APPENDIX

Table of Contents

Appendix A- Series of air photographs

Although this study did not complete a full analysis of successive aerial photographs (as in USACE, 2003), we did utilize the 1939, 1989, and 2002 photographs. The 1939 photograph is among the first aerial photographs taken in the region. These black and white, stereo pair photographs, taken 8/2/39, show the status of the gullies at that date, and evidence of land use up to that point. They provide a valuable comparison to current photography. However, note that much land use and landscape change likely occurred before this photograph was taken.

Figure A-1. 1939 aerial photograph of the Pavon sub-basin.

Figure A-2. 1989 aerial photograph of the Pavon sub-basin.

Figure A-3. 2002 aerial photograph of the Pavon sub-basin.

Appendix B- Rainfall data

Table A-1. Rainfall data for Water Year 2006 measured at Duncan Canyon (Pinole Creek watershed, near I-80). Data provided by Tim McDonough, Friends of Pinole Creek Watershed.

Date	Rainfall total (inches)
10/15/2005	0.25
10/28/2005	0.35
11/04/2005	0.05
11/07/2005	1.00
11/25/2005	0.25
11/28 to 11/29/2005	0.80
12/01/2005	2.55
12/17 to 12/18/2005	3.65
12/20 to 12/22/2005	2.45
12/27 to 12/28/2005	1.45
12/30 to 12/31/2005	5.20
1/01 to 1/02/2006	1.65
1/04/2006	0.10
1/06/2006	0.25
1/14/2006	0.65
1/17 to 1/18/2006	0.70
1/28/2006	0.30
1/30/2006	0.15
2/01/2006	0.15
2/04/2006	0.10
2/17 to 2/18/2006	0.45
2/26 to 2/28/2006	2.85
3/01/2006	0.40
3/03/2006	0.45
3/05 to 3/06/2006	2.50
3/07/2006	0.20
3/10 to 3/12/2006	0.65
3/14/2006	0.85
3/16 to 3/17/2006	0.35
3/20/2006	0.60
3/24 to 3/25/2006	1.85
3/27 to 3/29/2006	1.35
3/30 to 3/31/2006	0.90
4/02 to 4/05/2006	1.75
4/07/2006	0.90
4/10 to 4/12/2006	1.90
4/15 to 4/16/2006	1.15
5/19 to 5/21	0.45
TOTAL	**42.45**

Appendix C- Rainfall observations

The following text describes the important observations that the field team made during a number of rain events.

During one of the first major events of the season, the 12/17 and 12/18/05 storm, we observed active bank failure (small blocks were falling as we stood on the banks) along Gully A in the Mohring parcel. During the events in December and January, we observed significant soil piping, or input of water into the channels via small pipes that have formed in the soil profile, typically in the upper 0.5 m of the soil profile. This piping leads to localized saturation, erosion, and instability, ultimately causing bank failure in the immediate vicinity of the pipe. We also observed little surface overland flow in the pasture surface, indicating that the majoring of rainfall was able to infiltrate.

Figure A-4. Photograph of soil pipe discharging water into a gully channel.

The largest event, with the peak flow for the season occurred on 12/31/05. This event caused a majority of the deposition of sediment upstream of the ranch road on Gullies B and C. This deposition changed the channel morphology in these reaches from a low-flow

channel with low adjacent floodplain surfaces to an aggraded braided pattern extending from bank slope to slope. Deposition also occurred at the mouth of Gully A, extending up onto the adjacent floodplain surfaces. The package of deposition was in some places thicker than 0.6 m, and consisted of dominantly sand, with some silt and fine gravel. In Gully A, at cross-section AXS7, we observed continued incision, erosion, and soil piping. The largest change was the change in shape of the headcut, from a gradual slope between the pasture surface and the channel bed, to an abrupt, vertical headwall.

Figure A-5. Photograph of deposition at the mouth of Gully A. Photo taken looking downstream.

Returning to the field on 1/2/06, following more rain during 1/1 and 1/2, the field team observed bedload up to 40 mm in transport in Gully A just downstream of the Castro Ranch Road culvert. Significant amounts of overland flow on the pasture surface between Gullies B and C were observed, as the ground was obviously saturated from the rain events of the previous few days. At Gully D, we removed a large piece of wood debris that was partially blocking the culvert underneath the lower ranch road, suggesting that culvert plugging from debris is a real threat at this location. We also observed significant amounts of runoff being funneled down the ranch road, but the runoff was only carrying minor amounts of sediment.

Later in the season, during the 2/27 rain event, we noticed an important shift from soil piping, to dominantly overland flow input of water into the channels and headcuts. In particular, the large headcut between Gullies B and C was receiving only overland flow, which was carrying no sediment load. One potential solution to stabilizing this headcut, would be to address the concentration of surface flow directly into this headcut location. At the mouth of Gully A, we noted that the channel had begun to incise back through the package of sediment that had been deposited during New Years.

By the 3/2/06 event, the culvert under the ranch road at Gully C was completely plugged with sediment, diverting all flow across the pasture and the road. In Gully A, at the AXS7 headcut, the retreating headcut had exposed a long piece of rusty metal (object was unable to be identified, or removed from the bank) sticking out of the headcut wall 0.24 m below the current gully bed elevation. This suggests that at least the upper 0.24 m of

sediment in the pasture channel has been deposited since the time of human occupation, and is currently being incised through. This supports the idea of successive cutting and filling (incision and deposition) occurring in these gully systems.

And finally, during the 3/24 and 3/25 rain event, in Gully C at the ranch road, the main flow has switched back to a location nearer the plugged culvert, causing rilling and erosion of the road surface, so that it is only passable by truck.

These rain event observations may appear to be scattered and individually insignificant, but taken as a whole, they help form the basis of many of the hypotheses of how the Pavon Creeks sub-basin functions.

Appendix D- Longitudinal profiles

The following tables contain the raw data used to plot the longitudinal profiles for each gully.

Table A-2. Longitudinal profile of Gully A raw data.

Cumulative Distance (m)	Cumulative Elevation (m)
0	0
6	0.03
16.57	0.21
33.69	0.53
39.37	0.6
57.25	0.83
75.81	1.2
94.03	1.73
110.39	1.85
128.69	2.07
145.99	2.34
163.88	2.52
175.48	2.7
190.28	2.84
204.38	3.1
223.39	3.21
242.45	3.57
259.2	3.65
274.05	3.82
281.42	3.93
299.59	4.3
316.6	4.44
333.37	4.94
352.84	5.28
366.24	5.47
388.74	5.75
400.34	6.04
414.03	6.37
426.25	7.04
436.87	7.29
442.29	9.96
447.55	10.26
470.15	11.08
470.25	11.28
478.25	11.48
489.25	11.96
496.68	12.14
496.95	12.51

Table A-3. Longitudinal profile of Gully B raw data.

Cumulative Distance (m)	Cumulative Elevation (m)
10.92	1.92
1.12	0.39
-18.28	-2.58
-24.63	-2.53
-40.33	-2.65
-49.58	-4.13
-69.58	-6.65
-77.08	-7.42
-90.73	-9.11
-95.03	-9.66
-95.36	-10.33
-97.83	-11.13
-100.68	-11.62
-106.28	-12.7
-114.38	-14.12
-120.43	-15.54
-128.23	-16.71
-136.43	-17.26
-150.53	-18.88
-155.38	-20.41
-168.28	-21.78
-179.11	-23.36
-187.81	-25.33
-194.16	-26.63
-199.76	-27.95
-204.76	-30.2
-206.94	-31.14
-208.04	-31.98
-209.74	-32.89
-213.64	-33.99
-216.94	-34.4
-218.44	-36.17
-220.34	-36.54
-221.04	-36.82
-224.84	-37.89
-233.96	-39.18
-242.19	-39.96
-248.69	-40.89

509.69	12.85
527.32	13.19
546.16	13.67
559.35	14.05
574.59	14.44
593.94	15.02
618.24	15.74
638.13	16.35
650.33	16.6
663.83	16.96
679.62	17.32
693.46	17.7
706.76	18.19
719.9	18.64
734.7	19.09
755.91	19.93
769.27	20.39
773.77	21.07
780.67	22.45
790.98	23.02
803.48	24.07
815.9	25.39
829.2	26.24
833.25	27.19
844.12	27.63
848.04	27.64
852.84	28.73
859.54	29.58
859.94	30.37
868.04	30.38
871.01	31.08
877.21	32.15
897.21	39.15
910.04	39.48
917.54	39.57
923.54	40.9
928.04	41.65
AXS7 Branch	
299.59	4.3
312.86	4.68
330.13	5.11
342.18	5.34
361.4	5.54
371.05	5.99
391.15	6.41
404.95	6.9
419.35	7.53
427.53	8.45
429.64	9.22
429.84	10.11

-258.89	-41.78
-270.19	-42.8
-279.6	-44.05
-293.28	-44.88
-311.53	-46.15
-321.23	-47.48
-331.73	-49.55
-344.67	-51.43
-347.27	-52.3
-351.17	-52.7
-357.27	-53.97
-363.7	-55.5
-374.09	-58.62
-378.53	-59.27
-379.6	-59.37
-381.9	-60.39
-386.2	-61.21
-389.58	-62.34
-393.58	-62.44
-393.78	-63.59
-397.08	-64.19
-403.68	-64.95
-407.14	-65.56
-414.51	-66.34
-419.79	-66.87
-420.05	-67.56
-423.41	-67.71
-429.61	-68.41
-436.21	-69.07
-446.98	-69.71
-447.34	-70.54
-456.79	-71.02
-457.57	-71.78
-463.39	-72.49
-470.36	-72.94
-480.14	-73.37
-487.94	-74.79
-493.59	-75.92
-505.39	-76.95
-514.79	-77.73
-522.82	-78.81
-528.42	-79.12
-539.85	-79.74
-552.05	-80.82
-561.05	-81.99
-566.45	-83
-579.52	-83.57
-591.82	-83.84
-601.95	-83.99
-609.4	-84.12

441.37	10.48
447.61	10.74
448.13	11.17
460.33	11.68
474.53	12.18
494.83	12.93
510.03	13.75
530.13	14.77
547.08	15.76
565.92	16.9
582.72	17.92
586.17	17.97
586.42	18.36
589.92	18.31
590.12	18.77
593.05	18.45
593.54	19.05
599.52	19.15
599.78	19.6
608.98	20.67
619.7	21.98

Hanging culvert branch

693.46	17.7
707.71	17.92
723.76	18.98
725.64	19.09
726.8	19.43
731.02	19.49
732.22	19.89
733.64	20.5
734.14	21.41
737.79	21.92
740.76	22.9
746.37	23.23
748.47	23.84
751.69	24.26
753.69	28.26

-617	-84.31
-624.75	-84.38
-648.39	-84.95
-658.89	-85.18
-658.94	-85.73
-674.69	-86.15
-685.79	-86.48
-700.85	-86.9
-713.4	-87.13
-722.2	-87.66
-723.1	-86.85
-726.22	-86.83
-729.29	-87.02
-735.23	-90.04
-749.38	-90.42
-761.78	-91.17
-766.03	-91.41
-768.79	-92.54
-775.83	-92.84
-781.83	-92.93
-793.49	-93.26
-803.89	-93.58
-818.24	-94.09
-836.21	-94.37
-856.77	-94.48
-874.34	-94.85
-891.9	-95.08
-910.4	-95.45
-915.4	-95.58
-923.2	-95.75
-927.8	-95.88
-939.1	-96.3
-947.6	-96.42
-960.2	-96.64
-969.93	-96.81
-979.29	-97.04
-985.29	-97.26
-992.29	-97.58
-1007.29	-97.78
-1042.49	-99.38
-1047.17	-99.88
-1052.43	-100.16
-1054.43	-100.93
-1059.38	-101.39
-1059.48	-102.24

Left tributary

-55.04	-14.7
-65.64	-17.77
-70.5	-19.3
-76.2	-21.27

-87.37	-22.8
-101.91	-26.18
-108.56	-26.77
-117.69	-30.84
-121.72	-32.13
-131.97	-35.35
-135.02	-36.73
-145.06	-39
-162.13	-42.35
-186.26	-47.33
-201.47	-50.83
-218.48	-54.43
-240.38	-57.58
-253.56	-58.91
-261.18	-59.58
-261.46	-60.48
-270.62	-61.01
-281.64	-63.28
-287.13	-63.61
-297.46	-64.88
-304.06	-65.7
-319.7	-66.62
-327.28	-67.47
-340.01	-68.39
-353.42	-69.27
-368.33	-69.84
-375.37	-70.67
-387.67	-71.76
-395.27	-72.04
-401.96	-73.56
-410.76	-74.29
-427.36	-75.06
-430.61	-75.37
-445.4	-76.02
-456.77	-76.57
-474.69	-78.55
-485.06	-79.09
-504.26	-80.31
-518.3	-80.82
-538.51	-81.54
-553.35	-82.52
-556.45	-83.27
-566.45	-83

Table A-4. Longitudinal profile of Gully C raw data.

Cumulative Distance (m)	Cumulative Elevation (m)
0	0
0.1	3.7
70.1	6.84
72.6	7.33
92.8	8.46
106.8	8.93
124.5	9.26
139.5	9.72
145.5	9.9
156.77	10.05
169.32	10.3
196.82	10.57
206.52	10.75
222.3	11.02
239.2	11.27
244.7	11.39
256.4	11.54
264.9	11.73
273.1	12.03
274.85	12.14
282.05	12.76
286.65	13.1
294.25	14.4
299.75	14.72
303.67	15.29
313.8	15.66
328.2	16.59
341.1	17.21
356.96	17.55
363.33	17.87
383.73	18.12
396.57	18.49
414.06	19.17
424.48	19.53
442.53	20.01
455.11	20.35
468.47	20.73
485.8	21.21
500.8	21.55
515.4	21.84
533.99	22.31
552.49	22.89
570.69	23.6
588.76	24.06
609.84	24.74

Table A-5. Longitudinal profile of Gully D raw data.

Cumulative Distance (m)	Cumulative Elevation (m)
0	0
2.9	0.88
6.1	1.29
7.5	1.28
10.1	1.41
17.75	1.69
27.71	1.92
29.21	1.97
35.61	1.9
39.01	2.82
46.51	3.55
51.52	3.8
54.53	3.6
55.22	4.32
64.72	5.31
74.93	5.49
78.13	5.84
82.88	5.78
83.47	6.27
84.98	6.69
94.72	7.17
106.82	7.5
107.22	8.5
111.48	8.47
112.72	8.07
113.92	8.32
114.78	8.64
119.82	8.91
129.89	9.23
143.23	10.3
154.07	10.81
164.12	10.9
176.72	11.98
183.92	12.3
186.7	12.19
187.04	13.5
194.23	13.97
207.29	15.15
220.27	15.73
227.87	16.11
233.52	16.18
238.02	17.36
247.19	18.13
259.09	18.11
260.39	18.66

627.99	25.32
643.7	25.95
661.62	26.82
682.92	27.45
696.66	27.94
711.68	28.3
732.05	29.29
743.15	29.71
756.75	30.49
767.17	31.04
773.57	31.34
781.97	32.3
785.17	33.4
789.29	34.25
794.74	34.57
804.11	35.6
808.71	36.29
816.72	37.13
822.64	38.4
828.38	40.03
833.78	40.7
837.72	41.2
844.4	42.2
848.67	43.32
853.87	44.19
863.02	45.52
863.52	46.5
873.12	47.62
879.34	48.55
886.67	49.68
893.38	50.78
900.2	51.46
905.91	52.56
913.58	53.7
918.12	56.15
924.76	57.49
938.46	60.87
945.81	62.35
959.41	63.57
968.37	64.9
984.02	67.67
988.35	68.9
1002.7	72.57
1006.6	73.86
1016.6	75.73
1026.6	77.03

271.54	19.07
273.39	20.39
285.54	20.51
290.74	20.84
291.14	21.13
296.04	20.74
297.14	22.64
300.21	23.69
303.4	25.04
315.7	25.43
319.3	25.86
324.8	26.08
338.98	27.21
344.9	27.71
353.9	28.34
361.85	30.86
371.95	32.39
380.3	34.58
386.9	34.94
393.85	36.16
395.85	37.68
407.5	39.37
418.25	40.9
430.85	42.17
442.35	43.18
448.45	45.05
454	46.48
468.15	47.8
475.78	49.13
480.42	49.69
485.42	50.6
489.08	52.63
495.85	54.26
496.95	54.81
500.95	55.26
508.05	56.36
516.15	58.23
526.02	59.76
537.82	62.33
550.62	63.96
567.28	66.23
583.38	67.96
590.48	70.53
597.53	71.96
603.03	72.34
610.13	73.87
617.23	75.44
617.93	76.27
625.33	77.07
626.63	78.07

636.83	79.32
640.79	80.5
648.09	81.61
648.62	82.38
654.09	83.39
668.16	85.69
676.13	87.13

Appendix E- Channel cross-sections

The following section contains all 22 cross-sections measured by the field team (Figures A-10 through A-31). Cross-sections are labeled by gully, and increasing in number from the mouth to the headwaters. For example BXS1 is the cross-section closest to the mouth of Gully B, while BXS5 is the cross-section closest to the headwaters of Gully B. All cross-sections are oriented perpendicular to the direction of flow, looking downstream, and are referenced only to the monument rebar installed on each side of the cross-section. The blue profile was surveyed in the fall of 2005, before the wet season, and the red profile was surveyed in the spring of 2006, after the wet season. Plots are in meters, with variable vertical exaggeration (ranging between 2.5 and 8x). See Figures A-6 through A-9 for the location of each cross-section.

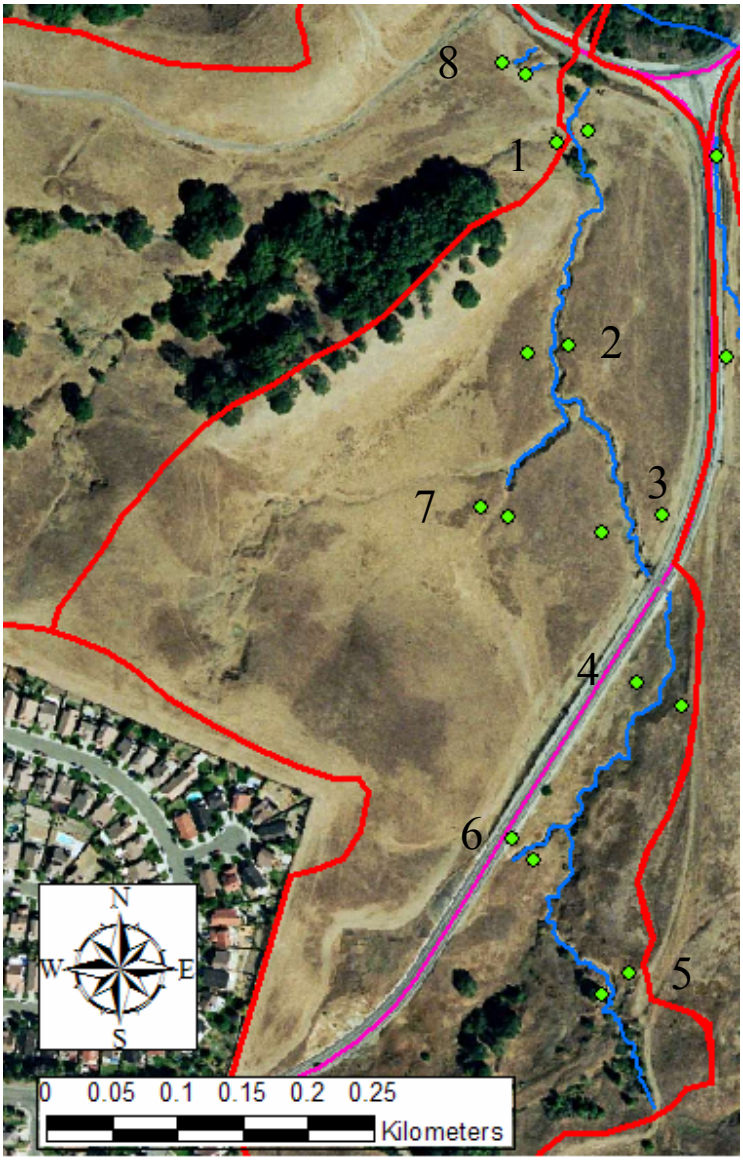

Figure A-6. Map showing the location of cross-sections established on Gully A.

