Post Project Appraisal of Cerrito Creek at El Cerrito Plaza

FINAL DRAFT

By
Sarah Berndt and Fran Smith
Graduate Students, Civil and Environmental Engineering
University of California, Berkeley

Landscape Architecture 227
Professor, Dr. Matt Kondolf
Gradaute Student Instructor, Toby Minear

Abstract

This paper presents a Post Project Appraisal (PPA) of the Cerrito Creek Restoration Project at El Cerrito Plaza in El Cerrito, CA. In 2003, a three-block day-lighted section of Cerrito Creek (approximately 700 feet in length) located between Talbot and Kains Streets was restored. This stretch of creek is bordered on the north by the Plaza parking lot and on the south by residential units (mainly apartment buildings), which greatly limits the size on the project. Urbanization on both sides reduced the creek to nothing a narrow, deep ravine, but after the neighboring shopping center agreed to retract their parking lot by 20 ft, the City of El Cerrito was able to begin the restoration. Using the project design drawings, interviews with community members, and data collected during site visits we evaluated the project. Our team created a detailed reach map, took cross-sections at various points of interest throughout the channel and conducted a pebble count of the major gravel bar. We compared the reach map with the design drawings to determine changes in vegetation, rock weirs, and boulder locations. In addition, we compared cross-sections to see how the shape of the channel and steepness of slopes changed over time. There was some possibility that several rock weirs have been removed by the flow, since we could not locate them where they were shown on the design drawings. However, since as-built conditions were not recorded, these weirs may not have been built. Overall, we determined the project to be a success, and more importantly, we hope that the data collected can be used as post-project baseline data for future analysis of this channel.

Introduction

Cerrito Creek drains a portion of the East Bay Hills flowing westward to San Francisco Bay forming the border between Alameda and Contra Costa Counties. This creek is located in southern El Cerrito within the San Pablo Bay Watershed and historically drained into the San Francisco Bay tidal marshes. The marshes were mostly filled over time and the creek is now channeled through storm drains out to the Albany mudflats. In addition, like many other creeks within the watershed, large stretches of Cerrito Creek are now either in underground culverts or engineered channels.

Figure 1: Satellite photo of the Cerrito creek site (Google Maps)

The reach of the creek within the scope of this project is a three-block daylighted section starting at Talbot Avenue and extending approximately 700 feet down to Kains Avenue. Cornell Avenue (1 block west of Talbot) runs over the reach to the parking lot so the stream flows through a box culvert at that point. This splits the reach into a downstream section extending from Kains to Cornell and an upstream section from Cornell to Talbot; throughout the rest of this paper this is how we will identify the two sections.

The project is bordered by the El Cerrito Plaza shopping center to the north and dense residential units (mainly apartments) to the south (Figure 1). As part of a renewal project for El Cerrito Plaza, the owner agreed to retract the parking lot, allowing approximately 20 additional feet for a new stream channel and flood terrace system (Hanford ARC website, http://www.hanfordarc.com/cerrito.htm). In collaboration with the Friends of Five Creeks, the City of El Cerrito hired Wolfe-Mason Associates to design the project and Hanford ARC to grade the new meander, add rock weirs and toe protection, and re-vegetate the landscape.

Project Constraints

Prior to evaluating the success of the project, it is important to mention some of the constraints that helped to modify the design in order to still achieve the goals.

Although the parking lot was moved back approximately 20 feet, the site was still very constrained for space. The lack of space limited the number of meanders that could be incorporated into the design. Meanders help to reduce water velocities which were eroding and undercutting the banks. Instead of several meanders, rock weirs and in-stream boulders were installed to dissipate energy and reduce velocities during high flow conditions (Class lecture, Sarah Sutton, October 26 2005). Rip-rap consisting of large boulders was installed along nearly the entire length of the channel to provide increased bank strength and stability.

The community involvement in this project was and continues to be essential, therefore the acceptance of the community was an important factor in the design. While willows are one of the best native plants for bank stabilization and strength, there was community input that installation of willows would attract vagrants, collect trash and be difficult to maintain (Sarah

Sutton, 10/26/05). Compromise in the design included limiting the number of willows planted. They were used only in select areas where very steep slopes near the water were present. Some of the members of the community still have trouble accepting the native grasses that were planted along sections of the banks and often mistake the grasses for weeds. For this reason many of the post-project plantings have not included grasses but other species that generally provide a "neater" appearance to the project.

Lastly, the project encountered many constraints with time and money. Finding the proper grants and completing the work within the allotted time was a challenge. These constraints are especially difficult because the project is located in an urban environment where the cooperation of so many people is required. In particular, there was a large coordination effort with PG&E to relocate a number of power poles along the northern bank. Due to money constraints, there is no extensive post-project data from which to base a post project appraisal (PPA).

Restoration Project Goals

The success of any restoration project can only be judged based on the specific goals of that project. The term "restoration" has many different meanings and therefore there are no generic evaluation techniques that can be applied to determine if the project is a success. Goals can also vary based on opinion. We gathered information on project goals from available project documents and the views of various people involved in the project including, Susan Schwartz (Friends of Five Creeks) and Sarah Sutton (Wolfe Mason Associates). The project documents reviewed include a Department of Water Resources grant application, an agenda bill to the El Cerrito City Council, a draft description of the Cordonices and Cerrito Creeks, and lastly design drawings for the project. The goals that we determined had been set for this project are as follows:

- Creation of a "natural meandering channel"
- Reduction of flooding and bank erosion
- Removal of invasive species
- Re-vegetation of slopes with native plants
- Enhancement of environmental values and promotion of community stewardship
- Reduction of sedimentation and maintenance problems

Using this list we chose methods to evaluate each goal. These goals are the basis for the overall evaluation of project success.

