Section 4

Mono Basin Tributaries:
Lee Vining, Rush, Walker, and Parker Creeks

Monitoring Results and Analysis
For Runoff Season 2009-10

Mono Basin Tributaries:
Lee Vining, Rush, Walker, and Parker Creeks

Monitoring Results and Analyses for Runoff Year 2009-2010

Prepared for:
Los Angeles Department of Water and Power

Prepared by:
McBain & Trush
P.O. Box 663
Arcata, CA 95518
(707) 826-7794

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The Mono Basin stream monitoring program continued through Runoff Year 2009 (RY2009) under the guidance of the State Water Resources Control Board and its appointed Stream Scientists. The primary focus of the Stream Scientists in RY2009 has been completion of instream flow studies (Taylor et al. 2009) and preparation of a Synthesis Report integrating previous runoff years' monitoring data and analyses. The Synthesis Report recommends revisions to the SWRCB Order 98-05 instream flows and stream restoration flows (SRFs). However, additional monitoring activities conducted in RY2009 not presented in the Synthesis Report are presented in this Annual Report.

We first summarize the runoff year hydrology and present annual hydrographs for the four Mono Lake tributaries, present cross sections re-surveyed on Lee Vining Creek in 2009, and finally, describe the riparian vegetation mapping and wood riparian acreage estimates conducted in late-summer and fall of 2009.

2 HYDROLOGY

2.1 Annual Hydrographs

Runoff Year 2009 was a Normal runoff year type, with a forecasted 88% of average runoff expected from the four Mono Lake tributaries – Rush, Lee Vining, Parker, and Walker creeks. With the prior two consecutive runoff years (RYs 2007-08) providing below average runoff, and below-average snowpack already evident in spring of 2009, the effects of drought conditions became evident in Grant Lake Reservoir storage. In RY2008, Grant Lake Reservoir had reached its second-lowest recorded storage level of 6,100 acre-feet, or 12.9% of the 47,171 acre-feet capacity on February 12, 2009. Increased turbidity was observed by LADWP and documented by the Mono Lake Committee (MLC 2009) during spring of 2009. The fisheries scientists had also documented poor trout condition factor resulting in part from higher than average water temperatures from a low Grant Lake Reservoir. Order 98-05 states that "Licensee is not required to reduce storage in Grant Lake below 11,500 acre-feet in order to provide SRFs"; thus minimum instream flows were released to Rush Creek throughout RY2009 (Figure 1) without a peak flow release. A variance was also requested by LADWP and granted by the SWRCB to lower minimum baseflow releases to 22 cfs during the period April 1 to May 15, to help increase GLR storage. The annual maximum streamflows for Rush Creek at Damsite, below the Return Ditch, and below the Narrows were 252 cfs, 54 cfs, and 111 cfs, respectively.

Lee Vining Creek had a more typical runoff pattern for a Normal runoff year, with a snowmelt flood and recession extending through the spring and into mid-summer. Snowmelt flood peaks for Lee Vining above Intake extended from approximately May 19 to June 20 with three independent peak events of 215, 230, and 201 cfs (Figure 2). The annual maximum streamflows for Lee Vining above the Intake and below the Intake were 230 cfs and 232 cfs, respectively, occurring on different dates. LADWP diversion operations resulted in diversion of the annual maximum peak of 230 cfs on June 1 (discharge below the Intake was 103 cfs), and the peak of 225 cfs on June 20, 2009 (discharge below the Intake was 201 cfs). The higher peak value of 232 cfs for Lee Vining below the Intake is likely a rating curve (statistical) error and does not necessarily reflect a true higher peak below than above the Intake structure.

Parker and Walker creeks had a similar runoff pattern as Lee Vining Creek (Figures 3 and 4), with snowmelt flood peaks extending over a month-long period from May 21 to June 24, and with a snowmelt recession extending into summer. Parker and Walker creeks had no diversions during RY2009.

2.2 Synoptic Streamflow Gaging

Synoptic discharge measurements were collected at numerous locations along Rush Creek and Lee Vining Creek, by McBain and Trush staff, Mono Lake Committee personnel, and by LADWP field crews. The purpose of this data collection is to quantify streamflow losses to shallow groundwater along the stream corridors during different seasons. Measurement locations, dates, and the flowdata for Rush

Creek are presented in Table 1. Lee Vining Creek data have not been added to a database yet. The flow losses in Rush Creek documented in the winter data collected by LADWP were consistent: 1.0 to 1.1 cfs/mi during three measurements at a typical RY2009 winter baseflow of 34 cfs release from the

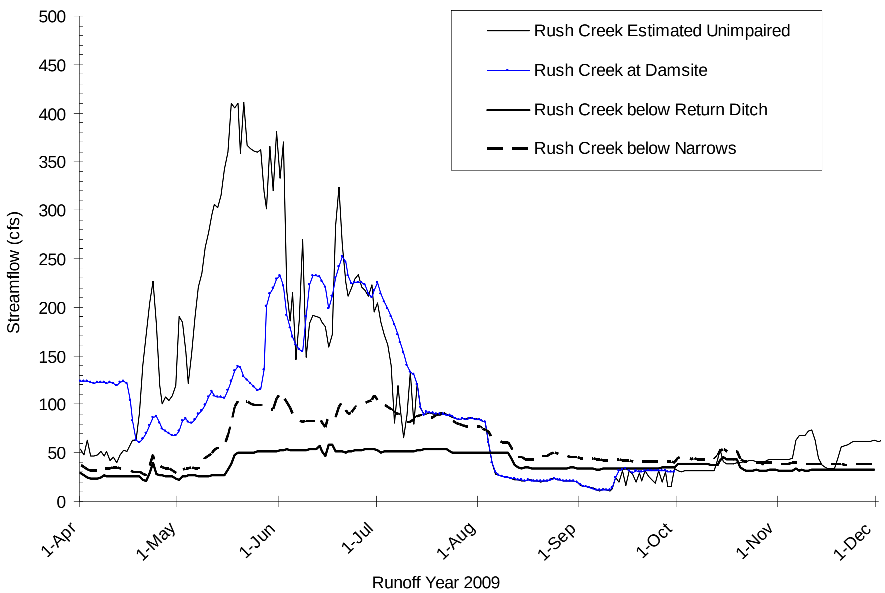

Figure 1. Rush Creek hydrographs for Runoff Year 2009.

