

Pre-assessment of Riverbend 2013 Site, American River, CA



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1. INTRODUCTION AND OBJECTIVE

1.1 Objective

Results described in this report are a summary of data collected at the proposed 2013 restoration site located near Riverbend Park in Rancho Cordova, CA. Data collected from this site will provide an initial site assessment as well as a reference point for post-restoration analysis.

Objectives for the fieldwork and analysis are summarized below:

- Conduct grain size analyses using six (6) bulk samples
- Map Mehrten or Fair Oaks Formation bedrock exposures
- Obtain gravel depths in the existing stream bed

1.2 Site Overview

There appears to be a limited supply of suitable spawning gravel near Riverbend Park in Rancho Cordova (Figure 1.1). This site lies below Nimbus Dam, where the Lower American River has incised into Miocene to Pliocene-aged sandstone and siltstone of the Fair Oaks and Mehrten Formations. Aerial photos of the Riverbend site show extensive bedrock exposures, and initial site surveys indicated that gravel depth may be a limiting factor for spawning. A site visit conducted by the gravel advisory team on January 25, 2013 raised significant questions about surface grain size, armoring, an abundance of subsurface fine material, and sand content of the gravel bar. This report attempts to quantify these variables so that the project design team can propose a reasonable restoration solution.



Figure 1.1: Site location map for the 2013 Riverbend project.

2. METHODS

2.1 Bulk Samples and Sieve Analysis

Bulk samples were used to characterize grain size at the Riverbend location. With this method, a sample weighing several 100 kg was collected at each of six sites. The location of the samples was chosen to emphasis mid-channel areas where spawning gravel may be enhanced, and

gravel bars that may serve as a gravel sources for augmentation in the river. At each location, the sample size was calculated as 20x of the weight of the largest surface grain. Surface and substrate samples were collected and sieved separately to determine an armoring index. The depth of the surface sample was defined as the diameter of the largest surface grain. After the sample location was chosen, a metal baffle (Figure 2.1i) was installed to prevent the finest materials from escaping downstream during sampling.

The location of each sample was marked with a Trimble high resolution GPS. Bulk samples were collected with a shovel, and ferried to the sieving site in five gallon buckets. At the sieving site samples were drained and weighed using a digital scale. Seven rocker sieves were used (Figure 2.1ii) to sieve the sample into designated size classes. Sieve openings were 5/16, 5/8, 7/8, 1.25, 1.75, 2.5, and 3.5 inches in size. Grains larger than 3.5 inches were measured with a template to determine the intermediate diameter. The grains from each size class were weighed on a digital balance, and the finest grains were brought back to the lab for further sieving using a rotap. Grain size data were plotted to show percent size distribution as cumulative frequency percent.



i



ii

Figure 2.1: i). Metal baffle prevents fines from escaping downstream. ii) Five gallon buckets containing different size classes after grains were sieved.

2.2 Bedrock Mapping

Field workers first assessed the site on foot, recording exposed bedrock locations on a map and making notes about the lithology. This site has many exposed bedrock blocks and bedrock outcrops. A high resolution Trimble GPS was used to log displaced bedrock block locations and bedrock outcrops. A shapefile was created for the map area by walking around the exposed bedrock and logging the track on the Trimble GPS. Map data were plotted using ArcGIS. High-resolution aerial photographs of the site area were then analyzed to check the accuracy of the field data. Contacts were drawn using both the collected data and the photographs as a guide for shape and orientation.

2.3 Apparent Gravel Depth Measurement

The field team also measured the depth of the gravel along the right and left banks and on the gravel bar where bulk samples were collected. A grid approach was adopted for gravel thickness measurements, with 10 – 15 foot spacing between measurements. At each site, a rebar probe was pounded into the river gravel using a sledge hammer. Rebar probes were marked to display depth in half foot increments, starting at 0.5 feet and going to 3.0 feet. After each gravel depth measurement was taken, the location was logged using a Trimble GPS. Gravel depth was recorded in a field notebook.

Gravel depth measurements were not possible in the channel center and downstream areas because flow was too deep or fast for wading measurements. A moderate amount of force was employed to pound the depth probe into the gravel, so it should be noted that the measurements taken could represent depth to bedrock, or they could represent depth to excessively large grains. For this reason, data collected should be considered the apparent or minimum gravel depth. At some sites the rebar penetrated to bedrock, leaving fine clay sediment on the rebar probe. The

length of the sediment on the probe was subtracted from the gravel thickness measurement before being recorded. Gravel depths were plotted in ArcMap, and a contoured depth map was generated based on the field data.

3. RESULTS

3.1 Bulk Samples

Six bulk samples were collected and analyzed at the proposed 2013 site (Figure 3.1). Samples A, B, and C, were taken near the east (left) bank of the river and on the gravel bar. Sample F was taken in the main channel near the left bank. Samples E and G were taken in the main channel near the right bank of the river. Sample E was located at the mouth of the side channel along the western edge of the study area, and sample G was taken closer to the center of the channel (Figure 3.1).

Figures 3.2 and 3.3 show composite cumulative grain size distributions for the surface and subsurface samples. All surface samples had excess coarse material, and all subsurface samples had excess fine material. These two parameters indicate a highly armored river bed.

Individual results for each site show some variability, with D_{50} values for surface samples ranging from 1.5 to 3.5 inches (Figure 3.4-3.9). Subsurface D_{50} values are much lower than surface D_{50} values, with a range from 5/16 to 2.5 inches. Fines are abundant in the subsurface, with samples B, C, and A containing 20% fines or greater. Samples F and E contain approximately 10% fines each, while Sample G contains less than 1% fine material.