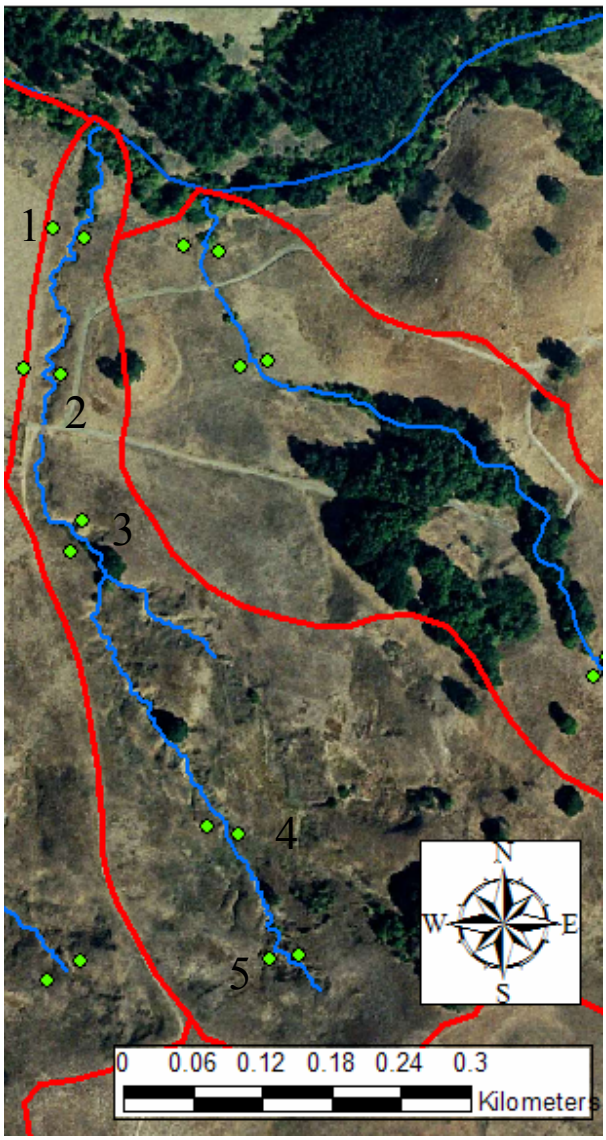

Figure A-7. Map showing the location of cross-sections established on Gully B.

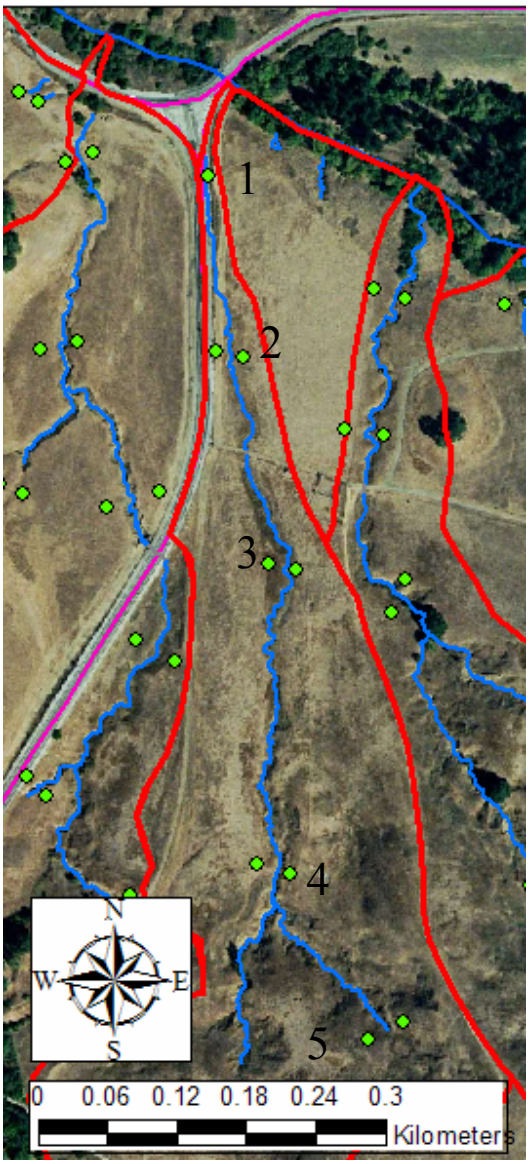

Figure A-8. Map showing the location of cross-sections established on Gully C.

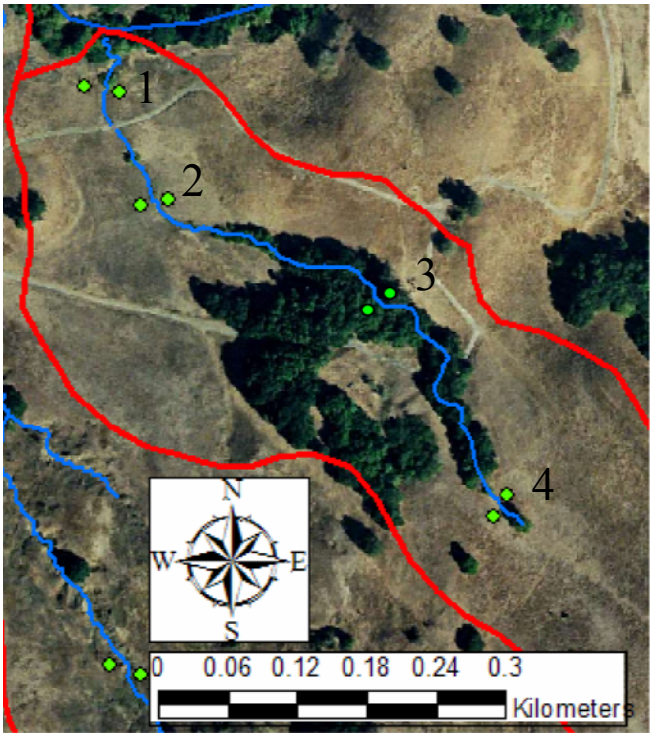

Figure A-9. Map showing the location of cross-sections established on Gully D.

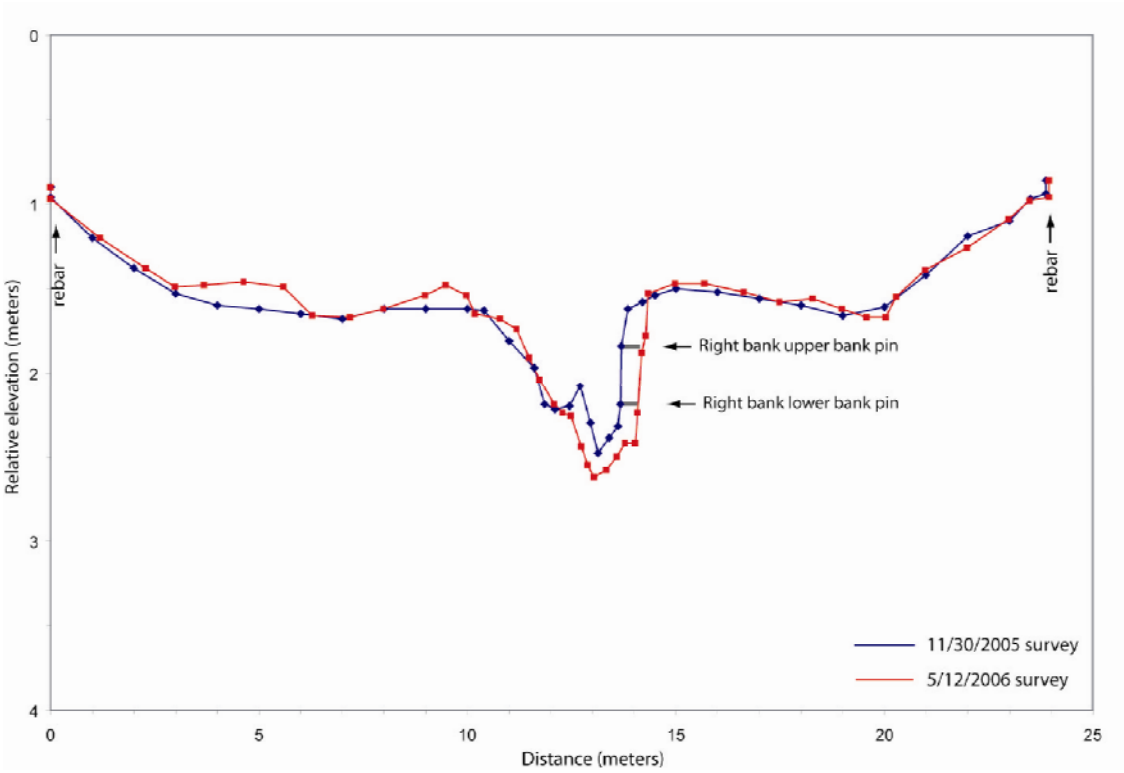

Figure A-10. Cross-section AXS1.

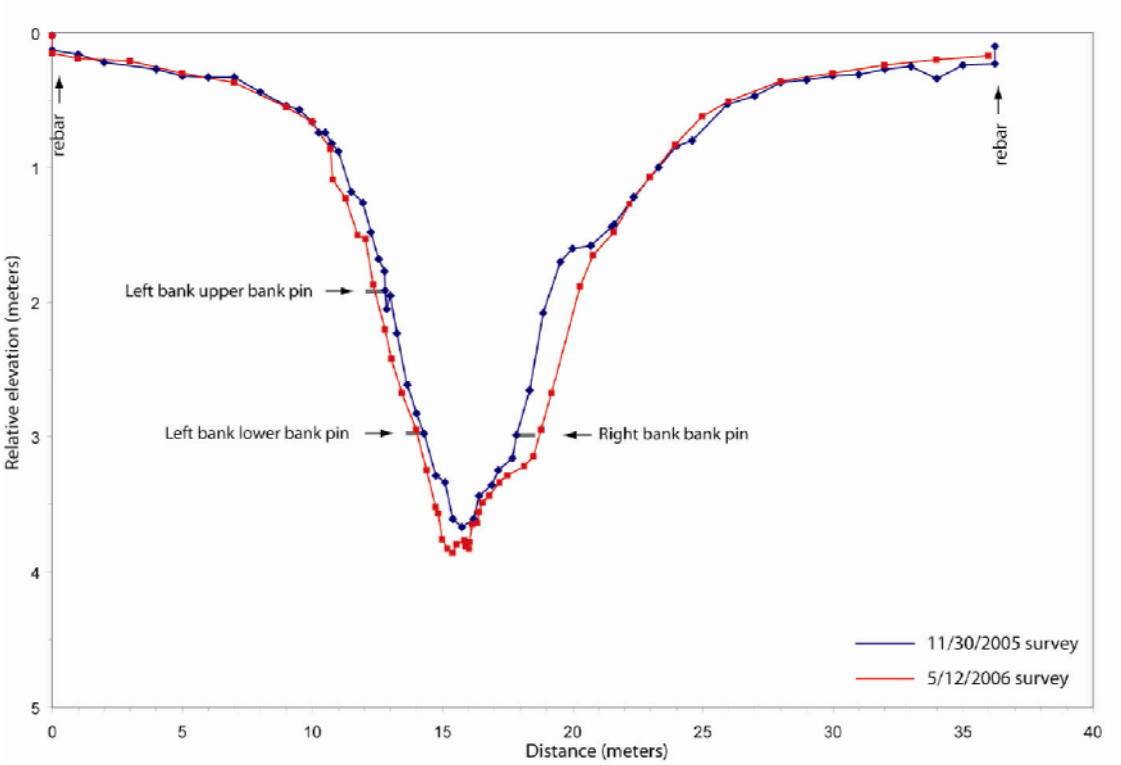

Figure A-11. Cross-section AXS2.

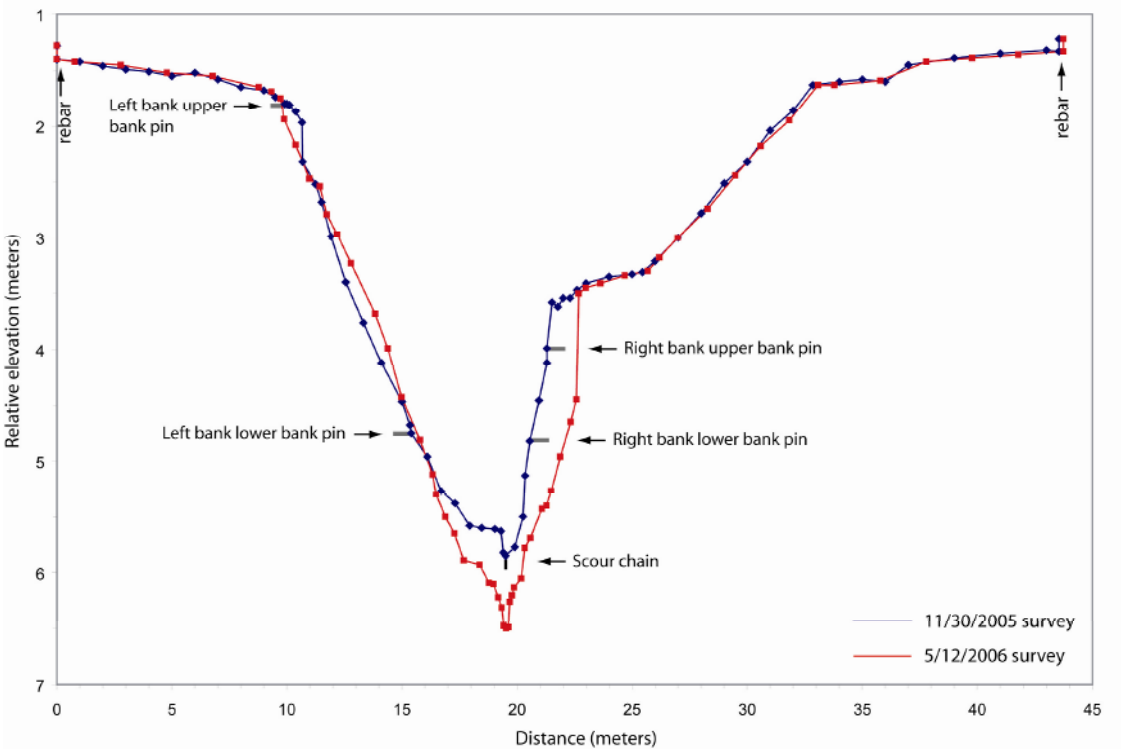

Figure A-12. Cross-section AXS3.

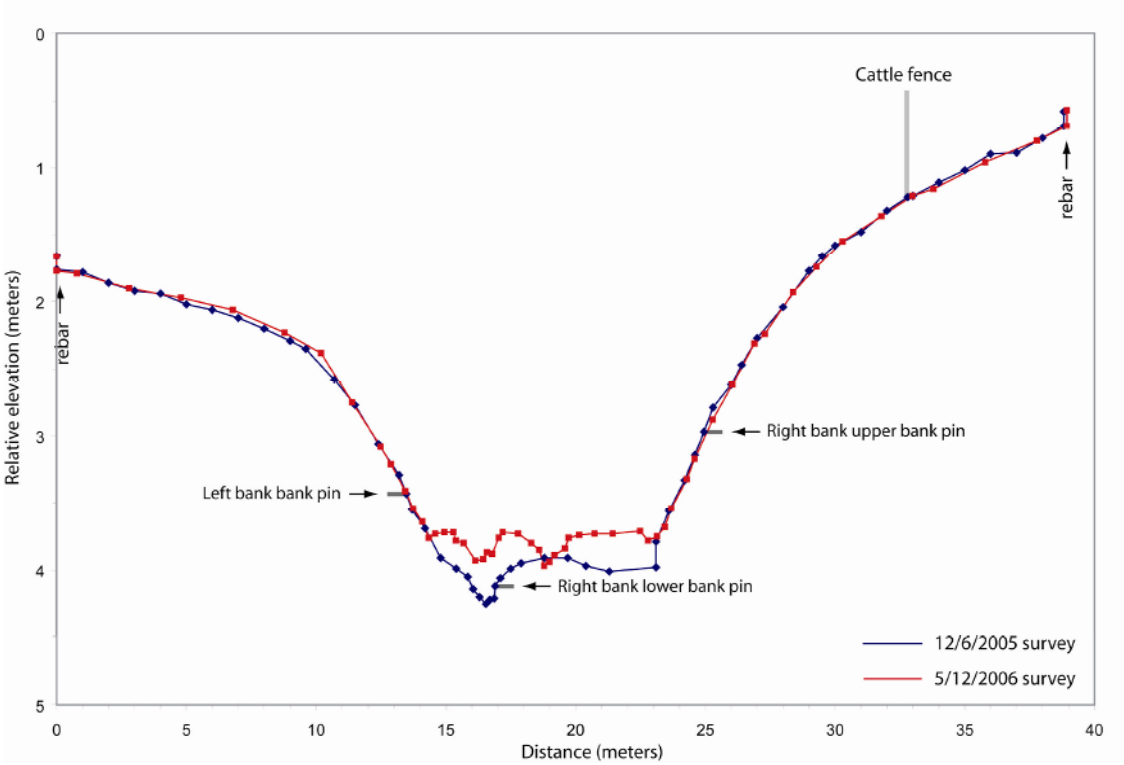

Figure A-13. Cross-section AXS4.

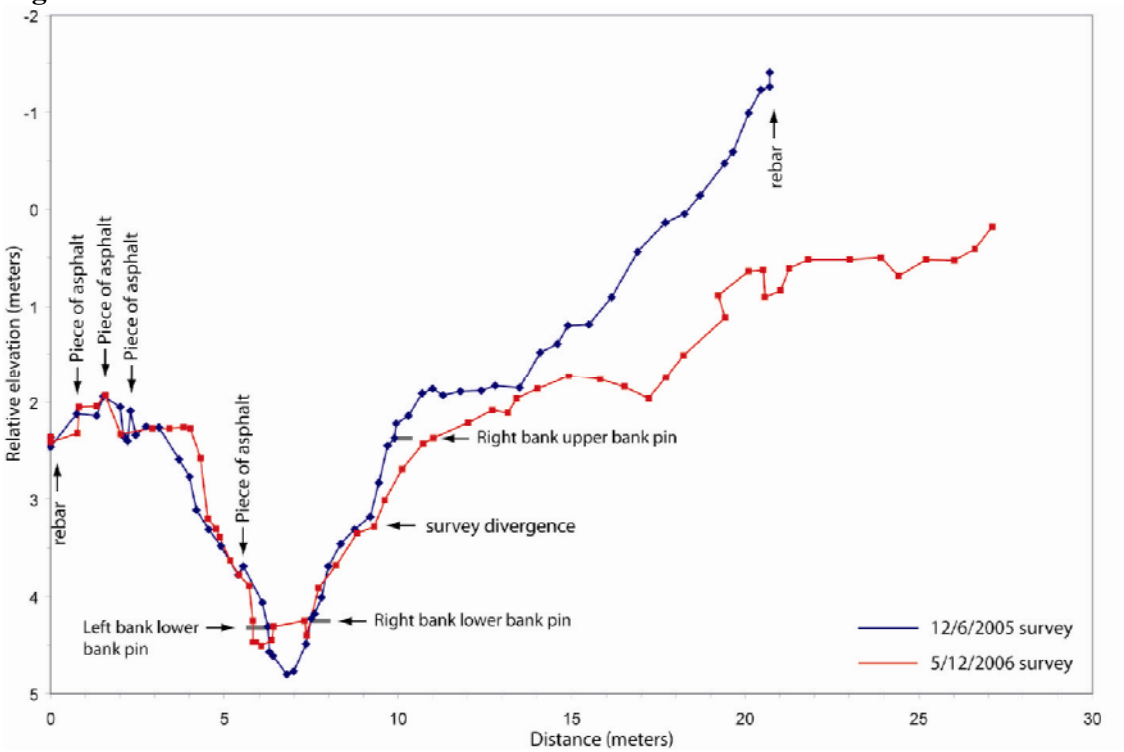

Figure A-14. Cross-section AXS5. Note: could not re-occupy right bank rebar. The survey diverges due to a different alignment of the second survey. However, points on the left bank reflect real changes through the wet season.