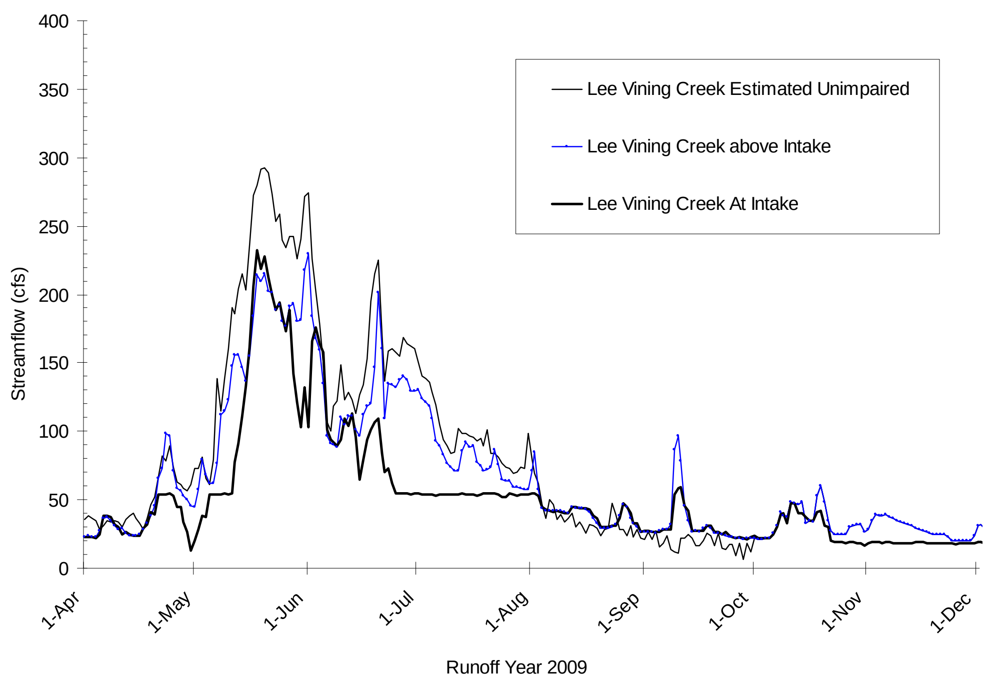

Figure 2. Lee Vining Creek hydrographs for Runoff Year 2009.

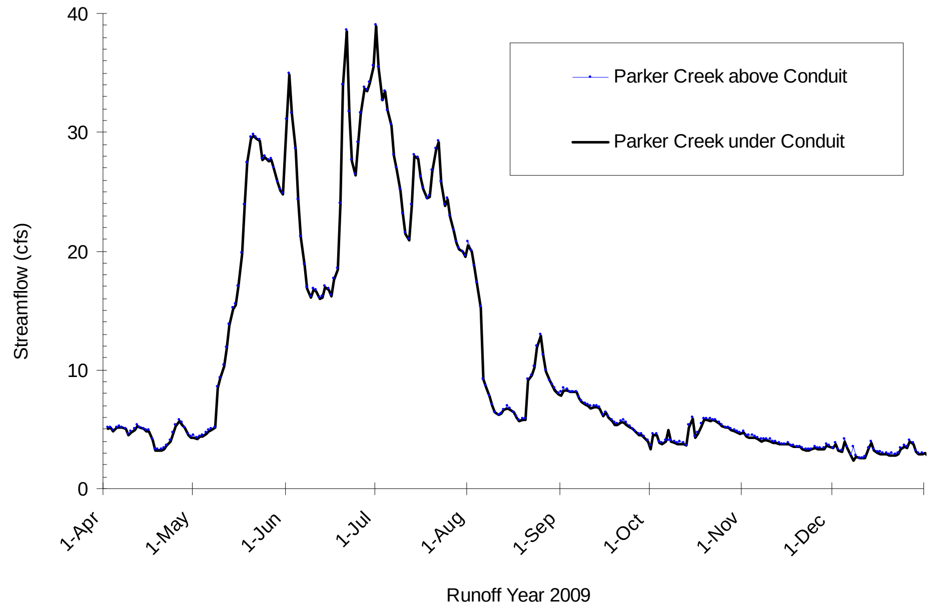

Figure 3. Parker Creek hydrographs for Runoff Year 2009.

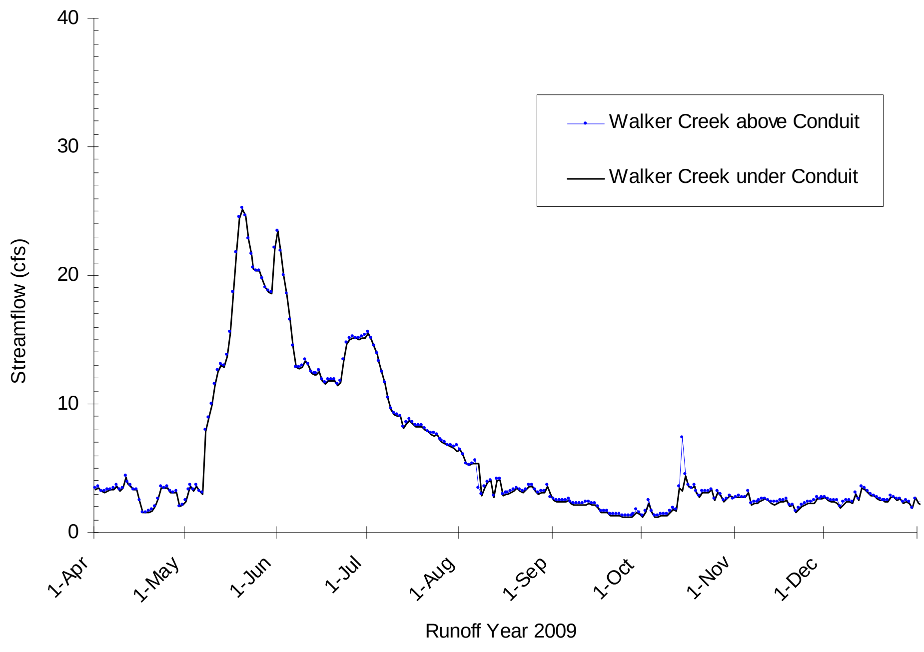

Figure 4. Walker Creek hydrographs for Runoff Year 2009.