Methods

To analyze the main project goals, our team created a detailed map of the reach. Starting at the downstream edge of the reach (Kains Avenue culvert) with STA 0+00 and working east upstream to the Talbot Avenue culvert at STA 6+94, we captured major features on the immediate sides of both banks. We made special note of the location of the rock toe, various retaining walls along the bank, large trees, and the pedestrian path. Since we were unable to obtain a set of as-built drawings for the project, we then compared our map to the original design drawings to see how the channel has changed in the past two years. We also gained insight on the project from a lecture given by Sarah Sutton who was involved with Wolfe Mason Associates at the time of this project.

In addition, we surveyed five different cross-sections (see Figures 2-7) taken throughout the entire length of the reach to determine the current conditions of the channel as well as any changes in channel geometry from the original design. The original design cross-sections were taken at apparently arbitrary angles and positions; we decided to survey cross-sections at specific markers (trees and utility poles) at an angle perpendicular to the direction of the channel. In addition to not having rebar marking the sites of the cross sections, there was no elevation benchmark in the field. From the project design plan, we took the elevation of the base of a utility pole directly adjacent to the pedestrian path (STA 2+15) as our benchmark, assuming this elevation has not changed over time.

To determine average sediment size, we performed a pebble count on one of the few gravel bars present. The sediment type was uniform throughout the downstream reach therefore we believe our pebble distribution is representative of both the gravel bars and the bed material.

To evaluate community stewardship we spoke with a number of people within the local community to document their feelings on the restoration. We spoke to three shopping center patrons, one neighbor, and two pedestrians walking the creekside path. In addition, we interviewed Susan Schwartz, head of the Friends of Five Creeks, which was the prominent proponent of this project and continues to lead the re-vegetation and maintenance efforts.

Results and Discussion

Reach map comparison

The lack of post-project and baseline data make post project evaluation difficult. Without as-built drawings available, we used the design drawings as the basis for evaluation. By comparing our detailed reach map with the design drawings we were able to see differences in the planned and current design of the site. Future PPAs can use this reach map to track changes at the project site over time. The full reach map can be found in Appendix A.

Overall, we found that since construction, the flow path of the stream has not changed significantly. The concrete was completely removed from the channel and extensive rock toe has been installed. As we mentioned earlier, because the site is so narrow there is no room for lateral movement of the channel. Therefore, the rock toe lines the channel edges throughout the upstream reach and continues along the majority of the downstream reach. This widespread use of rock toe has essentially created an engineered trapezoidal channel. Where rock toe is not present, there are "sack-crete" and block retaining walls in place to protect the southern slope.

The design plans called for approximately 25 in-stream boulders, however, our reach map shows that only 11 remain in the stream. Five of the boulders shown in the reach map are in the upstream section of the reach, however, the design drawings do not show any in this section of the reach. The lack of boulders overall can probably be attributed at least in part to on-site construction decisions not reflected in the design drawings. It is also possible that these rocks were transported or buried during high flows in 2004 and 2005.

The design drawings call for five rock weirs in the downstream reach and three in the upstream reach. During our field study, we found three weirs in the downstream reach and two in the upstream reach. There is one grouping of rocks in the downstream reach (STA 1+10) that appears to be a failed weir; as for the other two rock weirs, there was inconclusive evidence as to whether or not they were ever installed. Outside of comparing numbers of installed and failed weirs, it is difficult to evaluate the success of the weirs in helping to achieve project goals.

The reach map also offers details regarding general planting and vegetation along the stretch of the project. All of the trees that were marked for protection on the design drawings are still thriving at the project sight. However, we did learn that the first round of plantings installed by the contractors did not have a high survival rate (Personal communication with Susan

Schwartz, November 11, 2005). The slopes are not irrigated which made it hard for the initial vegetation to establish. Furthermore, the types of vegetation installed were not ideal. However, the Friends of Five Creeks did come in and replant the slopes with native vegetation and we saw that all of these plants seem to be doing very well. Additionally, the rock toe was planted with alders and other trees were planted on the upper terrace along the pedestrian path. There is relatively no canopy cover at this time because the project is less than two years old. However, we believe that the trees planted along the reach will eventually grow and provide shade in the area. While details on exact number of specific species are hard to compare, the reach map shows extensive vegetation along the banks similar to what is show in the design drawings.

Cross-Sections

We compared our 2005 cross-sections with the general channel shape shown in the design plans. The design plans include 14 cross-sectional views along the reach and provide the details for constructing and re-grading the bank slopes. We were able to estimate one cross-section for comparison and two other cross-sections were compared to design cross-sections nearby. The other two cross-sections that we measured can be used to get a general idea of the bank slopes in those regions. Assuming the slopes were constructed as originally designed, we can make some conclusions about how the slopes have changed. The graphical representations of the cross-sections can be found in Appendix B.

We selected locations for cross-sections based on features of interest in the stream. These locations are indicated on the reach map. Cross-section A is the furthest downstream location, at approximately STA 0+25, near the downstream end of the restored portion of the creek. Cross-section B is located in the downstream reach across a rock weir located at approximately STA 1+10. Cross-section C is at approximately STA 2+00 in the middle of the downstream reach where there appears to be a failed rock weir. Here we attempted to replicate a design cross-section shown between two utility poles, but there is no longer a pole on the south bank, so we estimated the location. Cross-sections D and E were taken in the upstream section of the project. As shown in the reach map, this section is a straight uniform channel, so the location of D is such that it captures the general overall trends. The last location, cross-section E, is at the very beginning of the project, just downstream of the influent culvert. Here, the deepest and largest pool over the entire stretch of the project is located.