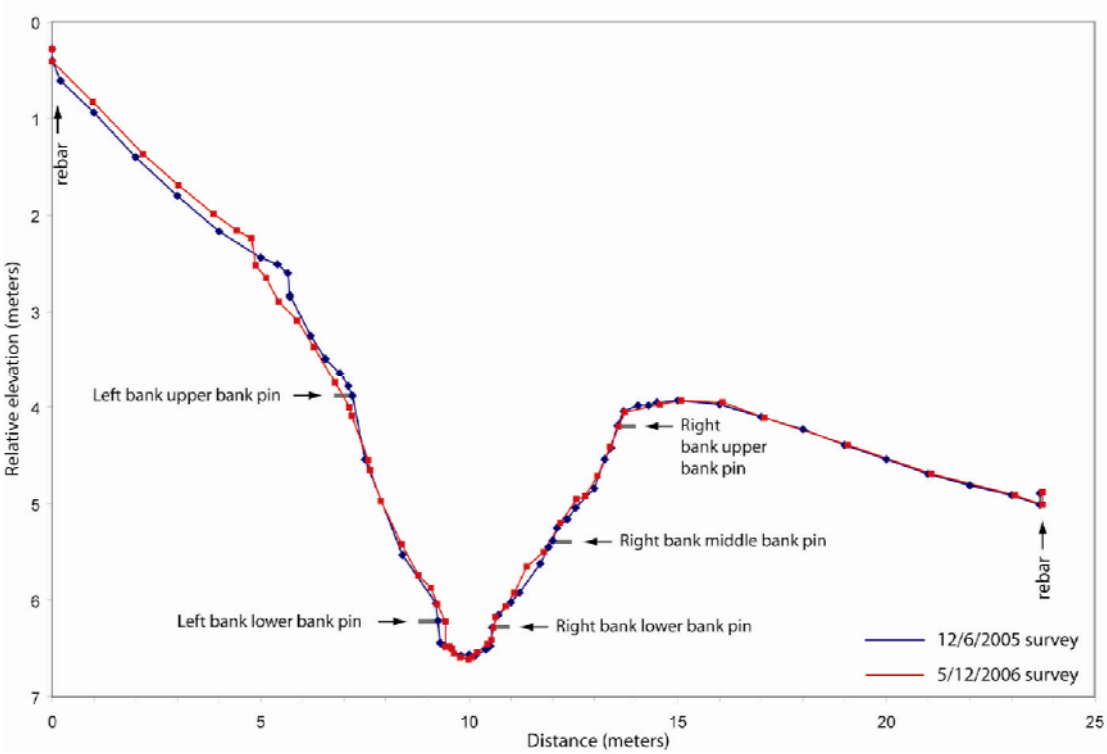

Figure A-15. Cross-section AXS6. This cross-section is located downstream of the hanging culvert on Castro Ranch Road.

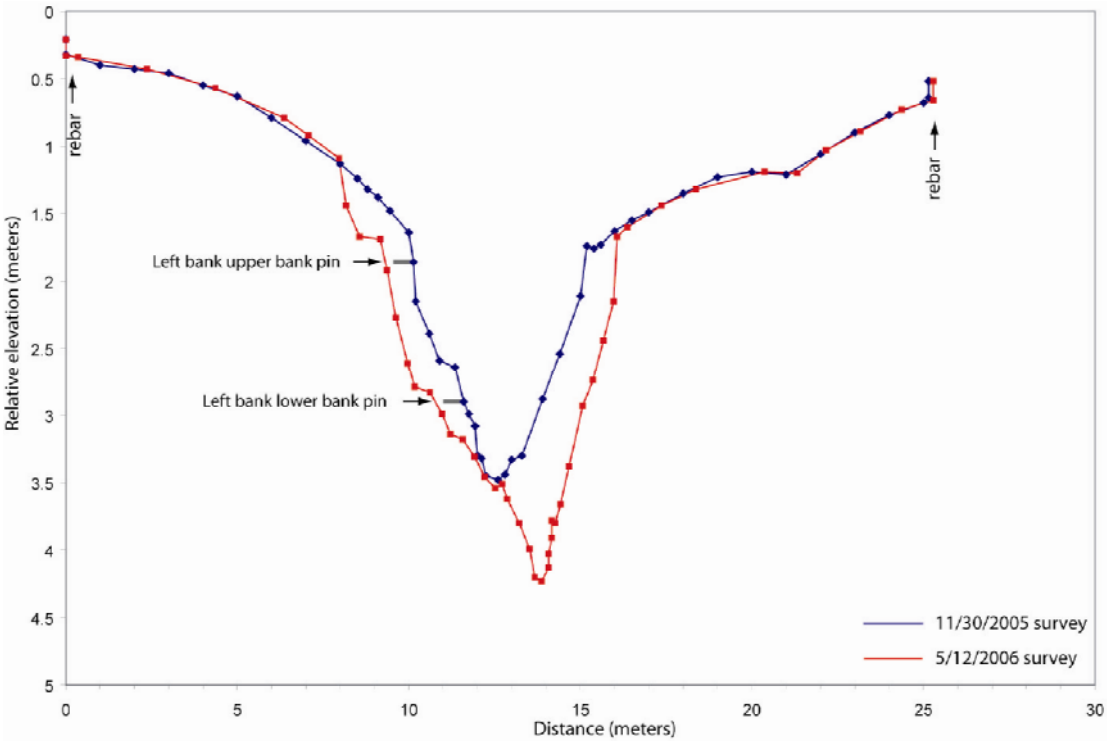

Figure A-16. Cross-section AXS7. This cross-section is located on a tributary to Gully A originating in the Mohring Lease parcel.

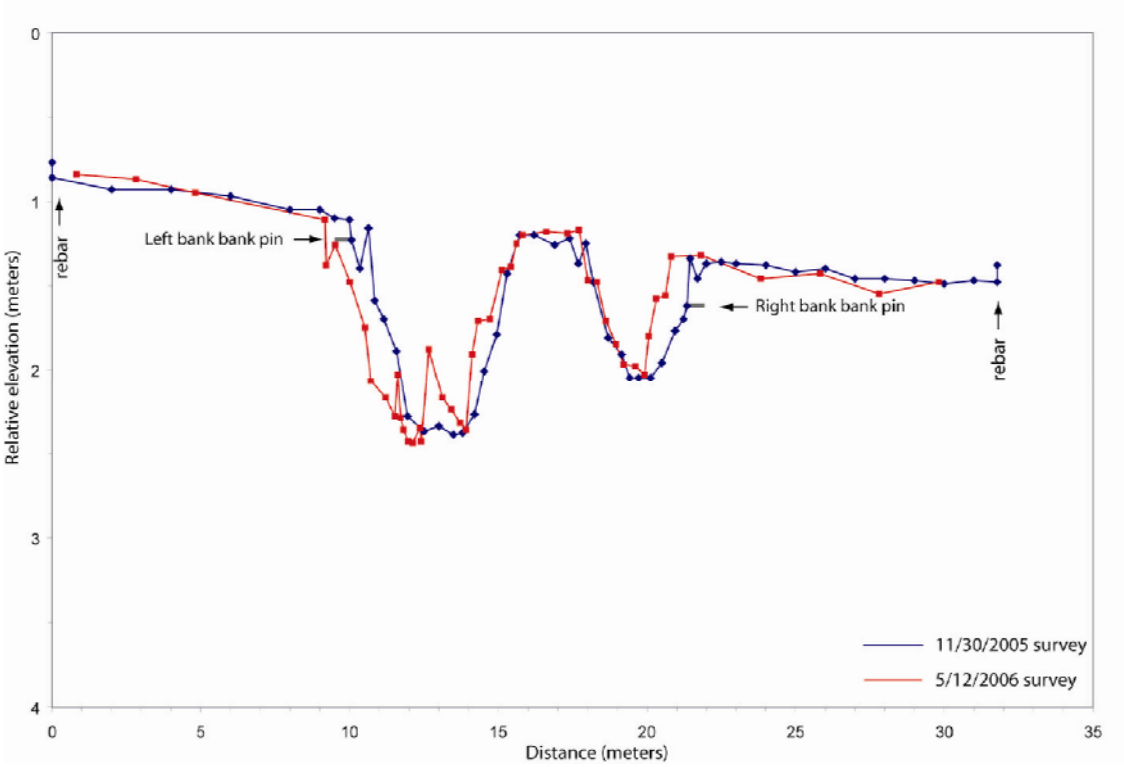

Figure A-17. Cross-section AXS8. This cross-section is located west of Gully A, on an actively extending headcut in the Mohring Lease parcel pasture. Could not re-occupy either rebar, making the points on the right bank offset in the second survey.

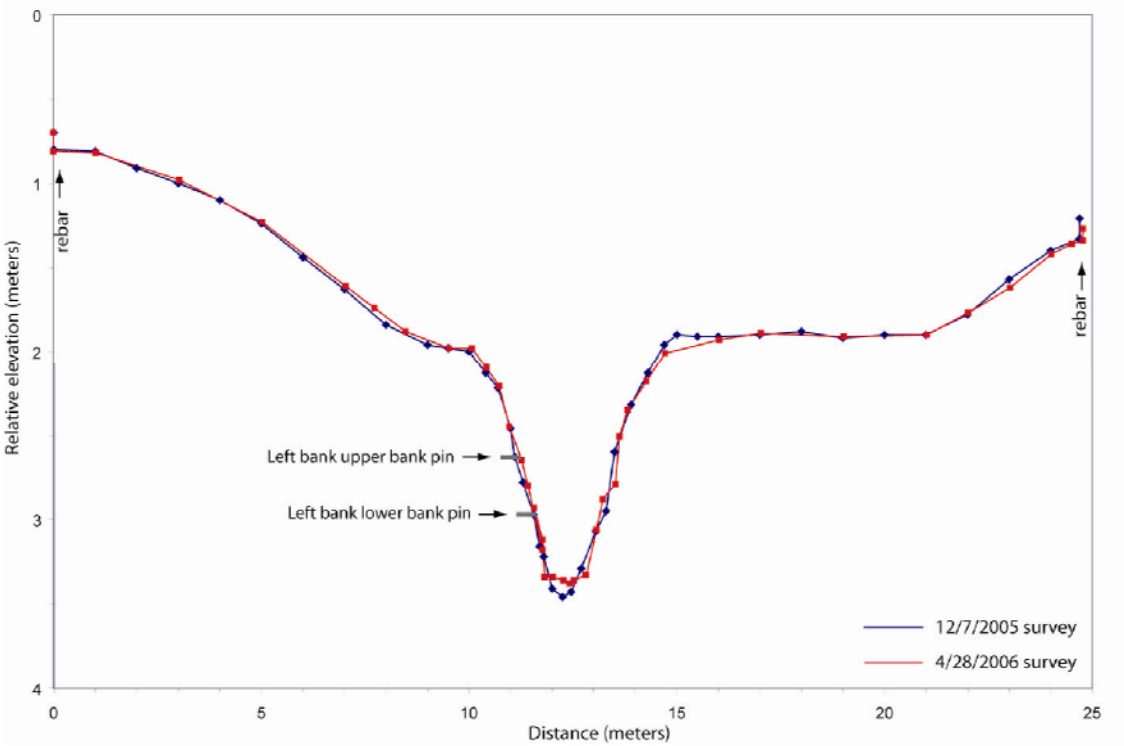

Figure A-18. Cross-section BXS1.

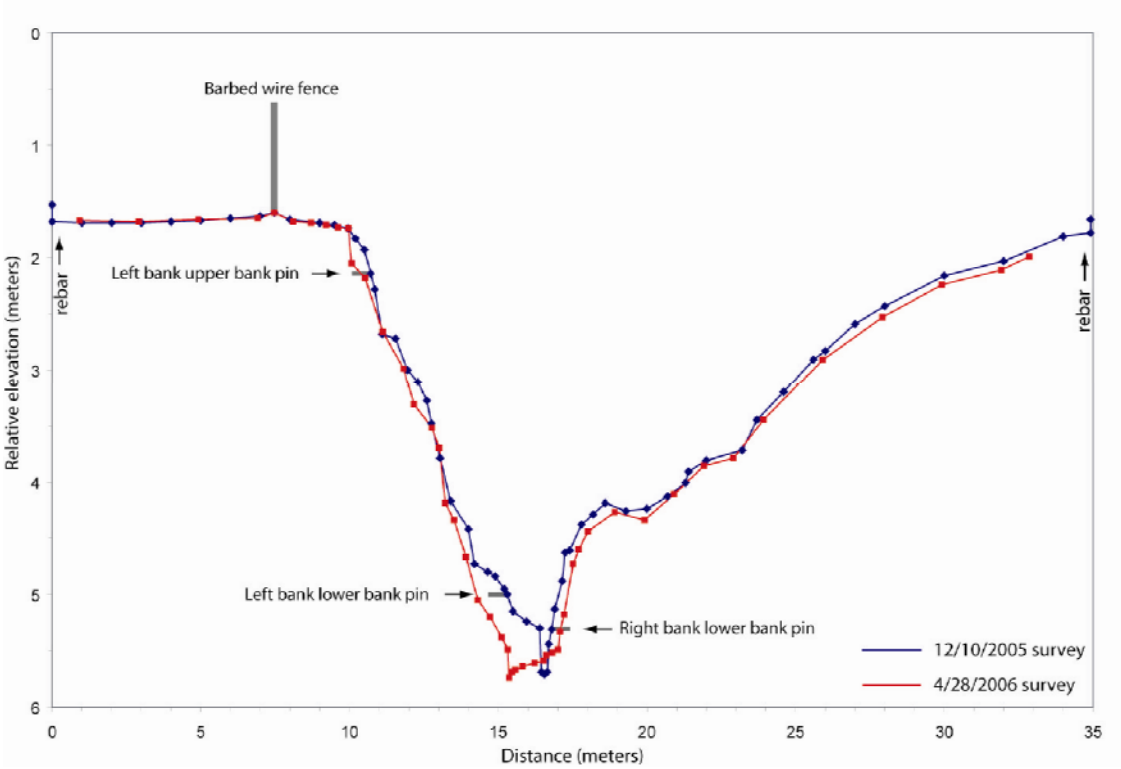

Figure A-19. Cross-section BXS2.

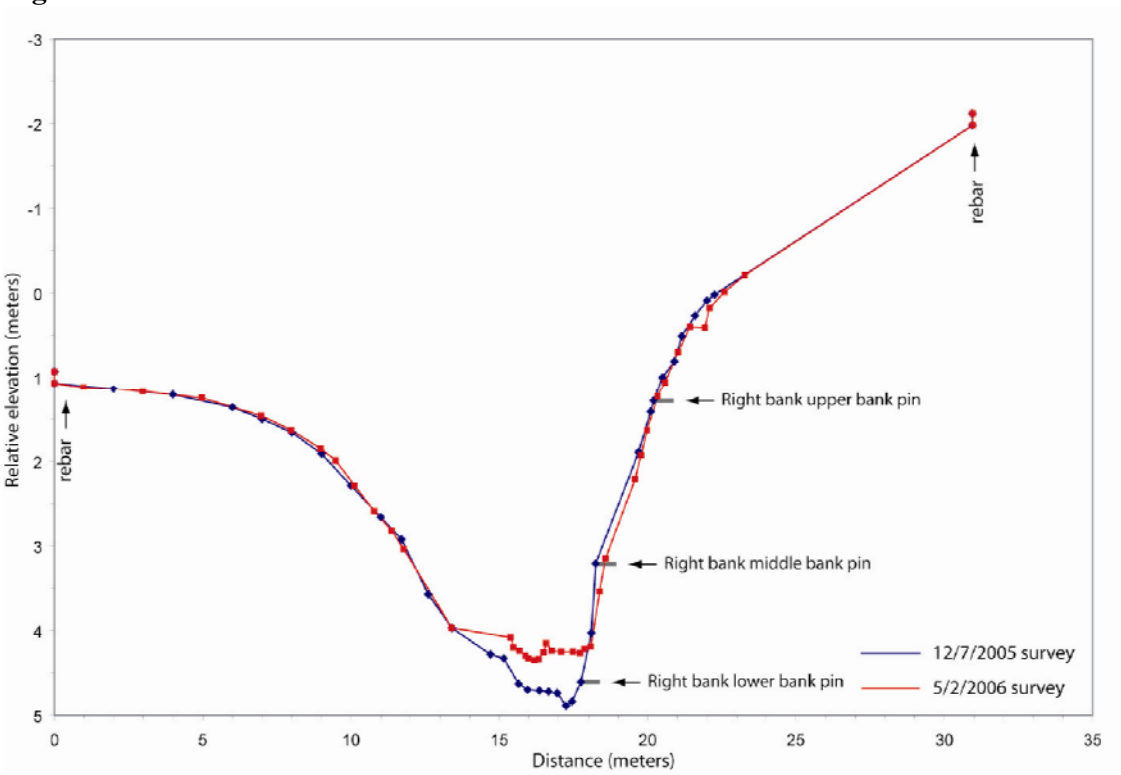

Figure A-20. Cross-section BXS3.

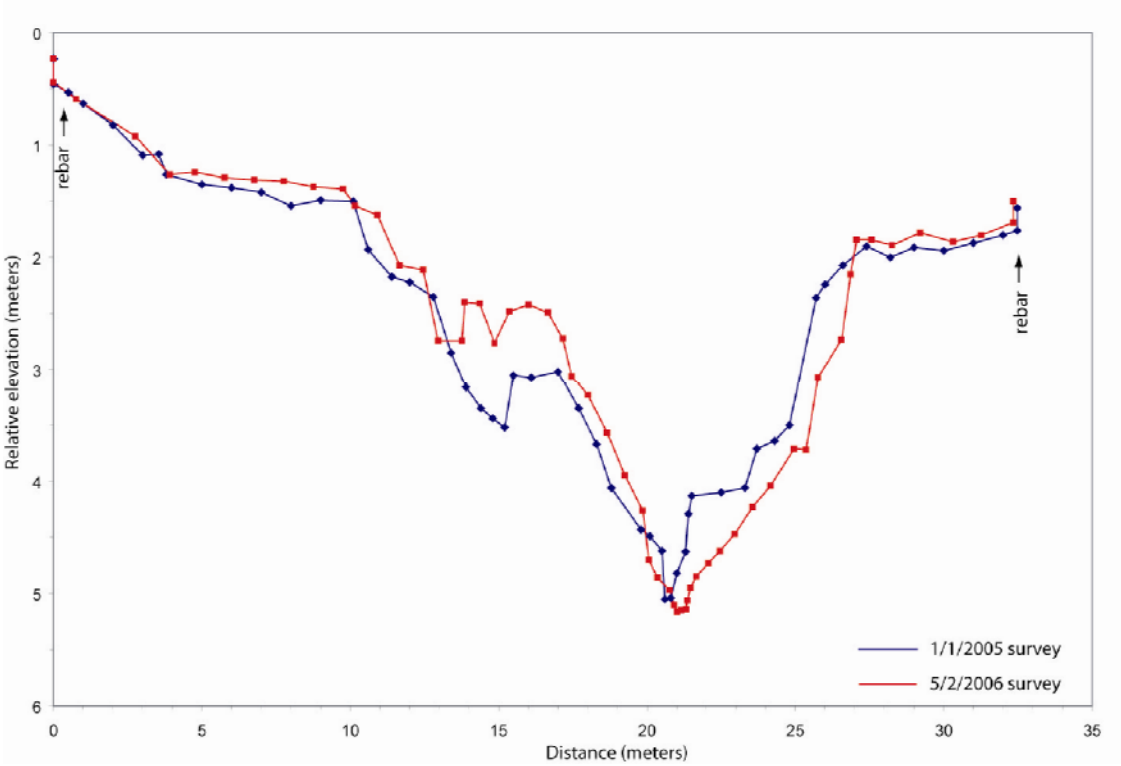

Figure A-21. Cross-section BXS4.