Table 1. Synoptic discharge measurements collected by McBain and Trushm LADWP, and the Mono Lake Committee on Rush Creek, used to assess streamflow loss to groundwater longitudinally along the stream corridor.

		M&T, MLC, DWP FLOW DATA RY 2009												
Measurement Location	Stream Mile	3-May	3-Jun	10-Jul	28-Jul	10-Nov	20-Nov	7-Dec	8-Dec	11-Jan	14-Jan	4-Feb	16-Feb	16-Mar
MGORD	1.4	23.0	47.8	48.5	48.9	30.7		17.2		34.1			34.1	33.1
Rush Creek at Old Hwy 395						27.1		16.4		31.6			32.0	31.2
Rush Creek abv Parker Creek	4.9	NA	41.8	49.7	39.3	22.3		14.0		28.8			29.9	28.1
Parker Creek below Conduit		4.4	28.0	21.5	22.0									
Parker Creek blw Hwy 395		6.4	27.6	16.8	18.4	3.3		1.0		1.7			1.8	2.3
Walker Creek below Conduit		3.6	20.0	9.2	7.0									
Walker Creek at confluence		6.6	17.4	7.6	4.8	2.7		1.4		1.6			2.8	2.5
Rush below Narrows (Sum of Gaged Flows: MC	5.6	44.0	92.8	73.0	72.1	36.7		19.6		37.4			38.6	37.9
Rush below Narrows (Sum of Measured Flows)	5.6	NA	86.8	74.2	62.5	28.3		16.4		32.1			34.4	32.9
Rush Creek 4Bii Channelo		NA	NA	NA	NA		0.7		0.0		0.6	0.9		
Rush Creek 8 Channel		NA	NA	NA	NA		1.4		0.5		2.1	1.7		
Lower Rush Creek Mainstem blw 10 Falls	7.6	25.1	92.2	69.8	63.8	30.6		16.3		31.0			31.9	30.8
Rush Creek at County Road	9.1	NA	NA	71.5	56.7	27.7		ICING		29.8			30.3	30.3
Net Loss MGORD to Parker			6.0	-1.2	9.6	8.4		3.2		5.3			4.2	5.0
Rate of Flow Loss (cfs/mi)			1.7	-0.3	2.7	2.4		0.9		1.5			1.2	1.4
Net Loss Narrows to Lower Rush			-5.3	4.4	-1.3	-2.3		0.1		1.1			2.5	2.0
Rate of Flow Loss (cfs/mi)			-2.7	2.2	-0.6	-1.2		0.1		0.5			1.3	1.0
Net Loss MGORD to Lower Rush		18.9	0.6	3.2	8.3	6.1		3.3		6.4			6.7	7.0
Rate of Flow Loss (cfs/mi)		3.0	0.1	0.5	1.3	1.0		0.5		1.0			1.1	1.1
Measured by:		M&T	MLC	M&T	MLC	DWP	MLC	DWP	MLC	DWP	MLC	MLC	DWP	DWP

*=Daily Average Discharge from MGORD Rating Curve (i.e., not directly measured)
t=Daily Average Discharge from MGORD+Parker+Walker releases
+=Measurement confounded by an instantaneous pulse flow release from Parker Conduit by LADWP
NA=Not Available

MGORD (spanning January 11 to March 16). Flow losses were exactly half (0.5 cfs/mi) when the MGORD flow release was at 17 cfs during the December 7th measurement. Flow losses above the Narrows were also consistently higher than below the Narrows, which was expected. Finally we noted consistent losses of streamflow to groundwater from the MGORD to the Narrows during the spring and fall measurements, but a possible gain in flow (approximately 1.2 cfs, though within sampling error) on the July 10 measurement, corresponding to the end of the RY2009 snowmelt period when groundwater elevation would be expected to be at an annual maximum.

3 GEOMORPHOLOGY

3.1 Lee Vining Creek Cross Section Surveys

During the RY2008 instream flow study on Rush Creek, water surface elevations were marked in the field at our monitoring cross sections to document stage heights associated with the range of test flow releases. Water surface elevations and the cross section morphology were subsequently re-surveyed, plotted, and presented in the RY2008 annual report. This monitoring was repeated in RY2009 during the April/May Lee Vining Creek instream flow study. All Lee Vining Creek cross sections were also resurveyed in July 2009. Those cross sections and associated water surface elevation data are presented in Appendix A.

4 RIPARIAN VEGETATION MONITORING

4.1 Riparian Vegetation Termination Criteria Evaluation

The riparian corridors of Rush and Lee Vining creeks were mapped in 2009 following the 1999 mapping protocols (McBain & Trush, 2000), to determine total acreages of woody riparian vegetation within each stream corridor. The woody riparian vegetation acreages derived from field mapping and GIS analysis are the basis for evaluating riparian vegetation recovery and for comparing to the Termination Criteria (Table 2). Riparian vegetation was not mapped along Walker and Parker creeks in 2009.

Similar to the mapping analysis in 1999 and 2004, the detailed plant alliances were combined into three broader categories to facilitate comparison between years, to reflect the general categories in the Termination Criteria, and to make overlays between years easier to interpret. The three general categories were:

- Desert- These patches are typically pinion pine, sagebrush, or sagebrush-bitterbrush dominated;
- Riparian herb- These patches are typically grasslands, wet meadows, herbs growing on cobble bars etc;
- Riparian woody- These patches are typically aspen, black cottonwood, willows, Jeffery pine, white fir, lodgepole, rose, or mixed rose.

Throughout the Rush and Lee Vining creek riparian corridor, from LADWP diversion facilities downstream to Mono Lake, net acreages of riparian woody vegetation recovery have not increased since 2004 when the riparian corridors were last mapped (Figure 5). Compared to the relatively fast rate of recovery observed between 1989 and 1999, there has been little or no further woody vegetation recovery since 2004. Woody riparian woody vegetation recovery has slowed on Rush Creek and woody vegetation area decreased on Lee Vining Creek between the 2004 and 2009 mapping. It is reasonable to assume that future recovery will consist primarily in increases in canopy area or stand perimeters, but will provide expanded acreages only where the streams create new sites for riparian hardwood species to colonize.

