A											
2	20+50	C	21+25	123.0	19+25	16ft +	11.1	6.5	SW 242°	1.4	2.4	NA	—
2	19+00	A	18+75	35.2	18+25	54.9	12.6	5.5	NW 273°	1.9	1.9	NA	—
2	19+00	B	18+75	42.4	18+25	63.6	14.7	5.3	NW 273°	1.7	1.5	NA	—
2	5+75	A	6+00	49.6	5+25	86.0	15.8	12.6	SW 242°	1.9	1.5	NA	—

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 11-23-04

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			COMMENT
Week No.	STA (ft)	Alpha	
2	20+50	A	SAME DIG AS LAST WEEK NO NEW ACTIVITY OVER IT. REDD APPEARS COMPLETED
2	20+50	C	ABOVE ALPHA A. LOOKS LIKE REDD CONSTRUCTION ACTIVITY OCCURRED, HOWEVER IT DOES NOT LOOK LIKE A COMPLETED REDD
2	19+00	A	APPEARS THAT REDD CONSTRUCTION ACTIVITY OCCURRED BUT WAS NOT COMPLETED
2	19+00	B	APPEARS THAT REDD CONSTRUCTION ACTIVITY OCCURRED BUT WAS NOT COMPLETED
2	5+75	A	DOES NOT APPEAR TO BE ANY COMPLETED REDDS. THE "STA" HAS LOTS OF CLEANED GRAVEL AND A FEMALE (APPEARS "SPAWNED") SWIMMING AROUND ~~THE~~ CLEANED GRAVEL
			TOOK DIMENSIONS OF WHOLE "CLEANED GRAVEL" AREA

CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 12-6-04

Weather: CLR
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 0930

Start Water Temp (°C): 8

End Time: 1100

End Water Temp (°C): 8

Turbidity: 3.4

Visibility (ft): GOOD

Crew: R. CUTHBERT, R. FULLER

Comments: OBSERVED 1 FEMALE (APPEARED TO HAVE SPAWNED) AND 1 MALE SWIMMING THROUGH RIFFLE R21.

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*
3	23+25	B	–	–	–	–	–	–	–	–	–	–	–
3	20+50	A	–	–	–	–	–	–	–	–	–	–	–
3	20+50	C	–	–	–	–	–	–	–	–	–	–	–
3	19+00	A	–	–	–	–	–	–	–	–	–	–	–
3	19+00	B	–	–	–	–	–	–	–	–	–	–	–
3	5+75	A	–	–	–	–	–	–	–	–	–	–	–
3	10+75	A	–	–	–	–	–	–	–	–	–	–	–

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne **Reach:** Bobcat Flat (RM 43)

Date: 12-6-04

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			COMMENT
Week No.	STA (ft)	Alpha	
3	23+25	B	SAME DIG SITE AS PREVIOUS WEEK, NO NEW DIGGING ACTIVITY, REDD APPEARS TO NOW BE COMPLETE
3	20+50	A	SAME DIG SITE AS PREVIOUS WEEKS, NO NEW DIGGING ACTIVITY
3	20+50	C	SAME DIG SITE AS PREVIOUS WEEKS, NO NEW DIGGING ACTIVITY
3	19+00	A	SAME DIG SITE AS PREVIOUS WEEK, NO NEW DIGGING ACTIVITY
3	19+00	B	SAME DIG SITE AS PREVIOUS WEEK, NO NEW CONSTRUCTION
3	5+75	A	SAME DIG SITE AS PREVIOUS WEEK, NO NEW ACTIVITY
3	10+75	A	SAME DIG SITE AS WEEK 1, POSSIBLY NEW DIGGING ACTIVITY, REDD APPEARS TO BE CLOSE TO COMPLETION

CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 12-13-04

Weather: OVC
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 0945

Start Water Temp (°C): 9

End Time: 1130

End Water Temp (°C): 9

Turbidity: 0.88 NTU

Visibility (ft): GOOD

Crew: R. CUTHBERT, R. FULLER

Comments:

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*
4	21+00	A	21+25	62.0	20+50	74.6	6.0	4.9	SW 220	1.5	4.9	3	OHV

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne **Reach:** Bobcat Flat (RM 43)

Date: 12-13-04

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			COMMENT
Week No.	STA (ft)	Alpha	
4	21+00	A	APPEARS TO BE A COMPLETED REDD W/ TWO CHINOOK NEARBY. APPEARS TO BE 1 MALE + 1 FEMALE

CHINOOK SALMON REDD MAPPING DATA SHEET

[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 12-24-04

Weather: OVC
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 1100

Start Water Temp (°C): 10

End Time: 1200

End Water Temp (°C): 10

Turbidity: 3.72

Visibility (ft): GOOD

Crew: R. CUTHBERT, E. EAGLETON

Comments: NO SPAWNING ACTIVITY OBSERVED.

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*

CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations, control pins, and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 1-5-05

Weather: CLR
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 1115 - [illegible]

Start Water Temp (°C): 9

End Time: 1230

End Water Temp (°C): 9

Turbidity:

Visibility (ft): POOR

Crew: R. CUTHBERT, R. FULLER

Comments: Although visibility was poor identification of redds in the riffles would have been good (if a redd were present). No new activity.

*cover codes: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Pin 1		Pin 2		Redd Dimensions (ft)		Compass Berring	Flow at Head of Redd		Cover	
Week No.	STA (ft)	Alpha	ID	Dist. (ft)	ID	Dist (ft)	Length (ft)	Width (ft)	(degrees)	depth (ft)	velocity (ft/s)	Distance to (ft)	Type*

Appendix D

Post-Construction Completed Data Sheets
and Redd Locations Mapped onto November 17, 2005
Aerial Photographs.

2005 CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 10/29/05

Weather: clear
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 1:00

Start Water Temp (°C): 52

End Time: 5:30

End Water Temp (°C): 52

Turbidity: none

Visibility (ft): 10 feet +

Crew: Allison Boucher

Comments:

CODES:
Habitat: PT = Pool tail, RF = rifflle, LB = Lateral bar CR = Crest
Location: LB = left bank, RB = Right bank, CL = Center
Cover: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Location and Habitat				Cover		Observations		Comments
Redd ID	Week No.	Patch/ Riffle No.	River STA (ft)	Location Code	Habitat Code	Flow Depth (ft)	Distance from redd (ft)	Cover Code	Adults Observed? (Y/N)	Spawning Observed? (Y/N)	Add'l comment sheet attached? ____Yes __X__No
	1	R18							n	n	
	1	P1+2							n	n	small fish feeding bottom of P2
	1	P3							n	n	
	1	P4							n	n	small fish feeding river left at end
	1	R21							n	n	
	1	P5+6							n	n	
	1	R22							n	n	

2005 CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne
Date: 11/6/05
Start Time: 1400
End Time: 1700
Turbidity: None
Crew: Dave
Comments:

Reach: Bobcat Flat (RM 43)
Weather: OVC
(CLR-clear, OVC-overcast, RN-rain)
Start Water Temp (°C): 52 F
End Water Temp (°C): 52 F
Visibility (ft): 10 ft +

CODES:
Habitat: PT = Pool tail, RF = rifflle, LB = Lateral bar CR = crest
Location: LB = left bank, RB = Right bank, CL = Center
Cover: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Location and Habitat				Cover		Observations		Comments
Redd ID	Week No. 2	Patch/ Riffle No.	River STA (ft)	Location Code	Habitat Code	Flow Depth (ft)	Distance from redd (ft)	Cover Code	Adults Observed? (Y/N)	Spawning Observed? (Y/N)	Add'l comment sheet attached? ____Yes __X__No
	2	R18							N	N	
	2	Patch1							N	N	Rising small fish
	2	Patch2							N	N	" " "
	2	Patch3							N	N	" " "
	2	Patch4							N	N	" " "
	2	Patch5							N	N	" " "
	2	Patch6							N	N	
	2	R22							N	N	

2005 CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations and cover are mapped onto 1"=50' aerial photographs]

pg 1 of ______

Stream: Tuolumne
Reach: Bobcat Flat (RM 43)
Date: 11-18-05
Weather: C/R
(CLR-clear, OVC-overcast, RN-rain)
Start Time: 0815
Start Water Temp (°C): 50°F
End Time: 10 15
End Water Temp (°C): 50°F
Turbidity: clear - None
Visibility (ft): > 10 ft.
Crew: Dave
Comments: *2yr old @ Patch 6 probably a moving fish. It crossed over the crest while I was watching and finned on upstream.

CODES:
Habitat: PT = Pool tail, RF = riffle, LB = Lateral bar CR = Crest
Location: LB = left bank, RB = Right bank, CL = Center
Cover: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Location and Habitat				Cover		Observations		Comments
Redd ID	Week No.	Patch/ Riffle No.	River STA (ft)	Location Code	Habitat Code	Flow Depth (ft)	Distance from redd (ft)	Cover Code	Adults Observed? (Y/N)	Spawning Observed? (Y/N)	Add'l comment sheet attached? ____Yes __X__No
	3	R18							N	N	
	3	Patch 1							n	n	Rising small fish
	3	Patch 2							n	n	" " " Adults salmon holding in backwater?
1	3	Patch 3		LB	CR	1 ft.	5 ft.	Pool TRB	Y	Y	Redd building. No mate spotted. ♀ sores 2 yr old
	3	Patch 4							N	N	
	3	Patch 5							N	N	
	3	Patch 6							Y	N	Fresh bright fish 2 yr. old* Rising small fish
	3	R 22							N	N	
	3	R21							n	n	

2005 CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations and cover are mapped onto 1"=50' aerial photographs]

pg 1 of ______

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: 12/2/05

Weather: clear, soft wind
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 11:40

Start Water Temp (°C): 51 °F

End Time: 4:00

End Water Temp (°C): 51° F

Turbidity: none

Visibility (ft): 10' plus

Crew: Allison

Comments:

* lots of small fish feeding on a mayfly hatch; mayflies were large & straw colored

CODES:
Habitat: PT = Pool tail, RF = riffle, LB = Lateral bar
Location: LB = left bank, RB = Right bank, CL = Center
Cover: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Location and Habitat				Cover		Observations		Comments
Redd ID	Week No.	Patch/ Riffle No.	River STA (ft)	Location Code	Habitat Code	Flow Depth (ft)	Distance from redd (ft)	Cover Code	Adults Observed? (Y/N)	Spawning Observed? (Y/N)	Add'l comment sheet attached? ______Yes ______No
2	4	R18		LB	PT	1	5	TRB	1 2yr healthy F	y	cover was deep holding water immed downstream of redd
	4	P1							n	n	
	4	P2							n	n	large fish splash in down stream pool
	4	P3							n	n	*
	4	P4							n	n	*
	4	R21							1	n	downstream (dieing)
	4	P5							n	n	*
	4	P6							n	n	*
	4	R22							n	n	

2005 CHINOOK SALMON REDD MAPPING DATA SHEET
[redd locations and cover are mapped onto 1"=50' aerial photographs]

Stream: Tuolumne

Reach: Bobcat Flat (RM 43)

Date: December 17, 2005

Weather: OVC
(CLR-clear, OVC-overcast, RN-rain)

Start Time: 12 30 pm

Start Water Temp (°C): 49° F

End Time: 14 45 pm

End Water Temp (°C): 49°F

Turbidity: None

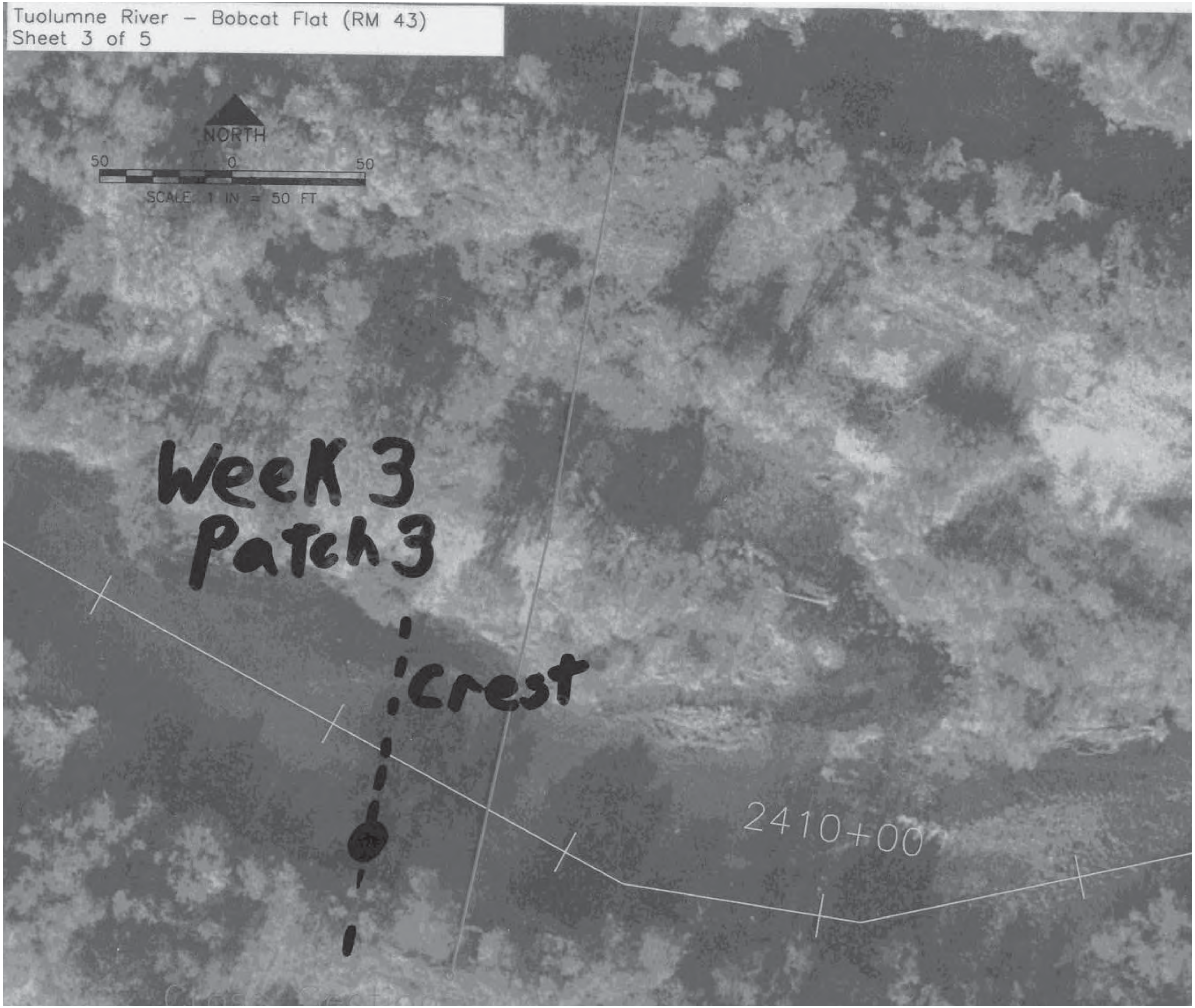
Visibility (ft): 10' plus

Crew: Dave

Comments: New Redd discovered in patch 6. Mayfly hatch @ patch 1 through R21 unbelievable! O mykiss ≈ 8 inch range feeding heavily on small duns (slate grey size 20) one fly every 6 to 12 inches matrix!