2013 Site Bulk Sample Location Map

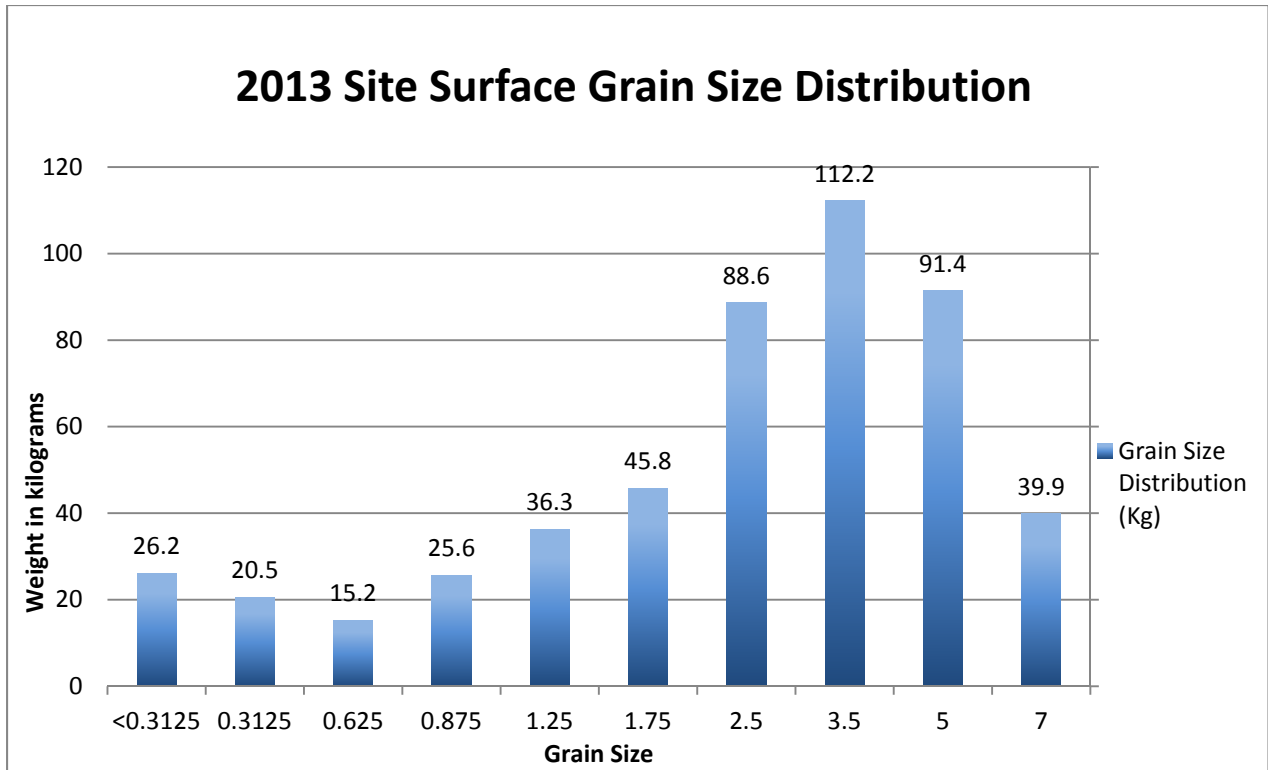


0 5 10 20 30 40 50 Feet

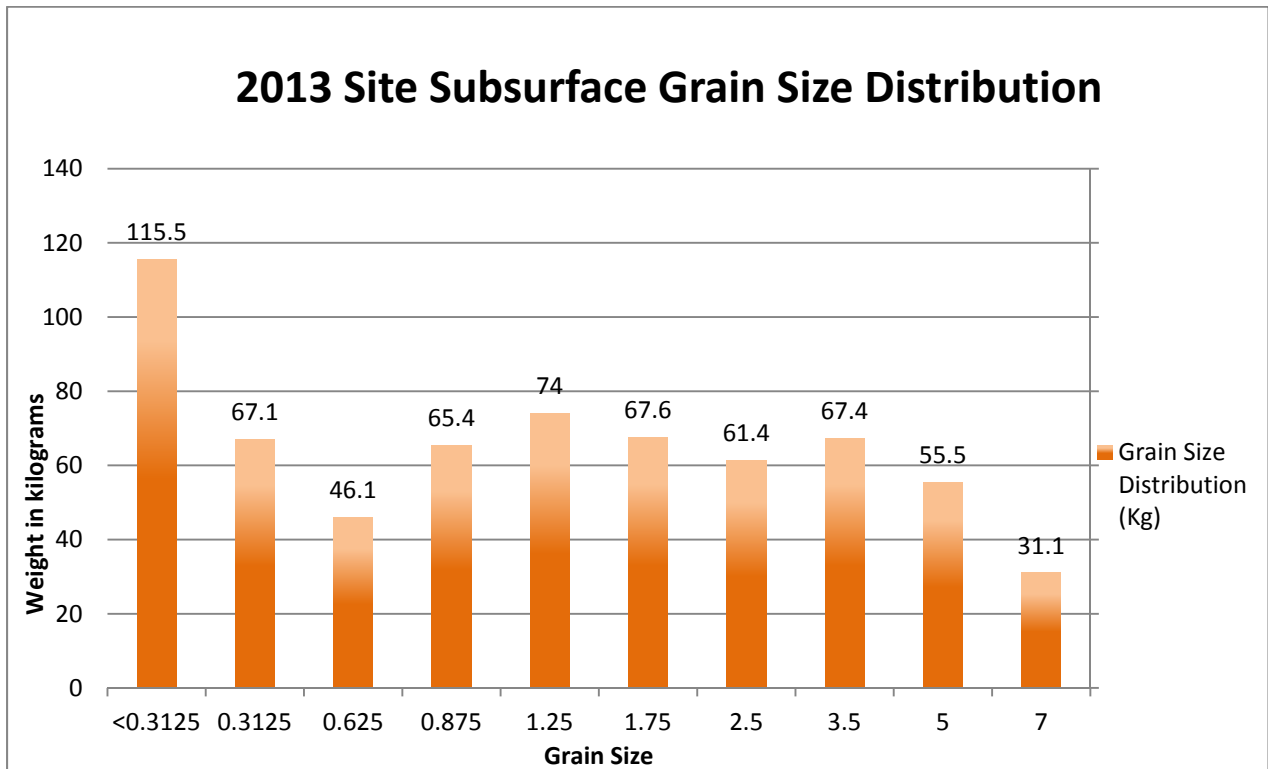
Legend

● Bulk Sample Location

Figure 3.1: Bulk sample location map.



Figures 3.2 : Cumulative grain size distributions for surface (composite of all six samples).