The vegetation acreages mapped are estimates affected by several sources of error. Most sources of error are considered small. Riparian vegetation Termination Criteria have been defined to a tenth of an acre for each reach of Rush and Lee Vining creeks. However the variation or error between mapping periods in any given reach may be closer to half an acre (+/-).

Some reaches along Rush and Lee Vining creeks have met termination criteria, other reaches are recovering or show promise of recovery in the near future (i.e., by 2025), while others still have not shown much recovery since 1989 (Table 2.). The rate of recovery has tapered off (i.e., riparian recovery is asymptotic, indicating that future riparian woody vegetation acreages may not increase. There are still reaches were little has changed since the early 1990's or 1999 and there is still a disparity in riparian acreage compared to the termination criteria (discussed in several bullets below). This observation has implications for several reaches in both Lee Vining and Rush Creek, summarized below.

- Overall Rush Creek woody riparian vegetation acreage increased 3.5 acres, or 2% since 2004.
- Rush Creek Reach 1 was not mapped in 2009. We assumed that the area of riparian vegetation has remained the same since 2004. In 2004 woody vegetation acreage had increased only 0.9 acres since 1989 and was still 4.3 acres from meeting the termination criteria.
- Rush Creek Reach 2 met the Termination Criteria requirements in 2004, and is now 1.9 acres above the Termination criteria for riparian woody vegetation.
- Rush Creek Reach 3a riparian woody vegetation increased 3.1 acres since 2004. However, 4.1 acres are still needed to meet the termination criteria. This reach has a few locations where further recovery could occur, however full recovery of riparian woody acreage is unlikely to meet the termination criteria.
- Rush Creek Reach 3b riparian woody vegetation acreage has met the termination criteria requirements. Channel rewatering in 1999 will likely allow riparian woody vegetation acreage to exceed the Termination Criteria.
- Rush Creek Reach 3c riparian woody vegetation expanded 1.1 acres since 2004, but needs 0.4 acre more to meet the Termination Criteria (this acreage is likely within the mapping variation associated with acreage estimates). Continued tree canopy expansion will likely allow riparian woody vegetation acreage to meet the Termination Criteria in the next 5 years.
- Rush Creek Reach 3d woody riparian vegetation expanded 1.2 acres since 2004, but needs 3.7 acres more of riparian woody vegetation to meet the Termination Criteria. Floodplain reconstruction, channel openings and gravel mine reclamation have all occurred in this reach. As restored areas continue recruiting new riparian woody species and older woody vegetation continues growing, the Termination criteria should be exceeded by 2025.
- Rush Creek Reach 4a woody riparian vegetation has decreased 1.1 acres since 2004, 1.2 acres short of the Termination Criteria. Reach 4a met the termination criteria in 2004 but are now are below the Termination Criteria
- Rush Creek Reach 4b riparian woody vegetation acreage slightly increased 0.9 acres since 2004. However, 12.5 acres are still needed in this reach to meet the Termination Criteria. With recent channel rewatering, past and future migration, scour and deposition on current surfaces adjacent to the main channel, recovery of riparian woody acreage should exceed the Termination Criteria.
- Rush Creek Reach 4c riparian woody vegetation acreage decreased 2.2 acres since 2004. Channel downcutting related to drops in lake level elevation have incised this reach and 9.6 acres are now needed to meet the Termination Criteria. Without channel migration, recovery of riparian woody acreage will not likely meet the Termination Criteria.
- Rush Creek Reach 5a riparian woody vegetation acreage decreased 2.3 acres since 2004. Channel downcutting related to drops in lake level elevation have incised this reach and 10.8 acres are now needed to meet the Termination Criteria. Woody riparian vegetation needs to increase 8.5 acres to meet the termination criteria. Without channel migration recovery of riparian woody acreage will not likely meet the Termination Criteria.

- Rush Creek Reach 5b did not exist before diversion and has no Termination Criteria. However, riparian woody vegetation has increased 1.5 acres in this reach since 2004

Lee Vining Creek riparian woody vegetation acreage compared to the termination criteria

- Overall Lee Vining Creek woody riparian vegetation acreage decreased 7.3 acres, or 8% since 2004.
- Lee Vining Creek Reach 1 was not mapped in 2009. We assumed that the area of riparian vegetation has remained the same since 2004. In 2004 Reach 1 had met the termination criteria requirements for riparian woody vegetation and was 7.6 acres above the Termination Criteria.
- Lee Vining Creek Reach 2 riparian woody vegetation recovery has been difficult to estimate between 1989 and 2009, because mapping extended past Hwy 395 in 2004 only. We only mapped reach 2b in 2009. In subreach 2b there was a 0.2 acre increase in woody riparian vegetation since 2004, and 3.0 acres are still needed in this reach (2a and 2b combined) to meet the Termination Criteria. With the current anthropogenic constraints on this reach (i.e., Hwy 120, Hwy 395; SCE substation, etc.) further increases in riparian woody acreage are unlikely.
- Lee Vining Creek Reach 3a riparian woody acreage woody riparian vegetation acreage decreased 3.1 acres since 2004; 12.7 acres are needed to meet the Termination Criteria. If existing channel distributary networks are cut off from streamflows a further decrease in woody riparian acreage could be expected, particularly if no acreage increases result from channel migration or scour and deposition on current surfaces adjacent to the main channel.
- Lee Vining Creek Reach 3b woody riparian vegetation acreage decreased 4.1 acres since 2004; 12.1 acres are needed to meet the Termination Criteria. If existing channel distributary networks are cut off from streamflows a further decrease in woody riparian acreage could be expected, particularly if no acreage increases result from channel migration or scour and deposition on current surfaces adjacent to the main channel.
- Lee Vining Creek Reach 3c met the termination criteria requirements in 2004. Woody riparian vegetation has decreased 0.4 acres since 2004, but is still 1.3 acres above the Termination criteria.
- Lee Vining Creek Reach 3d did not exist before diversion and has no Termination Criteria. However, riparian woody vegetation has increased 1.1 acres since 2004

Table 1. Synoptic discharge measurements collected by McBain and Trush, LADWP, and the Mono Lake Committee on Rush Creek in RY2009. All values are in cfs.