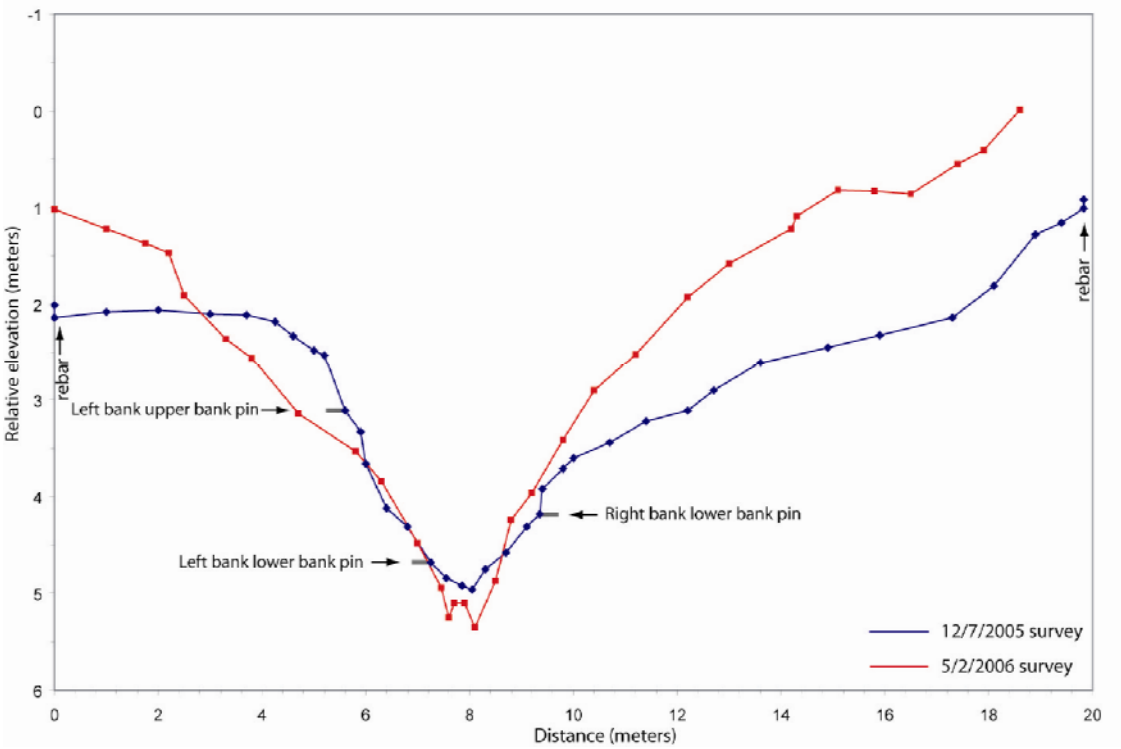

Figure A-22. Cross-section BXS5. Note: could not re-occupy either rebar, second survey is not on previous survey line.

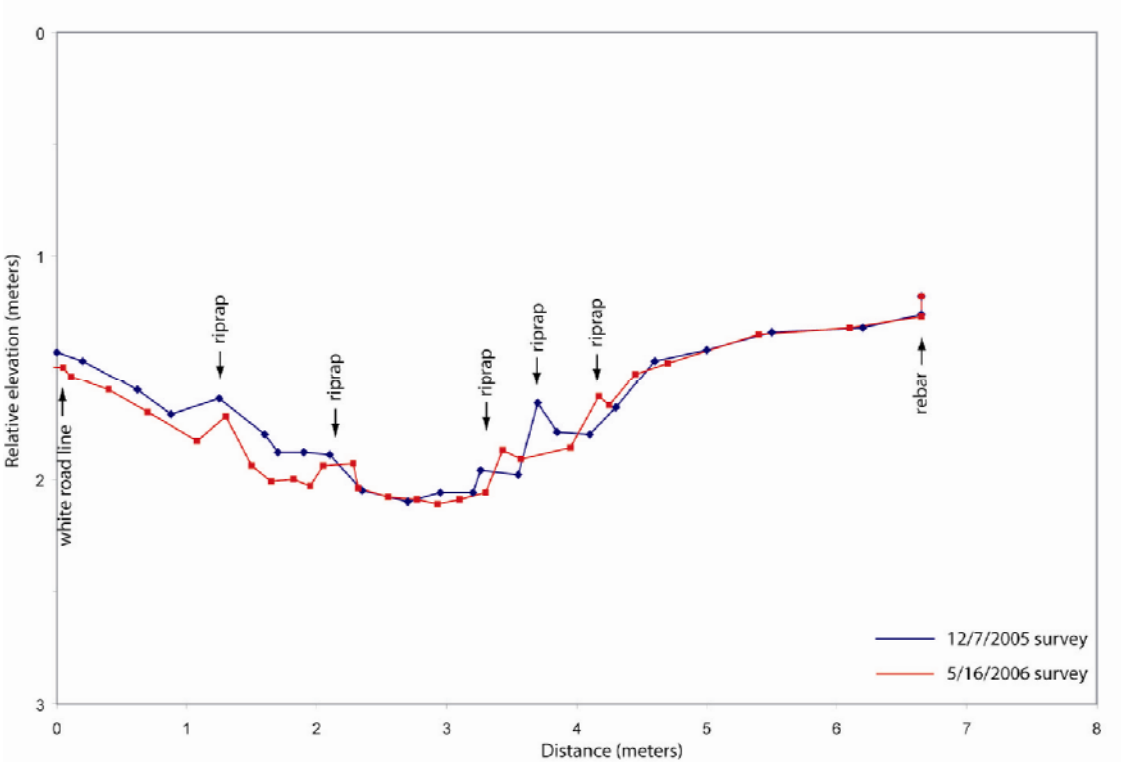

Figure A-23. Cross-section CXS1.

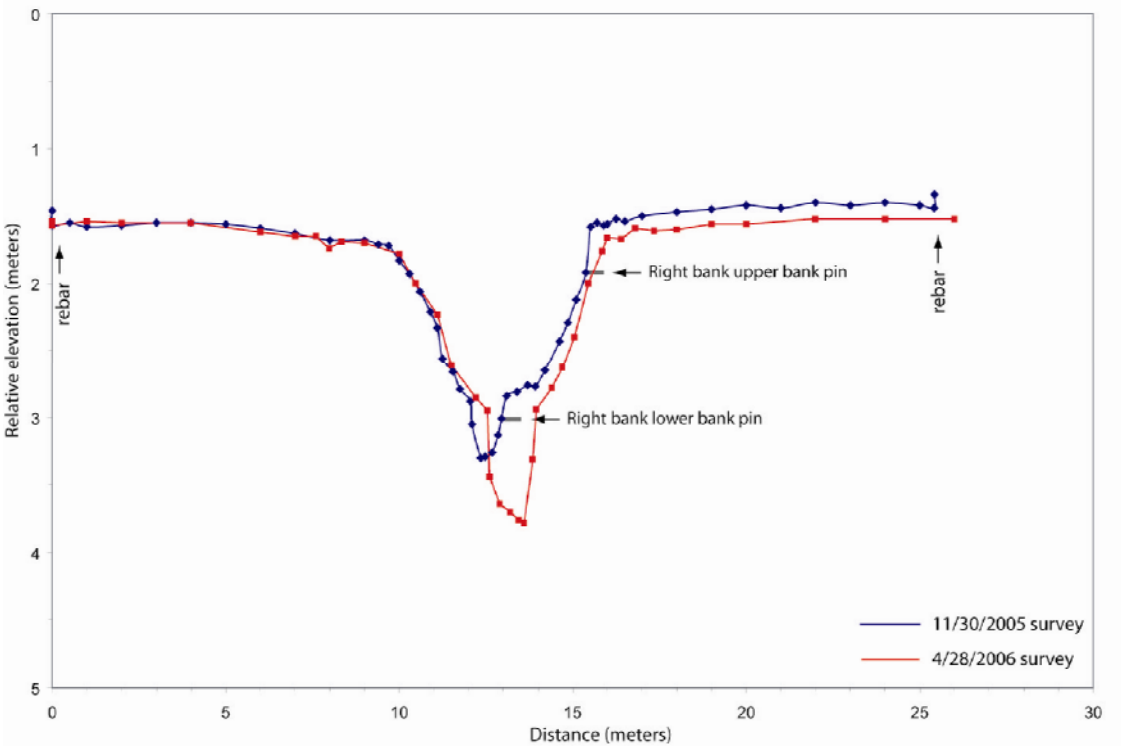

Figure A-24. Cross-section CXS2.

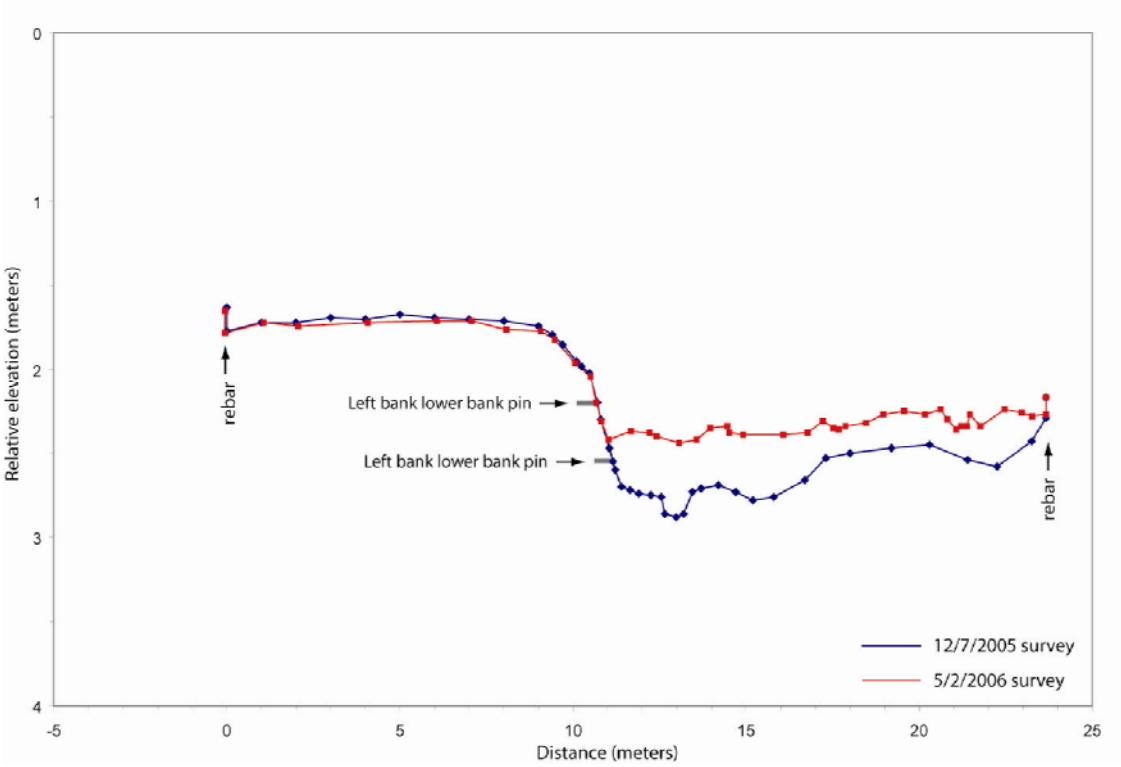

Figure A-25. Cross-section CXS3.

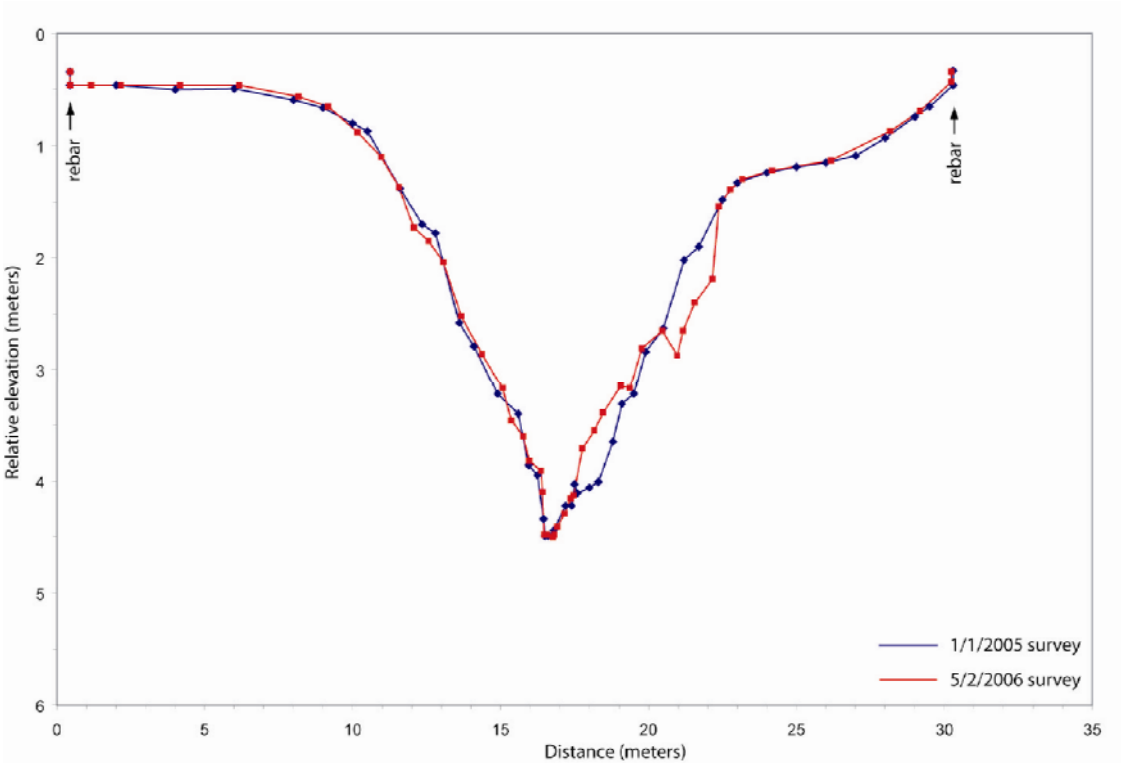

Figure A-26. Cross-section CXS4.

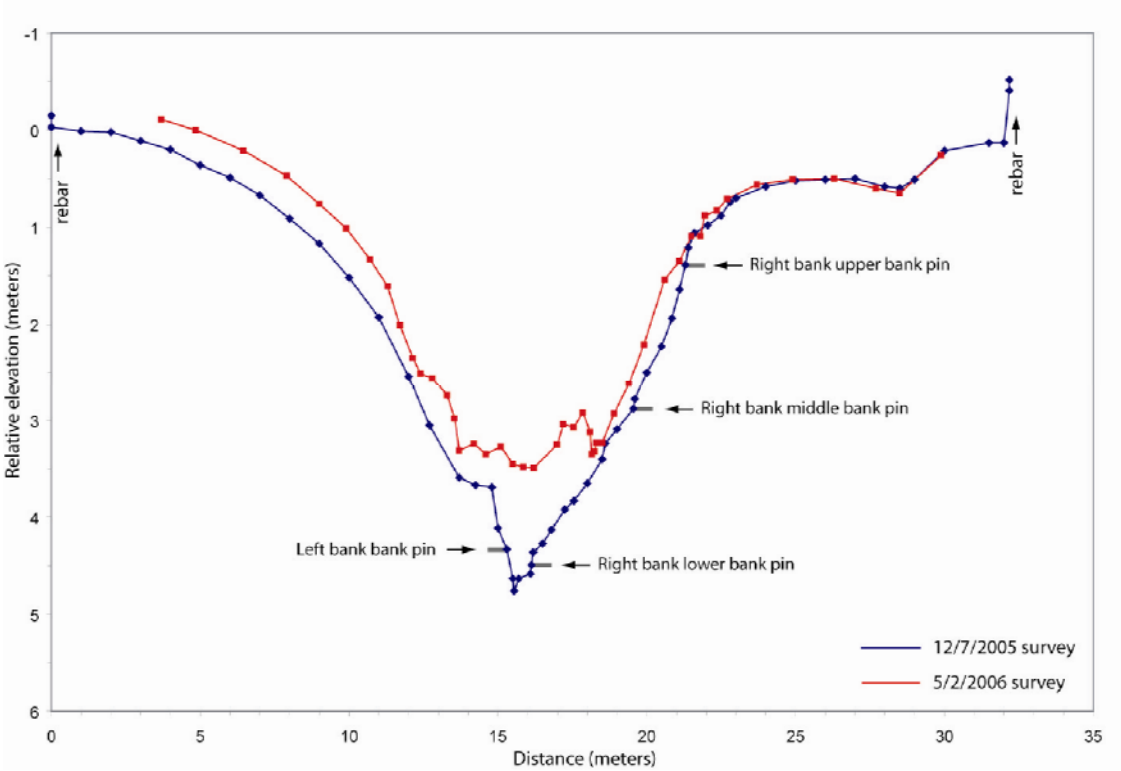

Figure A-27. Cross-section CXS5. Note: could not re-occupy either rebar, however second survey is within 1 m of previous survey line.

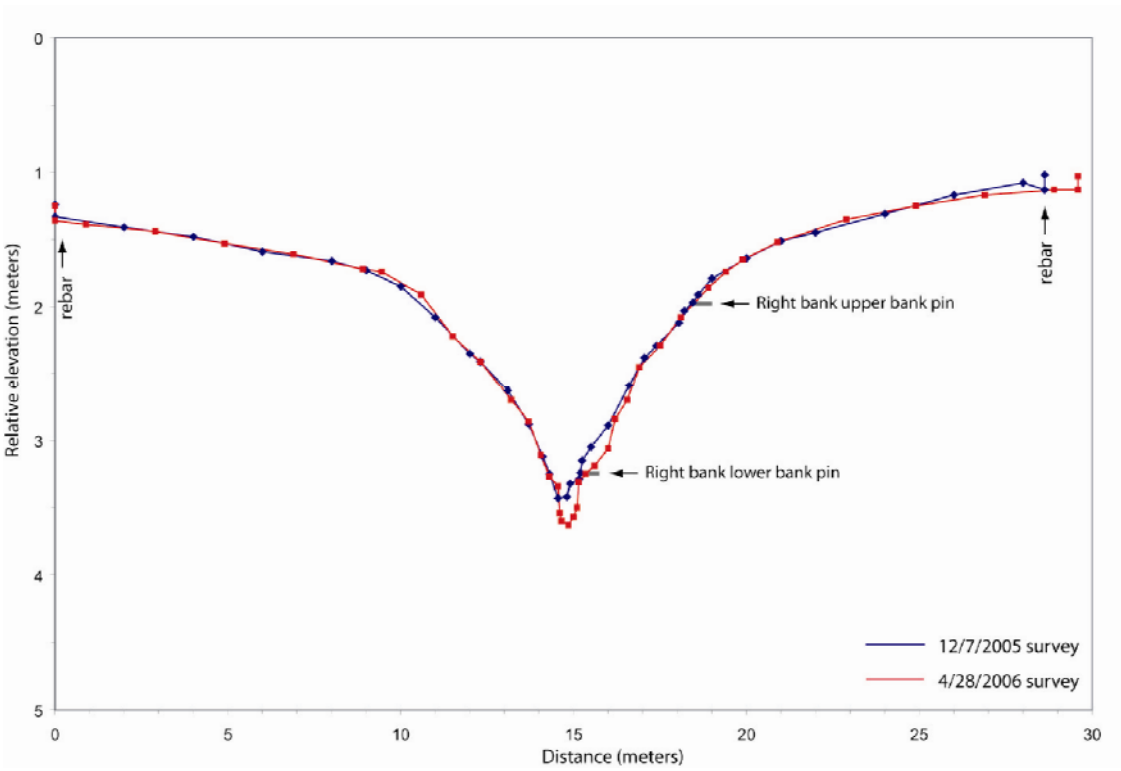

Figure A-28. Cross-section DXS1.

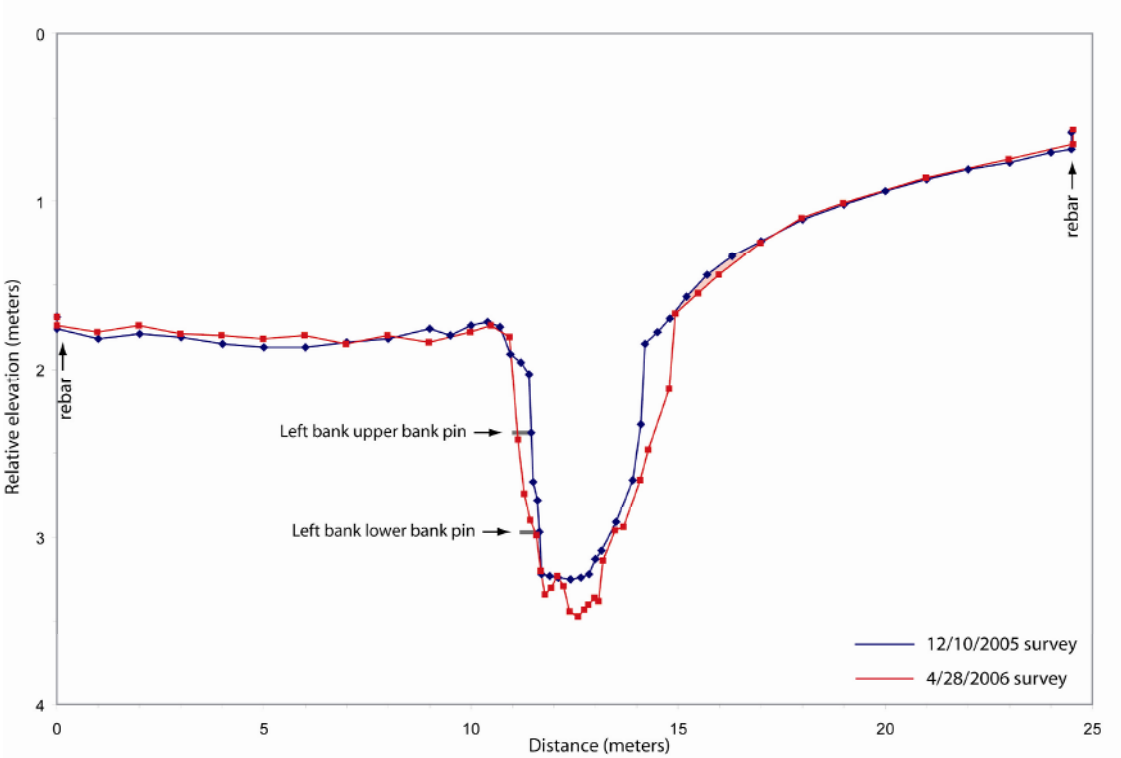

Figure A-29. Cross-section DXS2.