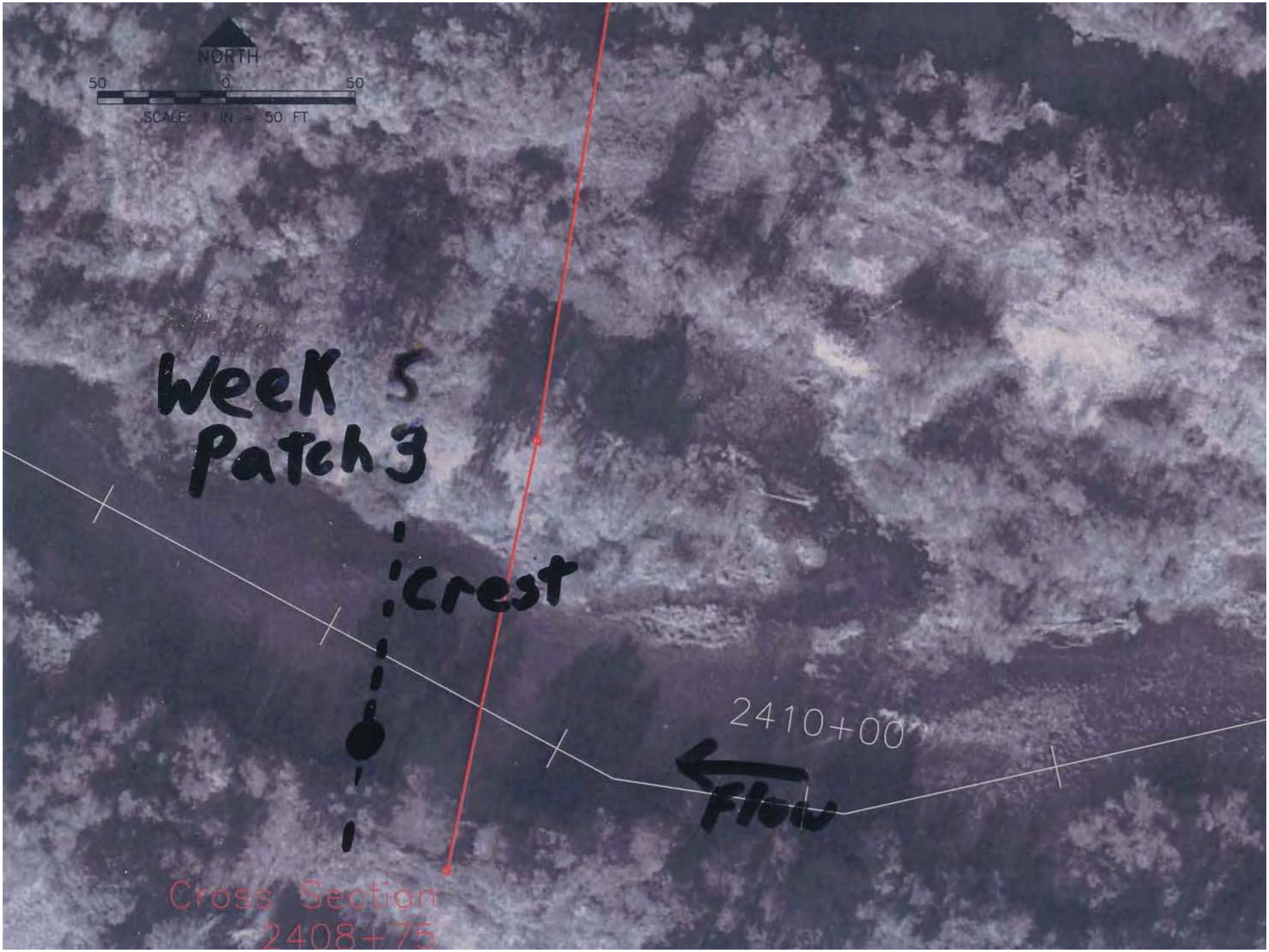
CODES:
Habitat: PT = Pool tail, RF = riffle, LB = Lateral bar
Location: LB = left bank, RB = Right bank, CL = Center
Cover: LWD - large woody debris; OHV - overhanging vegetation; SAV - submerged aquatic vegetation; BLD - boulder; TRB - turbulence; UCB - undercut bank: OTH - other

Redd ID			Location and Habitat				Cover		Observations		Comments
Redd ID	Week No. 5	Patch/ Riffle No.	River STA (ft)	Location Code	Habitat Code	Flow Depth (ft)	Distance from redd (ft)	Cover Code	Adults Observed? (Y/N)	Spawning Observed? (Y/N)	Add'l comment sheet attached? ____Yes ____No
2	5	R18		LB	PT	1	5	TRB	Y	N	
	5	Patch 1							N	N	
	5	Patch 2							N	N	
1	5	Patch 3		LB	CR	1	5	Pool TRB	N	N	DFG confirms Redd & adult sighting
	5	Patch 4							N	N	
	5	R21							N	N	
	5	Patch 5							N	N	
3	5	Patch 6		LB	CR	1.5	8	Pool TRB	N	N	New redd against bank. 4'x6' oblong @ crest
	5	R22									


Tuolumne River - Bobcat Flat (RM 43)
Sheet 3 of 5
NORTH
50
0
50
SCALE 1 IN = 50 FT
Week 3
Patch 3
crest
2410+00


Tuolumne River – Bobcat Flat (RM 43)
Sheet 5 of 5
NORTH
50 0 50
SCALE: 1 IN = 50 FT
Riffle 18
week 4
X crest

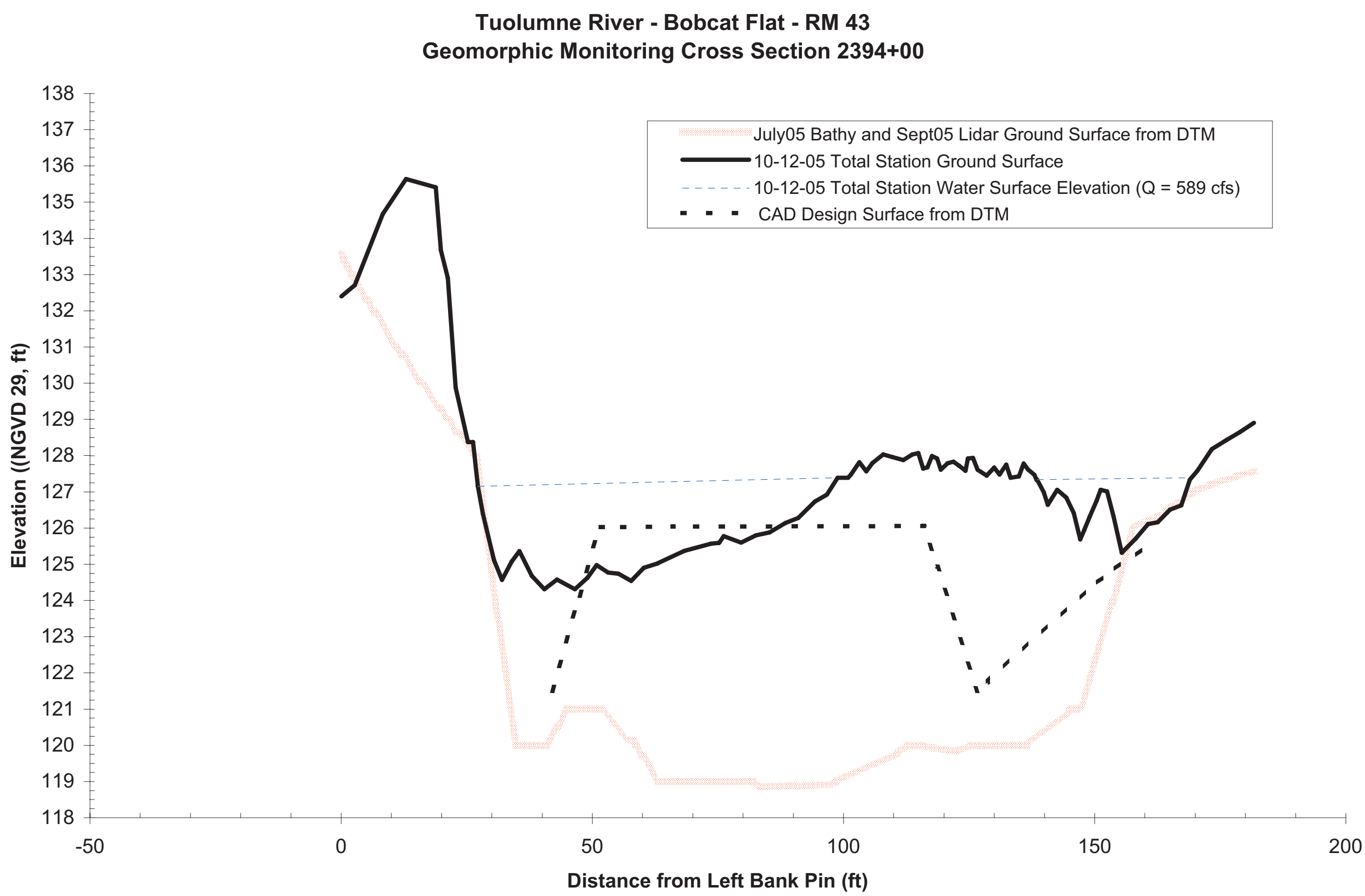

FLOW
Crest
Week 5
Patch 6

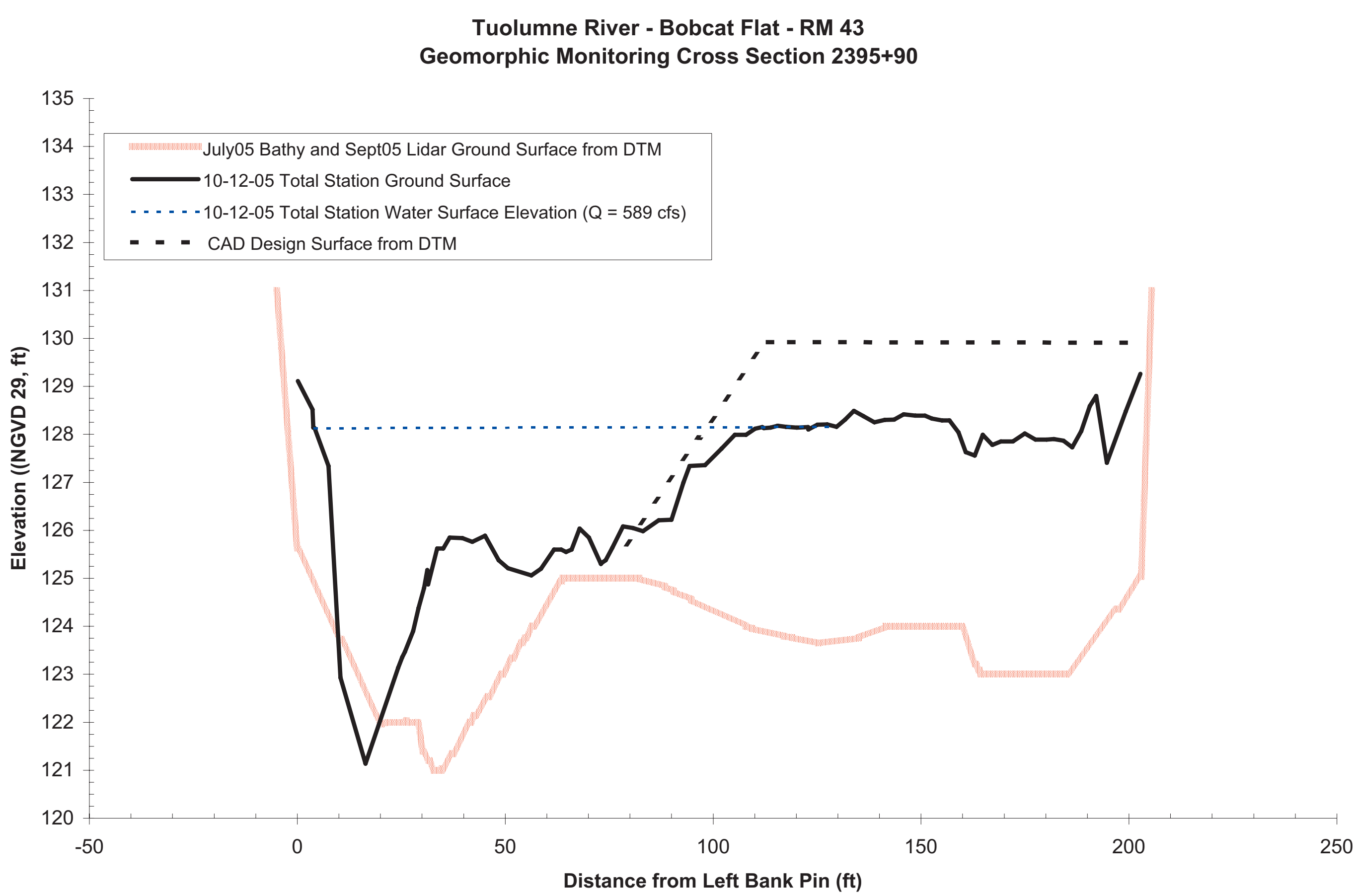

NORTH
50
0
50
SCALE: 1 IN = 50 FT
Week 5
Patch 3
Crest
2410+00
Flow
Cross Section
2408+75

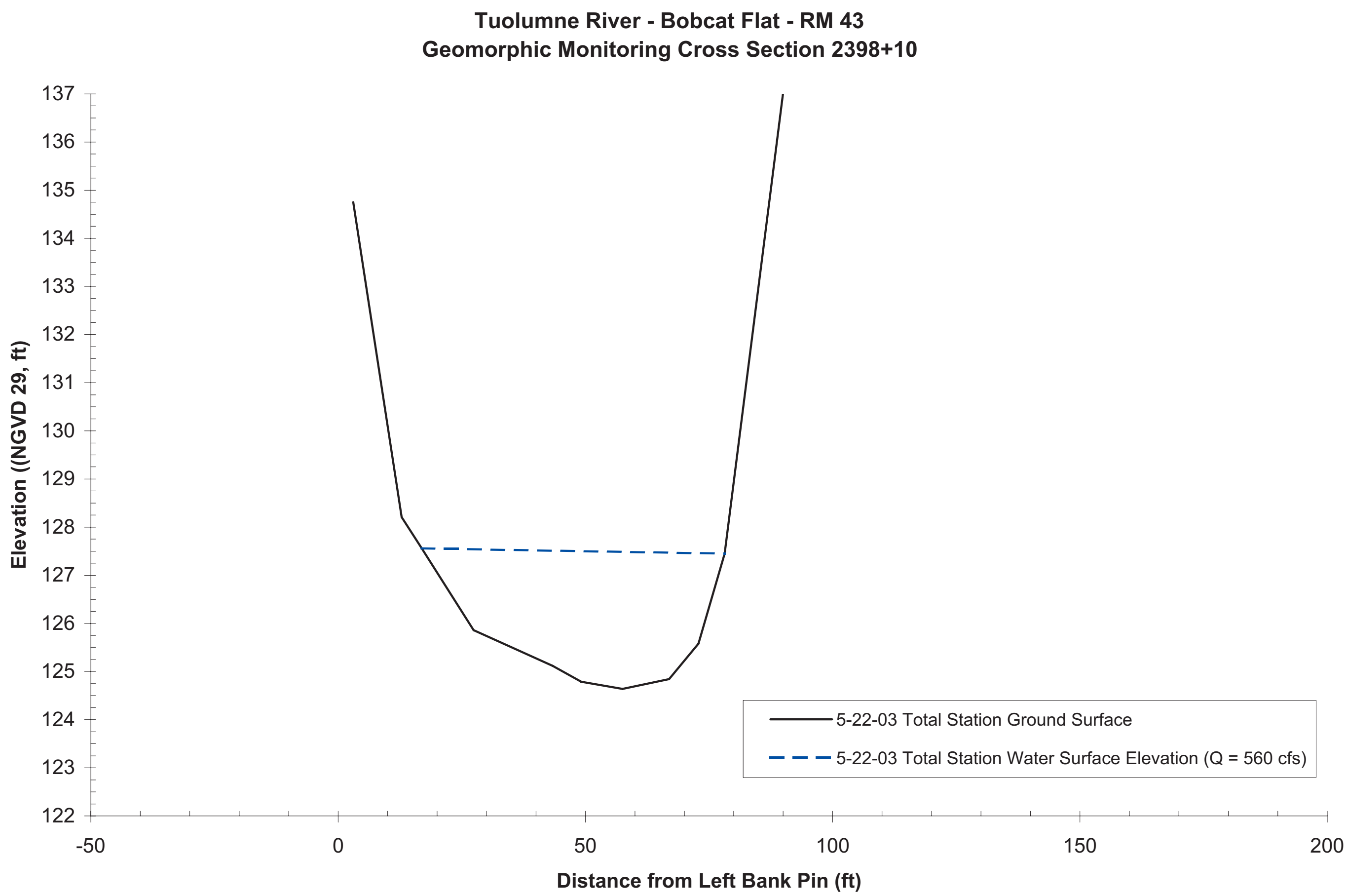

NORTH
50 0 50
SCALE: 1 IN = 50 FT
Riffle 18
weeks

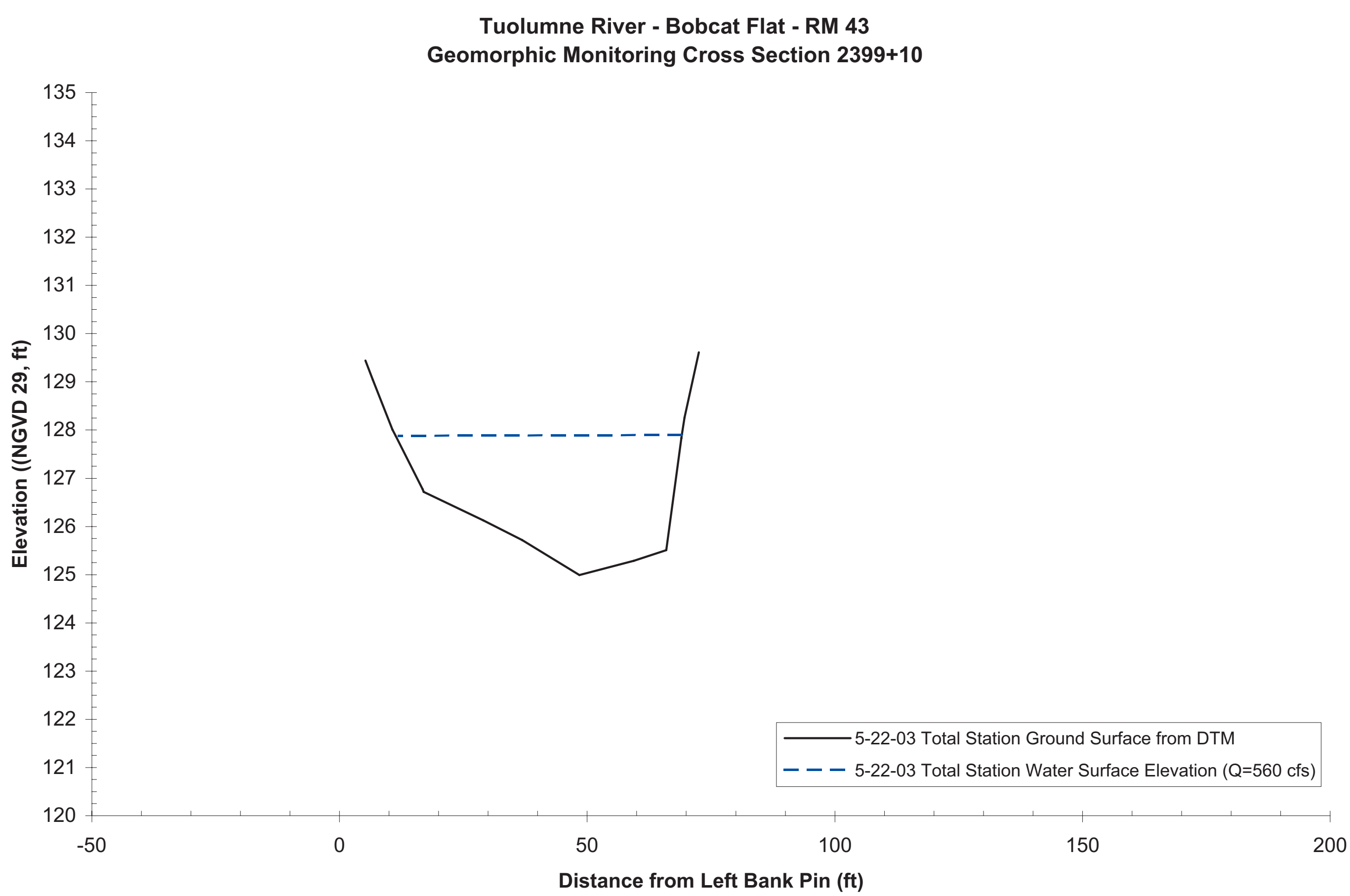
Appendix E

Monitoring Cross Section Charts.