						M&T, MLC, DWP FLOW DATA RY 2009							
Measurement Location	Stream Mile	3-May	3-Jun	10-Jul	28-Jul	10-Nov	20-Nov	7-Dec	8-Dec	11-Jan	14-Jan	4-Feb	16-Feb	16-Mar
MGORD	1.4	23.0	47.8	48.5	48.9	30.7		17.2		34.1			34.1	33.1
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Rush Creek abv Parker Creek	4.9	NA	41.8	49.7	39.3	22.3		14.0		28.8			29.9	28.1
Parker Creek below Conduit		4.4	28.0	21.5	22.0									
Parker Creek blw Hwy 395		6.4	27.6	16.8	18.4	3.3		1.0		1.7			1.8	2.3
Walker Creek below Conduit		3.6	20.0	9.2	7.0									
Walker Creek at confluence		6.6	17.4	7.6	4.8	2.7		1.4		1.6			2.8	2.5
Rush below Narrows (Sum of Gaged Flows: MG	5.6	44.0	92.8	73.0	72.1	36.7		19.6		37.4			38.6	37.9
Rush below Narrows (Sum of Measured Flows)	5.6	NA	86.8	74.2	62.5	28.3		16.4		32.1			34.4	32.9
Rush Creek 4Bii Channelo		NA	NA	NA	NA		0.7		0.0		0.6	0.9		
Rush Creek 8 Channel		NA	NA	NA	NA		1.4		0.5		2.1	1.7		
Lower Rush Creek Mainstem blw 10 Falls	7.6	25.1	92.2	69.8	63.8	30.6		16.3		31.0			31.9	30.8
Rush Creek at County Road	9.1	NA	NA	71.5	56.7	27.7		ICING		29.8			30.3	30.3
Net Loss MGORD to Parker			6.0	-1.2	9.6	8.4		3.2		5.3			4.2	5.0
Rate of Flow Loss (cfs/mi)			1.7	-0.3	2.7	2.4		0.9		1.5			1.2	1.4
Net Loss Narrows to Lower Rush			-5.3	4.4	-1.3	-2.3		0.1		1.1			2.5	2.0
Rate of Flow Loss (cfs/mi)			-2.7	2.2	-0.6	-1.2		0.1		0.5			1.3	1.0
Net Loss MGORD to Lower Rush		18.9	0.6	3.2	8.3	6.1		3.3		6.4			6.7	7.0
Rate of Flow Loss (cfs/mi)		3.0	0.1	0.5	1.3	1.0		0.5		1.0			1.1	1.1
Measured by:		M&T	MLC	M&T	MLC	DWP	MLC	DWP	MLC	DWP	MLC	MLC	DWP	DWP

*=Daily Average Discharge from MGORD Rating Curve (i.e., not directly measured)
t=Daily Average Discharge from MGORD+Parker+Walker releases
+=Measurement confounded by an instantaneous pulse flow release from Parker Conduit by LADWP
NA=Not Available

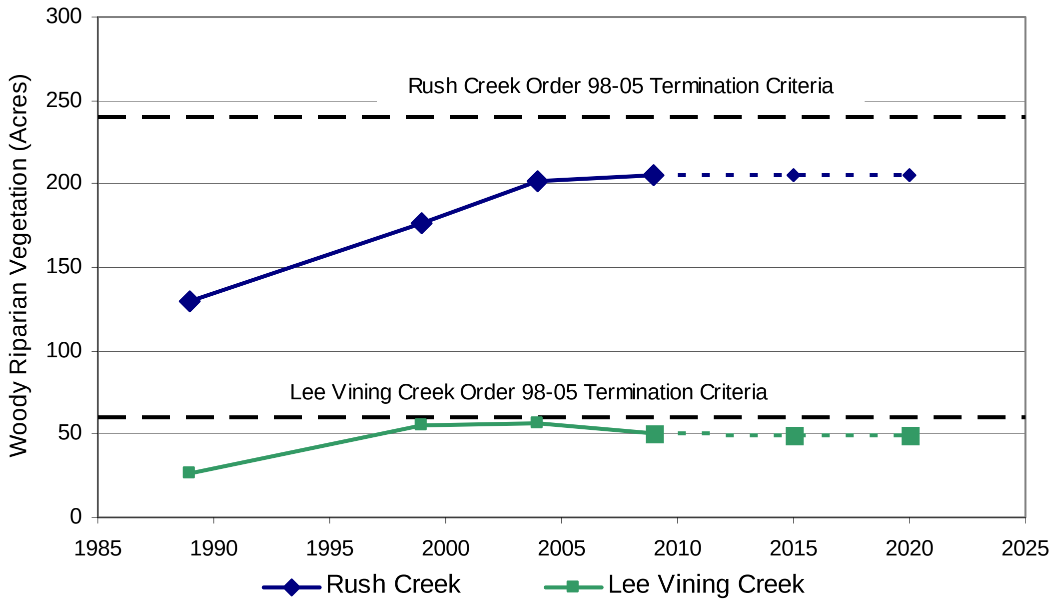
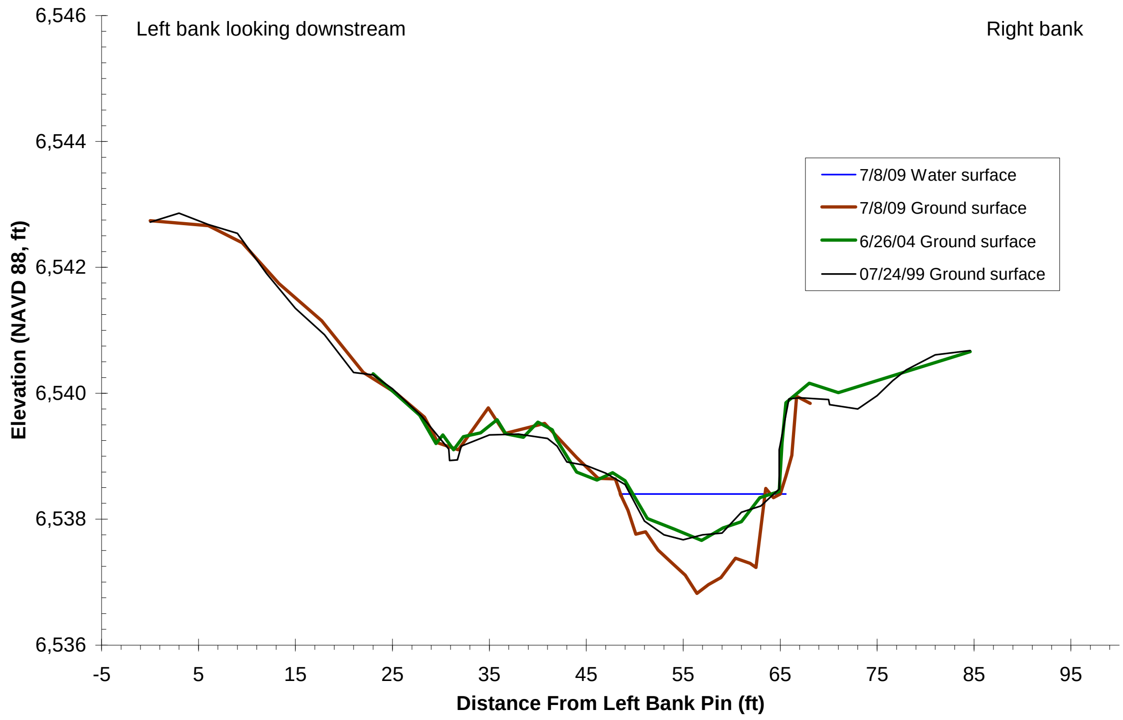