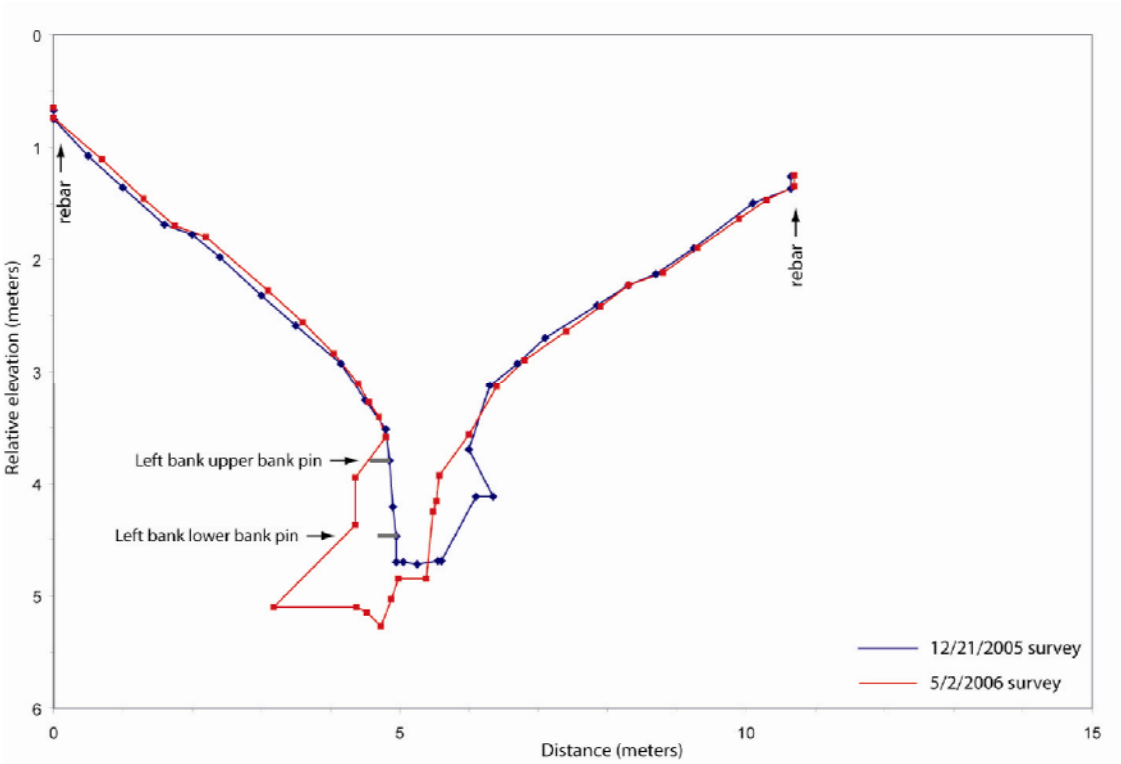

Figure A-30. Cross-section DXS3. Second survey left bank has a large undercut.

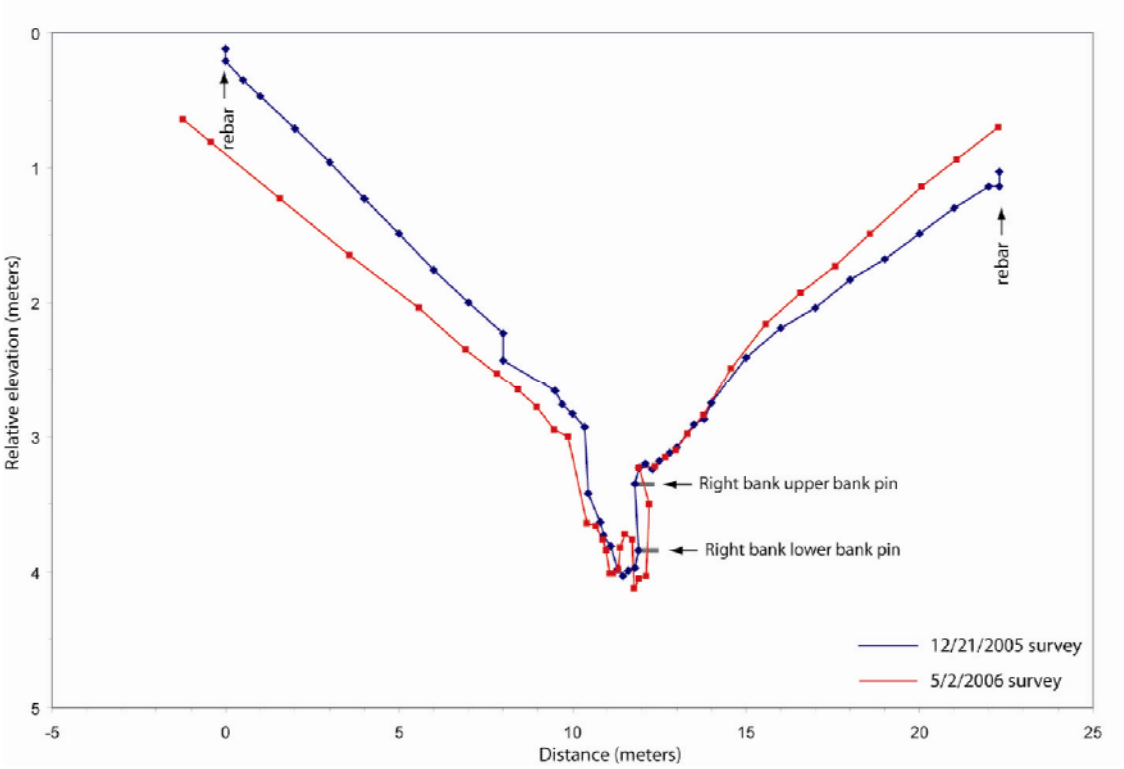

Figure A-31. Cross-section DXS4. Could not re-occupy either rebar, but second survey is tied into the right bank upper bank pin.

Table A-6. Cross-section rebar GPS locations. Latitude and longitude in decimal degrees (WGS 84).

Cross-section	Bank	Latitude	Longitude	Notes
AXS1	LB	37.97060	-122.24433	10m upstream of tributary confluence
AXS1	RB	37.97068	-122.24406	
AXS2	LB	37.96914	-122.24455	
AXS2	RB	37.96920	-122.24419	
AXS3	LB	37.96792	-122.24387	
AXS3	RB	37.96804	-122.24335	
AXS4	LB	37.96689	-122.24355	
AXS4	RB	37.96673	-122.24316	
AXS5	LB	37.96489	-122.24357	
AXS5	RB	37.96489	-122.24357	
AXS6	LB	37.96580	-122.24460	Next to 5th fence post from culvert
AXS6	RB	37.96566	-122.24441	
AXS7	LB	37.96808	-122.24493	
AXS7	RB	37.96801	-122.24470	
AXS8	LB	37.97114	-122.24481	
AXS8	RB	37.97106	-122.24461	
BXS1	LB	37.96966	-122.24127	
BXS1	RB	37.96959	-122.24097	
BXS2	LB	37.96856	-122.24154	Outside of barbed wire fence
BXS2	RB	37.96852	-122.24116	
BXS3	LB	37.96714	-122.24104	
BXS3	RB	37.67390	-122.24092	
BXS4	LB	37.96503	-122.23964	
BXS4	RB	37.96497	-122.23933	
BXS5	LB	37.96400	-122.23900	5m from bank
BXS5	RB	37.96403	-122.23872	10m from bank
CXS1	RB	37.97052	-122.24294	
CXS1	LB			No pin installed, outer white road line is edge
CXS2	LB	37.96914	-122.24282	
CXS2	RB	37.96911	-122.24255	
CXS3	LB	37.96750	-122.24227	Rebar is within 1m of each electric fence
CXS3	RB	37.96746	-122.24200	
CXS4	LB	37.96515	-122.24232	
CXS4	RB	37.96508	-122.24200	7.8m from edge
CXS5	LB	37.96380	-122.24120	
CXS5	RB	37.96395	-122.24086	
DXS1	LB	37.96955	-122.23998	10m from bank
DXS1	RB	37.96950	-122.23964	2m from fence post
DXS2	LB	37.96862	-122.23941	
DXS2	RB	37.96867	-122.23941	
DXS3	LB			Pin at washing machine; no GPS
DXS3	RB			Pin at base of 3 stem bay tree; no GPS
DXS4	LB	37.96625	-122.23588	
DXS4	RB	37.96641	-122.23588	

Appendix F- Bed and bank erosion

Table A-7 displays the raw data for each bank pin, including the date of installation, periodic erosion measurements, and total length exposed. Table A-8 displays the raw data for the headcut locations, including date of installation, periodic retreat measurements, and total retreat distance. Table A-9 displays the raw data for the scour chain locations.

Table A-7. Bank pin retreat data.

Cross-section	Bank	Upper/Lower	Date	Exposed	Notes
GULLY A					
AXS1	RB	Upper	Install	Flush	
AXS1	RB	Upper	12/30/2005	3.5" exposed	
AXS1	RB	Upper	2/27/2006	8" exposed	reinstalled 0.5" exposed on top, flush elsewhere
AXS1	RB	Upper	3/2/2006	0.5" exposed on top, flush elsewhere	
AXS1	RB	Upper	4/5/2006	3.0" exposed	
AXS1	RB	Upper	5/12/2006	unknown, fallen out	found in channel
AXS1	RB	Upper	TOTAL	26"	
AXS1	RB	Lower	Install	0.5" on top, flush on bottom	
AXS1	RB	Lower	12/21/2005	1" exposed	
AXS1	RB	Lower	12/30/2005	2.5" exposed	
AXS1	RB	Lower	4/5/2006	unknown, fallen out	fallen out and laying on bed, reinstalled in same hole - flush
AXS1	RB	Lower	5/12/2006	0.4" exposed	
AXS1	RB	Lower	TOTAL	18.4"	
AXS2	LB	Lower	Install	Flush	
AXS2	LB	Lower	3/2/2006	unknown, fallen out	Likely fallen out, could not find
AXS2	LB	Lower	5/12/2006	Could not find, but change unlikely	
AXS2	LB	Lower	TOTAL	unknown	
AXS2	LB	Upper	Install	Flush	
AXS2	LB	Upper	3/2/2006	unknown, fallen out	Likely fallen out, could not find
AXS2	LB	Upper	5/12/2006	Could not find, but change unlikely	
AXS2	LB	Upper	TOTAL	unknown	
AXS2	RB	Lower	Install	1.75" on top	
AXS2	RB	Lower	3/2/2006	no change	Likely in place, but did not observe directly
AXS2	RB	Lower	5/12/2006	Could not find, but change unlikely	
AXS2	RB	Lower	TOTAL	0"	
AXS3	LB	Upper	Install	0.75" Exposed	
AXS3	LB	Upper	12/30/2005	no change	
AXS3	LB	Upper	1/2/2006	unknown, fallen	18 inch pin

				out, found at base of slope	
AXS3	LB	Upper	5/2/2006	gone (fell out)	
AXS3	LB	Upper	TOTAL	18" +	
AXS3	LB	Lower	Install	Flush	
AXS3	RB	Lower	Install	0.5" Exposed	
AXS3	RB	Lower	12/30/2005	no change	
AXS3	RB	Lower	1/2/2006	8" exposed	
AXS3	RB	Lower	2/4/2006	no change	
AXS3	RB	Lower	5/12/2006	6.7" exposed	
AXS3	RB	Lower	TOTAL	6.7"	
AXS3	RB	Upper	Install	1" on top, flush on bottom	
AXS3	RB	Upper	12/30/2005	9" exposed	I installed it flush again
AXS3	RB	Upper	1/2/2006	unknown, fallen out	18 inch pin
AXS3	RB	Upper	5/12/2006	gone (fell out)	
AXS3	RB	Upper	TOTAL	27" +	
AXS4	LB	Lower	Install	1.25" on top, flush on bottom	
AXS4	LB	Lower	5/12/2006	can't find, but change unlikely	
AXS4	LB	Lower	TOTAL	0"	
AXS4	RB	Lower	Install	0.25" on top, flush on bottom	
AXS4	RB	Lower	5/12/2006	can't find, but change unlikely	
AXS4	RB	Lower	TOTAL	0"	
AXS4	RB	Upper	Install	0.5" on top, flush on bottom	
AXS4	RB	Upper	5/12/2006	can't find, but change unlikely	
AXS4	RB	Upper	TOTAL	0'	
AXS5	Headcut		Install	0.5" on right side, flush elsewhere	Halfway up headcut
AXS5	Headcut		5/12/2006	Can't find, likely fell out	
AXS5	Headcut		TOTAL	18' +	
AXS5	LB	Lower	Install	0.25" on top, flush elsewhere	
AXS5	LB	Lower	5/12/2006	Can't find, likely fell out	
AXS5	LB	Lower	TOTAL	18" +	
AXS5	RB	Lower	Install	Flush	
AXS5	RB	Lower	5/12/2006	Can't find, likely fell out	
AXS5	RB	Lower	TOTAL	18" +	
AXS5	RB	Upper	Install	1" on top, flush elsewhere	
AXS5	RB	Upper	5/12/2006	Can't find, likely fell out	
AXS5	RB	Upper	TOTAL	unknown	
AXS6	LB	Lower	Install	0.5" on top, flush on bottom	

AXS6	LB	Lower	5/12/2006	2.8" exposed	
AXS6	LB	Lower	TOTAL	2.8"	
AXS6	LB	Upper	Install	1.25" on top, flush on bottom	
AXS6	LB	Upper	5/12/2006	unknown, fell out	
AXS6	LB	Upper	TOTAL	18" +	
AXS6	RB	Lower	Install	0.5" on top, flush on bottom	
AXS6	RB	Lower	5/12/2006	1.2" exposed	
AXS6	RB	Lower	TOTAL	1.2"	
AXS6	RB	Middle	Install	0.5" on top, flush on bottom	
AXS6	RB	Middle	5/12/2006	0.6" exposed	
AXS6	RB	Middle	TOTAL	0.6"	
AXS6	RB	Upper	Install	Flush	
AXS6	RB	Upper	5/12/2006	0.4" exposed	
AXS6	RB	Upper	TOTAL	0.4"	
AXS6	LB	CULVERT	Install	1" on top, flush on bottom	1/4 way up the Left Bank at the Castro Rd culvert
AXS6	LB	CULVERT	TOTAL	unknown	
AXS6	RB	Upper CULVERT	Install	1.75" on top and left, flush elsewhere	1/3 way up bank at Castro Ranch Rd culvert; closest pin to culvert
AXS6	RB	Upper CULVERT	4/28/2006	2.0" exposed	
AXS6	RB	Upper CULVERT	TOTAL	.25"	
AXS6	RB	Middle CULVERT	Install	0.5" exposed on top, flush elsewhere	1/2 way up bank, on slope receiving flows
AXS6	RB	Middle CULVERT	4/28/2006	no change	
AXS6	RB	Middle CULVERT	TOTAL	0"	
AXS7	Headcut		Install	0.25" bottom	
AXS7	Headcut		12/21/2005	72", it had fallen out	We reinstalled flush
AXS7	Headcut		12/30/2005	unknown, it had fallen out again	Switched to upstream rebar measure
AXS7	Headcut		5/12/2006	unknown, it fell out	
AXS7	Headcut		TOTAL	see retreat data	
AXS7	LB	Upper	Install	Flush	
AXS7	LB	Upper	12/30/2005	58", it had fallen out	We reinstalled, flush
AXS7	LB	Upper	5/12/2006	unknown, it fell out	
AXS7	LB	Upper	TOTAL	76" +	
AXS7	LB	Lower	Install	0.5" on top, flush on bottom	
AXS7	LB	Lower	12/30/2005	no change	
AXS7	LB	Lower	5/12/2006	unknown, it fell out	
AXS7	LB	Lower	TOTAL	18" +	
AXS8	Center Headcut		Install	Flush	1.35m elevation
AXS8	Center		5/12/2006	unknown, it fell	possibly fell out in a block

	Headcut			out	
AXS8	Center Headcut		TOTAL	18" +	
AXS8	Left Headcut		Install	0.75" on left side, flush on right, 0.5" on bottom	
AXS8	Left Headcut		5/12/2006	unknown, it fell out	possibly fell out in a block
AXS8	Left Headcut		TOTAL	18" +	
AXS8	Left Headcut b		Install	0.25" on left, flush elsewhere	1.25m elevation
AXS8	Left Headcut b		5/12/2006	unknown, it fell out	possibly fell out in a block; found pin at bottom of channel
AXS8	Left Headcut b		TOTAL	18" +	
AXS8	Right Headcut		Install	0.5" on left, flush elsewhere	1.35m elevation
AXS8	Right Headcut		5/12/2006	unknown, it fell out	possibly fell out in a block
AXS8	Right Headcut		TOTAL	18" +	
GULLY B					
BXS1	LB	Lower	Install	1" on top, flush elsewhere	
BXS1	LB	Lower	3/2/2006	flush	
BXS1	LB	Lower	4/28/2006	flush	
BXS1	LB	Lower	TOTAL	0"	
BXS1	LB	Upper	Install	1.25" on top, flush elsewhere	
BXS1	LB	Upper	3/2/2006	0.75" on top, flush elsewhere	
BXS1	LB	Upper	4/28/2006	0.60" exposed	
BXS1	LB	Upper	TOTAL	0"	
BXS2	LB	Lower	Install	3/8" all around	
BXS2	LB	Lower	1/2/2006	12" exposed	
BXS2	LB	Lower	2/9/2006	unknown, fallen out	
BXS2	LB	Lower	4/28/2006	still can't find	
BXS2	LB	Lower	TOTAL	18" +	
BXS2	LB	Upper	Install	0.75" on left, flush elsewhere	
BXS2	LB	Upper	1/2/2006	unknown, fallen out	18" pin
BXS2	LB	Upper	2/9/2006	still can't find	
BXS2	LB	Upper	4/28/2006	still can't find	
BXS2	LB	Upper	TOTAL	18" +	
BXS2	RB	Lower	Install	3/8" on top, flush elsewhere	
BXS2	RB	Lower	1/2/2006	no change	
BXS2	RB	Lower	2/9/2006	13" exposed	18" pin, reinstalled 1" exposed
BXS2	RB	Lower	4/28/2006	1.2" exposed	
BXS2	RB	Lower	TOTAL	13.2"	