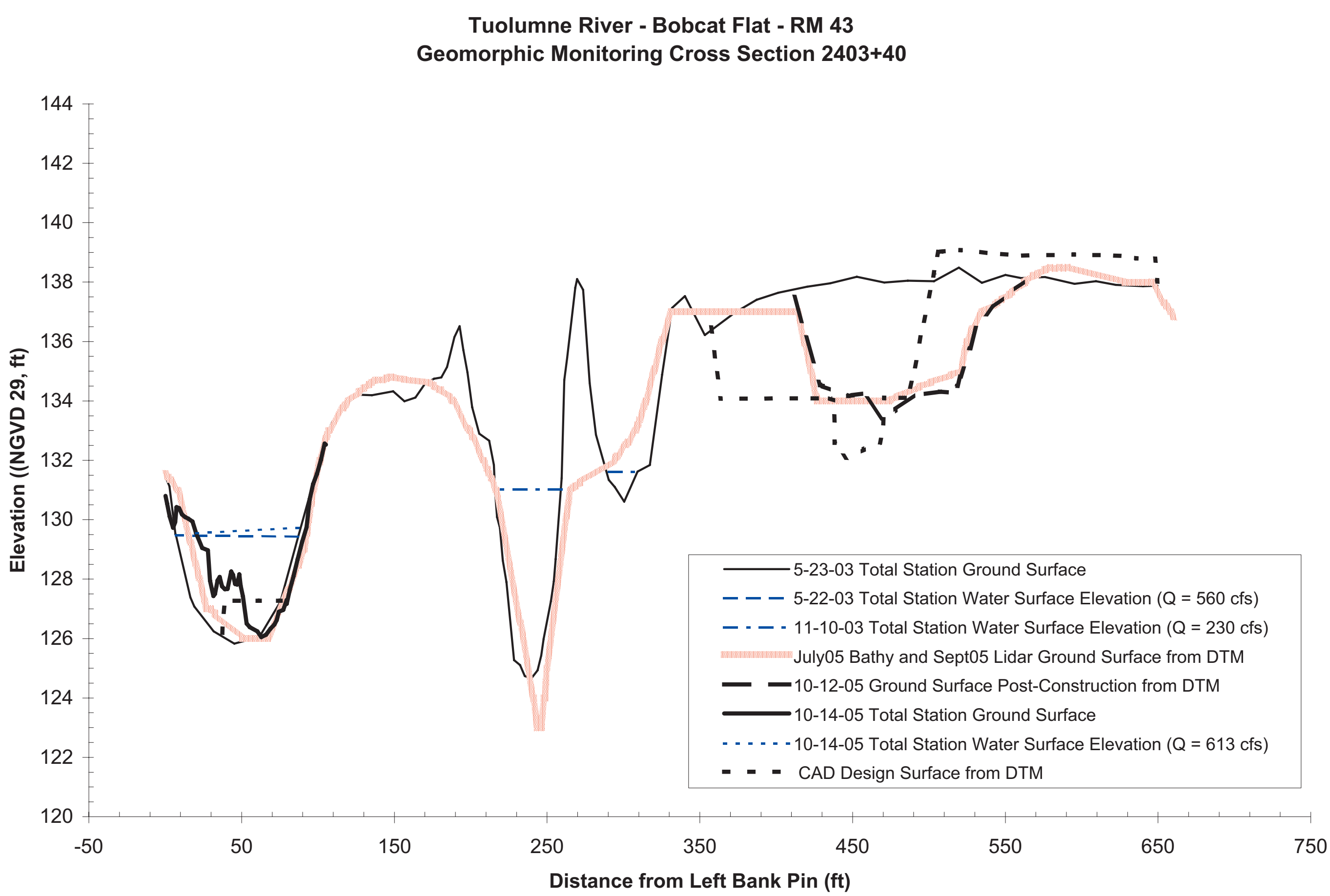

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2394+00
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-12-05 Total Station Ground Surface
10-12-05 Total Station Water Surface Elevation (Q = 589 cfs)
CAD Design Surface from DTM
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
138
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
119
118
-50
0
50
100
150
200

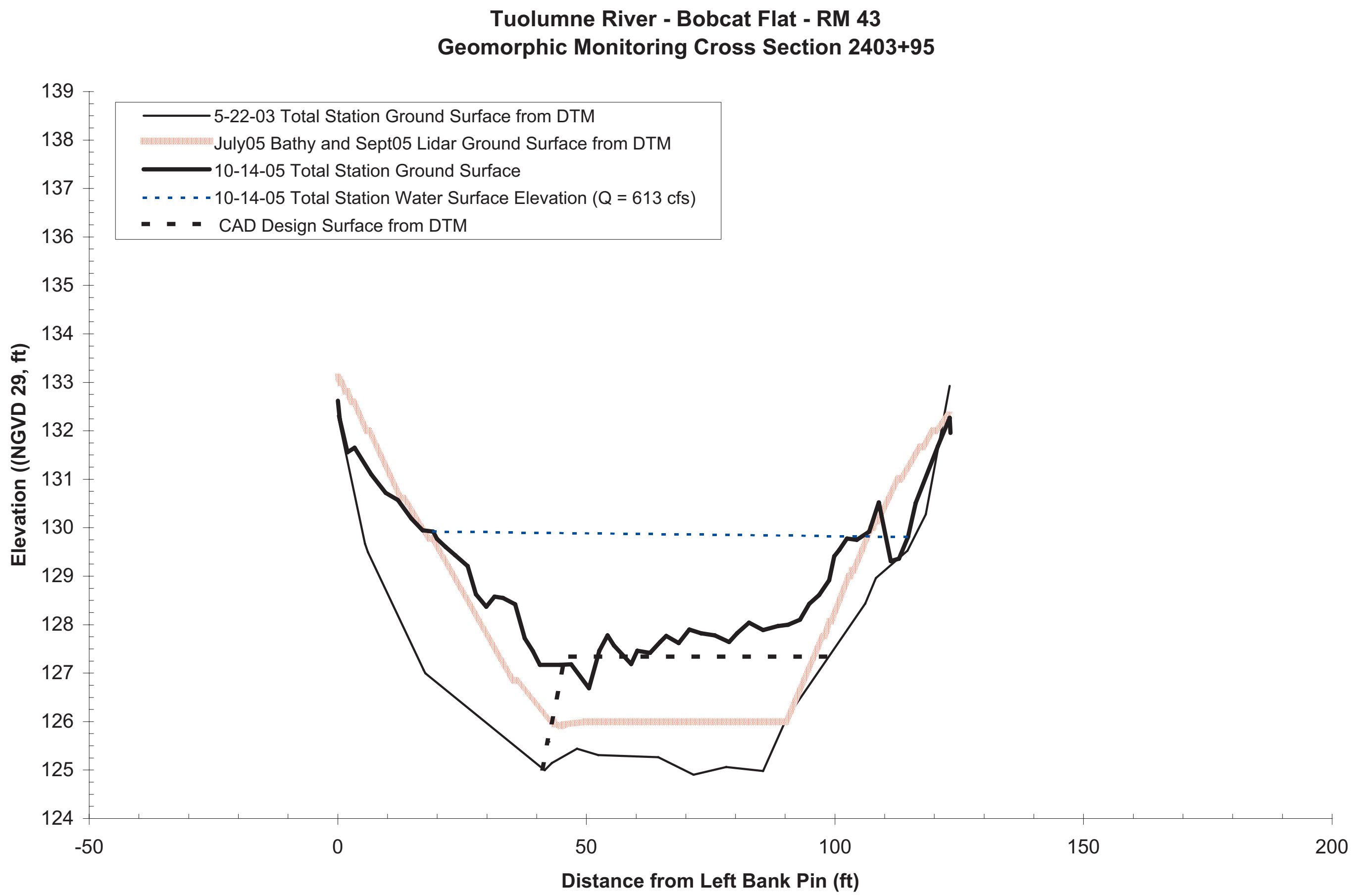

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2395+90
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-12-05 Total Station Ground Surface
10-12-05 Total Station Water Surface Elevation (Q = 589 cfs)
CAD Design Surface from DTM
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
135
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
-50
0
50
100
150
200
250

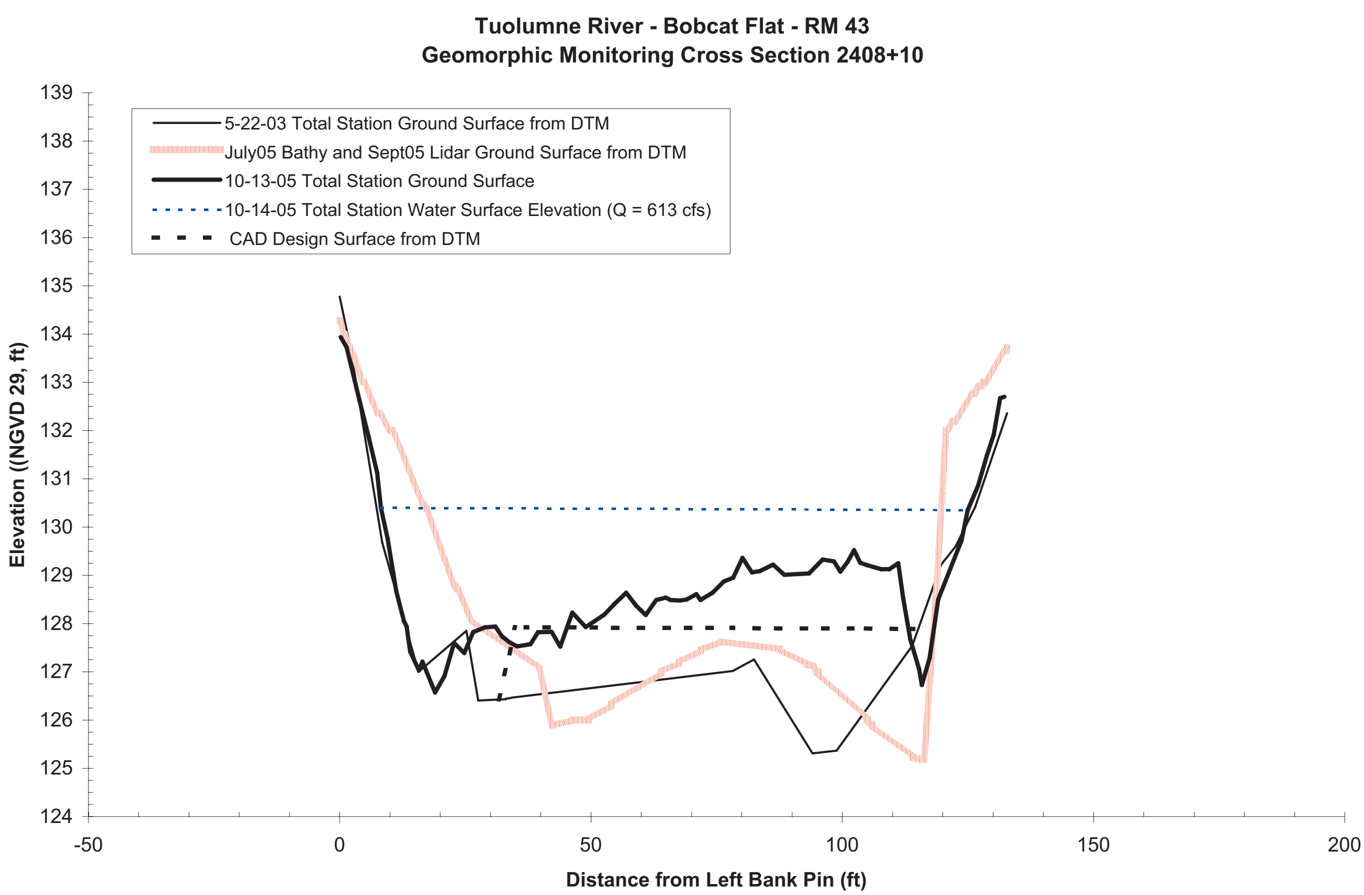

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2398+10
Elevation ((NGVD 29, ft)
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
-50
0
50
100
150
200
Distance from Left Bank Pin (ft)
5-22-03 Total Station Ground Surface
5-22-03 Total Station Water Surface Elevation (Q = 560 cfs)

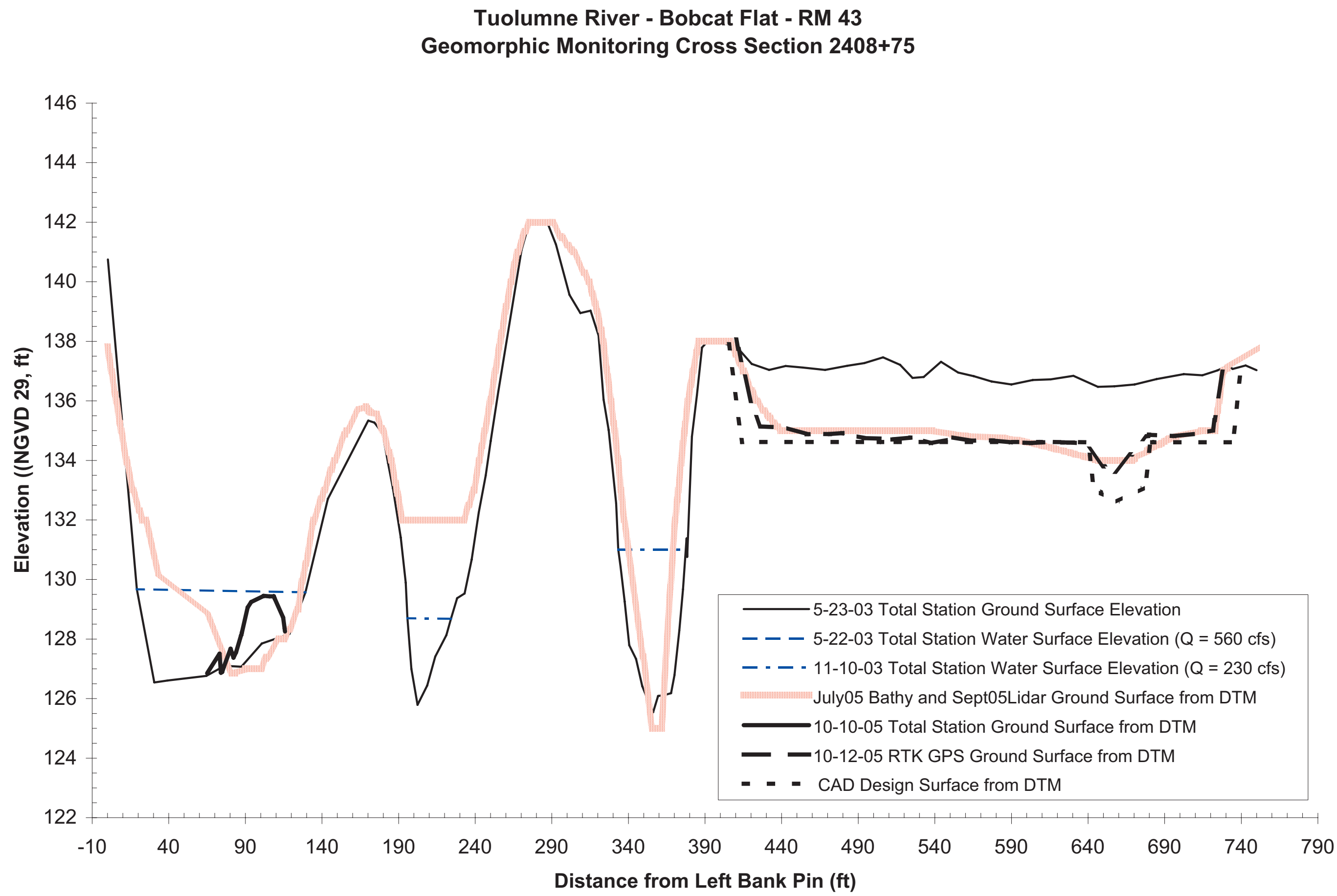

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2399+10
Elevation ((NGVD 29, ft)
135
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
-50
0
50
100
150
200
Distance from Left Bank Pin (ft)
5-22-03 Total Station Ground Surface from DTM
5-22-03 Total Station Water Surface Elevation (Q=560 cfs)


Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2400+50
Elevation (NGVD 29, ft)
Distance from Left Bank Pin (ft)
5-23-03 Ground Surface
5-22-03 Total Station Water Surface Elevation (Q = 560 cfs)
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-12-05 RTK GPS Ground Surface from DTM
10-14-05 Auto Level Ground Surface
10-14-05 Auto Level Water Surface Elevation (Q = 613 cfs)
CAD Design Surface from DTM

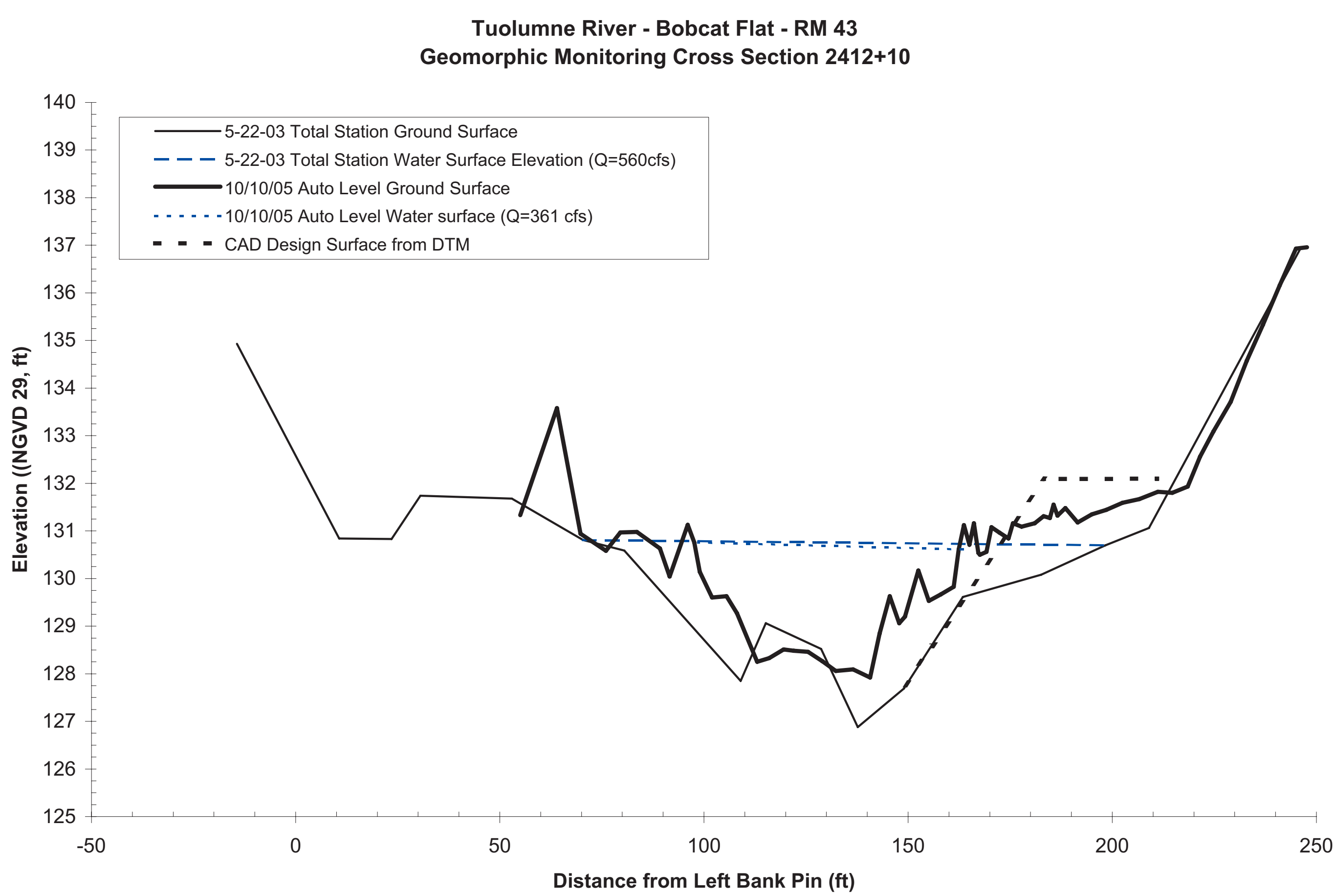

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2403+40
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
5-23-03 Total Station Ground Surface
5-22-03 Total Station Water Surface Elevation (Q = 560 cfs)
11-10-03 Total Station Water Surface Elevation (Q = 230 cfs)
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-12-05 Ground Surface Post-Construction from DTM
10-14-05 Total Station Ground Surface
10-14-05 Total Station Water Surface Elevation (Q = 613 cfs)
CAD Design Surface from DTM


Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2403+95
5-22-03 Total Station Ground Surface from DTM
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-14-05 Total Station Ground Surface
10-14-05 Total Station Water Surface Elevation (Q = 613 cfs)
CAD Design Surface from DTM
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
139
138
137
136
135
134
133
132
131
130
129
128
127
126
125
124
-50
0
50
100
150
200


Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2408+10
5-22-03 Total Station Ground Surface from DTM
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10-13-05 Total Station Ground Surface
10-14-05 Total Station Water Surface Elevation (Q = 613 cfs)
CAD Design Surface from DTM
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
139
138
137
136
135
134
133
132
131
130
129
128
127
126
125
124
-50
0
50
100
150
200

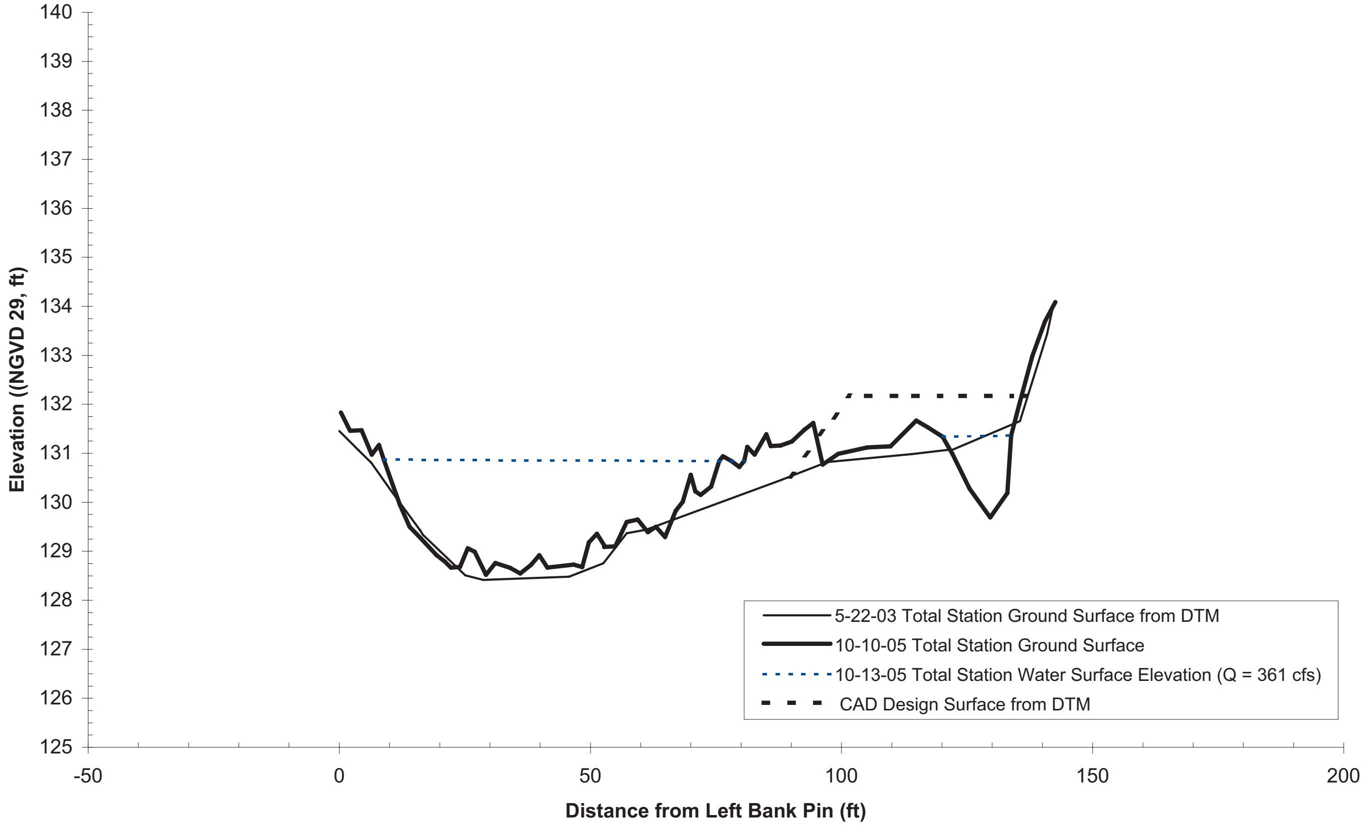


Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2408+75
Elevation ((NGVD 29, ft)
146
144
142
140
138
136
134
132
130
128
126
124
122
-10
40
90
140
190
240
290
340
390
440
490
540
590
640
690
740
790
Distance from Left Bank Pin (ft)
5-23-03 Total Station Ground Surface Elevation
5-22-03 Total Station Water Surface Elevation (Q = 560 cfs)
11-10-03 Total Station Water Surface Elevation (Q = 230 cfs)
July05 Bathy and Sept05Lidar Ground Surface from DTM
10-10-05 Total Station Ground Surface from DTM
10-12-05 RTK GPS Ground Surface from DTM
CAD Design Surface from DTM

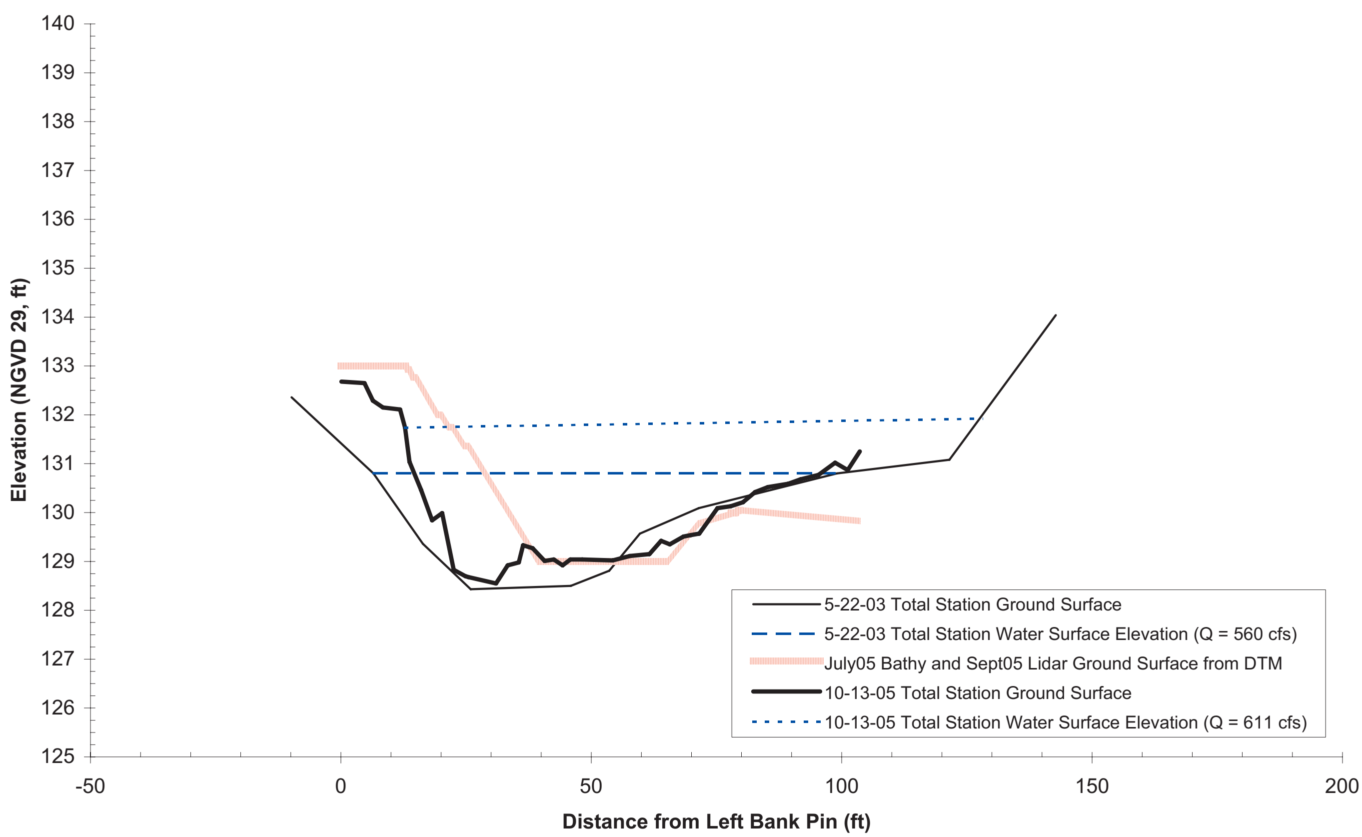


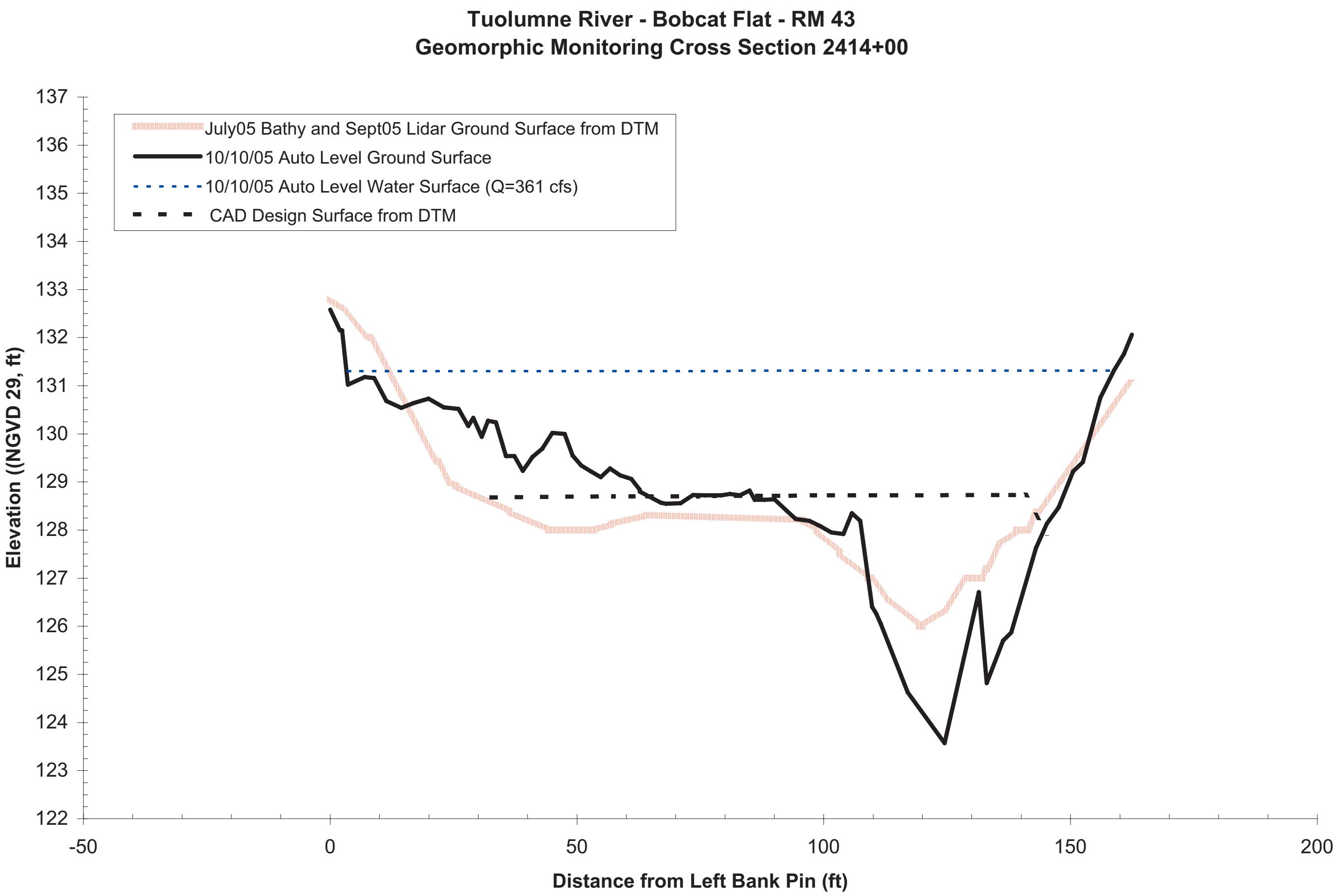
Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2412+10
Elevation ((NGVD 29, ft)
140
139
138
137
136
135
134
133
132
131
130
129
128
127
126
125
-50
0
50
100
150
200
250
Distance from Left Bank Pin (ft)
5-22-03 Total Station Ground Surface
5-22-03 Total Station Water Surface Elevation (Q=560cfs)
10/10/05 Auto Level Ground Surface
10/10/05 Auto Level Water surface (Q=361 cfs)
CAD Design Surface from DTM

Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2412+90



Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2413+20

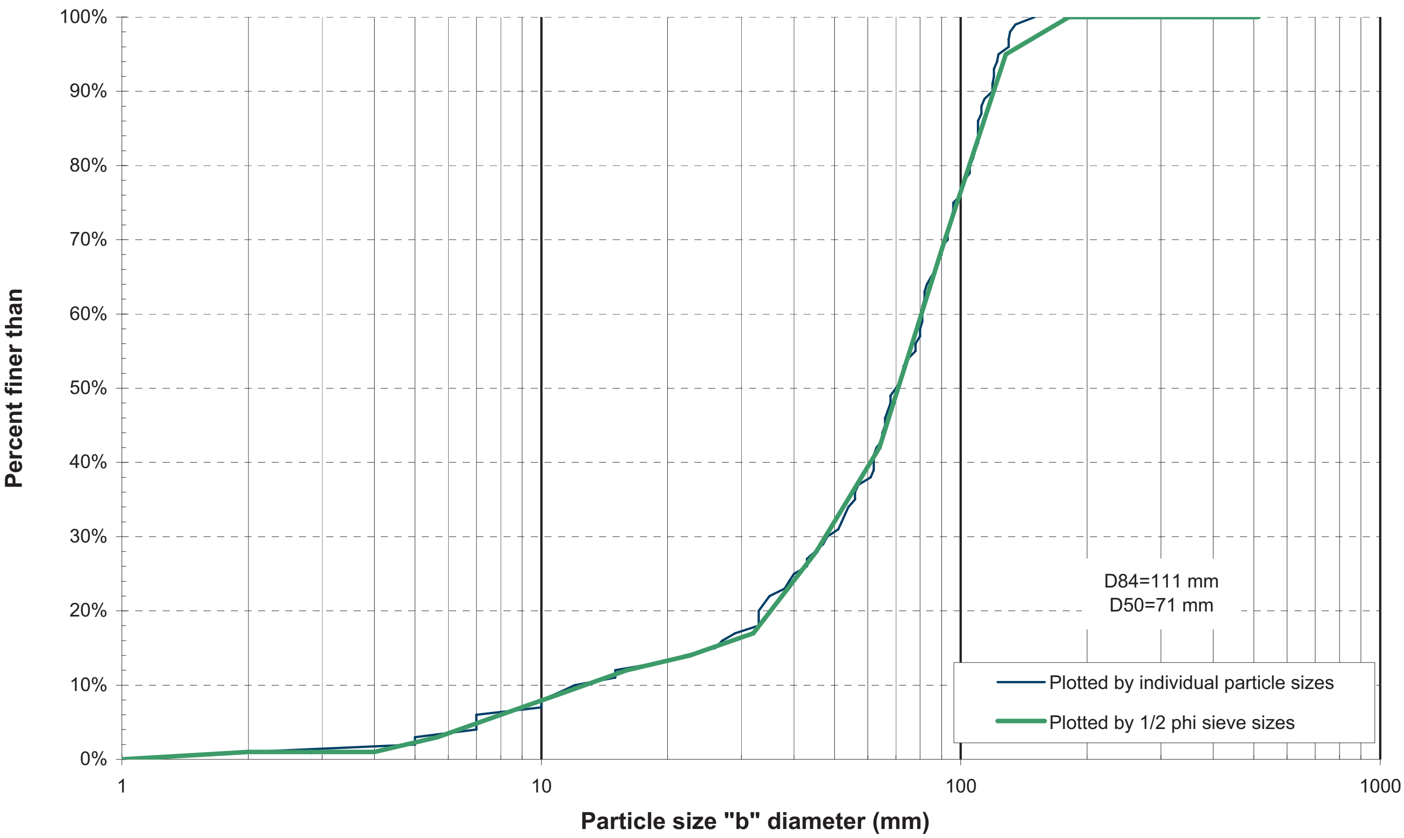



Tuolumne River - Bobcat Flat - RM 43
Geomorphic Monitoring Cross Section 2414+00
July05 Bathy and Sept05 Lidar Ground Surface from DTM
10/10/05 Auto Level Ground Surface
10/10/05 Auto Level Water Surface (Q=361 cfs)
CAD Design Surface from DTM
Elevation ((NGVD 29, ft)
Distance from Left Bank Pin (ft)
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
-50
0
50
100
150
200

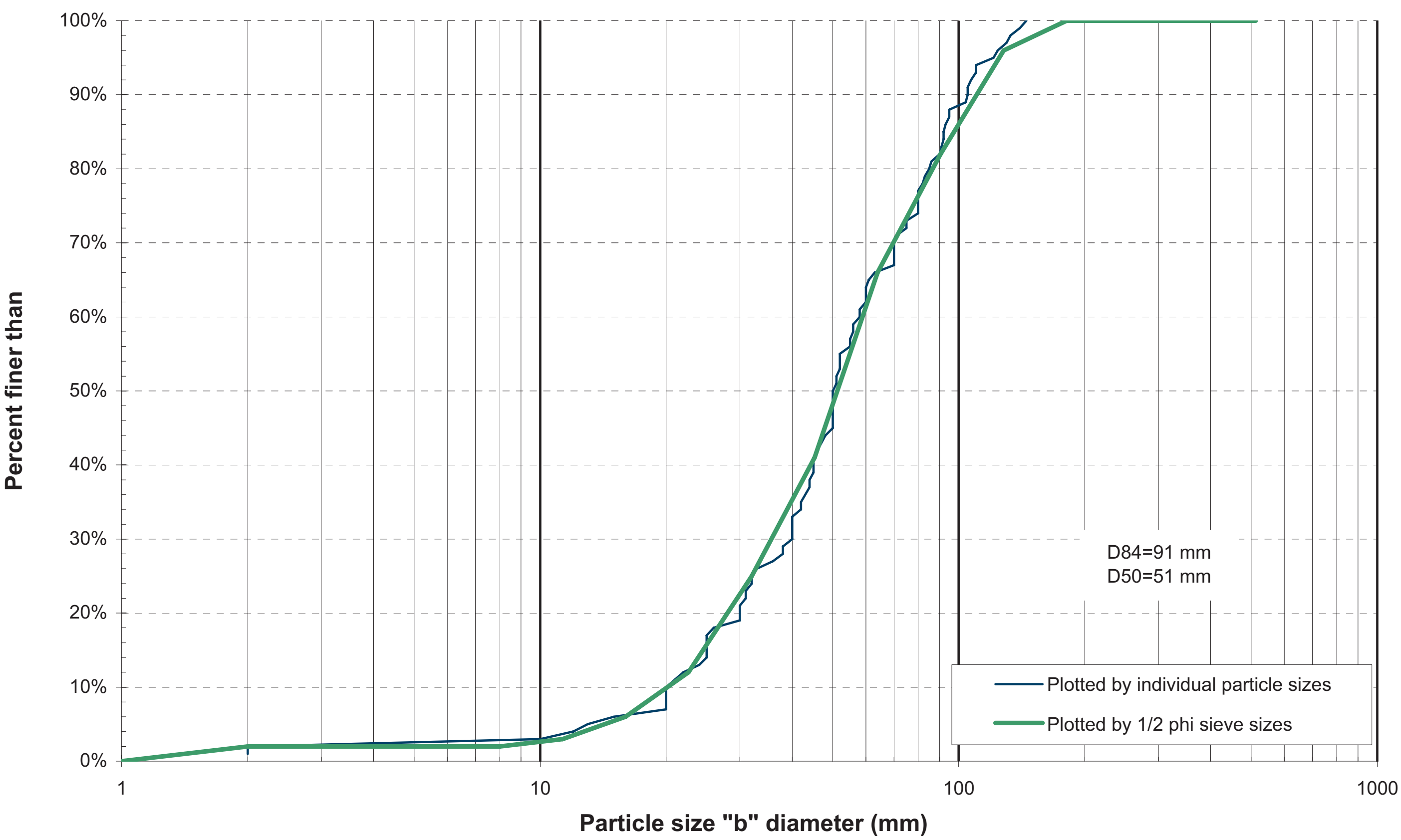
Appendix F

Pebble Count Charts.

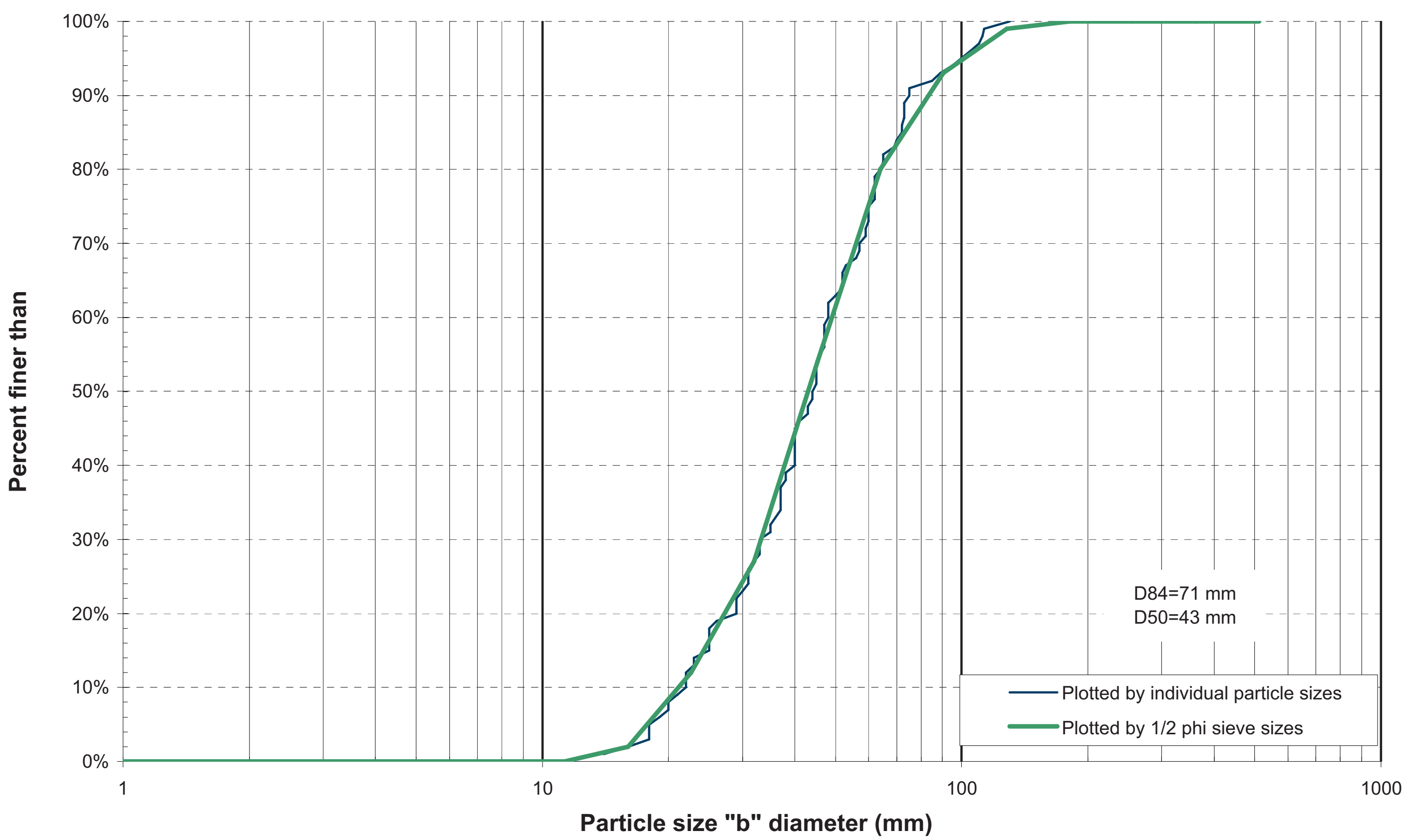
Tuolumne River - Bobcat Flat Pre-Construction Conditions
Pebble Count at Cross Section 2400+50 (Riffle 21)



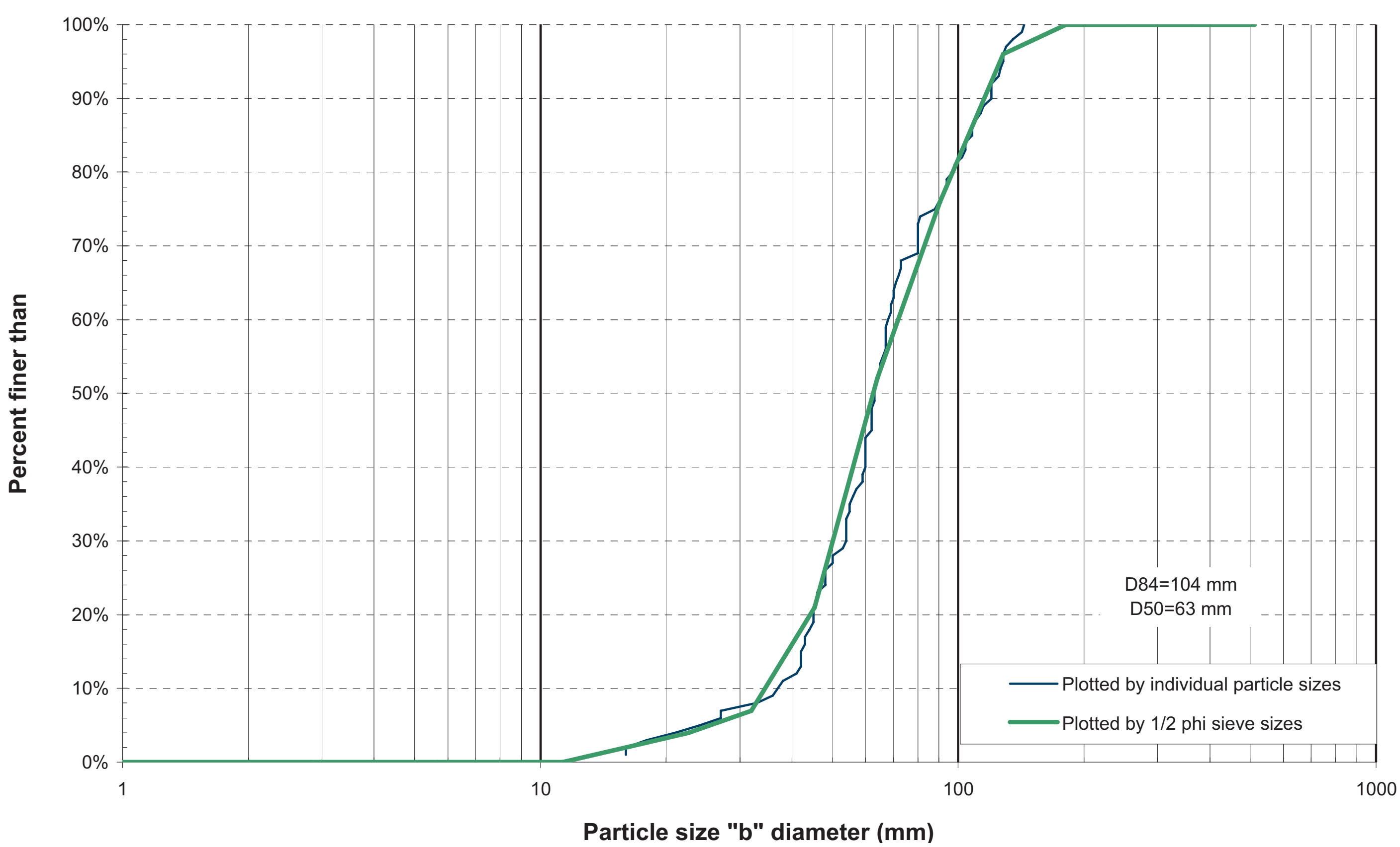
Tuolumne River - Bobcat Flat Pre-Construction Conditions
Pebble Count at Cross Section 2412+90 (Pool Tail / Riffle 20)