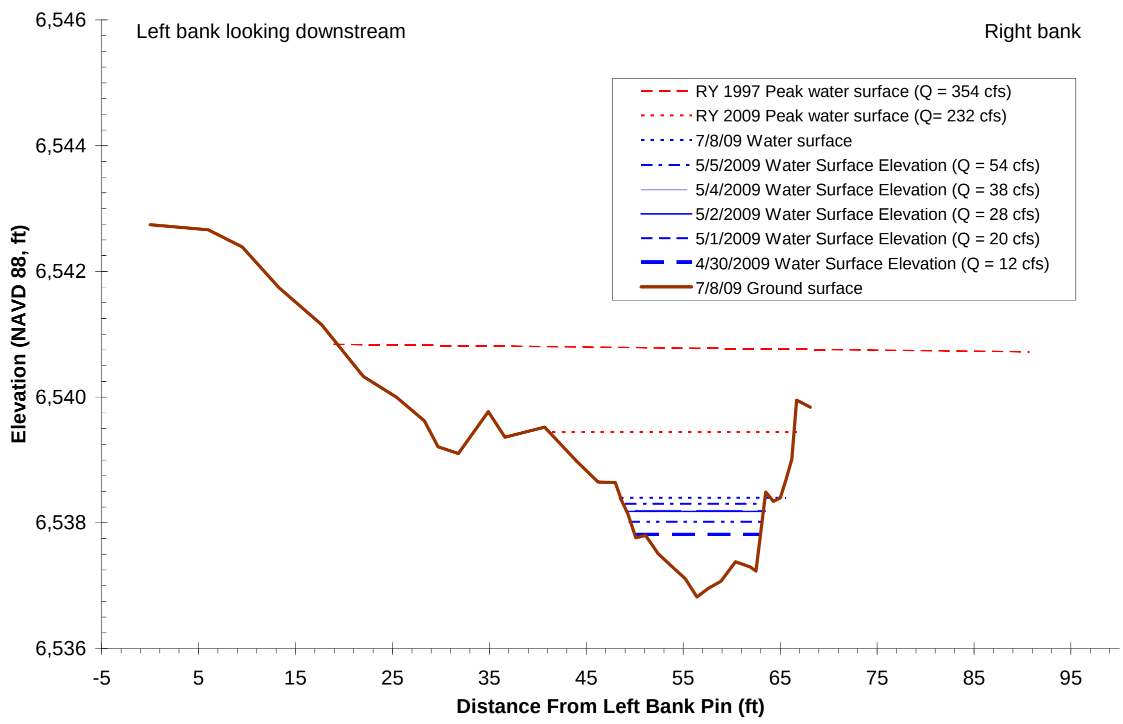
Figure 5. Riparian woody vegetation observed and projected recovery in the Rush Creek and Lee Vining Creek corridors.