Figures 3.3: Cumulative grain size distributions for subsurface (composite of all six samples).

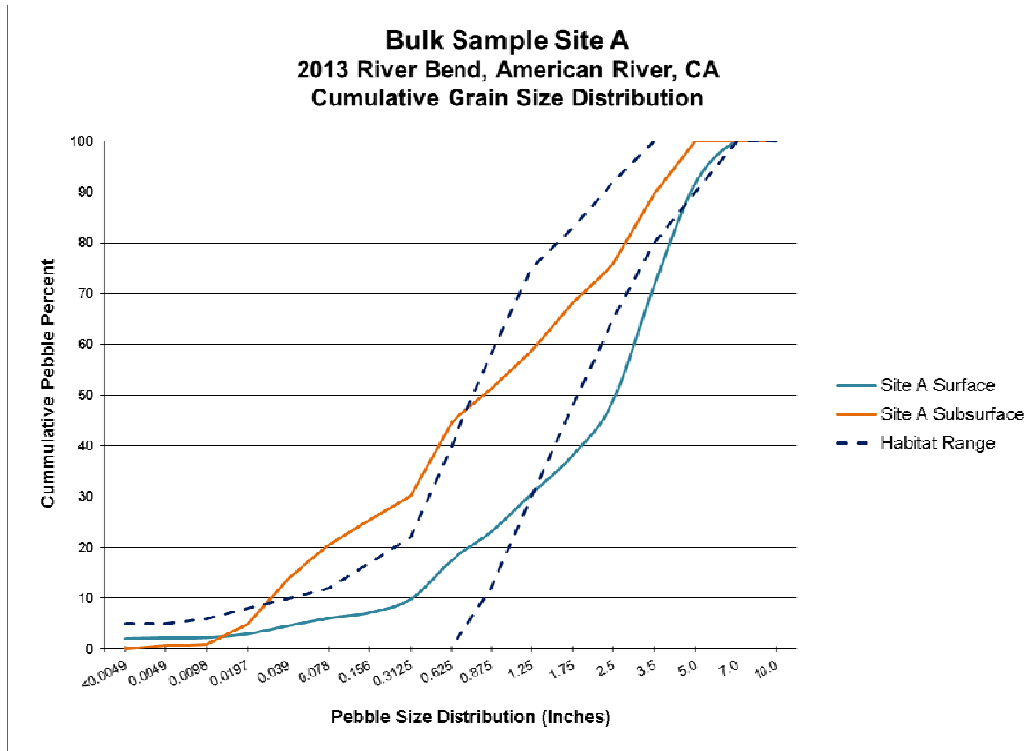


Figure 3.4: Bulk Sample A, surface (blue) D_{50} value= 2.5 inches, subsurface (orange) D_{50} value= 5/16 inches.