BXS3	RB	Lower	Install	1" on top, flush elsewhere	
BXS3	RB	Lower	2/4/2006	? Can't find, likely fallen out	18" pin
BXS3	RB	Lower	5/2/2006	unknown, fallen out, can't find	
BXS3	RB	Lower	TOTAL	unknown, likely buried	
BXS3	RB	Middle	Install	Flush	
BXS3	RB	Middle	5/2/2006	unknown, fallen out, can't find	
BXS3	RB	Middle	TOTAL	unknown, likely 18"	
BXS3	RB	Upper	Install	6/8" on top, flush elsewhere	
BXS3	RB	Upper	5/2/2006	unknown, fallen out, can't find	
BXS3	RB	Upper	TOTAL	unknown	
BXS5	Headcut		Install	Flush	Right hand branch of headcut (if looking downhill); Clumps of rush ~2.5m upstream of headcut (wet)
BXS5	Headcut		1/21/2005	unknown, fallen out, can't find it	lots of fresh blocks broken off
BXS5	Headcut		5/2/2006	unknown, fallen out, can't find it	
BXS5	Headcut		TOTAL	18" +	
BXS5	LB	Upper	Install	Flush	
BXS5	LB	Upper	5/2/2006	unknown	
BXS5	LB	Upper	TOTAL	unknown, likely 18" +	
BXS5	LB	Lower	Install	Flush	
BXS5	LB	Lower	5/2/2006	unknown	
BXS5	LB	Lower	TOTAL	unknown, likely 18" +	
BXS5	RB	Lower	Install	Flush	
BXS5	RB	Lower	5/2/2006	unknown	
BXS5	RB	Lower	TOTAL	unknown, likely 18" +	
GULLY C					
CXS2	RB	Upper	Install	0.5" Exposed	
CXS2	RB	Upper	1/2/2006	no change	
CXS2	RB	Upper	TOTAL	unknown	
CXS2	RB	Lower	Install	1.0" Exposed	
CXS2	RB	Lower	1/2/2006	no change	
CXS2	RB	Lower	TOTAL	unknown	
CXS3	LB	Lower	Install	5/8" on top and left, flush elsewhere	
CXS3	LB	Lower	5/2/2006	covered with aggradation	
CXS3	LB	Lower	TOTAL	unknown, buried	
CXS3	LB	Upper	Install	.05" on top, flush elsewhere	
CXS3	LB	Upper	5/2/2006	0.4" exposed	
CXS3	LB	Upper	TOTAL	.4"	

CXS5	LB	Lower	Install	Flush	
CXS5	LB	Lower	5/2/2006	unknown	
CXS5	LB	Lower	TOTAL	unknown, buried	
CXS5	RB	Middle	Install	Flush	
CXS5	RB	Middle	5/2/2006	unknown	
CXS5	RB	Middle	TOTAL	unknown	
CXS5	RB	Lower	Install	Flush	
CXS5	RB	Lower	5/2/2006	unknown	
CXS5	RB	Lower	TOTAL	unknown, buried	
CXS5	RB	Upper	Install	Flush	
CXS5	RB	Upper	5/2/2006	fallen out	
CXS5	RB	Upper	TOTAL	18' +	
GULLY D					
DXS1	RB	Lower	Install	1" on top, flush elsewhere	
DXS1	RB	Lower	1/2/2006	2.75" exposed on top	
DXS1	RB	Lower	1/21/2006	2.75" exposed	
DXS1	RB	Lower	2/27/2006	2.75 exposed	
DXS1	RB	Lower	3/2/2006	3.0" exposed	
DXS1	RB	Lower	4/5/2006	2.8" exposed	
DXS1	RB	Lower	4/28/2006	3.1" exposed	
DXS1	RB	Lower	TOTAL	3.1"	
DXS1	RB	Upper	Install	1.75" on top, flush elsewhere	
DXS1	RB	Upper	1/2/2006	1.75" exposed on top	
DXS1	RB	Upper	2/27/2006	no change	
DXS1	RB	Upper	4/28/2006	bankpin not found	
DXS1	RB	Upper	TOTAL	0"	
DXS2	Headcut		Install	5/8" on top, flush elsewhere	
DXS2	Headcut		1/2/2006	unknown, possibly fallen out	
DXS2	Headcut		4/28/2006	unknown, bankpin is gone	
DXS2	Headcut		TOTAL	18" +	
DXS2	LB	Lower	Install	1.5" on left, flush elsewhere	
DXS2	LB	Lower	1/2/2006	3.5" exposed	reinstalled flush
DXS2	LB	Lower	1/21/2006	no change	
DXS2	LB	Lower	3/25/2006	1.5" exposed	
DXS2	LB	Lower	4/5/2006	1.5" exposed	
DXS2	LB	Lower	4/28/2006	2" exposed	
DXS2	LB	Lower	TOTAL	5.5"	
DXS2	LB	Upper	Install	Flush	
DXS2	LB	Upper	1/2/2006	11" exposed	reinstalled flush
DXS2	LB	Upper	1/21/2006	no change	
DXS2	LB	Upper	3/25/2006	1.0" exposed	
DXS2	LB	Upper	4/5/2006	1.0" exposed	
DXS2	LB	Upper	4/28/2006	0.8" exposed	

DXS2	LB	Upper	TOTAL	12"	
DXS3	LB	Lower	Install	5/8" on top, flush elsewhere	
DXS3	LB	Lower	5/2/2006	unknown, fell out	
DXS3	LB	Lower	TOTAL	18" +	
DXS3	LB	Upper	Install	flush	
DXS3	LB	Upper	5/2/2006	0.6" exposed	
DXS3	LB	Upper	TOTAL	.6"	
DXS4	Headcut		Install	3/8"	
DXS4	Headcut		2/9/2006	4" exposed	
DXS4	Headcut		5/2/2006	12.2" exposed	pounded back in flush
DXS4	Headcut		TOTAL	12"	
DXS4	RB	Lower	Install	0.5" on top, flush elsewhere	
DXS4	RB	Lower	2/9/2006	? Not there? Buried?	
DXS4	RB	Lower	5/2/2006	lost	
DXS4	RB	Lower	TOTAL	unknown	
DXS4	RB	Upper	Install	0.5" on top, flush elsewhere	
DXS4	RB	Upper	2/9/2006	unknown, fallen out	12" pin, I reinstalled flush
DXS4	RB	Upper	5/2/2006	2.8" exposed	
DXS4	RB	Upper	TOTAL	14.8"	

Table A-8. Headcut retreat data.

Date	Cross-Section	Distance from headcut (m)	Geographic Description	Notes
1/2/2006 installed	Gully A at Castro Ranch Road	10.97	Left bank slump, immediately downstream of culvert	Rebar is in pasture on left side of channel
2/27/2006	Gully A at Castro Ranch Road	9.97		
3/2/2006	Gully A at Castro Ranch Road	10.03		
3/25/2006	Gully A at Castro Ranch Road	10.04		
4/5/2006	Gully A at Castro Ranch Road	10.00		
TOTAL		0.97		
12/30/2005 installed	AXS7	10.22	In gully upstream of headcut	Installed in-channel
1/1/2006	AXS7	7.05		Headcut went from sloped to vertical
1/2/2006	AXS7	6.23		
1/9/2006	AXS7	5.57		
2/4/2006	AXS7	5.10		
2/27/2006	AXS7	5.16		
3/2/2006	AXS7	4.73		Rusty metal sticking out today
3/25/2006	AXS7	2.20		
4/5/2006	AXS7	21.26	Old rebar has eroded, installed new monument rebar	Left side, on slight hill
4/28/2006	AXS7 new rebar	18.63		
TOTAL		At least 15.15		
1/2/2006 installed	Upstream of AXS7	10.70	Small headcut upstream of AXS7	Rebar is on right side of channel
2/4/2206	Upstream of AXS7	10.03		
2/27/2006	Upstream of AXS7	10.20 RB R side, 9.9 RB middle		
3/2/2006	Upstream of AXS7	10.08 RB R side, 9.57 RB middle		
4/5/2006	Upstream of AXS7	10.08 RB R side		
4/28/2006	Upstream of AXS7	10.08 RB R side		
TOTAL		0.62		
12/30/2005 installed	B/C headcut	9.99	At headcut between B/C	Rebar is next to fence post

1/2/2006	B/C headcut	9.42		
1/9/2006	B/C headcut	9.42		
3/2/2006	B/C headcut	9.36		
3/25/2006	B/C headcut	9.35		
4/5/2006	B/C headcut	9.35		
4/27/206	B/C headcut	9.37		
TOTAL		0.62		
1/2/2006 installed	Gully D at ranch road	10.00	Upstream, just on downstream side of road	
1/9/2006		10.12		
1/21/2006		10.10		
2/4/2006		10.07		
2/9/2006		unknown	Rebar was run over by ATVs	
TOTAL		no change		
1/9/2006	DXS2	10.13	Distance from in-channel rebar to knickpoint	Rebar is on bar on right side of channel
1/21/2006	DXS2	9.57 RB side, 10.08 LB side		
2/4/2006	DXS2	9.56 RB side, 9.68 LB side		
3/25/2006	DXS2	unknown	Cows trampled rebar	
4/5/2006	DXS2	Approx. 0.5 m extension		
4/5/2006	DXS2	8.81	Installed a new pin	In left side oak planting (inside cage)
TOTAL		1.07		

Table A-9. Scour chain locations.

Cross-section	Amount exposed at installation (inches)	Amount exposed after wet season	Notes
AXS1	1.25	Unknown	Completely scoured
CXS3	1.00	Unknown	Buried by 0.5m of sediment
DXS1	1.25	Unknown	Could not find

Appendix G- Sediment deposition

The following table displays the estimates of sediment deposition that occurred at each location. Deposition at Gullies A and C occurred this wet season, while deposition at Gully B has occurred since installation of the check dam.

Table A-10. Estimates of sediment deposition that occurred during the 2005-2006 wet season.

Location	Sediment deposition (m^3)
Gully C at the ranch road	1210
Gully A at the mouth	730
Gully B upstream of the check dam	160

Figure A-32. Photograph of sediment deposition at Gully C and the ranch road. Photo taken from the ranch road, looking downstream.

Figure A-33. Photograph of sediment deposition at Gully A at the mouth.

Figure A-34. Photograph of sediment deposition behind the check dam on Gully B. Photo taken looking downstream from the ranch road, during an EBMUD restoration day.

Appendix H- Sediment grainsize distributions

The sediment grainsize distribution at each cross-section location was measured using the modified pebble count methodology. The methodology prescribes that at least 100 pebbles at each location be measured, to insure that the data is statistically robust. Table A-11 provides the raw data, while the graphs (Figures A-35 through A-38) visually show the grainsize distribution.

In addition, notes describing the bed grainsize composition were taken at each cross-section. The following section includes these notes:

AXS1: Straight plane-bed reach. Is aggraded, but is likely able to transport most sediment through. Dominated by a sandy, muddy matrix with mainly 4-64 mm clasts. The lower terrace is now aggraded, with significant difference in cross-section from initial survey.

AXS2: Wide, plane-bed channel, full of sediment. Primarily a sand matrix with some gravels (4-64 mm). Starting to fluvially sort sediment sizes. Still a large amount of bank soil input. Inner terrace is dominantly composed of sand.

AXS3: A new carved inner notch channel 40cm wide and 40cm deep formed in the bottom of the channel this year. Large inputs from slumping banks (inputting mainly soil), but coarser gravels in pockets along the channel bed. One lens of gravels observed in the right bank.

AXS4: Very aggraded reach. Fine sandy to mud matrix with mainly 4-64 mm clasts, most very friable and break upon touch. Channel pattern is braided with sediment deposits extending to the bankfull width and depth.

AXS5: Debris flow with 180 mm blocks of bedrock, and up to 1m blocks of asphalt and concrete. Bedrock includes competent clasts of sandstone and friable clasts of mudstone. Soil matrix is clayey, yet crumbly. Sediment dominated by the clay matrix with 11 mm clasts of mud and siltstone.

AXS6: Channel has eroded down to bedrock. Highly fractured siltstone observed in bed. Bedrock is light grey to buff with thinner redbeds. Alluvium is primarily hillslope material that has been washed down. Hillslope material is tan to buff, silts and sands that are highly fractured and friable. Crumbles into 8-16 mm sized pieces. A few 16-32 mm grey clasts are observed (likely gravel from road bed). Visual estimate of D50 is 3.0 mm. The distribution is dominated by sand-sized clasts broken down from larger clasts.

AXS7: Freshly incised channel. The banks are providing all channel material. Sediment is a dark brown, sandy mud soil, that fails as blocks. Very muddy and sticky when wet. All grainsizes are <2, 2, and 4 mm. Only isolated clasts of 11-20 mm. Visual estimate of D50 is 1.2 mm.

AXS8: This cross-section is eroding only bank material (in place pasture soils). No fluvial sorting. There are "clasts" that are merely clumps of mud (blocks of soil that have been rounded as they have fallen off). Sediment is a dark brown, sandy mud soil with many cracks. Headcuts fail as blocks. Soil is still moist upstream of headcuts but bone dry on the sides.

BXS1: Plane-bed channel, with little topography. Dominated by silts, muds and fine sands, with lesser fine gravels. Sediment is well sorted.

BXS2: Matrix of silt and mud with coarse sands and fine gravels preferentially deposited in the thalweg and on the surface of the point bar.

BXS3: Large deposits of mud. Grainsize distribution is predominantly fines, but the thalweg does have coarse gravels to sands. These sizes are only dominant in the thalweg and on the tops of the bars.

BXS4: Top of the canyon reach. Sediment input is primarily soil material with some gravel and cobble (sourced from the upslope debris flow). The fine component is mud to clay.

BXS5: Qualitative pebble-count. Sediment distribution is composed primarily of bank material sourced from the headcut slump. Visual estimate of D50 is 2.0 mm. The coarsest portion is primarily 4 mm clasts in a matrix of fines. Very friable rock pieces, with none larger than 11 mm. Muddy when wet, grussy when dry.

CXS1: Road-side ditch, riprapped bed and banks. Riprap is 128-256 mm. Distribution is dominated by the deposition of silty fines with some coarser gravels in thalweg (mainly friable sandstones).

CXS2: Left bank has older riprap from previous grade control structure. Channel has some input of bank material (pasture soils) from slumping right bank. Primarily a matrix of fines, with some larger clasts (11 to 64 mm).

CXS3: All clasts are very friable. This reach is a very aggraded multi-threaded channel. It is composed predominantly of fines with a coarse armor of gravel (mostly friable clasts). About 80% of the willows in this restoration effort are sprouting and viable.

CXS4: Distribution is predominantly bank material (slumps). Some larger cobbles have rolled in from upstream. Overall sediment clasts are less friable. The fines are mainly silts and muds.

CXS5: Visual estimate of D50 is 2.0 mm. Distribution is dominated by soil material and friable bedrock that ranges from 2-11 mm. Most clasts crumble upon touch, making them difficult to count.

DXS1: Distribution is composed of mostly soil material. Very little storage of fluvial sediment in this reach.

DXS2: Mostly sand being deposited behind the willow waddles. Channel banks are providing some material as they slump. Soils are very dark brown to black clays, which are able to hold a vertical angle. Some larger clasts (22 to 45 mm).

DXS3: Narrow and deep channel carved into steep banks. Bank material provides some sediment (tan to brown silts). Some larger clasts stored behind trash and other obstructions. The steep slope provides enough energy to transport these larger clasts. Undercut banks are also common.

DXS4: Sediment distribution is composed only of hillslope soil material. No larger clasts.

Table A-11. Pebble count raw data for each cross-section location. Number of clasts counted in each grainsize class for each cross-section location. Riprap was not included in D50 calculations.

Grainsize (mm)	AXS1	AXS2	AXS3	AXS4	AXS5	AXS6	AXS7	AXS8	BXS1	BXS2	BXS3	BXS4	BXS5	CXS1	CXS2	CXS3	CXS4	CXS5	DXS1	DXS2	DXS3	DXS4
< 2	22	24	29	39	14				64	44	39	51		57	39	48	44		46	35	43	47
2	30	27	41	24	21				15	22	15	14		13	35	6	15		34	30	25	23
4	19	18	14	12	15				12	18	11	18		10	9	12	15		16	17	13	21
5.6	13	11	8	11	8				12	15	17	10		11	9	13	9		11	9	7	10
8	16	9	9	10	14				9	7	15	7		6	4	15	4		3	11	6	6
11	7	8	9	14	13				5	7	10	5		7	2	14	8		4	2	4	4
16	11	5	5	7	10				3	3	8	8		2	3	10	0		0	3	4	2
22	5	6	4	4	3				1	1	5	2		2	1	3	1		4	0	4	
32	2	3	2	3	8						1	1			1		0			4	3	
45	1	3	2	3	3							1			0		2			3	7	
64		1		1	3										2		0					
90					0												3					
128					2												1					
180					1																	
256																						
Riprap														7								
Total pebbles counted	126	115	123	128	115	0	0	0	121	117	121	117	0	115	105	121	102	0	118	114	116	113
Estimated D50						3.0	1.2	1.0					2.0					2.0				
Calculated D50	2.9	2.5	1.8	2.1	5.6				0.9	1.6	2.9	1.5		0.8	1.4	2.9	1.5		1.4	1.7	1.6	1.5

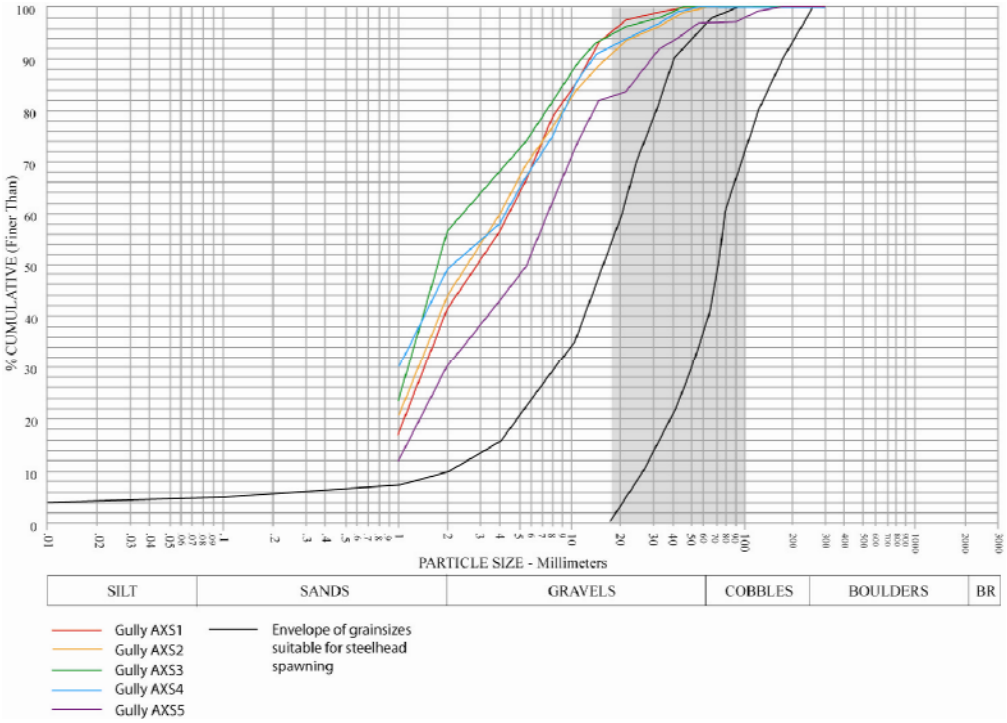

Figure A-35. Surface particle size distribution curves for cross-sections in Gully A. Envelope and shaded are highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993).

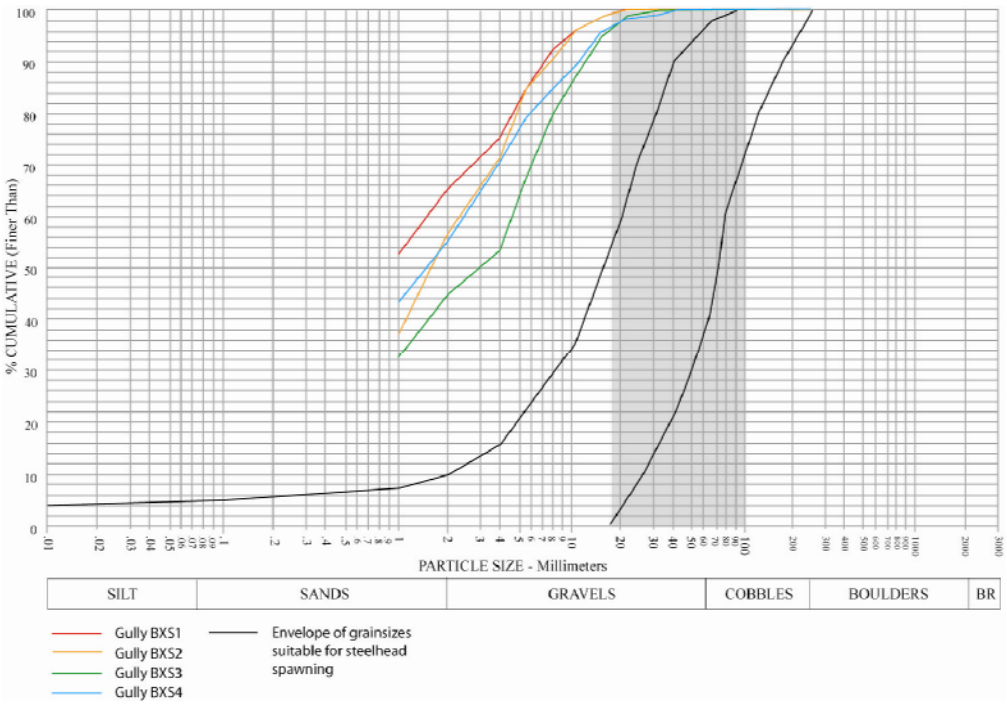

Figure A-36. Surface particle size distribution curves for cross-sections in Gully B. Envelope and shaded are highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993).