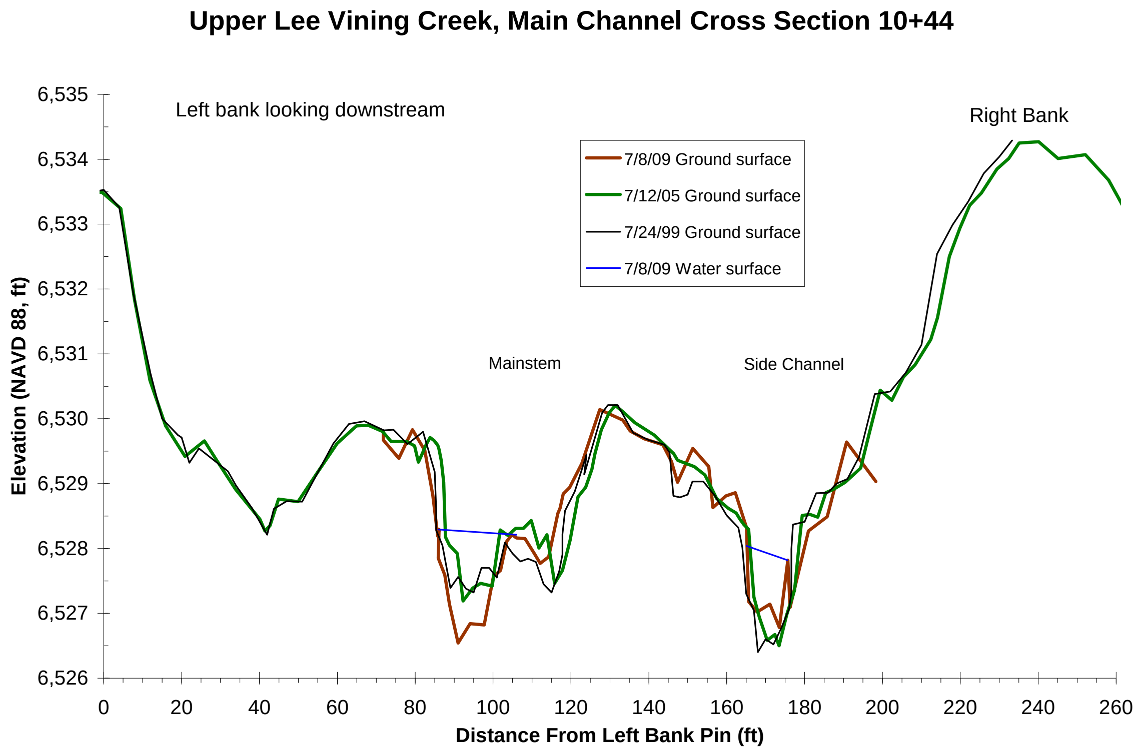
5 APPENDIX A. LEE VINING CREEK CROSS SECTIONS RE-SURVEYED IN RY2009

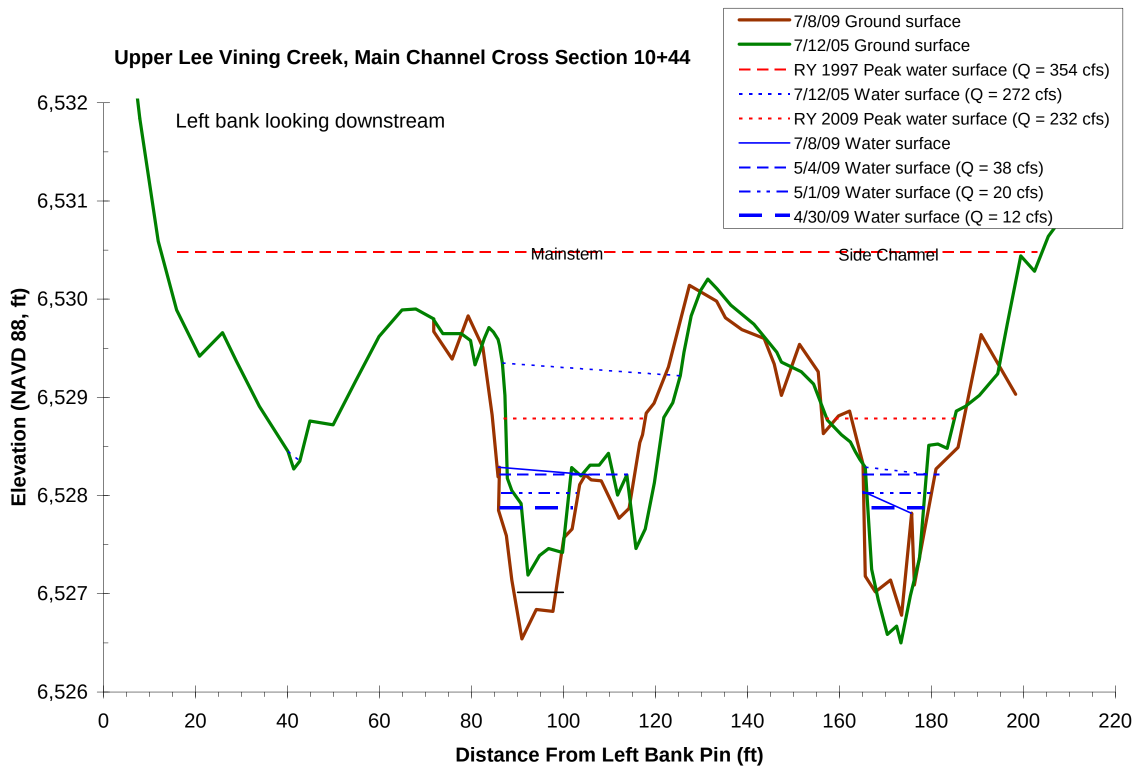
Upper Lee Vining Creek, Main Channel Cross Section 13+92