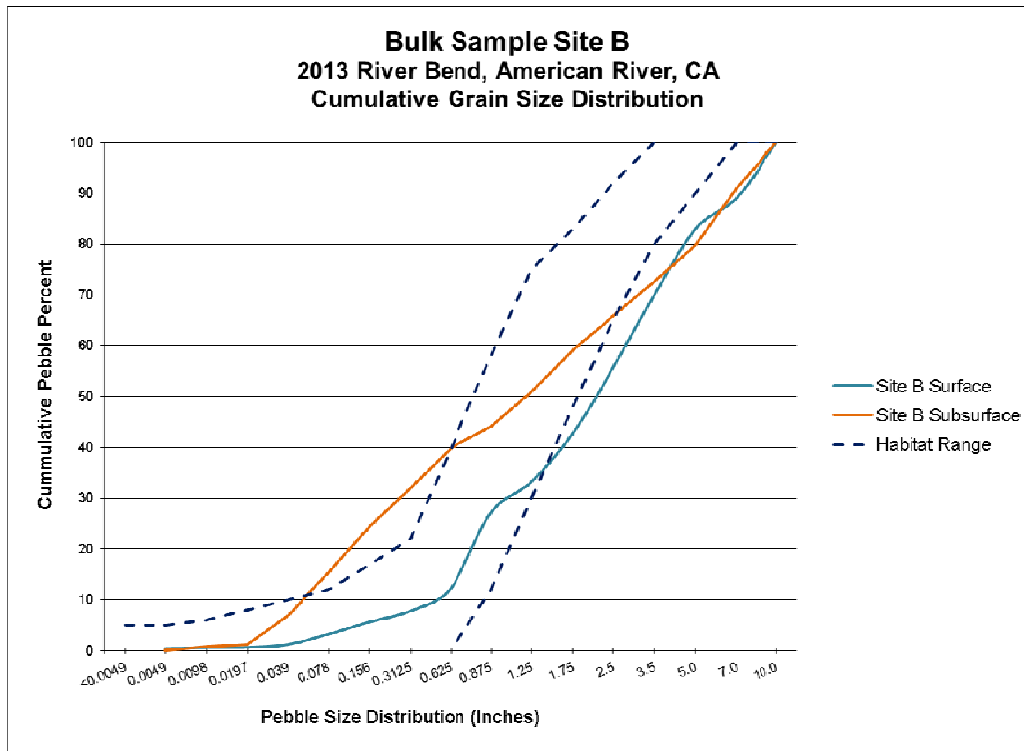


Figure 3.5: Bulk Sample B, surface (blue) D_{50} value= 1.75 inches, subsurface (orange) D_{50} values= 7/8 inches.

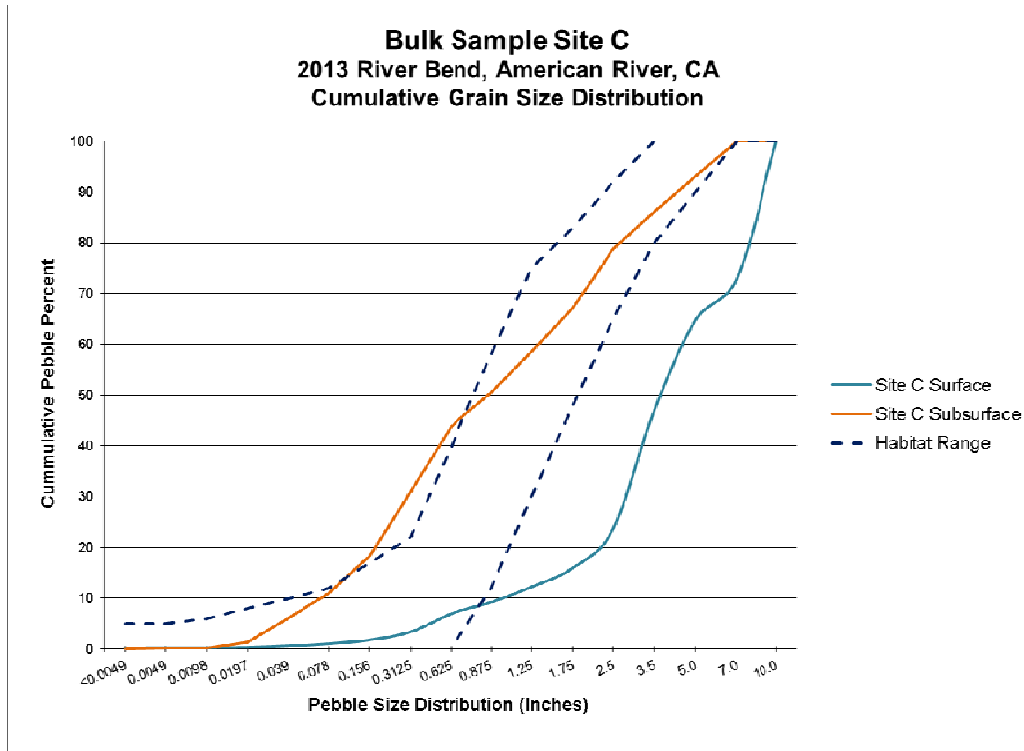


Figure 3.6: Bulk Sample C, surface (blue) D_{50} value= 3.5 inches, subsurface (orange) D_{50} values <5/16 inches.