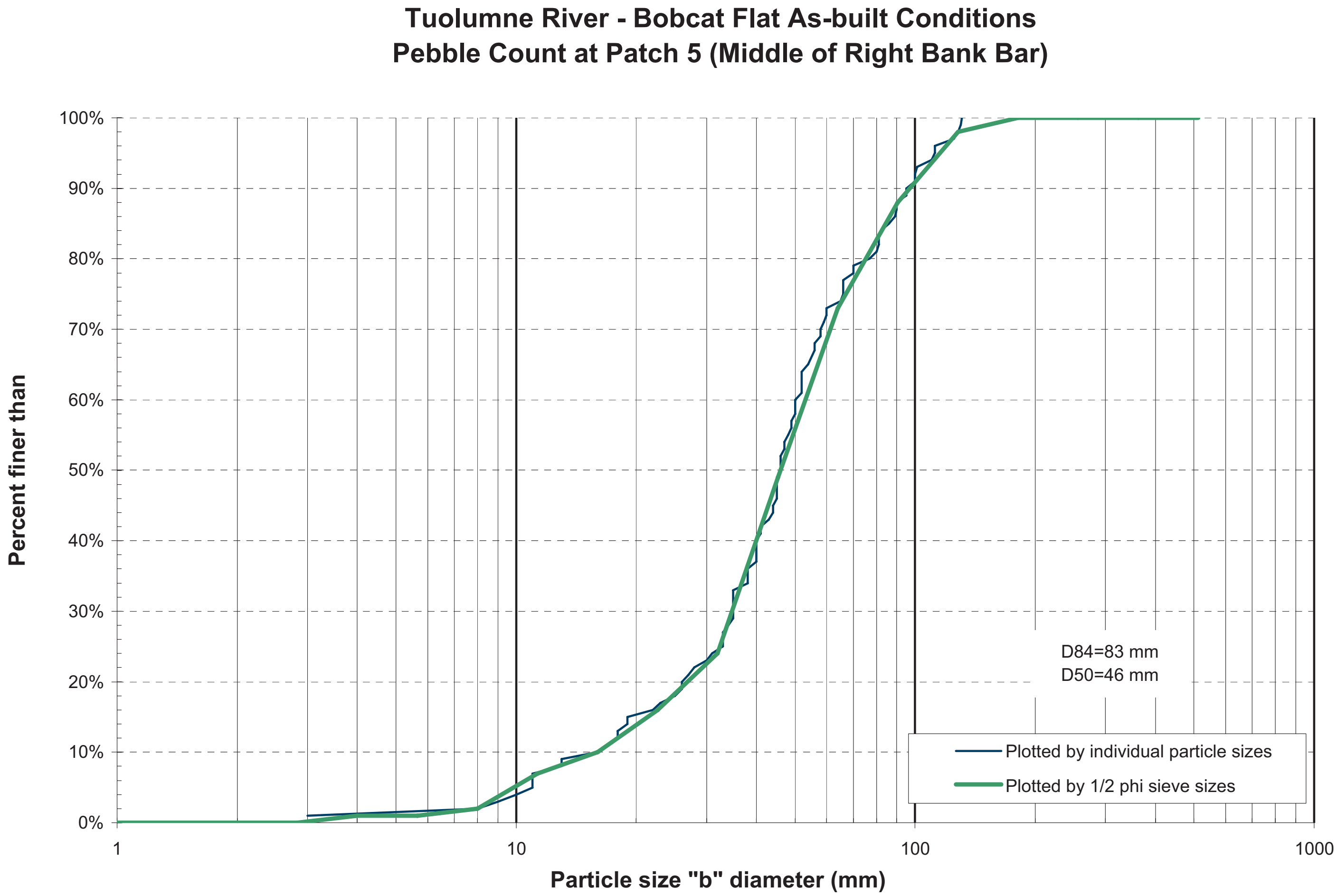


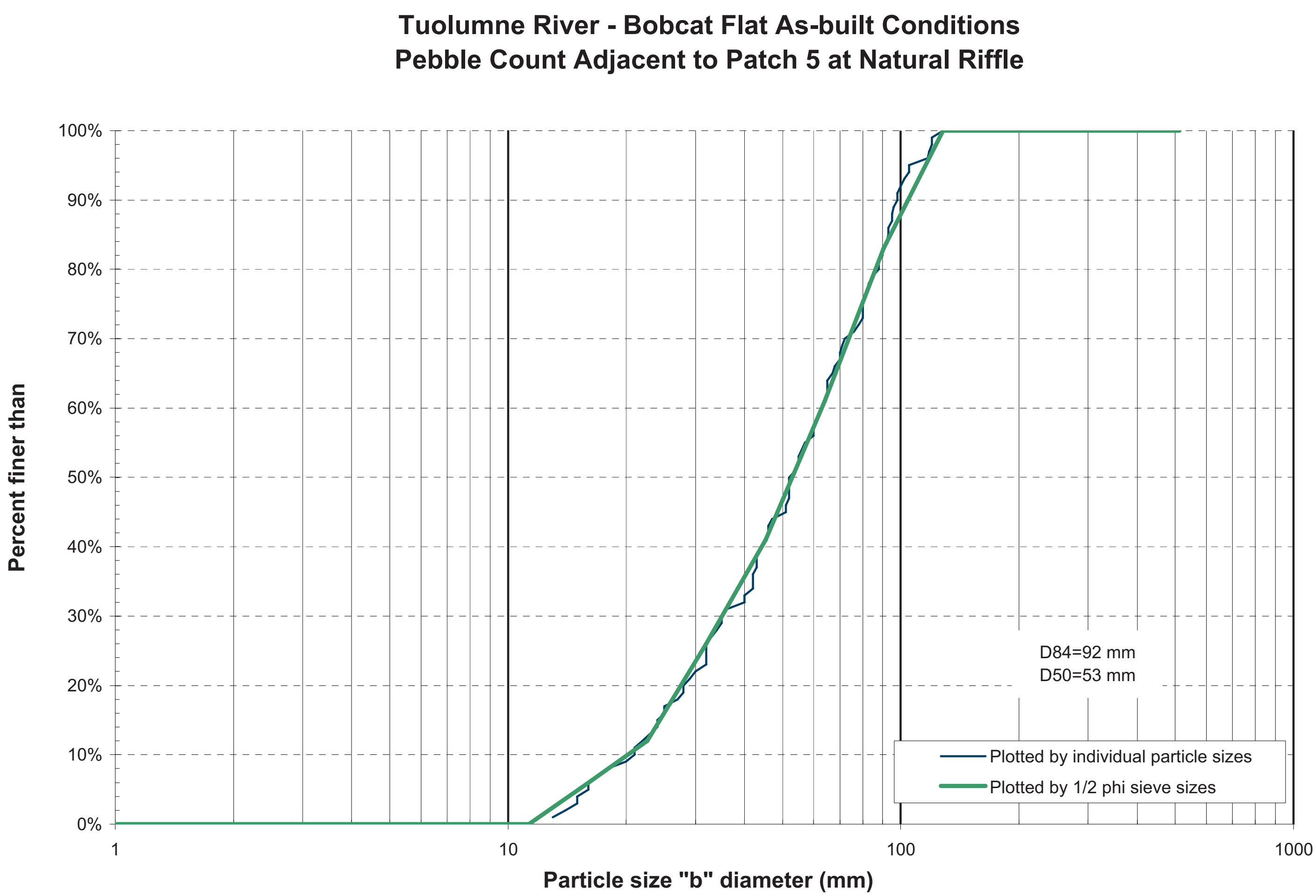
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 6 (Constructed Pool Tail/Riffle)



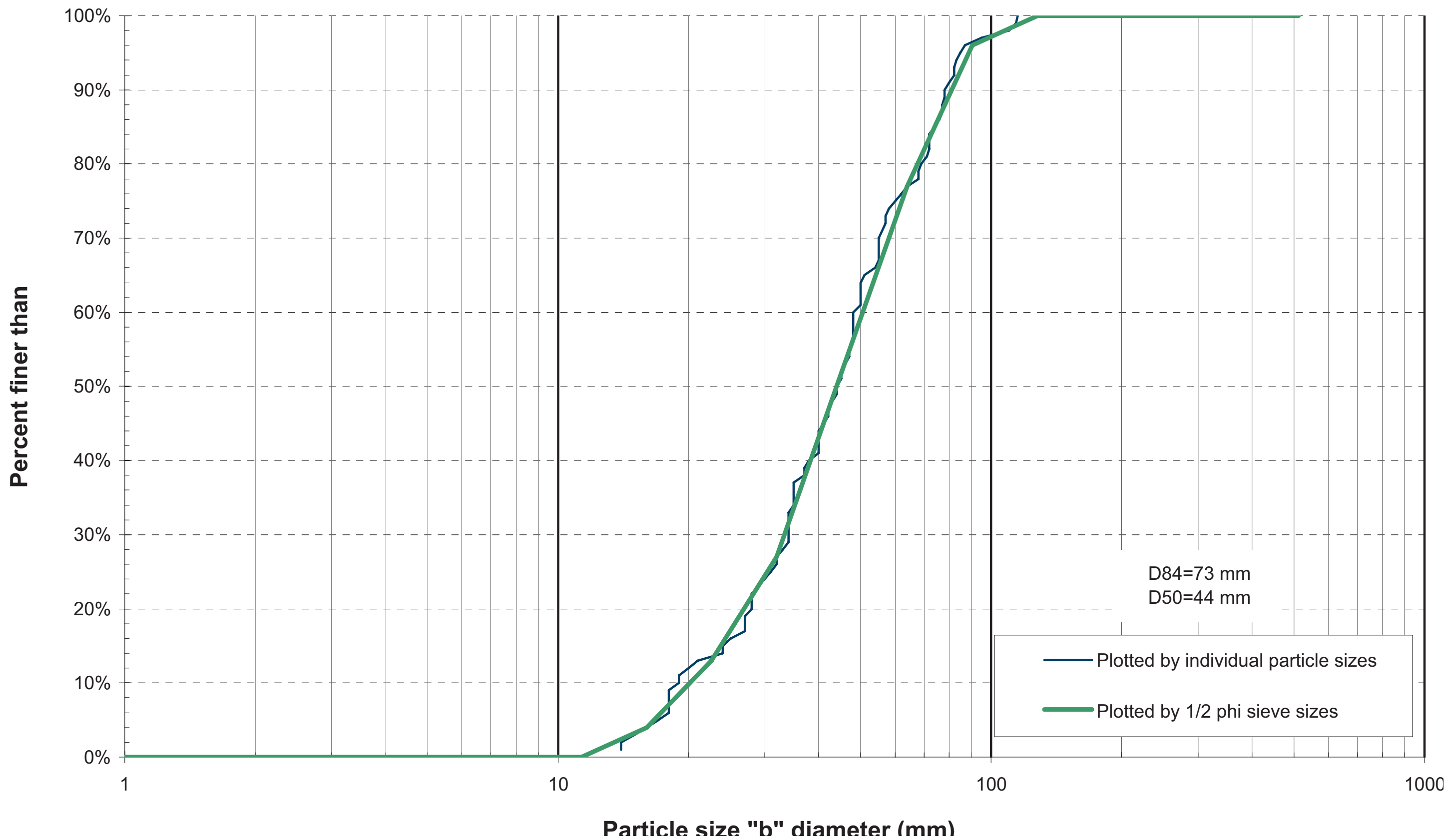
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 5 (Donwstream End of Right Bank Bar)



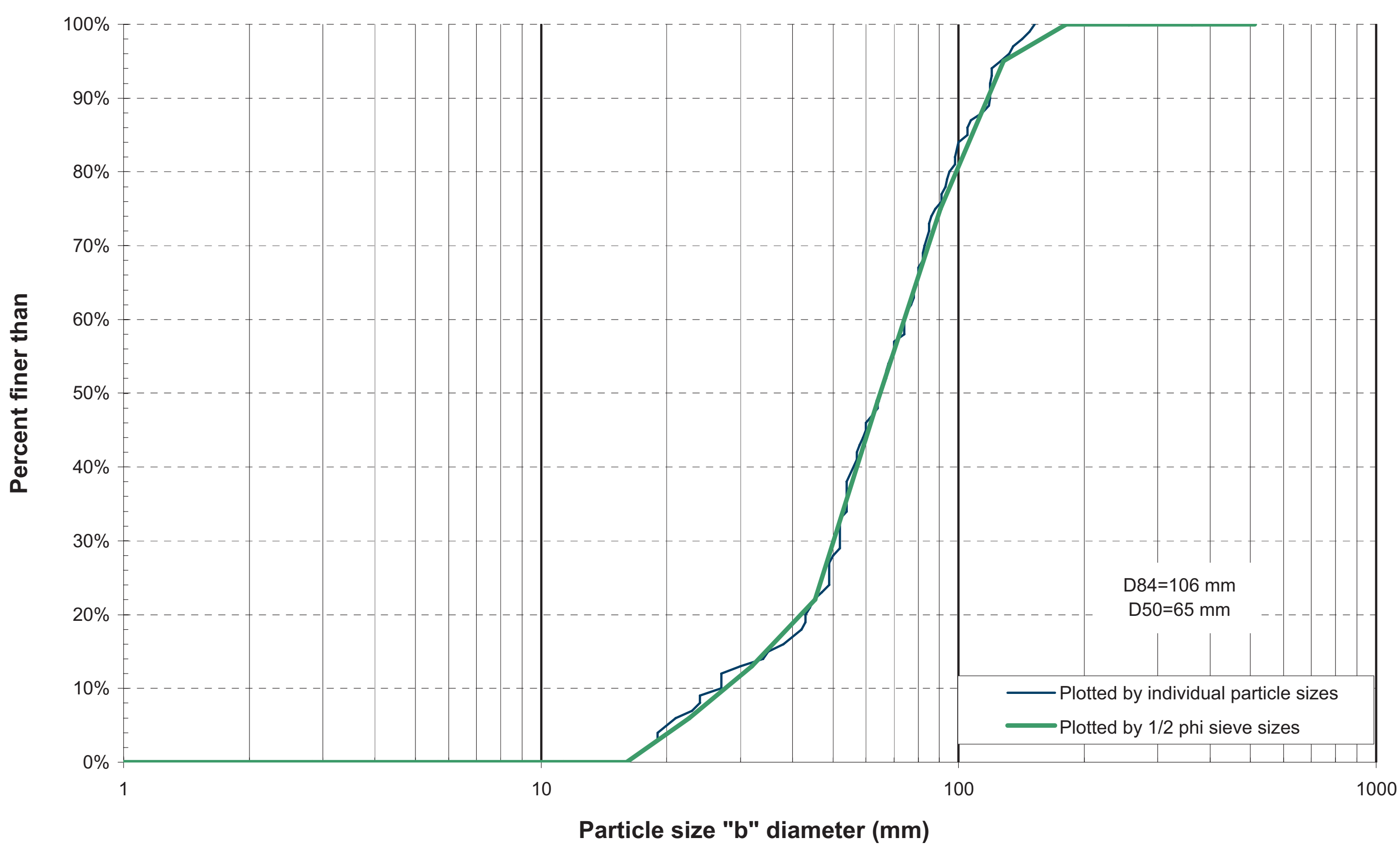

Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 5 (Middle of Right Bank Bar)
Percent finer than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
Particle size "b" diameter (mm)
D84=83 mm
D50=46 mm
Plotted by individual particle sizes
Plotted by 1/2 phi sieve sizes


Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count Adjacent to Patch 5 at Natural Riffle
Percent finer than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
Particle size "b" diameter (mm)
D84=92 mm
D50=53 mm
Plotted by individual particle sizes
Plotted by 1/2 phi sieve sizes

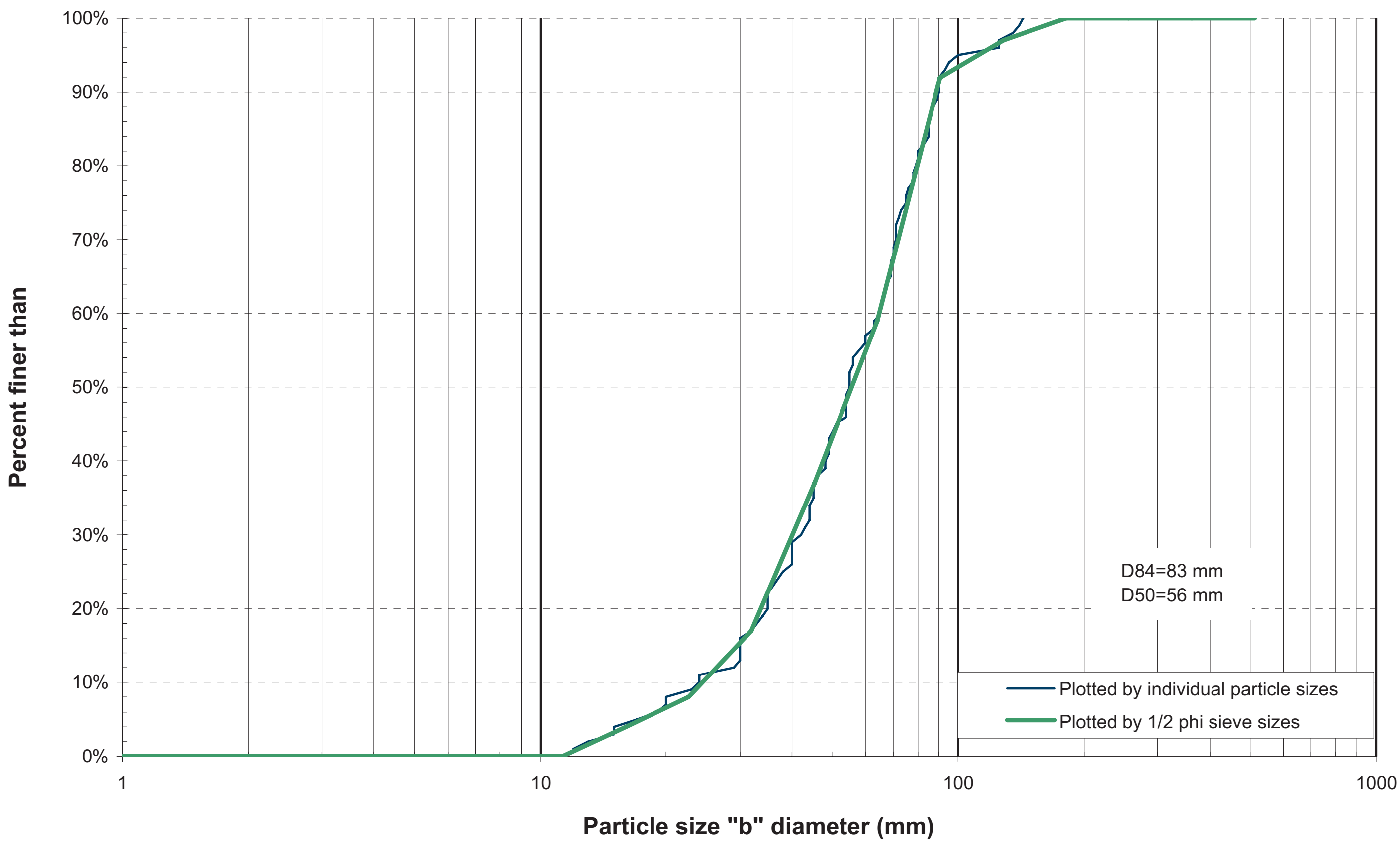
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 4 (Adjacent to Right Bank Extending Upstream)