Since we were able to compare cross-section A directly with the design drawings, we noticed some major differences. The stream has shifted completely over to the left bank with a slight scouring of the retaining wall such that the bottom of the wall is exposed. The stream shift is shown in Figure 2. The current stream bed is only two feet in width compared to the 10 foot design channel. There has been deposition on the right (north) side creating one of the only gravel bars within the channel. Overall the slope on the right side appears to be unchanged. During our field investigation we observed a large Redwood tree on the right bank between the edge of the bank and the pedestrian path. The leaf and stick debris from this and other surrounding Redwoods is forming a thick layer of ground cover which is inhibiting any other plants from growing in this section. We matched the cross sections using the bottom of the retaining wall; doing so suggests that the debris on the north bank may be as high as six inches.

Cross-section B (Figure 3) is taken across a fully-functional rock weir. Because there is low flow in the channel, the water is routed through a small crevasse in the rock weir. At the time of the survey there is no overflow. The channel at this point is slightly wider than the ten foot channel however the design shape is still present. We were unable to match this cross section because none of the design cross sections are taken at a rock weir.

Cross Section C, at the failed rock weir, shows some interesting changes. We used a cross-section taken at 2+15 to examine slope changes. Looking at Cross Section C (Figure 4), we see the upper slopes have remained relatively unchanged however it is evident that there was significant scour of the stream bed. This suggests that the rock weir was in fact blown out during highflow, including those rocks that were initially embedded.

Cross Section D was also compared to a typical cross section in this reach. Again, we would like to emphasize that this typical cross section, identified at "typical deisgn" in Figure 5, does not represent the as-built and is merely being used to identify changes in slope. The current slope looks almost identical to the design. Again, the rock toe is dictating the channel shape and direction of flow. The current channel is slightly wider than the ten foot design channel.

Lastly, Cross Section E (Figure 6) is taken the furthest upstream, only 4 ft from the culvert outflow. This is the deepest pool of the reach and seems to be growing in depth. The design cross section end at STA 6+50 with a bottom channel elevation of 30.2 feet. Our cross section taken at STA 6+90 shows a bottom channel elevation of 28.3 feet. Because this location is upstream of the design, we would assume that the channel bed would be at a higher elevation. However, at the site, the source culvert is approximately 1.5 feet above the water surface. During high flows, the water will shoot out of this culvert at very high velocities which can create significant scour of the bed. There is little to no sediment in the upper reach. The bed is covered with mud and the mud bars on either side are now overgrown with watercress. The sediment size and channel depth are consistent with high scouring flows in this reach.

Overall, since the right bank is so heavily reinforced by large rip-rap for a major portion of the reach and the left bank is almost entirely bordered by either rip-rap or retaining walls, the variation in bank slope and width should be minimal barring any large failure in the future.

Pebble Count

We observed very little fine sediment along the entire project and very few gravel bars. The downstream reach has a uniform sediment size in both the bed and the two gravel bars; the upstream reach is covered in mud. Given that the upstream portion of the creek comes from an underground culvert that is linked further upstream to a rectangular concrete channel, there is not a large upstream sediment supply. Additional flows will come from the parking lot runoff and surrounding residential areas. Our pebble count indicated a median grain size of 55mm (Figure 7, Table 6), with most particles in the "coarse gravel" category, typical of the entire project reach. The pebble count data is shown in Appendix C.

Further Observations from Field Work

One of the project goals included the removal of invasive species. We saw very little ivy which, according to Susan Schwartz, was extensive prior to its removal as part of this project. Some ivy remains near the upstream culvert coming from a neighboring yard, but there is none in the downstream reach. According the Ms. Schwartz the ivy previously hosted a large rat colony, however the removal of the ivy has decreased the rat population around the stream although we did observe one in the ivy near the upstream culvert. There is no extensive canopy cover from the trees that were planted during the restoration but the project is only a few years old and this should be re-evaluated in a few years. The other native grasses and plants that were planted have flourished with a survival rate of approximately 80% (Susan Schwartz, 11/11/05). We had the opportunity to view the site right before, during and after a weekend volunteer planting organized by Friends of Five Creeks. These activities have kept the community involved while also providing continued maintenance of the project.

Community involvement has been encouraged through public education as well. There are numerous signs located along the pedestrian path that give information about the project background, the current site and contacts for more information. From our discussion with Susan Schwartz we learned that classes of school children come to participate in urban stream education along this stretch of Cerrito Creek.

Considering the urban location of this creek, we found remarkably little trash in and around the stream. We observed many people using the pedestrian path, walking through the creek itself, and sitting around the creek near the street. Additionally, the parking lot is constantly full of cars or vendors. Still the creek seems to collect very little trash. This is possibly due to the community interest in maintaining the restoration project. There are doggy bags located at the east entrances and trash bins at the west end of both sections encouraging the community to clean up their own trash and have helped to keep the creek clean.

As previously mentioned, there is plenty of activity in and around the stream. We had the opportunity to speak with several members of the community and a few volunteers during our days of field work. All volunteers were excited about the project and the chance to help out with planting and maintenance around the creek. The community members had a range of reactions to the project. The complaints we heard ranged from feeling that the project was a failure to just wishing for more shading along the pedestrian pathway. One of the community members we spoke with expressed disappointment that her children were unable to reach the water as easily as before due to the increase in vegetation along the banks.