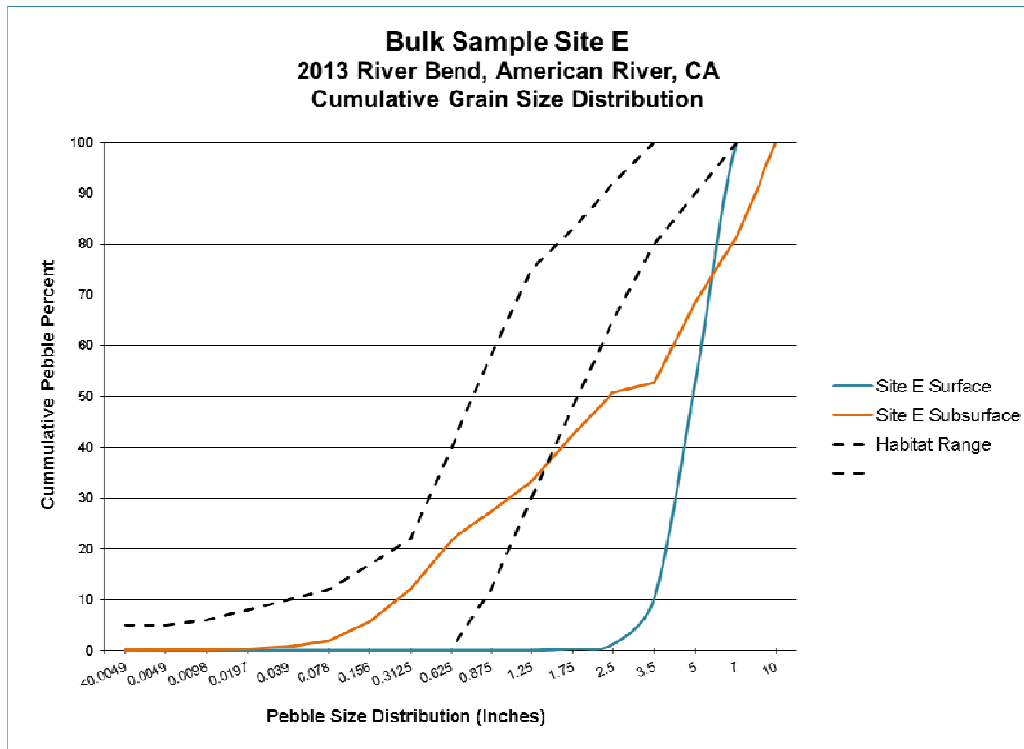


Figure 3.7: Bulk Sample E, surface (blue) D_{50} value= 3.5 inches, subsurface (orange) D_{50} value= 1.75 inches.

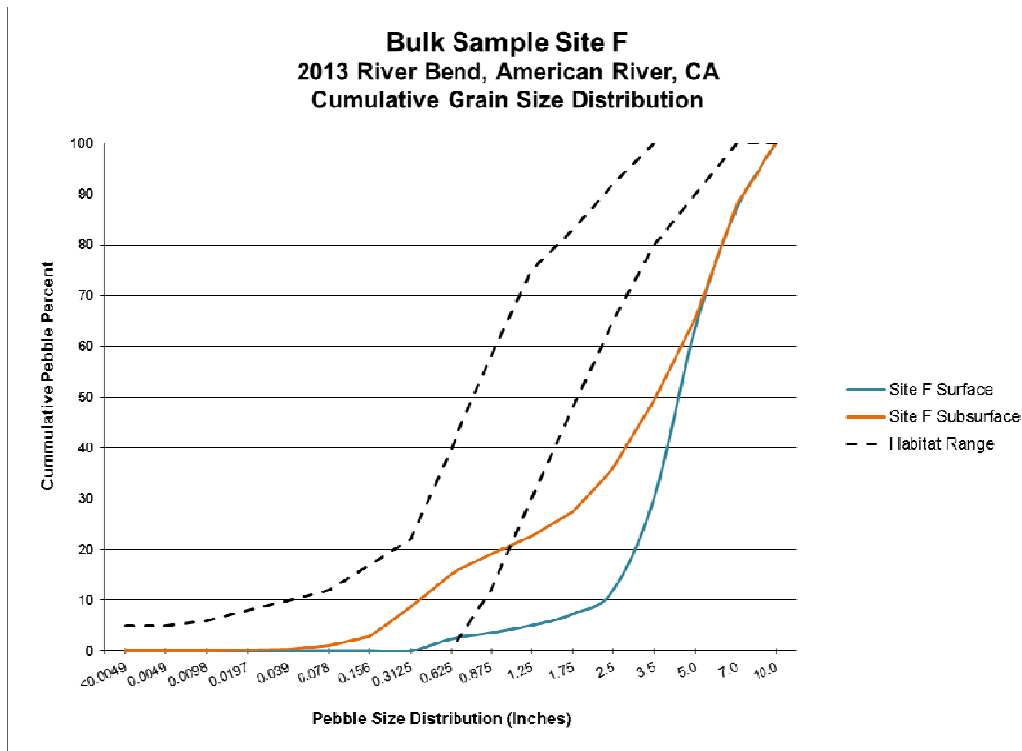


Figure 3.8: Bulk Sample F, surface (blue) D_{50} value= 3.5 inches, subsurface (orange) D_{50} value= 2.5 inches.