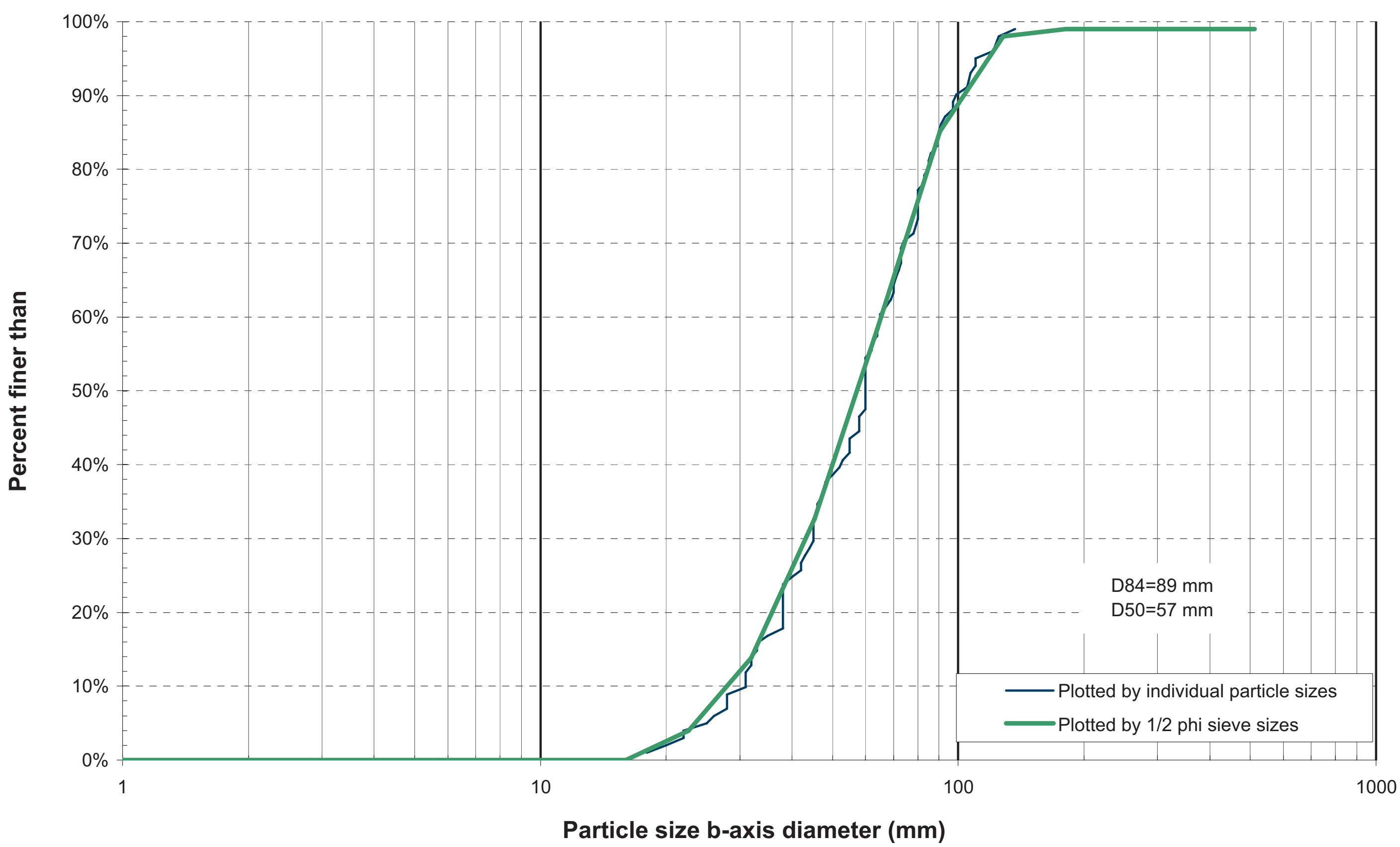
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 4 (Coarser Facies Unit from Channel Center to Left Bank)



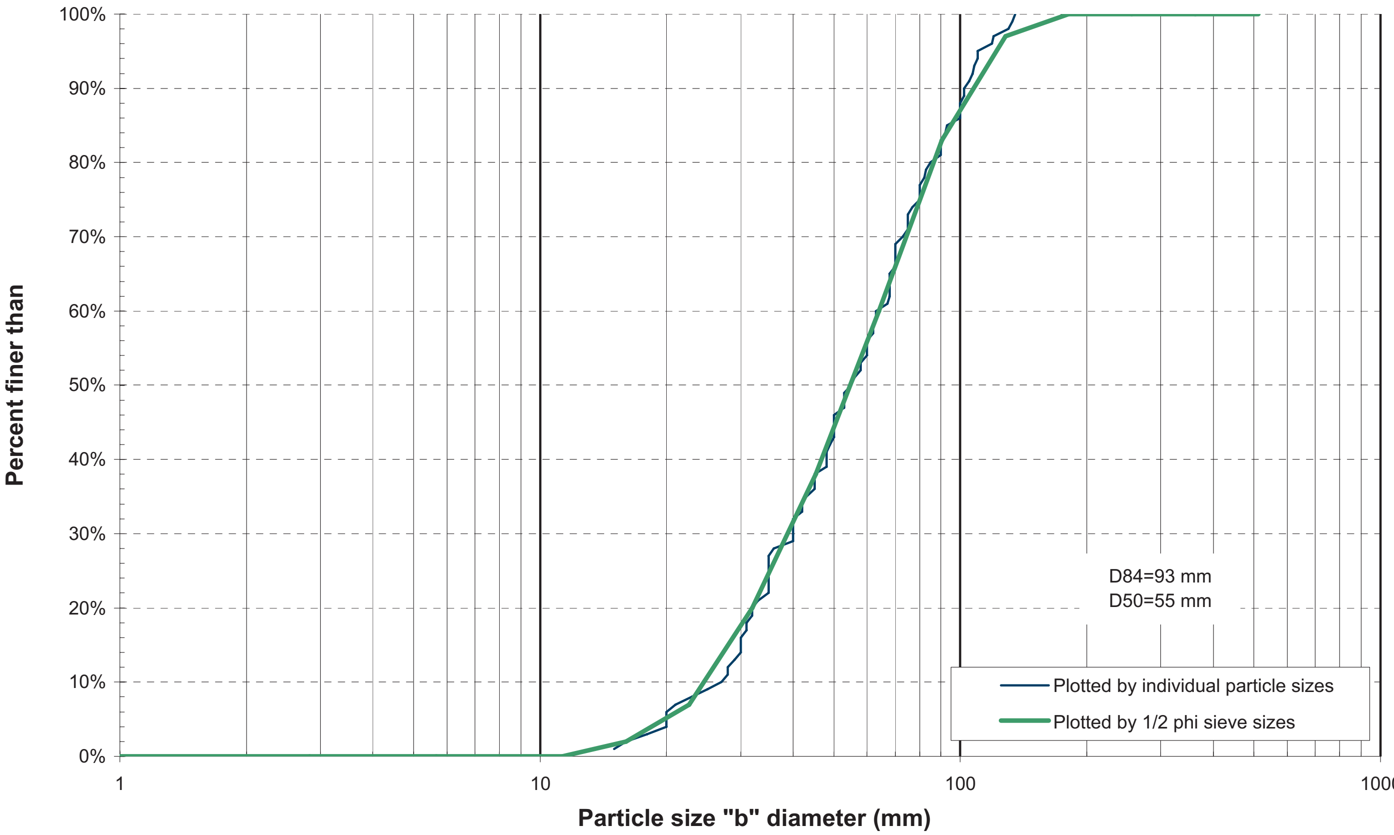
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 3 (Right Bank Submerged Bar)



Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 2 (Right Bank Bar)

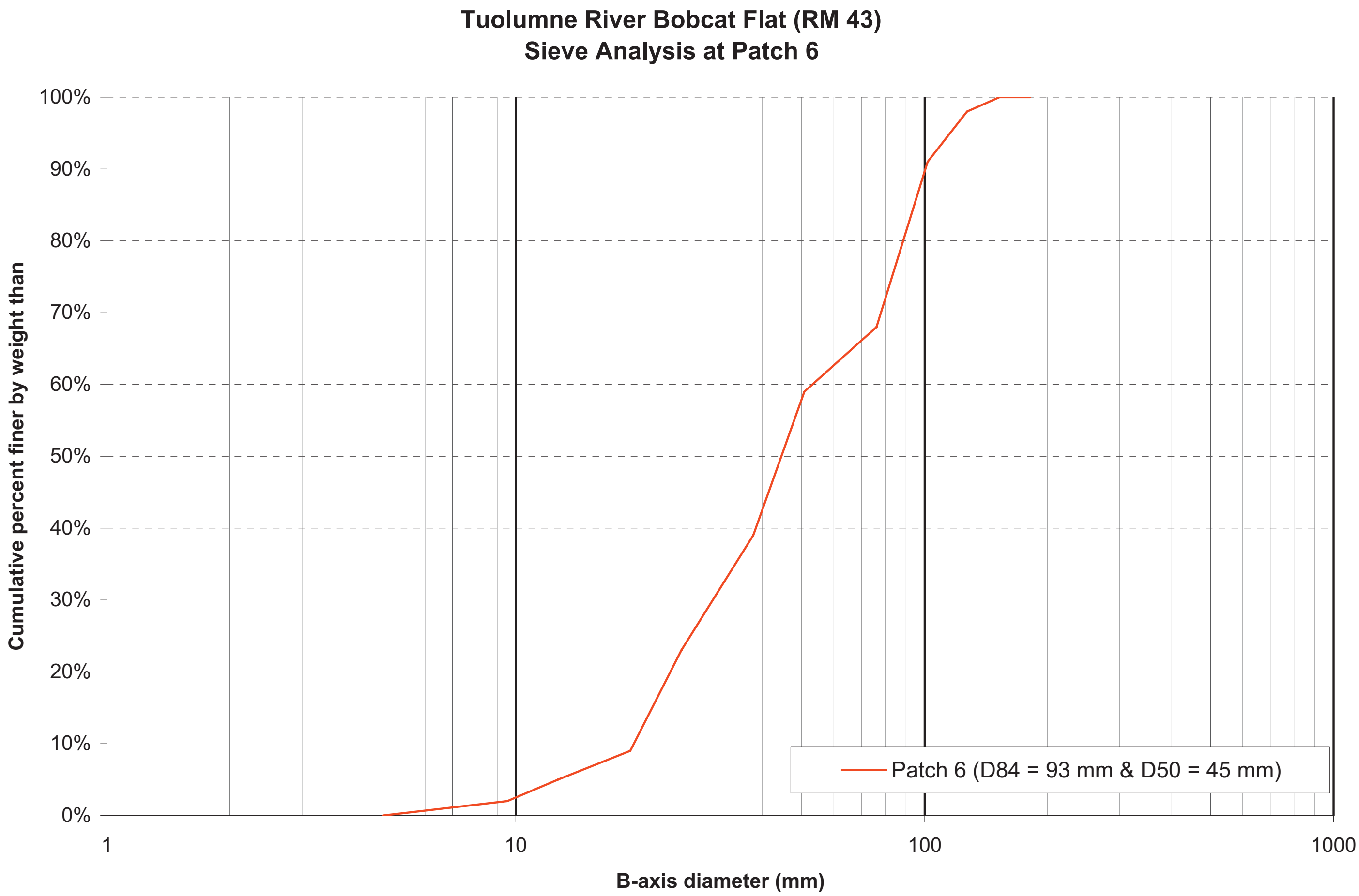


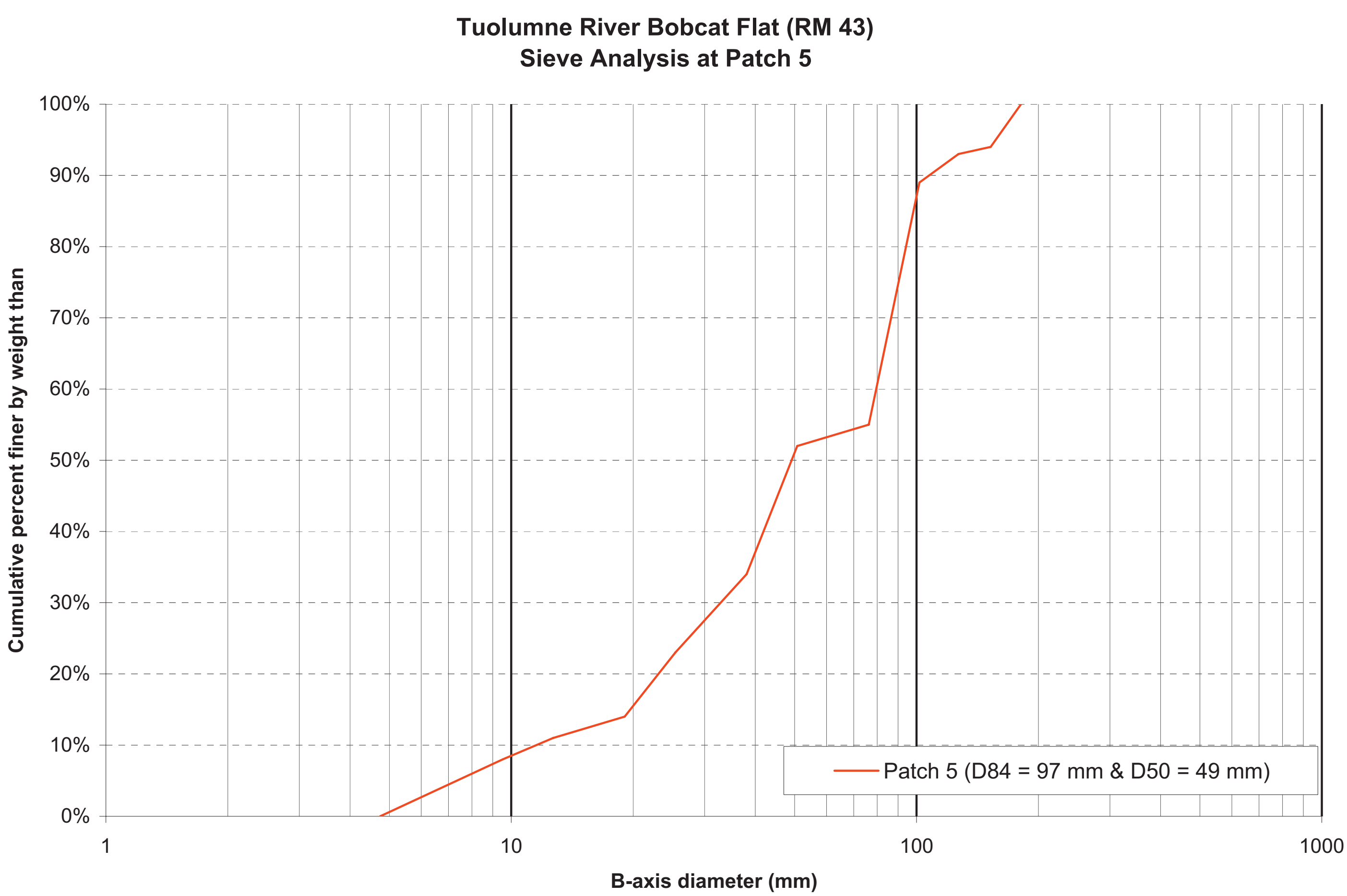
Tuolumne River - Bobcat Flat As-built Conditions
Pebble Count at Patch 1 (Pool Tail / Riffle 20)