Conclusions

Overall we conclude that this project is a success as the goals that were established at the beginning of the project were met within the constraints imposed on the location. Previous to the restoration, this section of creek was a narrow incised ditch covered with concrete and having little to no native vegetation. Despite heavy rip-rap along the banks of the channel, the upper slopes of the creek are now completely planted with thriving native. Clearly the vegetation goals have been met.

The constraints placed on urban creeks are extensive and this project was no exception. Although we mentioned some community complaints, we feel that the few people that approached us either represent a minority or are overall happy with the project but wished to share their ideas for improvement. This represents the difficulty in satisfying an entire community. However, with the number of people that we observed using the pathway and areas surrounding the creek, along with the public education and volunteer involvement we feel the community related goals have been met.

The goals reflecting erosion control, flood control and sedimentation are more difficult to decisively claim success or failure. Lack of baseline and post-project data made our evaluation of bank erosion nearly impossible. We observed some bed incision and slight undercutting of a retaining wall but the extensive rip-rap seems to maintaining the channel shape. Furthermore, no data has been recorded to describe high flow events before or after the project was completed nor any sort of history surrounding sediment loading. However, from our data and observations there do not seem to be any large problems from erosion, flooding or sedimentation.

Recommendations

While we were able to make some conclusions about the project and evaluate it overall as a success, we have some recommendations for further success. The first element of the project that needs to be addressed is the pedestrian path. This path was constructed to further encourage community interaction with the environment. It was constructed with recycled materials, rounded pieces of glass and plastic cylinders to hold the glass in place. This tumbled glass was an experiment into permeable materials that has admittedly failed. While attractive, the glass poses numerous problems. It spills out onto the surrounding soil, it is not wheelchair or bike accessible and it is not safe for pets or small children. The end goal is to have a surface that is both permeable (to help mitigate runoff from the parking lot) but also easily used by the community. At this time, there are no suggestions for new surface types and the City of El Cerrito is currently looking for groups to help test new materials.

Based on our interaction with the public and our observations from site work, we feel that community interaction could be further improved with a few modifications. First, we believe the community would benefit greatly from increased seating. One of the neighbors said there are a lot of elderly in the area who walk the path, but without seating it is hard for them to have full use of the site. The current seating is provided by a low-level retaining wall with smooth pavers at the top however park benches would be better. Second, increased signage would increase community awareness of the project. Currently all of the signs are only visible to people already using the path. We suggest increasing the signage toward the parking lot and adjacent streets.

Also as mentioned earlier, many users think the native grasses are weeds and do not understand why some plants were removed and other introduced. A sign describing native vegetation types within the San Pablo Watershed as well as identification signs for several of the major species would help to improve public opinion. Lastly, Friends of Five Creeks has been diligent with the upkeep. Continued maintenance from their work parties is essential for vegetation survival.

It is our hope that the information that we have compiled in this PPA will be of use in future assessments of the Cerrito Creek project. We would like to stress the importance of obtaining post-project baseline data so that the success of a project can be accurately evaluated. Future reach maps of this project can be compared with our reach map to provide important information about the way this section of creek is changing with time. If the goals of erosion, sediment and flood control are to be evaluated, data including storm flows, sediment loading, and incidence of flooding should be recorded.

References

California State. Department of Water Resources, Division of Planning and Local Assistance Urban Streams Restoration Program. Grant Application Spring 2002.

Cerrito Creek at El Cerrito Plaza. Plans by Wolfe Mason Associates, Prepared for the City of El Cerrito Department of Public Works 5/15/03. (Sheets L1-L8)

Friends of Five Creeks website: http://www.fivecreeks.org/ (November 10, 2005)

Hanford ARC website: http://www.hanfordarc.com/cerrito.htm (Novemeber 10, 2005).

Keimach, Jill and Hanin, Scott, *Acceptance of Offer of Dedication of Land from Regency Centers, Inc.*, Agenda Bill to El Cerrito City Council, December 17, 2001.

National Resource Projects Inventory (NPRI) Catalog, http://gis.ca.gov/catalog/BrowseRecord.epl?id=29012 (November 10, 2005)

Wolfe-Mason website: http://wolfemason.com/ (November 10, 2005)