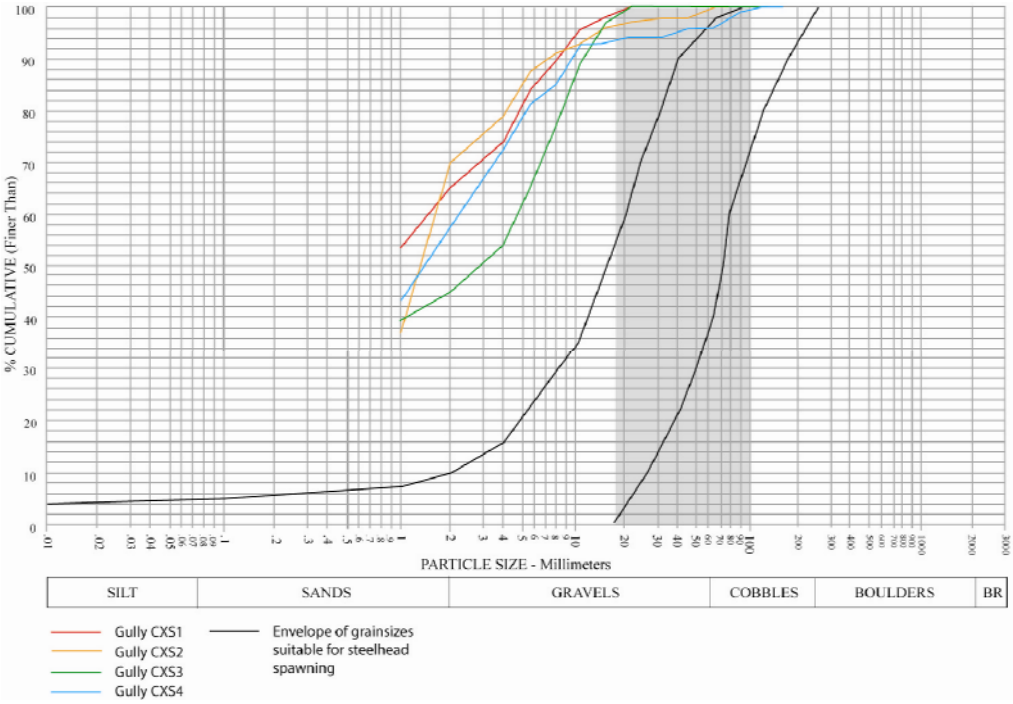

Figure A-37. Surface particle size distribution curves for cross-sections in Gully C. Envelope and shaded are highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993).

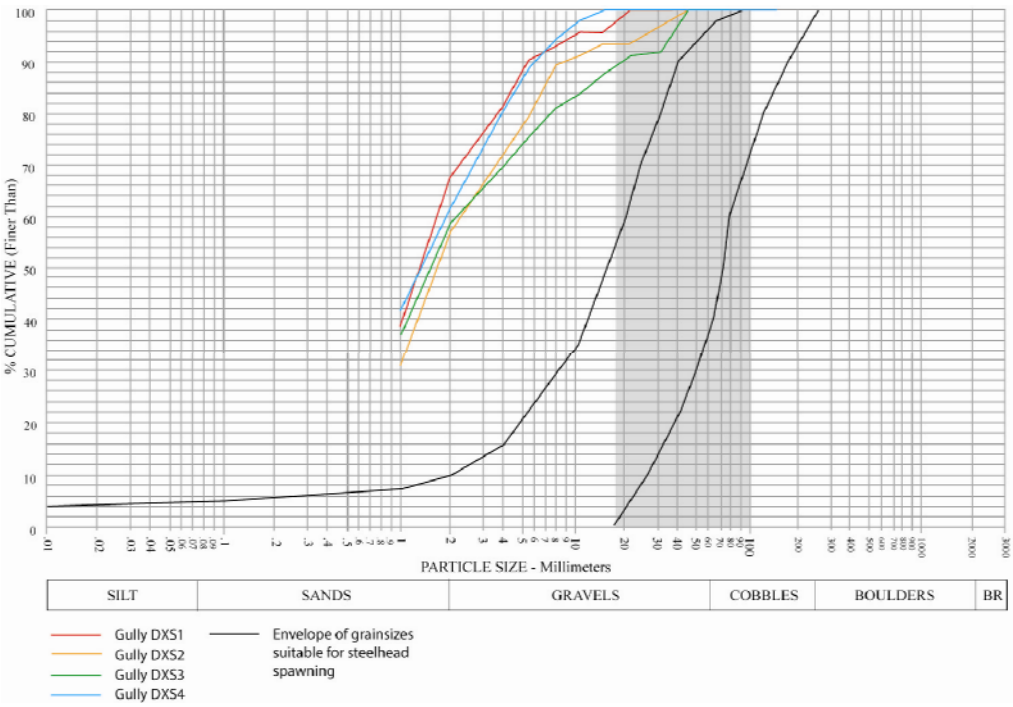

Figure A-38. Surface particle size distribution curves for cross-sections in Gully D. Envelope and shaded are highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993)

Appendix I- Turbidity

A small dataset of turbidity samples was collected from various locations in the sub-basin. Table A-12 lists the complete dataset.

Table A-12. All calculated turbidity values (in NTU) for sampled storm events.

	Gully A upstream of hanging culvert	Hanging culvert tributary	Gully A at Castro Ranch Road culvert	Gully A pasture runoff at AXS7	Gully A at AXS7	Gully A at mouth	Gully B at mouth	Gully C at ranch road	Gully C at mouth	Gully D at ranch road	Gully D at mouth	Castro Ranch Road surface runoff	Ranch road surface runoff	Headuct between B and C pasture runoff	Pinole Creek mainstem
12/18/05			5416				3253	6925		1048		44			
12/30/05			95			3395			1239						
1/2/06	12585	455	11940			7675	23133				48		46		
2/4/06				6					1253	38					
2/27/06			1207		556	4733	9080		9000		150			11	896
3/2/06			283	23		1533	7777	6320	4753		75		39		647
3/6/06						5917	22533		16258		150				1393
3/14/06									9447						
3/25/06			6330			7183	18825		12627		107				

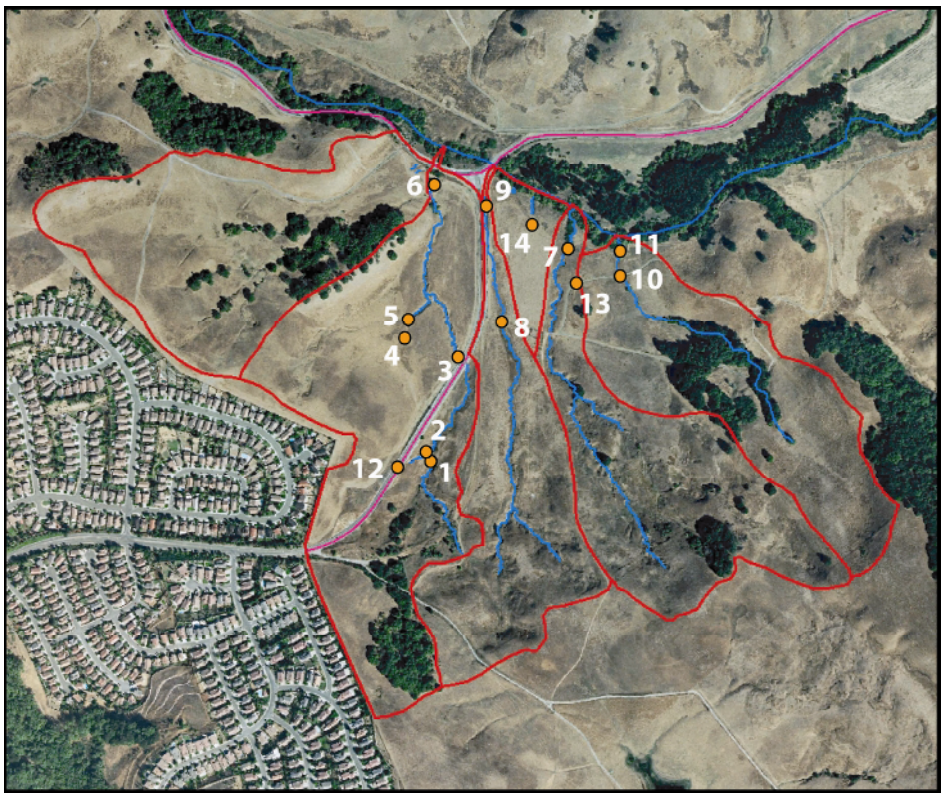

Figure A-39. Map showing the locations of turbidity samples. Numbers are in order shown in Table A-12.

Appendix J- Discharge

The field team measured discharge at various locations during two storm events. The events measured were dictated by when equipment was available for use from EBMUD. A Marsh-McBirney Flowmate 2000 flow meter and a standing rod were used for the measurements.

Table A-13. Measured discharge in the Pavon Creeks.

Date	AXS1	A Trib	A at CRR	AXS7	BXS1	BC	CXS1	DXS1
Measures in cms								
2/27/06	0.035	na	na	0.035	0.011	na	0.057	0.006
3/2/06	0.015	0.001	0.003	0.002	0.007	0.0003	0.005	0.006
Measures in cfs								
2/27/06	1.231	na	na	1.219	0.397	na	1.999	0.194
3/2/06	0.520	0.031	0.095	0.080	0.242	0.011	0.185	0.228

cms = cubic meters per second
cfs = cubic feet per second
na = did not measure at this location
AXS1 = Gully A at cross section 1
A Trib = Gully A on the tributary with AXS7, immediately upstream from the confluence with the mainstem of Gully A
A at CRR = Gully A on the downstream side of the culvert underneath Castro Ranch Road
AXS7 = Gully A at cross section 7
BXS1 = Gully B at cross section 1
BC = the large headcut between gullies B and C
CXS1 = Gully C at cross section 1
DXS1 = Gully D at cross section 1

Appendix K- Road assessment

The field team conducted a rapid assessment of the general condition of each of the ranch roads and the fire trails in the sub-basin. Every 20 m along the road, the team would take a GPS location, record the road width, condition (good, medium, poor), measure any rills, note the direction that runoff would drain, noted any berms, and any other relevant notes. The overall conclusion shows that the roads are generally in very good condition, and are not contributing large volumes of sediment, nor significantly concentration runoff flows. A few short road segments are noted as medium or poor condition, and would benefit from some focused maintenance.

Table A-14. Raw data for the assessment of ranch roads and fire trails.

Pavon Creeks Road Assessment

(points located every 20 Meters, unless otherwise noted)

Ranch Road to Gully D (starting at the corral, working towards Gully D

Point	Latitude	Longitude	Road width (m)	Condition	Rill Volume (m^3)	Direction water drains	Berms	Notes
1	37.96815	-122.24114	8.9	Good		Down	None	Well vegetated, arc of road
2	37.96830	-122.24107	3.8	Good		Down	LB	Cracks in bed
3	37.96848	-122.24104	3.85	Good			None	Cracks in bed
4	37.96861	-122.24100	3.92	Good	0.3	Down	LB	
5	37.96883	-122.24098	2.74	Good	0.108	Down	LB	Photo looking upstream
6	37.96902	-122.24085	3.7	Good	0.024	Down and Right	None	Start rill at RB; getting hillslope drainage
7	37.96909	-122.24072	3.5	Good	0.024	Down	LB	Drains some over LB berm
8	37.96914	-122.24050	2.85	Good	0.12		LB & RB	Most water from road-LB rill
9	37.96918	-122.24028	3.6	Good		Down	RB	LB grades out
10	37.96920	-122.24005	2.75	Medium	0.4		LB	Well vegetated but cracks and soggy during wet season. Drains LB into gully. Very uneven, clods
11	37.96921	-122.23982	3.9	Medium	0.0214	Down	RB	RB berm=0.3m; drains in gully to Gully D
12	37.96926	-122.24960	3.6	Medium	0.576	Down	LB & RB	Cracked and rilled; 0.2m berms on both banks
13	37.96932	-122.24942	3	Good		Down	LB & RB	Vegetated and cracked
14	37.96942	-122.24918	3	Good	0.35	Down	LB	Outsloped
15	37.96951	-122.24900	2.79	Medium	1.08	Down	LB & RB	Steep, not as well vegetated
16	37.96955	-122.23880	2.94	Medium	0.03		None	Steep
17	37.96944	-122.24859	2.8	Good		Down and left	RB	

18	37.96930	-122.24845	2.98	Good		Down	None	
19	37.96917	-122.24829	3.1	Medium		Down and Right	LB	Hardpack, not as well vegetated
20	37.96908	-122.24811	3.65	Medium			None	Hardpack
21	37.96899	-122.24792	3.2	Good		Down and Right	LB	
22	37.96893	-122.24771	2.6	Good		Down	None	
23	37.96886	-122.24749	2.94	Good		Down	None	Hardpack, but vegetated; some loose soil and animal burrows
24	37.96880	-122.24727	2.95	Good		Down	None	
25	37.96874	-122.24705	3.55	Good			None	
26	37.96869	-122.24682	2.7	Good			None	Loose soil and burrows on flat

Cabin to Corral Segment (starting near Gully D, working towards Castro Ranch Road)

Point	Latitude	Longitude	Road width (m)	Condition	Rill Volume (m^3)	Direction water drains	Berms	Notes
1			3	Good		Field	None	Hardpack
2	37.96810	-122.23652	3.2	Good		Down	None	Well vegetated, hardpack, photo
3	37.96798	-122.23634	2.8	Good		RB to D	None	Hardpack; little vegetation; LB cut hillslope 0.6m tall
4	37.96784	-122.23621	3.15	Good		Right	None	Dusty, loose sediment, but no evidence of transport
5	37.96768	-122.23608	3.1	Good		Right	None	Curve into trees, LB cut hillslope and cow trail; hardpack
6	37.96750	-122.23615	3.25	Medium		Right into D	None	LB hillslope erosion (0.7x1.2x0.2m)
7	37.96735	-122.23630	3.8	Medium		Right into D	None	No vegetation; muddy, lumpy, but no evidence of erosion; LB hillslope 1.0m tall
8	37.96736	-122.23624	3.6	Medium		runs across road	None	On Gully D centerline; photo; black corrogated plastic culvert on downstream, but no evidence on upstream.
9	37.96732	-122.23665	3.2	Medium	4	back to D	None	Very cracked and rutted but little evidence of erosion
10	37.96740	-122.23676	3.1	Medium		Right	LB	Very shrink/swell, cracked, big holes, but little erosion; 0.2m LB berm; drains right into wetland seep area

11	37.96748	-122.23697	2.95	Poor	0.96		None	Surface flow across road, very mucky, across rill
12	37.96758	-122.23721	3.15	Medium		Right	None	Hardpack, little vegetation but low erosion
13	37.96757	-122.23740	2.85	Good		Down	None	Hardpack, LB hillslope 1.0m tall
14	37.96753	-122.23764	4.2	Good		Right	None	No vegetation (in trees); slopes out; LB hillslope 0.8m; no bad erosion
15	37.96756	-122.23786	4.8	Good		Right	None	No vegetation; gravel and coarse in road material
16	37.96758	-122.23807	4	Good	0.05	Down and Right	None	Only minor erosion on hillslope; rills off slope
17	37.96760	-122.23840	4.9	Good		Down	None	Some material graded off slope (downstream side)
18	37.96767	-122.23857	3.6	Good		Down	None	Dipping bedrock in bed; hardpack, low vegetation density
19	37.96774	-122.23877	3.45	Good			None	LB inboard ditch starts in 10m (0.8 wide x 0.2m deep)
20	37.96776	-122.23896	3.2	Good	0.004		None	Hardpack and gravels
21	37.96780	-122.23917	3.46	Medium	0.432	Down	RB	LB rill; 0.2 RB berm
22	37.96783	-122.23940	3.2	Good	0.12		None	Cracks; shrink/swell
23	37.96786	-122.23961	3.15	Medium	0.448	Down	None	Most is vegetated; right side rill
24	37.96788	-122.23983	3.6	Good		Down and Right	None	Ditch jumps at 37.96790, -122.23997. Berm between road (LB) and ditch- captures upper road runoff and LB hillslope runoff- very little road erosion at jump - mainly downstream hillslope gully formation
25	37.96793	-122.23240	3.3	Good		Right	LB	Hard but vegetated; LB berm 0.2m
26	37.96798	-122.23026	3.45	Good		Right	LB	
27	37.96803	-122.23050	4.4	Good		Down	None	Well vegetated, right rill
28	37.96806	-122.23073	3.9	Good	0.032	Down	None	Right rill
29	37.96810	-122.23093	4.3	Good		Down	None	
30	37.96812	-122.23114	3.9	Good		Right	None	At ranch road to Gully D
31	37.96811	-122.23136	3.3	Good		Right into gully	None	2m past Gully B culvert
32	37.96818	-122.23160	3.35	Good		Right	None	

33	37.96826	-122.23180	3.5	Good			None	
34	37.96830	-122.23201	3	Good		Right	LB	0.15m berm
35	37.96834	-122.23224	3.4	Good			None	
36	37.96837	-122.23246	3.5	Good				Gully C erosion starts in 0.5m. Gully C erosion is 6.35 road length, 3.5 width. Far side GPS 37.96837, -122.24251. Gully 1=0.5 x 0.29, Gully 2=0.35 X 0.26, Gully 3= 0.30 x 0.16
37	37.96844	-122.23282		Medium		Right	None	LB wheel ruts; some surface flow across

Ranch Road between B and C (fire trail, starting at the corral, working towards the top of the basin)

Point	Latitude	Longitude	Road width (m)	Condition	Rill Volume (m^3)	Direction water drains	Berms	Notes
1	37.96792	-122.24144	2.9	Good		Left to B	None	Well vegetated; some cracks; photo
2	37.96776	-122.24150	2.5	Good			None	Cracks
3	37.96756	-122.24150	2.6	Good		Left to B	None	Cracks, some pockets of loose soil,
4	37.96739	-122.24140	2.7	Good			None	Well vegetated; cracks; photo of cracks and upstream of Seth
5	37.96721	-122.24140	2.6	Good			None	No erosion
6	37.96706	-122.24135	2.45	Good		Down and Right	None	
7	37.96688	-122.24126	2.65	Good		Down	None	Steeper
8	37.96670	-122.24114	2.8	Good	0.264		None	Left rill
9	37.96655	-122.24107	2.6	Good		Down	None	
10	37.96638	-122.24098	2.6	Good	0.264		None	Cracks
11	37.96618	-122.24092	2.6	Good			None	Cracks; photo of slump and upstream at Seth
12	37.96603	-122.24089	2.3	Good	0.154		None	Big cracks, some 0.05m wide
13	37.96584	-122.24084	2.5	Good	0.269		None	
14	37.96567	-122.24081	2.9	Medium	2.704		None	Steepest reach; shrink/swell
15	37.96551	-122.24077	2.7	Medium	0.84		None	Well vegetated; needs grading
16	37.96533	-122.24077	2.4	Medium	0.864	Down	None	
17	37.96513	-122.24071	2.8	Medium	0.354	Down	None	
18	37.96497	-122.24069	2.6	Medium	0.132	Down and left	None	Cracked, less steep, middle with less erosion, still fire ruts
19	37.96479	-122.24068	2.55	Good	0.096		None	Well vegetated;

								cracks
20	37.96461	-122.24065	2.4	Good	0.012		None	
21	37.96446	-122.24052	3.05	Good	0.012	Down and left	None	
22	37.96430	-122.24042	2.5	Good	0.36		None	
23	37.96413	-122.24033	3.65	Good	0.405	Down and left	None	
24	37.96397	-122.24021	2.4	Good	0.192	Down and left	None	
25	37.96380	-122.24011	2.2	Good	0.54		None	Flatter; outsloped; no erosion
26	37.96365	-122.23997	2.4	Good	0.042	Right into C	None	
27	37.96349	-122.24987	2.7	Good		Right into C	None	
28	37.96333	-122.24984		Good		Down and Right	None	17.2m distance to drainage divide

Alberta's Driveway (starting at the drainage divide, working towards Castro Ranch Road)

Point	Latitude	Longitude	Road width (m)	Condition	Rill Volume (m^3)	Direction water drains	Berms	Notes
1	37.96196	-122.24278	3.3	Good		Down	LB & RB	LB Berm=0.2m, LB Berm=0.3m; gravel
2	37.96207	-122.24295	3.23	Good	0.32		None	Start of anthropogenic ditch on LB side-0.6m high, 0.3m deep; catches hillslope water, not much road runoff
3	37.96222	-122.24307	3.4	Good		Down	None	
4	37.96238	-122.24320	3.2	Good		Down	LB & RB	Some runoff into ditch as this point; RB berm=0.4m, LB berm=0.15; ditch looks fresh, no erosion
5	37.96252	-122.24333	3.23	Good	2.025	Down and left	RB	RB berm=0.25
6	37.96265	-122.24348	3.3	Good			RB	Flat; RB berm 0.3
7	37.96278	-122.24366	3.2	Good			RB	Same berm as above; 0.2 hump between road and ditch on LB
8	37.96288	-122.24383	2.9	Medium	2.73	Down and Right	None	Rock placed in holes; one rill outlet on right into pasture-OK
9	37.96395	-122.24400	3.6	Medium	0.636		None	Some drainage into ditch here; some outslope into pasture on right no berm
10	37.96304	-122.24423	3.3	Good	0.15		None	

11	37.96314	-122.24440	3.4	Medium	0.6	Right	None	Right rill filled with rock- has held up OK; small gully on right outslope, LB ditch stops here and drains across road- 3x10 area of loose rock and soil, but no evidence of bad erosion
12	37.96322	-122.24461	3.38	Good			None	At creek crossing- headwaters of Gully A - about 0.6 wide and 0.5 deep; culvert looks good, not plugged
13	37.96334	-122.24478	3.3	Good			None	Gravel with chunks of asphalt
14	37.96339	-122.24500	3.3	Good			None	Good, old asphalt
15	37.96347	-122.24519	3.3	Good		Down and Right	None	Asphalt has ruts
16	37.96360	-122.24540	3.7	Good			None	Asphalt is old and has ruts
17	37.96369	-122.24551	5.23	Good			None	Out gate, 5m from Old Castro Ranch Road
18	37.96379	-122.24579	7.54	Good			None	Old Castro Ranch Road midpoint, 2 lanes; Castro Ranch Road ends 40m downhill with debris

Appendix L- Bankfull channel dimensions

The following bankfull channel dimensions were measured in the field during the post-wet season cross-section surveys. They represent the best professional judgment of the true bankfull metrics based upon field observations.