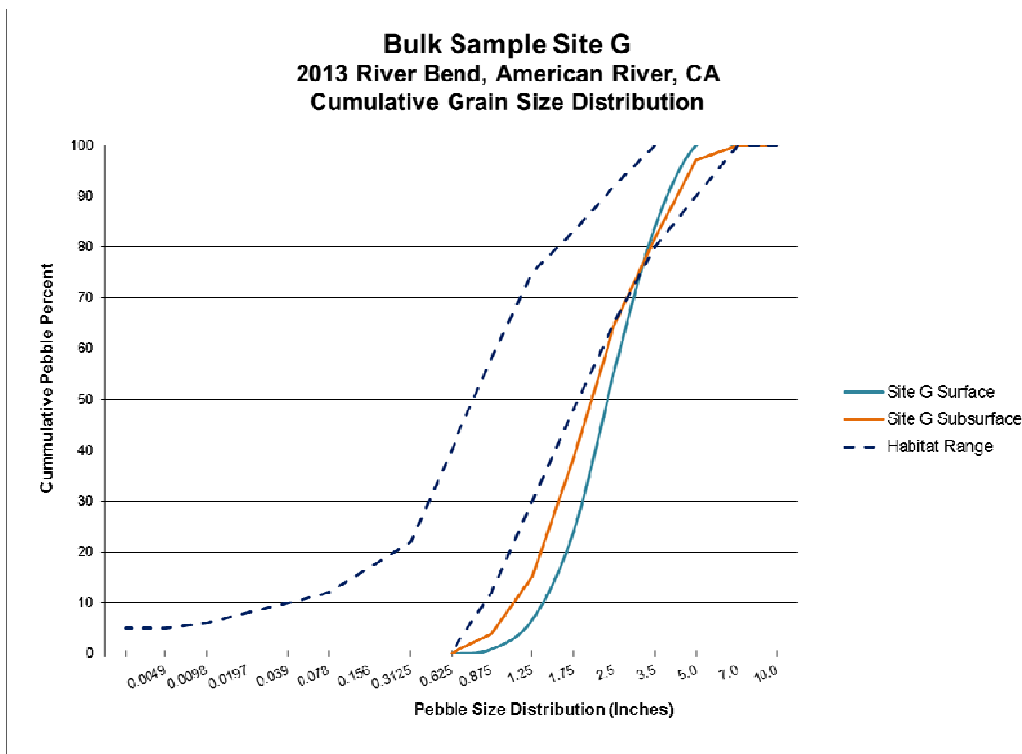


Figure 3.9: Bulk Sample G, surface (blue) D_{50} value= 2.5 inches, subsurface (orange) D_{50} value= 1.75 inches.

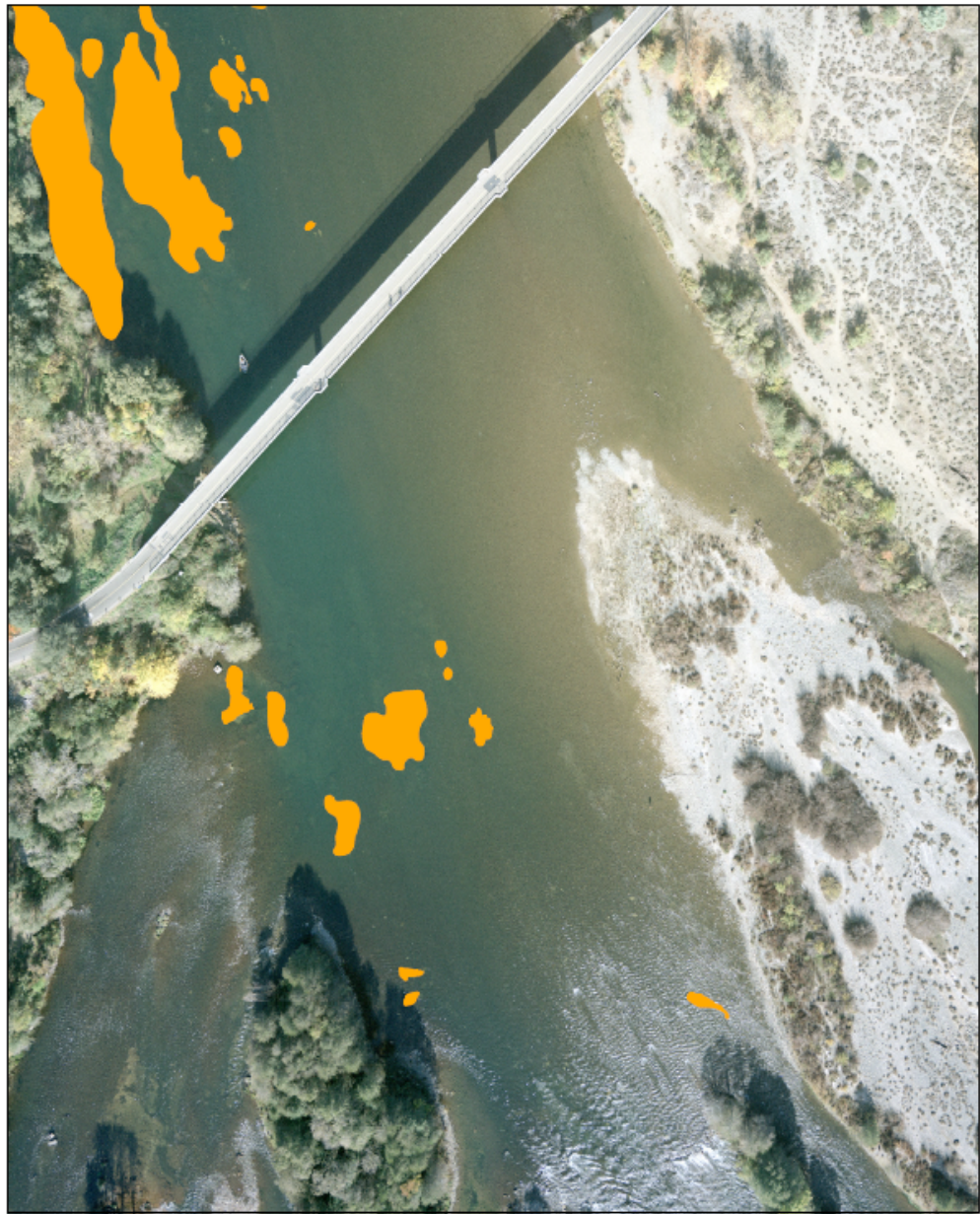
3.2 Bedrock Map

The bedrock map (Figure 3.10) indicates that the majority of the exposed bedrock is located in the northeastern region of the study area, along the right bank. Exposed bedrock consisted of a light tan/brown clay to siltstone, of moderate to low resistance, although it is highly impermeable. Bedrock exposures tended to form linear outcrops that trend downstream parallel to the current direction.

3.3 Apparent Gravel Depth Map

The apparent gravel depth map (Figure 3.11) shows measured gravel depths in the form of an elevation raster graphic. Data indicate that much of the northern central channel and the western side channel have an apparent gravel depth of less than one foot. Apparent gravel depth increases with proximity to the gravel bars. In the southern end of the site, a zone of deeper gravel was noted on either side of the central channel. There was no indication of gravel depth greater than 3 feet in this area.