Appendix A – Reach Map

Appendix B – Cross Section Data and Graphs

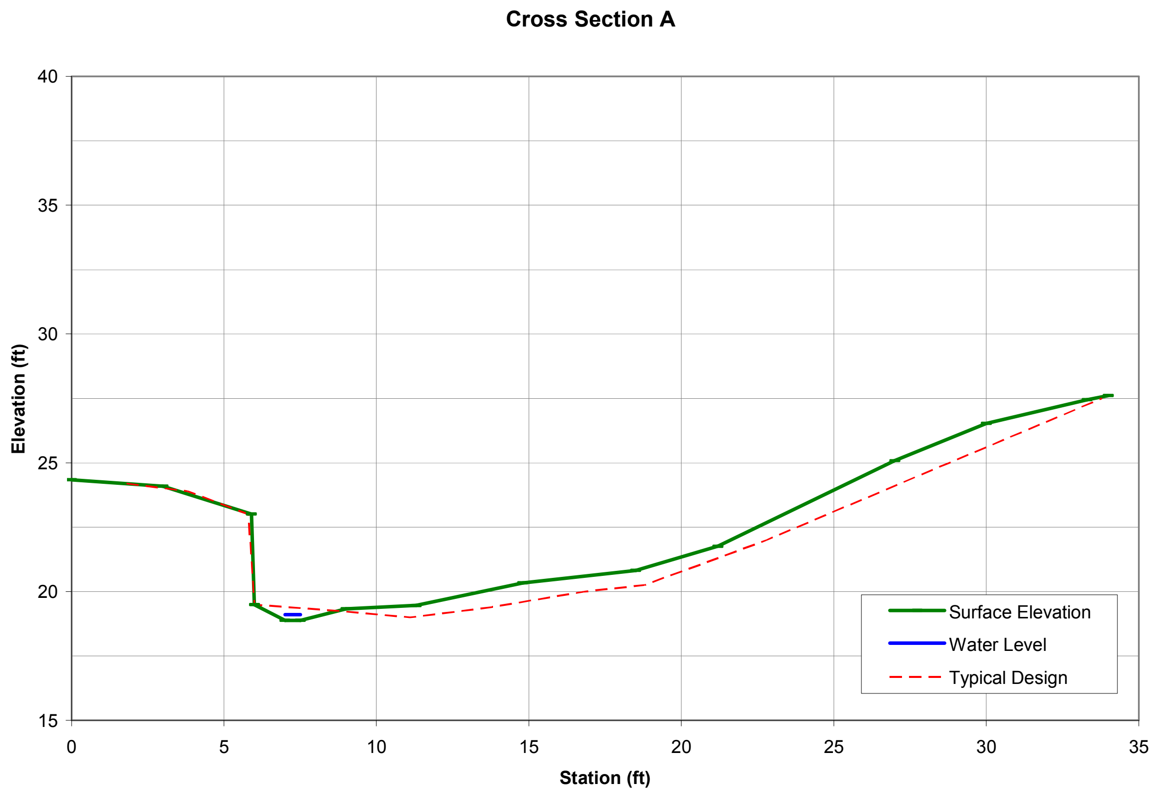

Figure 2: Cross Section A, STA 0+25 upstream from Kains Avenue culvert

Table 1: Cross-Section A Data

Cross Section A @ STA 0+25					instrument height = 28.62 ft
Station (ft)	Elevation (ft)	Absolute Elevation (ft)	Water depth (ft)	Water Level (ft)	Notes
0	4.28	24.34			Leftside
3	4.53	24.09			
5.9	5.61	23.01			top of retaining wall
6	9.12	19.5			edge of water
7	9.74	18.88	0.22	19.1	
7.5	9.74	18.88	0.23	19.11	
9	9.29	19.33			edge of water
11.3	9.16	19.46			end of gravel bed
14.8	8.28	20.34			
18.5	7.8	20.82			
21.2	6.86	21.76			
27	3.54	25.08			step bank
30	2.09	26.53			
33.3	1.17	27.45			
34	1.01	27.61			start of walking path