Table A-15. Bankfull channel widths and depths at each cross-section.

Cross Section	Bankfull Width (m)	Bankfull Depth (m)	Notes
AXS1	1.3	0.60	
AXS2	1.8	0.40	
AXS3	1.8	0.55	
AXS4	9.5	0.20	Wide aggraded reach
AXS5	1.7	0.35	
AXS6	0.8	0.50	
AXS7	1.1	0.50	
AXS8	0.7	0.30	
BXS1	1.4	0.45	
BXS2	2.3	0.55	
BXS3	3.0	0.40	
BXS4	1.4	0.55	
BXS5	0.4	0.30	
CXS1	2.1	0.25	Riprapped roadside ditch
CXS2	1.0	0.65	
CXS3	3.0	0.15	Wide aggraded reach, currently 13.5m wide and 0.10m deep
CXS4	0.7	0.55	
CXS5	0.9	0.30	This is a debris flow deposit
DXS1	1.0	0.40	
DXS2	1.6	0.35	
DXS3	0.9	0.75	Steep, narrow canyon reach
DXS4	0.7	0.40	

Appendix M- Sinuosity

Sinuosity is defined as the channel distance divided by the valley distance. The sinuosity for major reaches of each gully was measured in GIS using 2000 black and white aerial photographs provided by Contra Costa County. The trace of each channel was heads-up digitized, and a best-fit valley distance line was visually drawn. GIS provided the distance for each of the line segments. The following table summarizes data for each reach, and for the entire gully. This data will be most useful for any future design of channel planform for restoration efforts.

Table A-16. Measured sinuosity for individual reaches of each gully. PVR = Pinole Valley Road. CRR = Castro Ranch Road. RR = ranch road.

Gully A			
Location	Channel distance (ft)	Valley distance (ft)	Sinuosity
From PVR to tributary confluence	931	788	1.18
From tributary confluence to CRR	605	522	1.16
From CRR to top of aggradation	464	411	1.13
From top of aggradation to old CRR	1002	816	1.23
From old CRR to head of gully	245	216	1.13
Entire gully	3247	2753	1.18

Gully C			
Location	Channel distance (ft)	Valley distance (ft)	Sinuosity
Channelized reach at mouth	388	381	1.02
From the top of channelized to RR	525	459	1.14
From the RR to top of aggradation	288	275	1.05
From aggradation to midway	468	368	1.27
From midway to confluence	764	644	1.19
From confluence to head of gully Right	566	489	1.16
From confluence to head of gully Left	589	488	1.21
Entire gully	3588	3104	1.16

Gully B			
Location	Channel distance (ft)	Valley distance (ft)	Sinuosity
From mouth to RR	1113	871	1.28
From RR to confluence	524	472	1.11
From confluence to basin	939	847	1.11
From basin to head of gully	619	525	1.18
Tributary Right	451	388	1.16
Entire gully	3646	3103	1.17

Gully D			
Location	Channel distance (ft)	Valley distance (ft)	Sinuosity
From mouth to RR	313	250	1.25
From RR to trees	461	437	1.05
From trees to head of gully	1423	1284	1.11
Entire gully	2197	1971	1.11

Appendix N- Soils

Soils Report for Pavon Creek Gullies, prepared by Ken Oster

United States Department of Agriculture

NRCS

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America's Conservation Agency

February 6, 2006

Subject: Soils Report for Pavon Creek Gullies – prepared by Ken Oster, Area 2 Resource Soil Scientist, and Lisa Hokholt, District Conservationist – Contra Costa County

On January 9, 2006, a site visit to the Pavon Creeks watershed was conducted with Ken Oster and Lisa Hokholt of NRCS and Sarah Pearce of SFEI. The purpose of the site visit was to examine soil factors related to four gully systems (A, B, C, D). Soils on the Pavon Creeks watershed consist of Altamont clay, 15 to 30 percent slopes on the upper watershed, and Cropley clay, 2 to 5 percent slopes on the lower watershed. Both are clayey throughout and have high shrink-swell potential. These soils crack deeply when desiccated during the dry summers.

Precipitation from early storms infiltrates through the preferential flow paths down these cracks. There is little surface runoff until the cracks swell shut after the initial storms. Even when wetted, these soils have little sheet erosion because they are well-aggregated and vegetated with annual grasses and forbs. However they do have slow infiltration rates when wet and have greater runoff than loamy soils. Hoof prints indicate the soil is compacted by cattle when wet. This compaction has likely reduced the infiltration rates even more.

Altamont soils are vulnerable to rotational landslides during the wet season even when not disturbed. Storm water saturates this soil and lubricates the plane between the soil and the incompetent underlying mudstone. These landslides cannot be prevented, and while some temporarily retain water between the scarp and slump, they are mostly well vegetated and do not seem to contribute sediment to the gullies.

Gully A

Causes: Castro Ranch Road seems to intercept some stormwater that formerly flowed toward Gully C and now directs it towards Gully A. This occurs at the culvert under Castro Ranch Road at the upper end of the Pavon Creeks sub-watershed. This added flow may account for increased erosion in Gully A. The surface of pastures is compacted, apparently by livestock traffic when the soils are too wet (clay soils are more easily compacted when wet). Water is infiltrating 3 to 12 inches deep and the rest of the storm-water is running off. Surface water from precipitation exceeds the soil's infiltration rates. The flow of runoff over the surface of the soil has laid down the grasses. Heads of grasses point downhill. This increased runoff apparently increases erosion.

Effects: We crossed the lower part of Gully A across the Cropley soil. There were a string of three disconnected eroded head-cuts along the same drainage-way, but each head-cut

was separated by a vegetated strip. Each eroded spot is small, only about 3 to 4 feet across. There is a danger these head-cuts could advance during subsequent storms. Since they are small, it would be feasible to fill them to prevent further erosion.

One of three small, disconnected head-cuts.

The large gully through the Cropley soil fails along the side walls as large blocks. These blocks may be loosened by desiccation cracks and then dislodged when wetted by storm-water.

These gullies seem to have a long term history of cutting and filling. Sediment has apparently filled former, larger gullies and formed inset terraces. While the Cropley soil between the gullies is very dark gray and uniform, inset terraces are paler brown and stratified suggesting they washed into and filled a former larger gully. The color of the soil in the inset terraces matches that of the Altamont soil in the upper watershed. The Altamont soil may be the source of this fill. Ken reports finding a darker buried surface layer at a depth of 120 cm when augering through one of these inset terraces. The auger hole was about 170 cm from the outside edge of the insert terrace.

Inset terrace. From front to back: grassed treat, eroded riser, grassed tread, grassed slope of former bank of larger gully.

Subsequently, storms have cut gullies through these inset terraces. Sediment deposited by storms since late December are beginning to deposit new inset terraces 10 or more centimeters thick in the bottom of the downstream end of the gully.

Gully B

Causes: The pasture draining into Gullies B and are well vegetated, but compacted by hooves. They have slow infiltration. Storm water seems to penetrate only 3 to 6 inches deep in the higher pasture, and 6 to 12 inches deep in the lower pasture. This causes more runoff to flow across the rim of gullies and increase side-bank failure.

Effects: Sarah observed some water piping through the soil and exiting in the gully wall within a foot of the rim of the gully. There are entrances to burrows on the surface outside the gully. Water may be piping through these burrows.

The upper gully cuts through the Altamont clay and the side walls of the gully seem to fail by crumbing rather than as large blocks. The desiccation cracks seem only centimeters apart, so the soil failed as small clods. The highly fractured mudstone is also unraveling into the gully.

Gully D

The soil immediately along the gully is loamy at the head-cut and at the "waterfall" half-way between Pinole Creek and the trees. However, the soil around it is clayey.

Head cut of section of Gully D showing erosive flows.

Surface runoff concentrating above access road, then flowing to eroded area below road. Gully D.

Suggested Remedies: Temporarily exclude grazing or delay grazing from all sites until soils are dry enough following the rainy season to prevent soil compaction. Natural shrinking and swelling of the soil, combined with continuerd vegetative cover, will reverse compaction after several years. Roughening the soil surface may also increase retention of storm-water and decrease runoff. Head-cuts may need to be laid back to 2:1 slopes (or more) and armored with rock and/or vegetation.

This check dam at Gully B was eroded around the side, causing further erosion impacts to the site.

Appendix O- Specific recommendation locations

The following is a brainstorm list of potential locations to focus restoration activities. Looking forward to the immediate future, we suggest that some areas of the sub-basin would respond to restoration efforts better than others. This is based upon our observations, and current understanding of the system. Although restoration of these areas may not reduce the greatest amount of sediment input, we suggest that restoration of these areas will have a greater chance of success, and may be the most cost-effective:

- Stabilizing the AXS7 headcut to prevent further headward extension (this may be difficult because the system is still actively incising, but the reduction in future sediment load would be worthwhile if it works)
- Stabilizing the smaller headcuts in the pasture surface upstream of the AXS7 headcut
- Laying back the gully sideslopes on Gully A downstream of the Castro Ranch Road culvert (good chance of success because the channel has likely reached its greatest point of incision, and is currently in the widening phase)
- Stabilizing the DXS2 headcut
- Removing the remainder of the trash from the canyon reach on Gully D (will improve water quality, and decrease chances of culvert plugging)
- Fixing the culvert and finding a solution for the Gully C and ranch road crossing
- Increasing the size of culvert under Gully D and the lower ranch road to prevent future clogging (an easy fix with potentially large benefits)
- Re-routing the drainage collected by the ditch along the upper ranch road to prevent further hillslope gullying
- Ensuring the continued stability and drainage routing of runoff collected in ditch along the Nunes driveway in the upper Gully A watershed
- Fixing the hanging culvert to reduce erosive energy of stormwater flows. This solution should also address the bank erosion on this short tributary to prevent future Castro Ranch Road failure.
- Stabilizing and maintaining the remaining grade control structure on Gully B downstream of the ranch road to prevent future failure (failure would release a large plug of sediment, and jeopardize the ranch road)
- Stabilizing the headcut between Gullies B and C to prevent further headward extension (potential to prevent pasture gullying, and de-valuation of the pasture)
- Stabilizing the channel in the headwaters of the Gully D watershed (good chance of success because of soil properties and small upstream drainage basin area)

In other areas, we suggest that restoration may not be as successful, may fail, and are likely not very cost-effective. These include:

- Stabilizing side slopes on Gully B in the canyon reach (downstream of BXS4)
- Stabilizing the large surface landslides in the headwaters of Gully A
- Adjusting the culvert (and grade) of Gully A underneath Castro Ranch Road

In the longer-term, a number of issues will need to be addressed to ensure that the basin is managed as the stakeholders deem best. These issues include:

- Production and control of overland flow (surface runoff) across pasture surfaces
- Groundwater levels (pipe flow and sapping that increase gully erosion) and lack of groundwater in the summertime to support vegetation such as willows
- Long-term management of grazing (erosion issues versus fire management)
- Large-scale landslides, especially in the headwaters of the gullies

Appendix P- Photograph series

The following photos are important to document the current condition of locations within the watershed, but due to space limitations, were not able to be included in the technical report.

Figure A-40. Looking upstream along Gully A near AXS1, 3/2/2006.

Figure A-41. Measuring velocity in Gully A, 2/27/2006.

Figure A-42. Taking a measurement of an exposed bank pin at AXS1, 2/27/2006.

Figure A-43. Ken Oster and Lisa Hokholt on terrace surface downstream of AXS3, 1/9/2006.

Figure A-44. Block failure along gully side slope, near AXS3.

Figure A-45. Typical failure style of saturated banks in Gully A downstream of Castro Ranch Road.

Figure A-46. Cattle in the Gully A channel, 5/12/2006.

Figure A-47. Looking upstream at the culvert on Gully A at Castro Ranch Road.

Figure A-48. Unmeasured other headcut on the AXS7 tributary, 1/9/2006.

Figure A-49. A piece of rusty metal exposed in the AXS7 headcut wall, 3/2/2006.

Figure A-50. An example of pasture surface runoff feeding bank slump erosion on Gully A, 2/27/2006.

Figure A-51. Pasture surface runoff in Gully A near Castro Ranch Road, 12/18/2006.

Figure A-52. The small headcut immediately upstream of AXS7.

Figure A-53. One of the small headcuts in the pasture upstream of AXS7.

Figure A-54. The series of small headcuts upstream of AXS7, 1/1/2006.

Figure A-55. Initiation of surface flow in a small Gully A tributary basin, 1/2/2006. Seth is standing at the point of initiation.

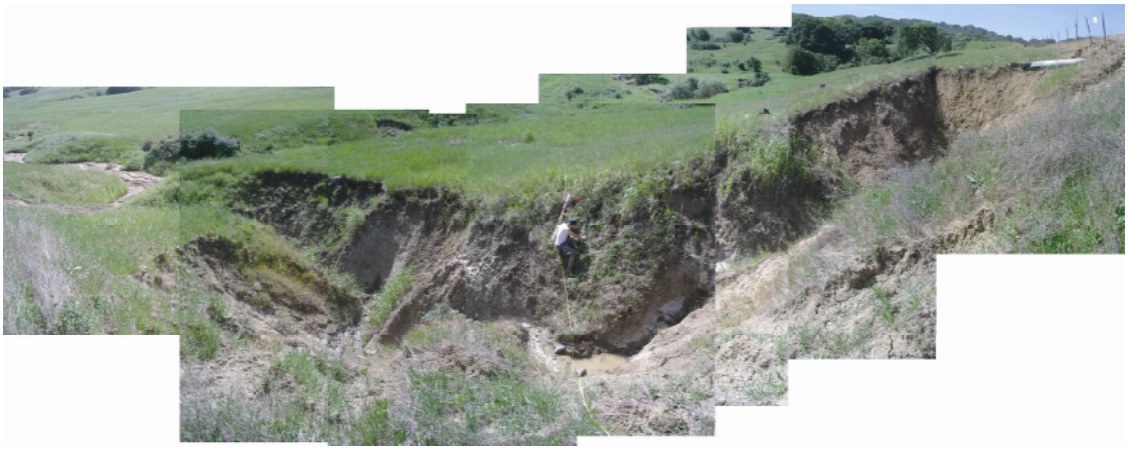


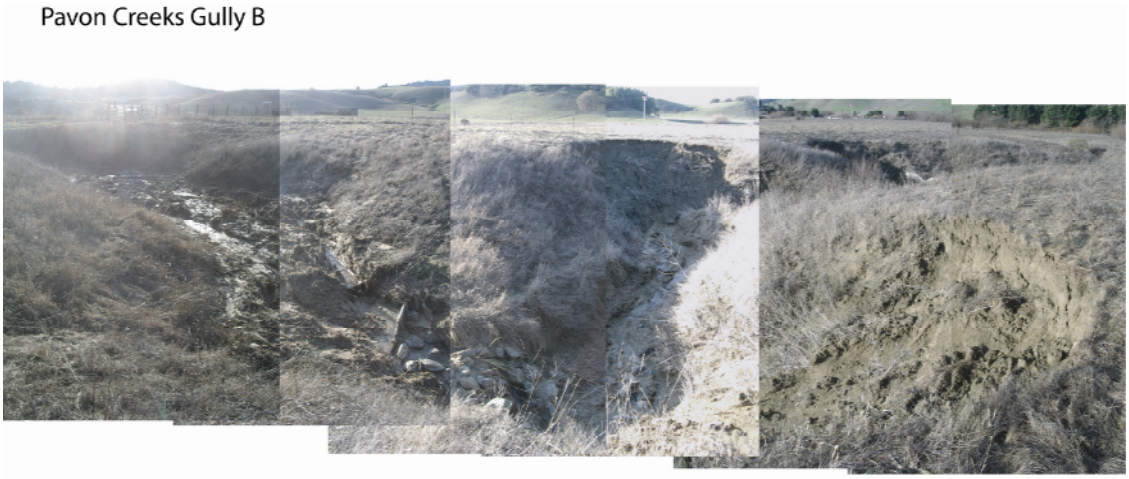
Figure A-56. A panorama taken from AXS6. The hanging culvert is on the right, and Gully A is on the left.

Figure A-57. The hanging culvert at AXS6, 5/12/2006.

Figure A-58. Aggradation on Gully A, at the confluence with the AXS6 tributary.

Figure A-59. Looking upstream along Gully B near the mouth, 3/6/2006.

Figure A-60. Failed check dam on Gully B, looking upstream.



Panorama photo of the check dam on Gully B. The deposition upstream (left side) of the dam, and the incision downstream (right side) as well as bank erosion is clearly visible. Photos taken 1/9/06.

Figure A-61. Panoramic photograph of the check dam on Gully B.

Figure A-62. Bedrock outcrop at the base of a bank in Gully B.

Figure A-63. A step in the profile of Gully B, upstream of the ranch road.

Figure A-64. Gully B aggradation upstream of the ranch road, 1/21/2006.

Figure A-65. One of many small knickpoints in the headwaters of Gully B. Note the previously deposited fluvial material in the gully bed.

Figure A-66. One of the active landslides in the Gully B watershed.

Figure A-67. Channel banks in the canyon reach of Gully B.

Figure A-68. Looking upstream in the canyon reach of Gully B, 1/1/2006.

Figure A-69. Mudball from Gully B.

Figure A-70. The fire trail between gullies B and C, near the drainage divide.

Figure A-71. Looking upstream at storm flow in Gully C, 12/30/2006.

Figure A-72. Pasture surface flow returning into an incised reach of Gully C downstream of the ranch road, 1/2/2006.

Figure A-73. Braided aggrading reach in Gully C, 1/1/2006.

Figure A-74. Channel aggradation at CXS3, 1/1/2006.

Figure A-75. Looking up the Gully BC headcut, 2/27/2006.

Figure A-76. Looking at a soil pipe at the BC headcut, 1/2/2006.

Figure A-77. The gully DXS2 headcut, 1/21/06.

Figure A-78. Looking upstream in the canyon reach of Gully D.

Figure A-79. Crack formed in shrink-swell soil.