2013 Bedrock Exposure Map



0 5 10 20 30 40 50
Feet

Legend


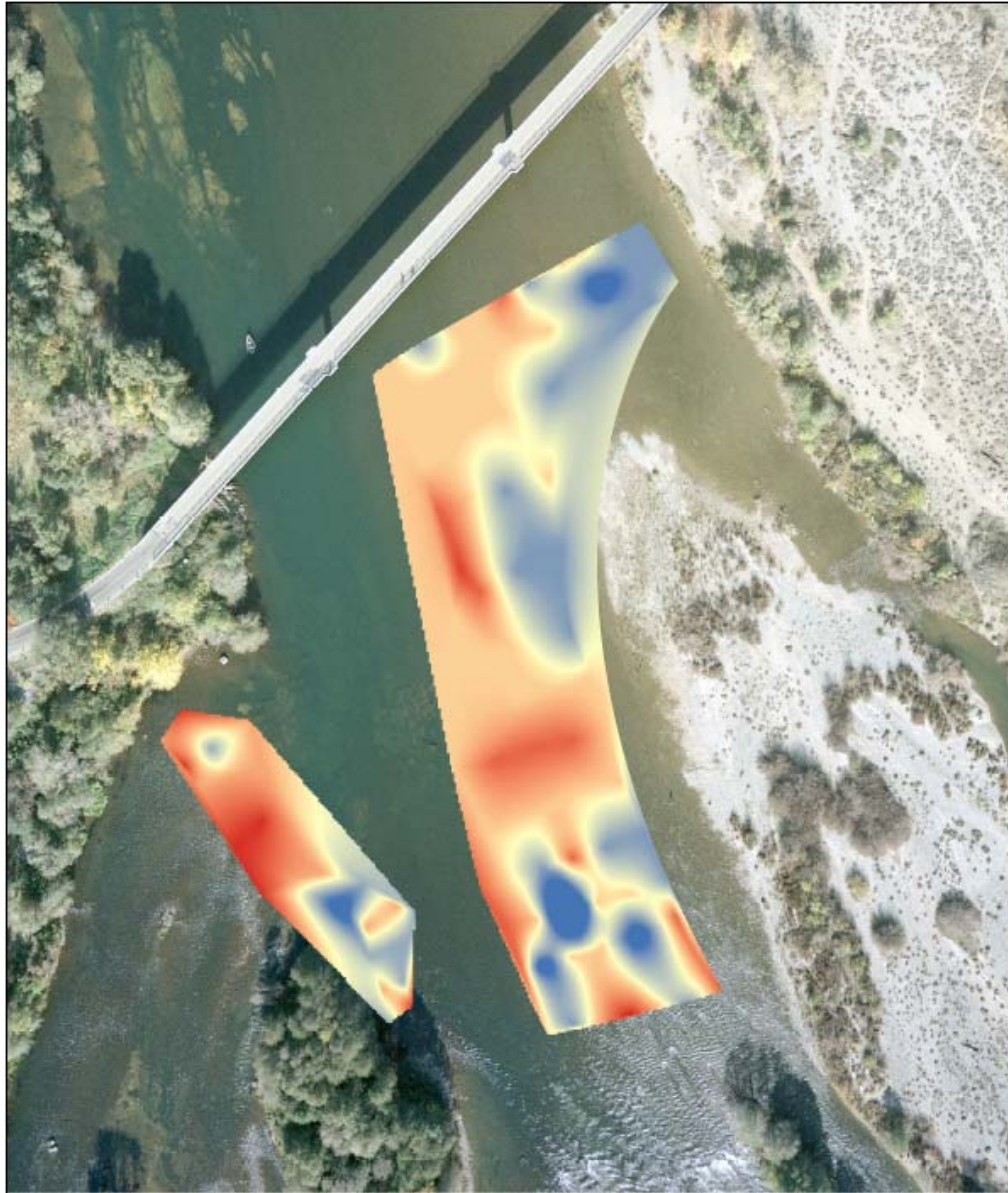
 Bedrock Exposure

Figure 3.10: Exposed bedrock map. Some smaller bedrock exposures are probably isolated erosional blocks.

2013 Apparent Gravel Depth Map



Legend
Gravel Depth Value
High : 1.5 - 2 ft
- Moderate: 1 - 1.5 ft
Low : < 1 foot

Figure 3.11: Apparent gravel depth map. Thicknesses are minimum gravel thickness.

4. DISCUSSION

4.1 Bulk Samples

The excess of large grains on the surface and abundance of fine material in the subsurface indicates that significant gravel armoring has occurred at this site.

Bulk Samples A and B were taken from the exposed gravel bar on the eastern edge of the study area. These sites are exposed at low flow and removed from the dynamics of the central channel. These locations were less affected by fluvial processes, and had surface grains that were slightly coarser than preferred spawning gravel size. Subsurface grain size on the gravel bar is more of a problem. Approximately 30% of the subsurface grains at sites A and B were smaller than 5/16 of an inch. These data lead us to conclude that the western gravel bar is too sandy to prove a viable source for spawning gravels. Sieving the gravel bar will not produce a significant amount of spawning gravel.

Samples F and C were collected near the gravel bar, but in areas that were usually wetted and exposed to fluvial activity. Samples F and C displayed more armoring than samples from the exposed gravel bar. Sample F is heavily armored, and was collected closer to the central channel. This is due to the higher flow velocities associated with the central channel. The percentage of fines associated with sample F was significantly less than the other samples taken from the gravel bar region. This is due to winnowing and exposure to fluvial processes that dominate the thalweg. Sample C was slightly less armored, and was taken from the protected side of the gravel bar. Sample C has high sand content that is similar to the grain size of the main gravel bar.