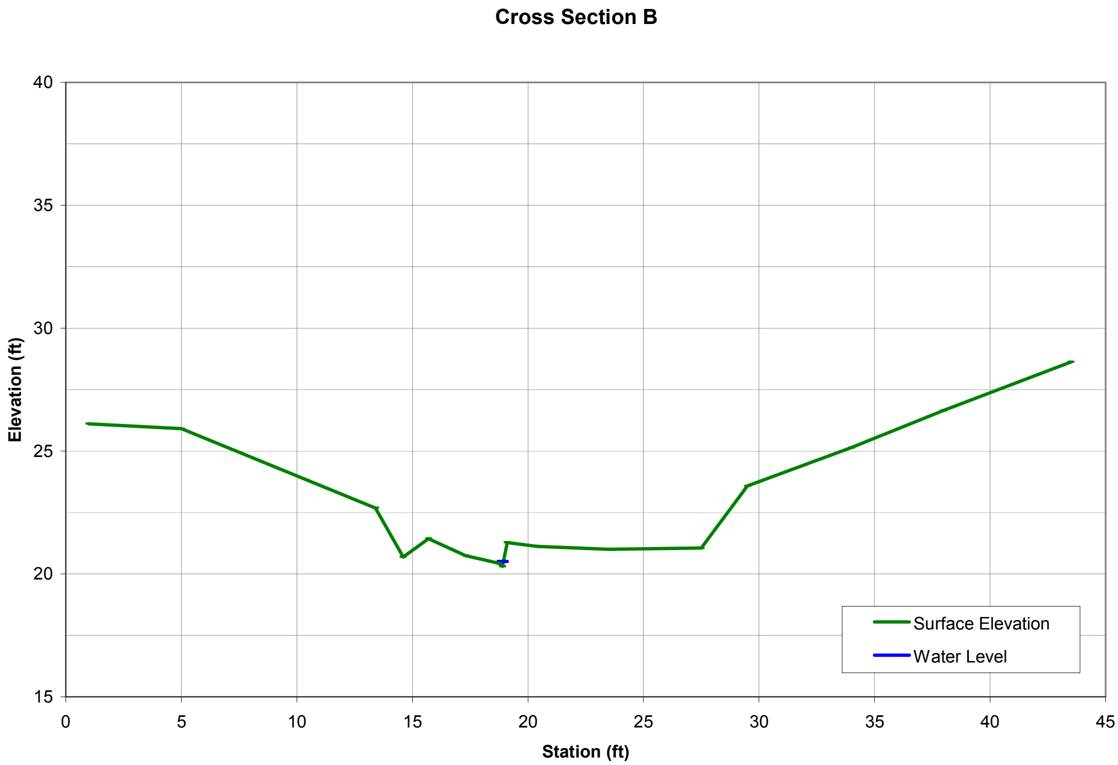

Figure 3: Cross Section B, STA 1+10 upstream from Kains Avenue culvert

Table 2: Cross-Section B Data

Cross Section B @ STA 1+10					instrument height = 28.62 ft
Station (ft)	**Elevation (ft)**	**Absolute Elevation (ft)**	**Water depth (ft)**	**Water Level (ft)**	**Notes**
1	2.51	26.11			leftside
5	2.71	25.91			
13.4	5.93	22.69			half-way down sandbag retaining wall
14.6	7.92	20.7			base of wall
15.7	7.18	21.44			on rock weir
17.3	7.87	20.75			on rock weir
18.7	8.17	20.45	0.06	20.51	increek
18.9	8.31	20.31	0.2	20.51	deepest point of channel
19.1	7.34	21.28	0	20.51	end of channel
20.4	7.5	21.12			end of rock weir
23.5	7.62	21			
27.5	7.57	21.05			start of rip rap
29.5	5.04	23.58			end of rip rap
34	3.48	25.14			
38	1.97	26.65			
43.5	0	28.62			

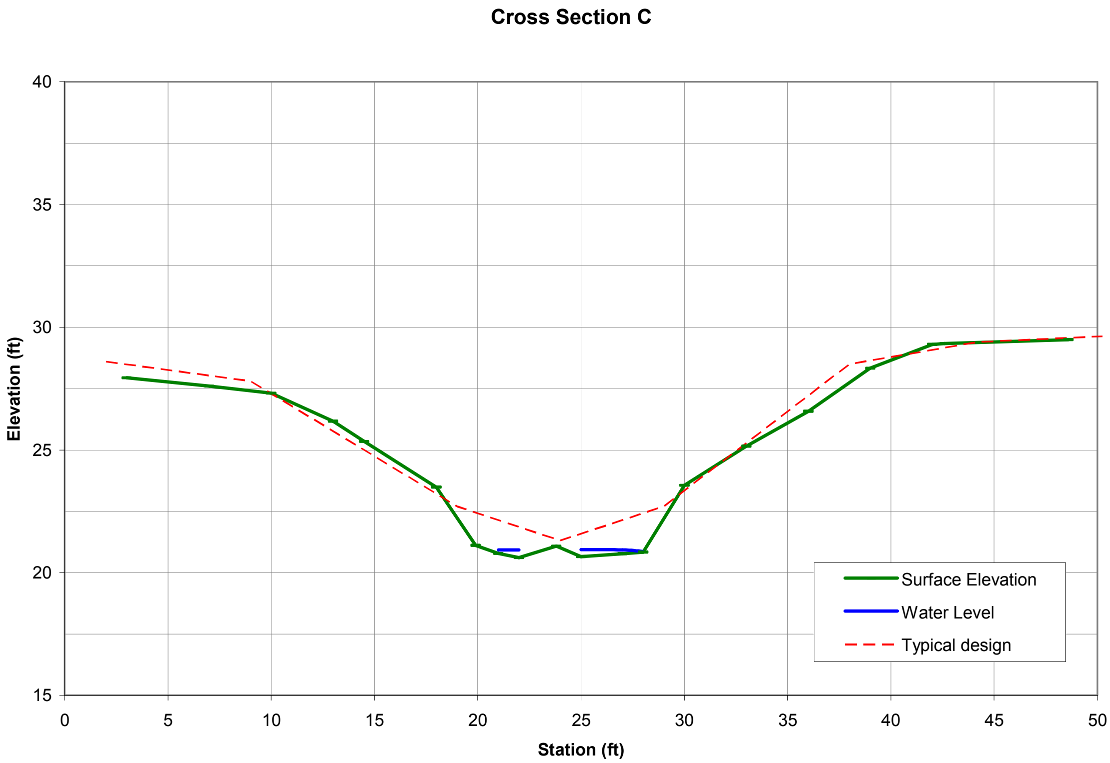

Figure 4: Cross Section C, STA 2+00 upstream from Kains Avenue culvert

Table 3: Cross-Section A Data

Cross Section C @ STA 2+00					instrument height = 33.83 ft
Station (ft)	Elevation (ft)	Absolute Elevation (ft)	Water depth (ft)	Water Level (ft)	Notes
3	5.89	27.94			
7	6.23	27.6			
10	6.52	27.31			
13	7.66	26.17			
14.5	8.49	25.34			
18	10.35	23.48			top of riprap
19.9	12.72	21.11			bottom of riprap
21	13.05	20.78	0.14	20.92	
22	13.22	20.61	0.31	20.92	
23.8	12.76	21.07			on top of in-stream rock
25	13.18	20.65	0.29	20.94	
27	13.06	20.77	0.16	20.93	
28	12.99	20.84	0.02	20.86	bottom of riprap
30	10.28	23.55			top of riprap
33	8.68	25.15			
36	7.26	26.57			
39	5.5	28.33			
42	4.53	29.3			base of utility pole
42.6	4.5	29.33			start of path
48.6	4.34	29.49			end of path