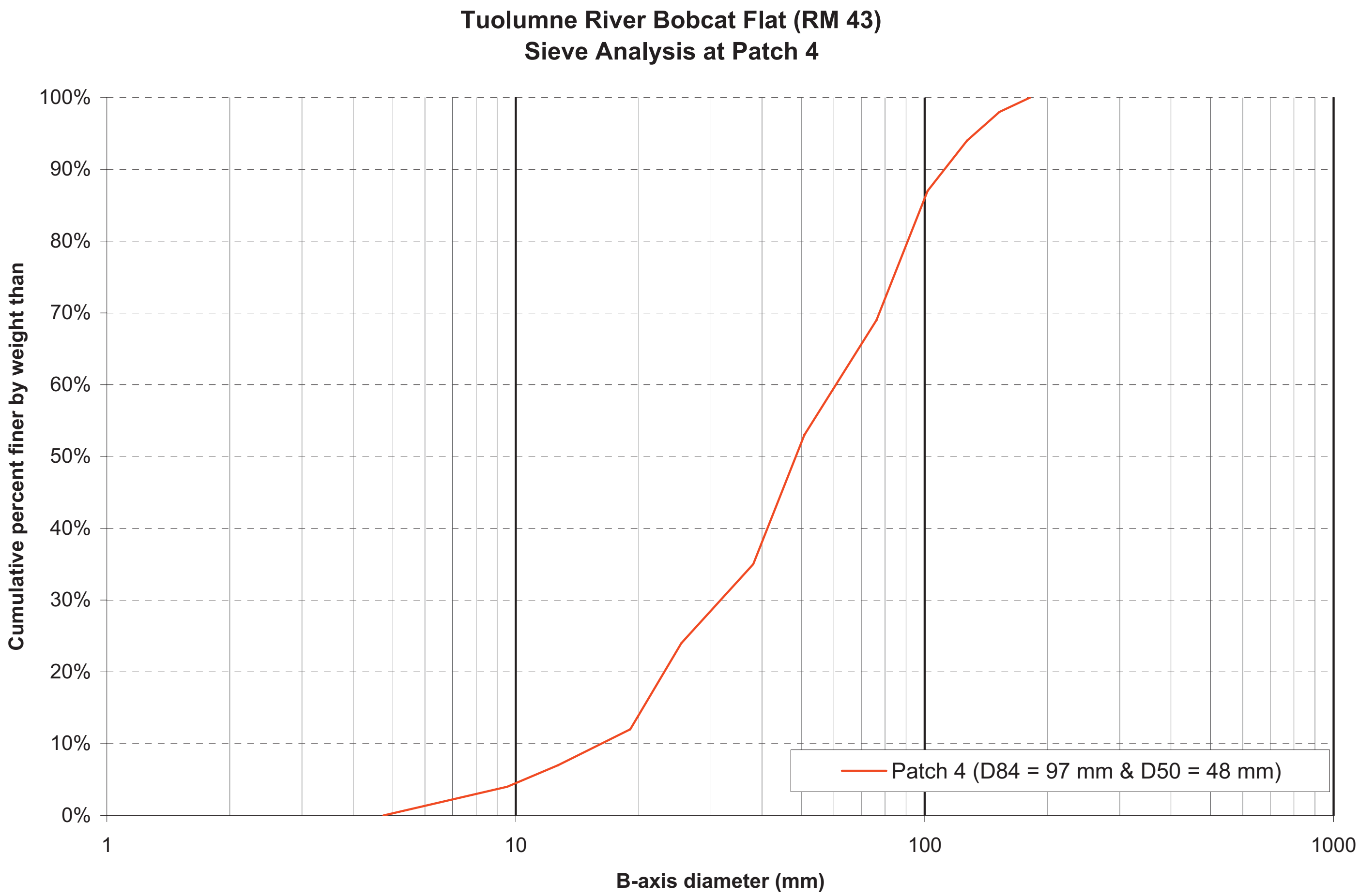


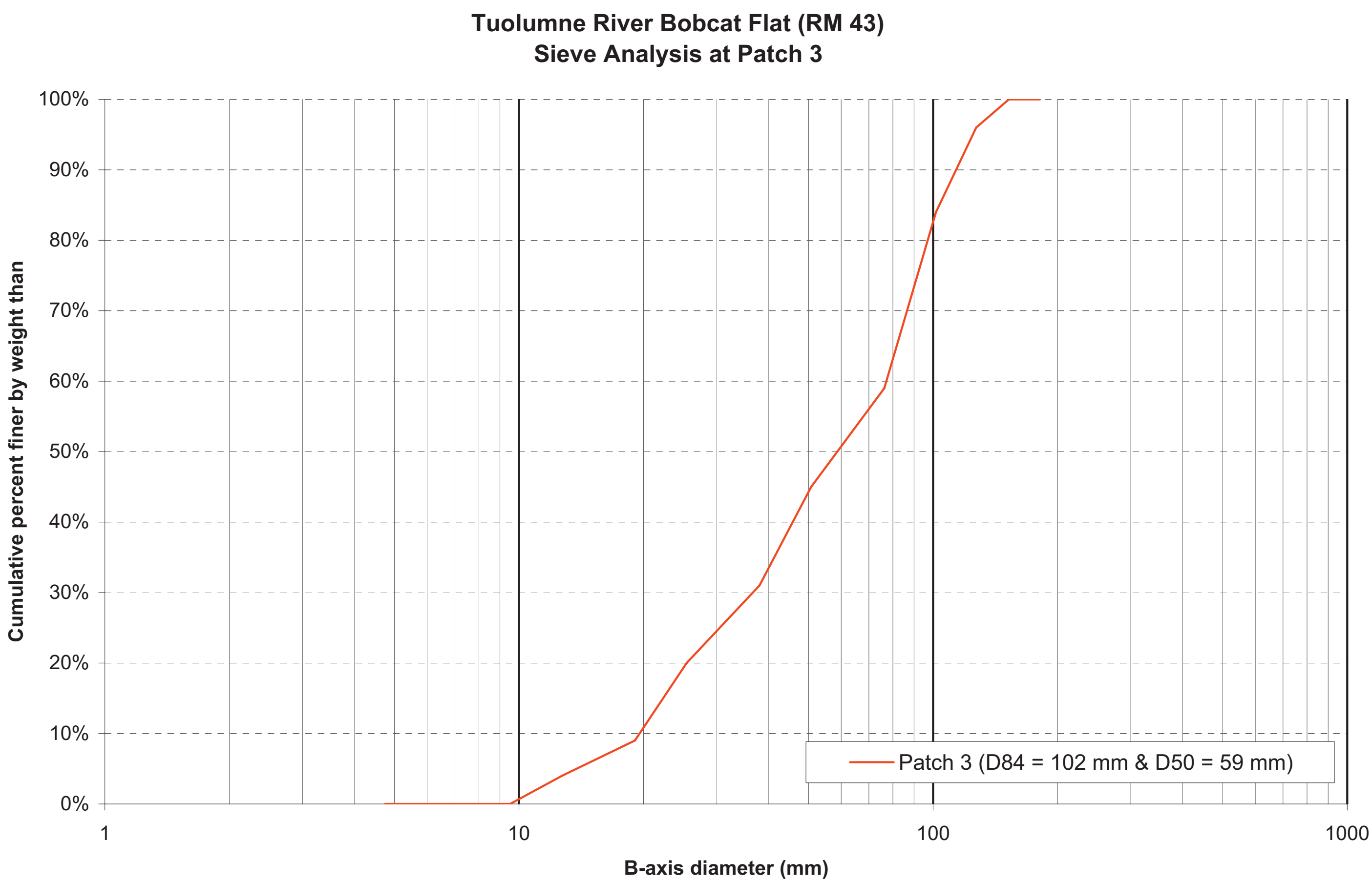
Appendix G

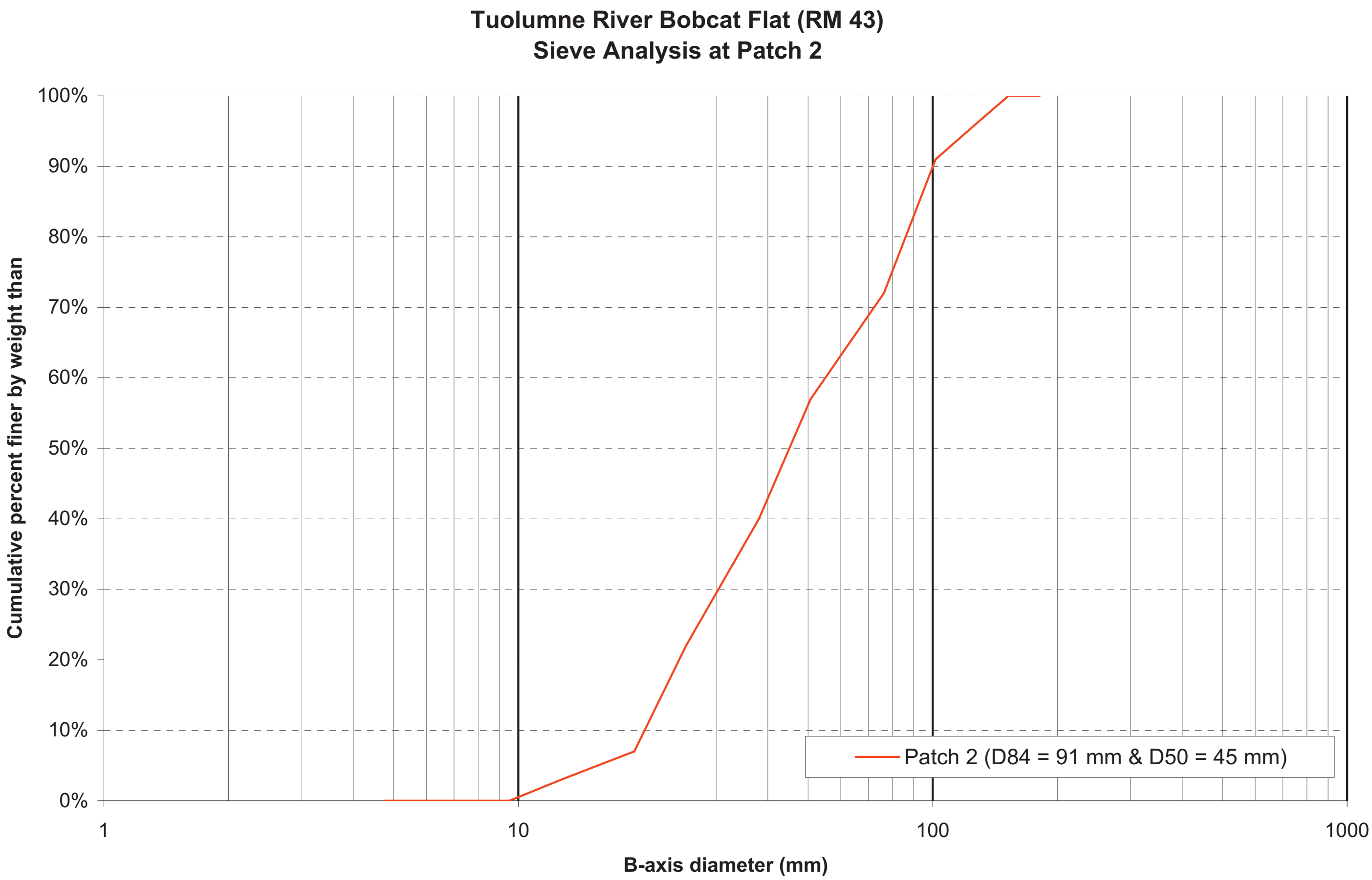
Bulk Sample Charts.


Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 6
Cumulative percent finer by weight than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
B-axis diameter (mm)
Patch 6 (D84 = 93 mm & D50 = 45 mm)

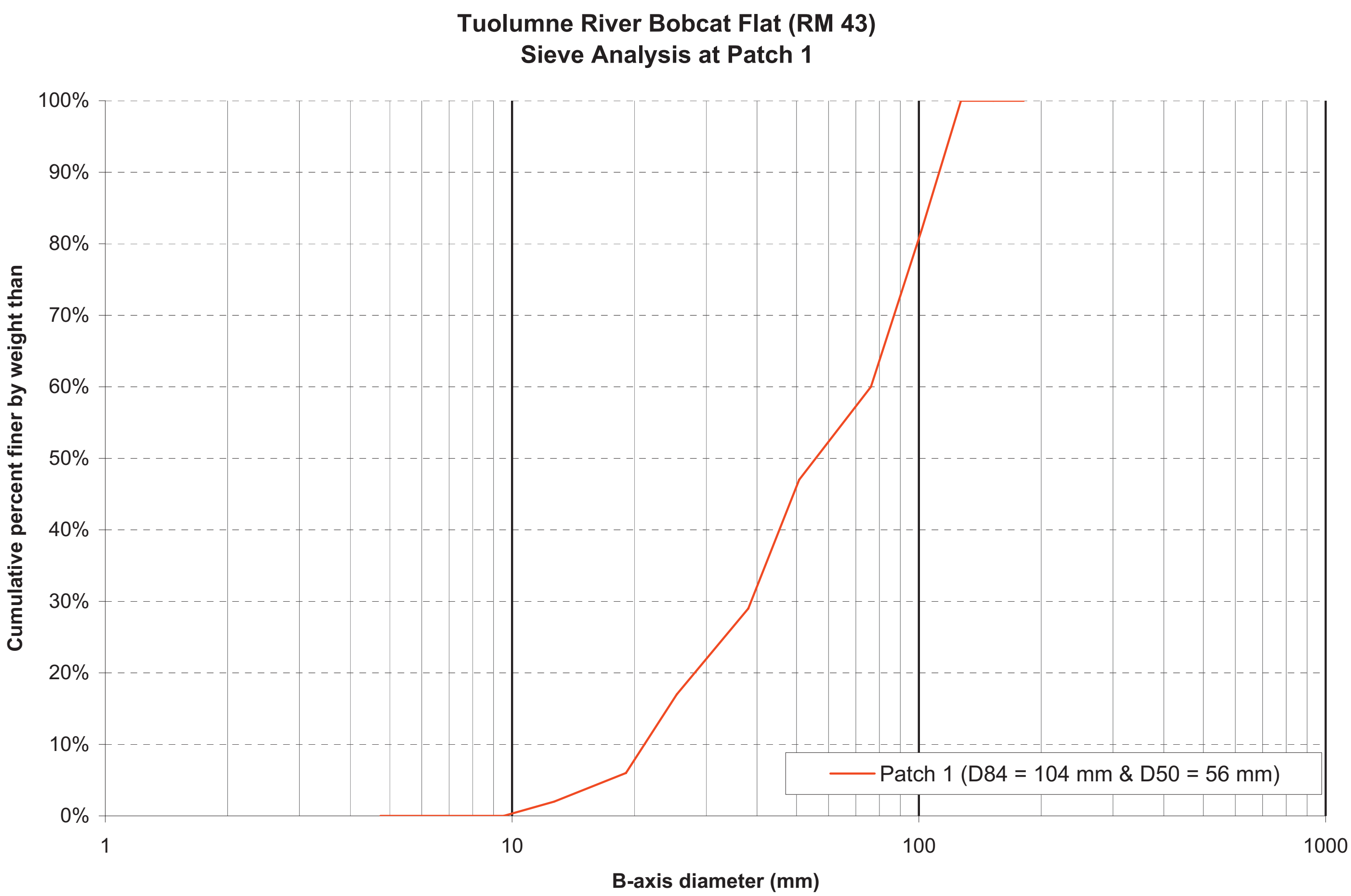

Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 5
Cumulative percent finer by weight than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
B-axis diameter (mm)
Patch 5 (D84 = 97 mm & D50 = 49 mm)


Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 4
Cumulative percent finer by weight than
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1
10
100
1000
B-axis diameter (mm)
Patch 4 (D84 = 97 mm & D50 = 48 mm)


Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 3
Cumulative percent finer by weight than
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1
10
100
1000
B-axis diameter (mm)
Patch 3 (D84 = 102 mm & D50 = 59 mm)



Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 2
Cumulative percent finer by weight than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
B-axis diameter (mm)
Patch 2 (D84 = 91 mm & D50 = 45 mm)



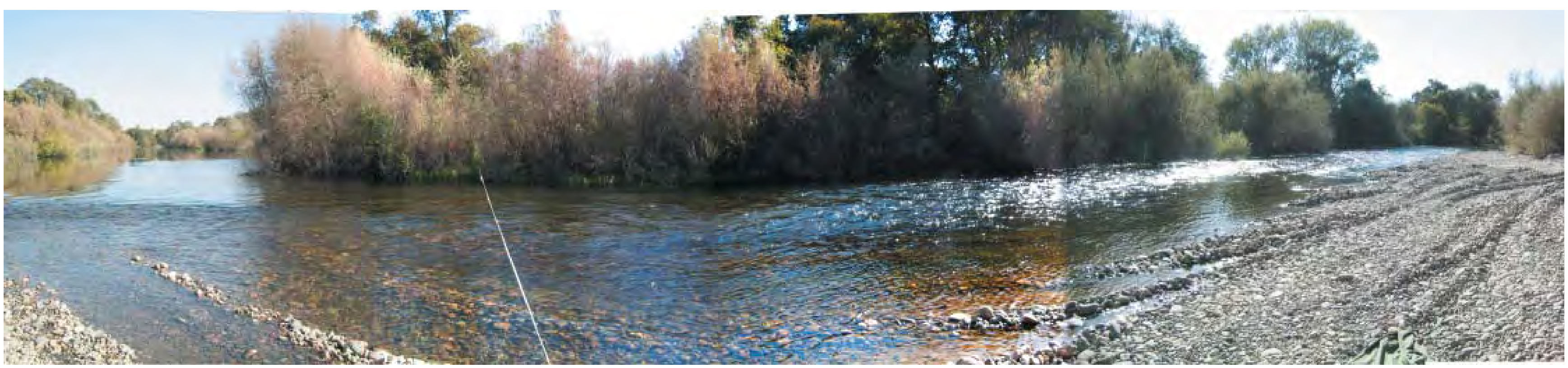
Tuolumne River Bobcat Flat (RM 43)
Sieve Analysis at Patch 1
Cumulative percent finer by weight than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
10
100
1000
B-axis diameter (mm)
Patch 1 (D84 = 104 mm & D50 = 56 mm)

Appendix H

Pre-Project Photos and
Post-Project Photopoints

Pre-construction looking upstream from Patch 2 into Patch 1.

Pre-construction looking from right to left bank at Patch 2.



Post-construction photpoint #1 looking from right to left bank at Patches 1 and 2 (see Figure 11 for photopoint location).

Pre-construction looking downstream from Patch 2 into Patch 3.

Pre-construction looking from right to left bank at Patch 3.

Post-construction photpoint #2 looking from left to right bank at Patch 3 (see Figure 11 for photopoint location).

Pre-construction panorama looking from right to left bank at Patch 4.

Post-construction photpoint #3 looking from right to left bank at Patch 4 (see Figure 11 for photopoint location).

Pre-construction photo looking from right to left bank (Photo taken by Friends of the Tuolumne).

Post-construction photopoint #4 looking from right to left bank at Patch 5 (see Figure 11 for photopoint location).

Pre-construction photo looking from right to left bank just up-
stream of Patch 6 (Photo taken by Friends of the Tuolumne).

Post-construction photopoint #5 looking from right bank downstream at Patch 6 (see Figure 11 for photopoint location).