Samples E and G were taken from right or west bank, where a prominent an active side channel splits from the main channel around a vegetated gravel bar. Sample E, taken upstream of

the side channel, displays severe armoring, with a surface D_{50} value of 3.5 inches. The material in sample E is poorly sorted, and this sample also had excess coarse material.

Sample G displayed a very different grain size pattern, with similar surface and subsurface size distributions. Armoring was minimal at this site. D_{50} values for surface and subsurface are 1.75 inches and 1.25 inches respectively, and the diameter of these gravels is almost within the window that defines suitable spawning habitat. This is the only sample site for this pre-assessment project where grain size distribution is close to the suitable habitat size range. Fines are essentially absent at this site, and the smallest grains sampled are approximately 5/16 inches in diameter.

4.2 Bedrock Map

The bedrock map (Figure 3.10) shows the presence of exposed bedrock outcrops within the study area. The majority of the bedrock exists along the western (right bank) where the central channel splits. Outcrops in this area consist of impermeable clay bedrock with a smooth surface that creates little resistance to gravel mobility. Gravel placed on this clay may not adhere after placement.

4.3 Apparent Gravel Depth Map

The apparent gravel depth map (Figure 3.11) indicates a significant disparity of gravel within the central channel, with a slightly greater apparent gravel depth near the gravel bars. Average measured gravel depths near the center channel range from 0.5 feet to 1.0 feet. Gravel was thicker along the upstream edge of the gravel bar, ranging from 1.0 to 1.5 feet. A few pockets of deeper gravel occur along the gravel bar, and could indicate gravel-filled pools or depressions.

The average apparent gravel depth for the western side channel was less than 0.5 feet

(Figure 3.11), although gravel thickness increased in the protected area near the vegetated central island. The mean gravel depth in the western side channel area (right bank) is probably too shallow for suitable salmonid habitat or gravel retention unless the project design results in major modification of the stream channel.

5. APPENDIX



Photo 1: Overview of 2013 site area.



Photo 2: Sample A surface sample.



Photo 3: Sample A surface-subsurface boundary.



Photo 4: Sample A subsurface sample.



Photo 5: Sample F surface sample.



Photo 6: Sample F surface-subsurface boundary.



Photo 7: Sample E surface-subsurface boundary.

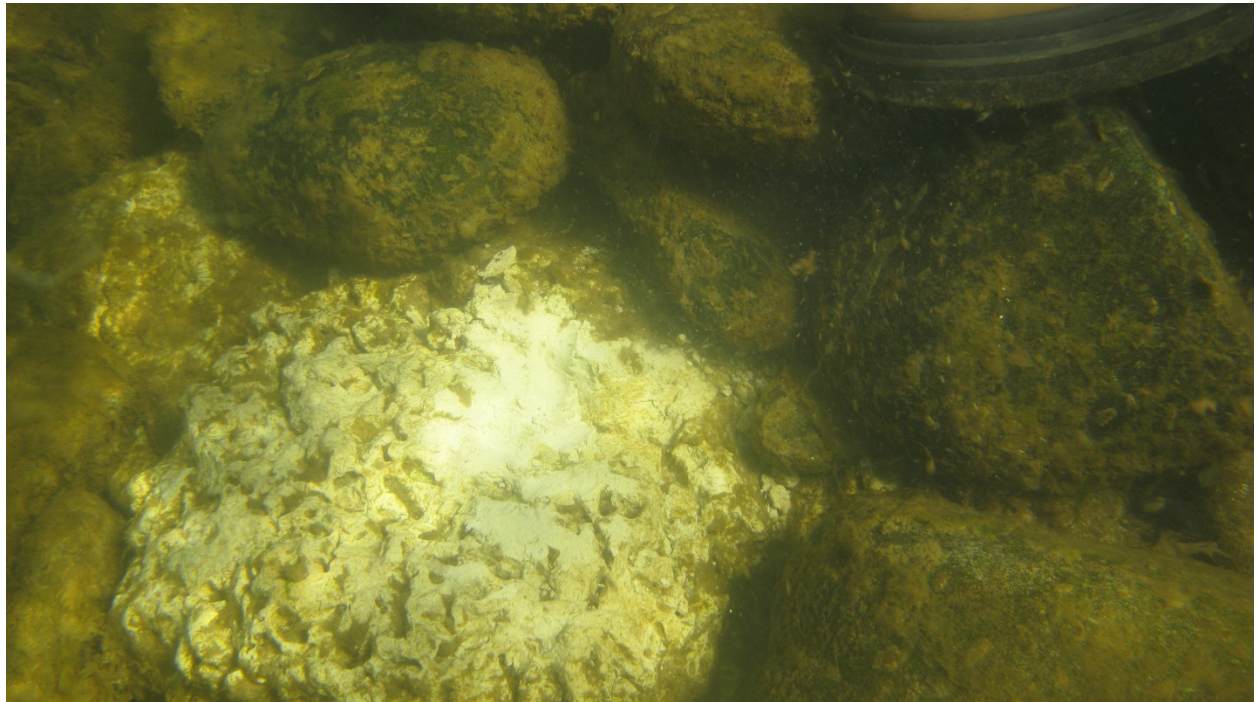


Photo 8: Exposed Bedrock in the center channel.