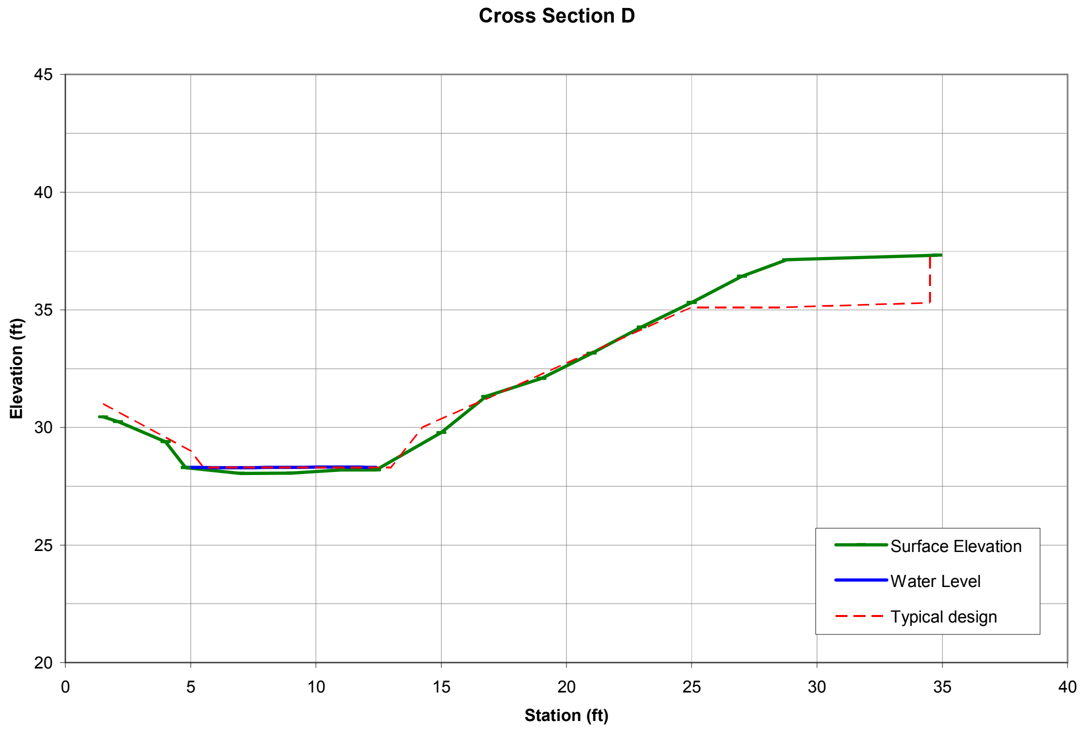

Figure 5: Cross Section D, STA 6+20 upstream from Kains Avenue Culvert

Table 4: Cross-Section D Data

Cross Section D @ STA 6+20					instrument height = 41.31 ft
Station (ft)	Elevation (ft)	Absolute Elevation (ft)	Water depth (ft)	Water Level (ft)	Notes
1.5	10.86	30.45			
2.1	11.07	30.24			top of rip rap
4	11.92	29.39			
4.8	13.02	28.29	0.01	28.3	edge of channel
7	13.26	28.05	0.24	28.29	
9	13.25	28.06	0.25	28.31	
11	13.12	28.19	0.13	28.32	
12.4	13.11	28.2	0.11	28.31	edge of channel
15	11.53	29.78			
16.8	9.99	31.32			top of riprap
19	9.23	32.08			
21	8.16	33.15			
23	7.04	34.27			
25	6	35.31			
27	4.88	36.43			
28.8	4.19	37.12			start of path
34.8	3.99	37.32			end of path

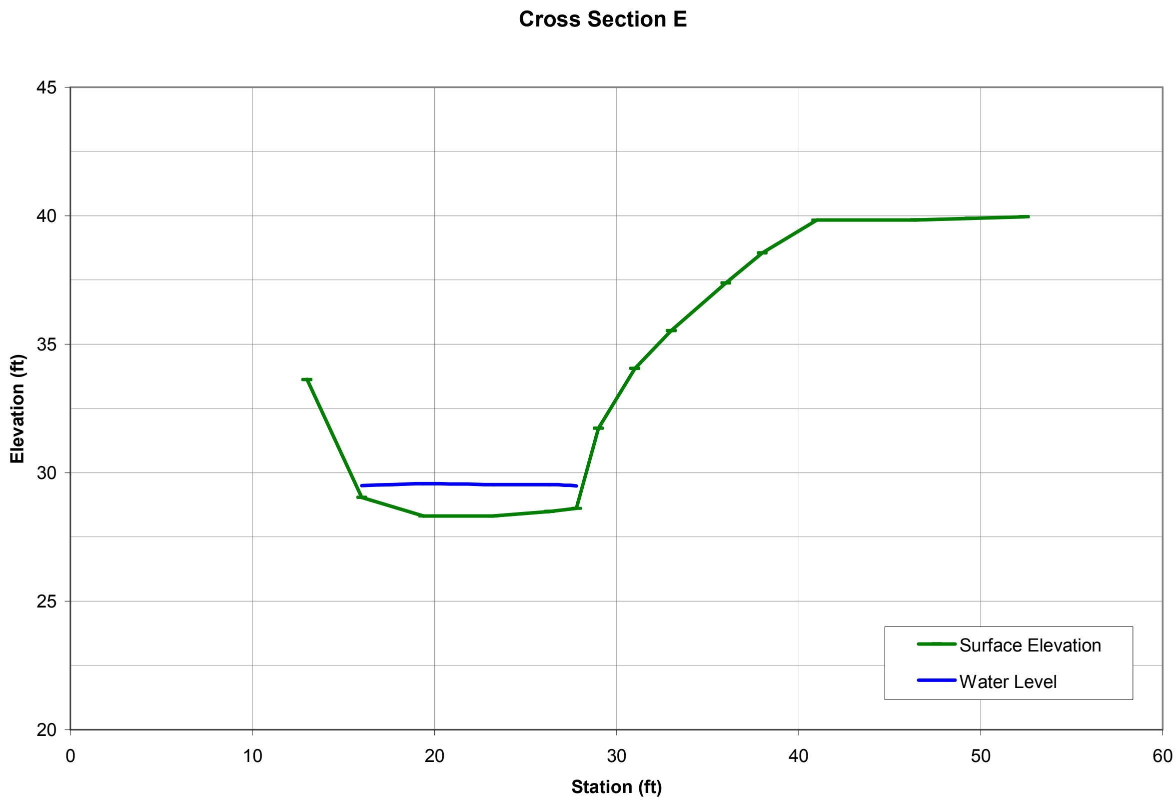

Figure 6: Cross Section E, STA 6+90 upstream from Kains Avenue culvert

Table 5: Cross Section E Data

Cross Section E @ STA 6+90					instrument height = 41.31 ft
Station (ft)	Elevation (ft)	Absolute Elevation (ft)	Water depth (ft)	Water Level (ft)	Notes
13	7.68	33.63			top of rip rap
16	12.27	29.04	0.46	29.5	edge of channel
19.4	13	28.31	1.26	29.57	
23.2	13	28.31	1.23	29.54	
26.3	12.82	28.49	1.05	29.54	
27.8	12.7	28.61	0.88	29.49	edge of channel/bottom of riprap
29	9.58	31.73			top of riprap
31	7.26	34.05			
33	5.78	35.53			
36	3.93	37.38			
38	2.76	38.55			
41	1.48	39.83			
46.4	1.47	39.84			start of path
49.4	1.41	39.9			
52.4	1.35	39.96			end of path

Appendix C – Pebble Count Data

Table 6: Grain Size Distribution Data			
Grain Size (mm)	**Observation**	**Total**	**Percent Finer**
< 8	III	3	0
8	II	2	3
11.3	II	2	5
16	IIIIIII	7	7
22.6	IIIIIIIIII	10	14
32	IIIIIIIIIIIII	13	24
45	IIIIIIIIIIIIIIIIIIIIIIIII	25	37
64	IIIIIIIIIIIIIIIIIIIEE	21	62
90	IIIIIIIIIEEE	12	83
128	IIIE	4	95
180	I	1	99
256		0	100

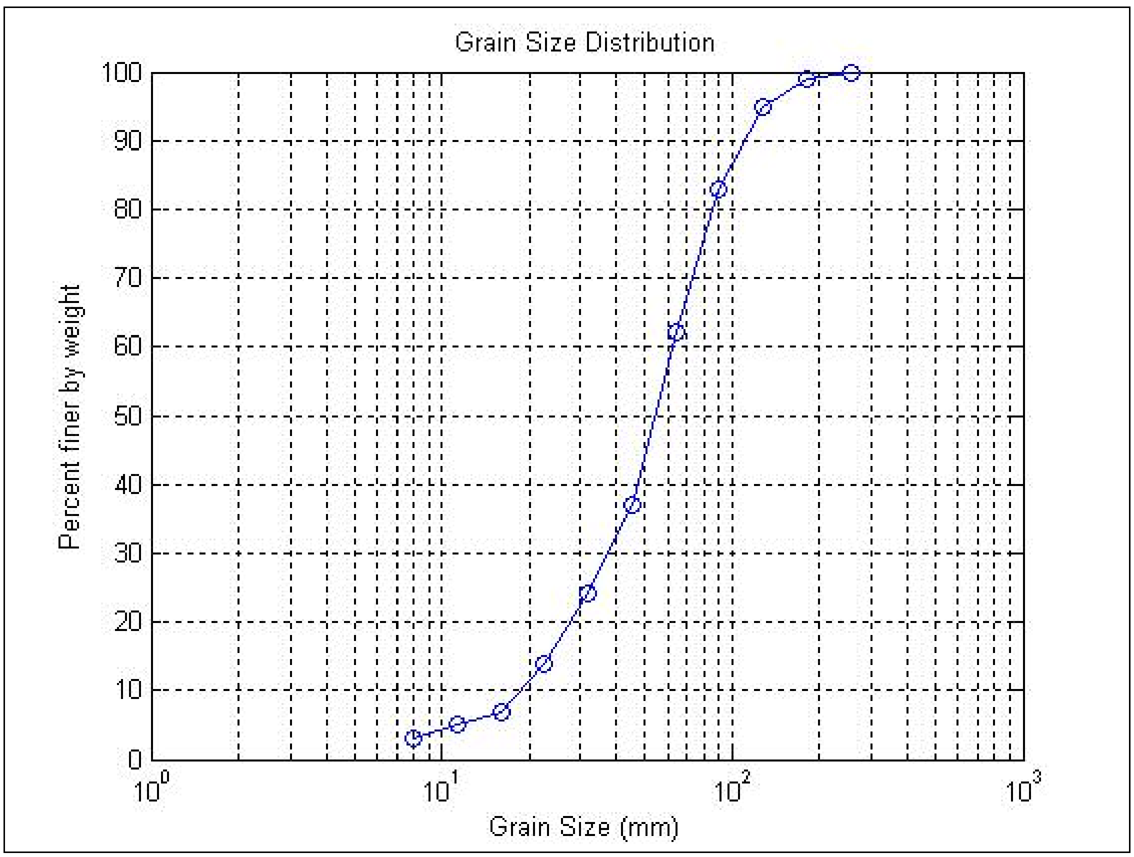

Figure 7: Grain Size Distribution Chart (Sieve Analysis)