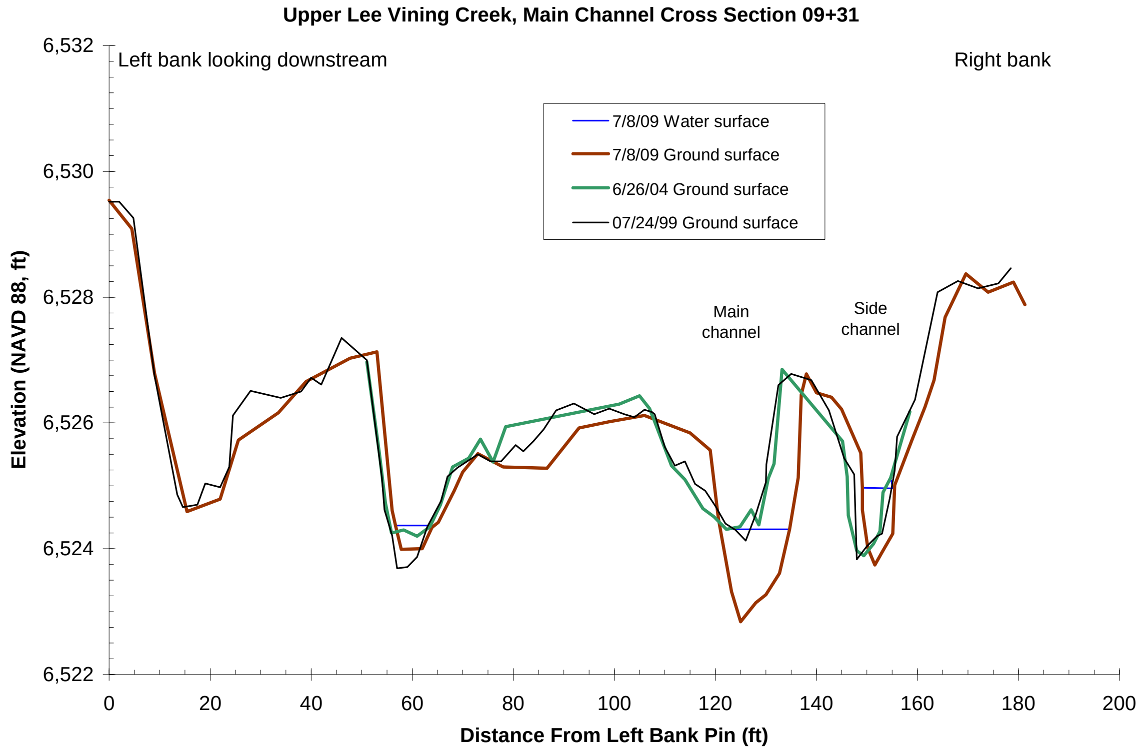


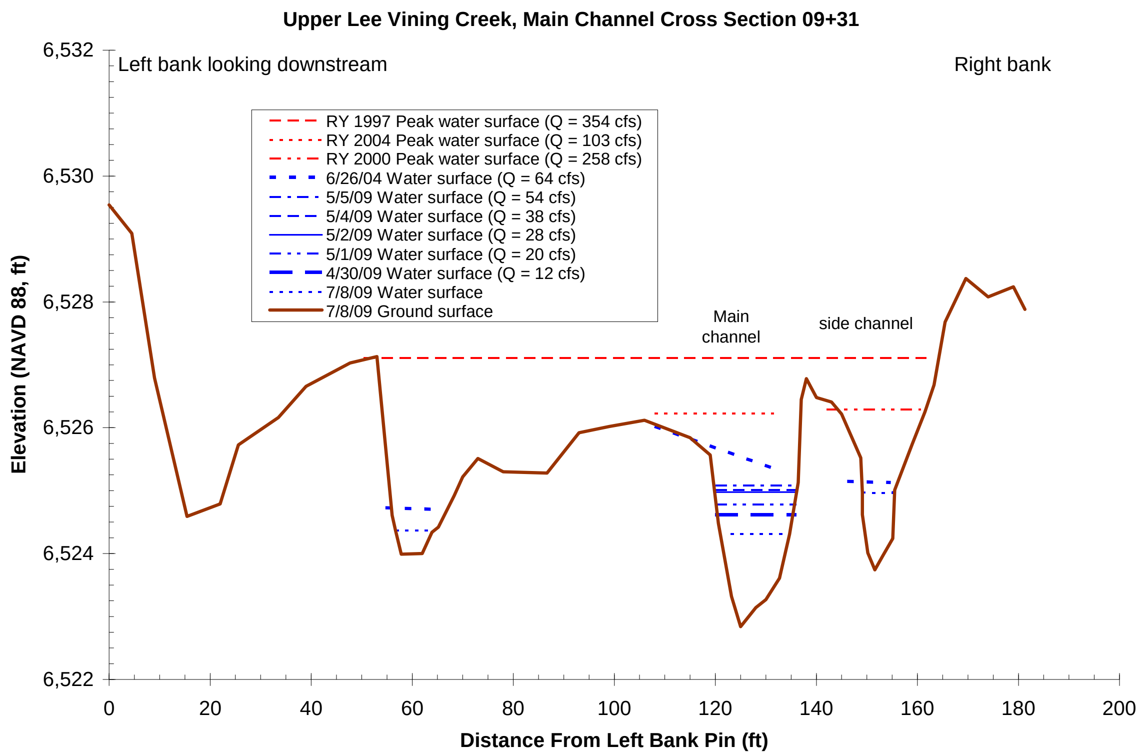
Upper Lee Vining Creek, Main Channel Cross Section 13+92

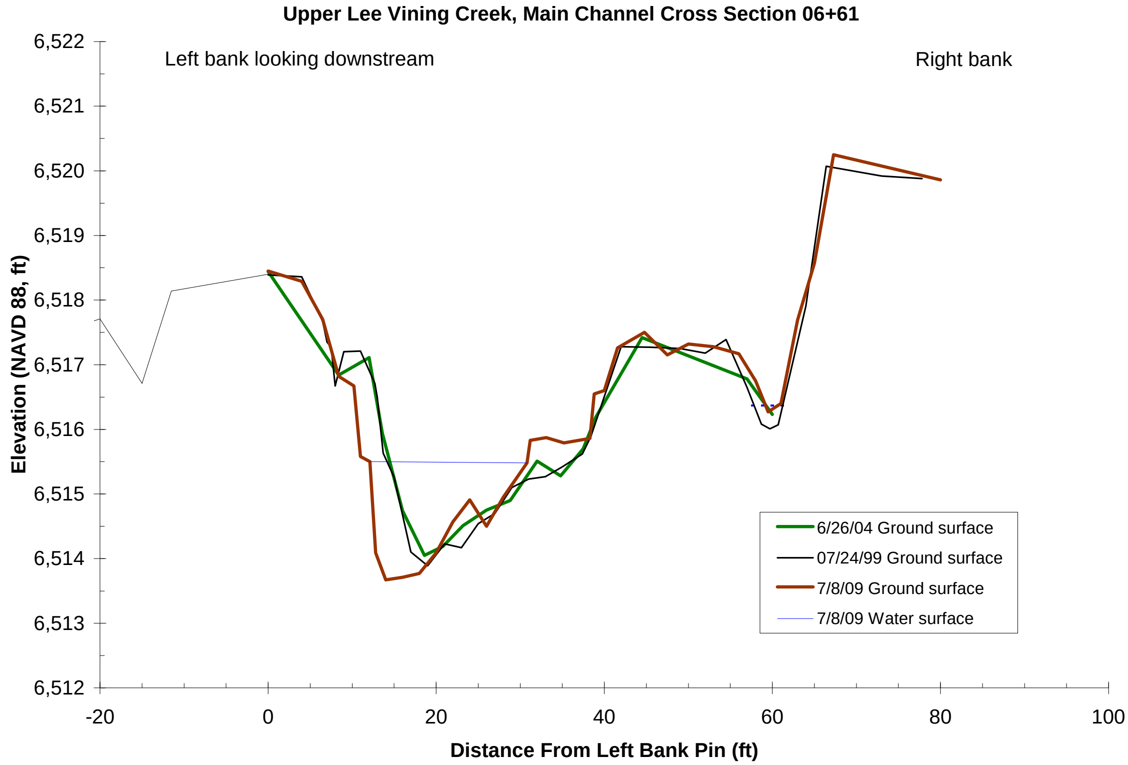


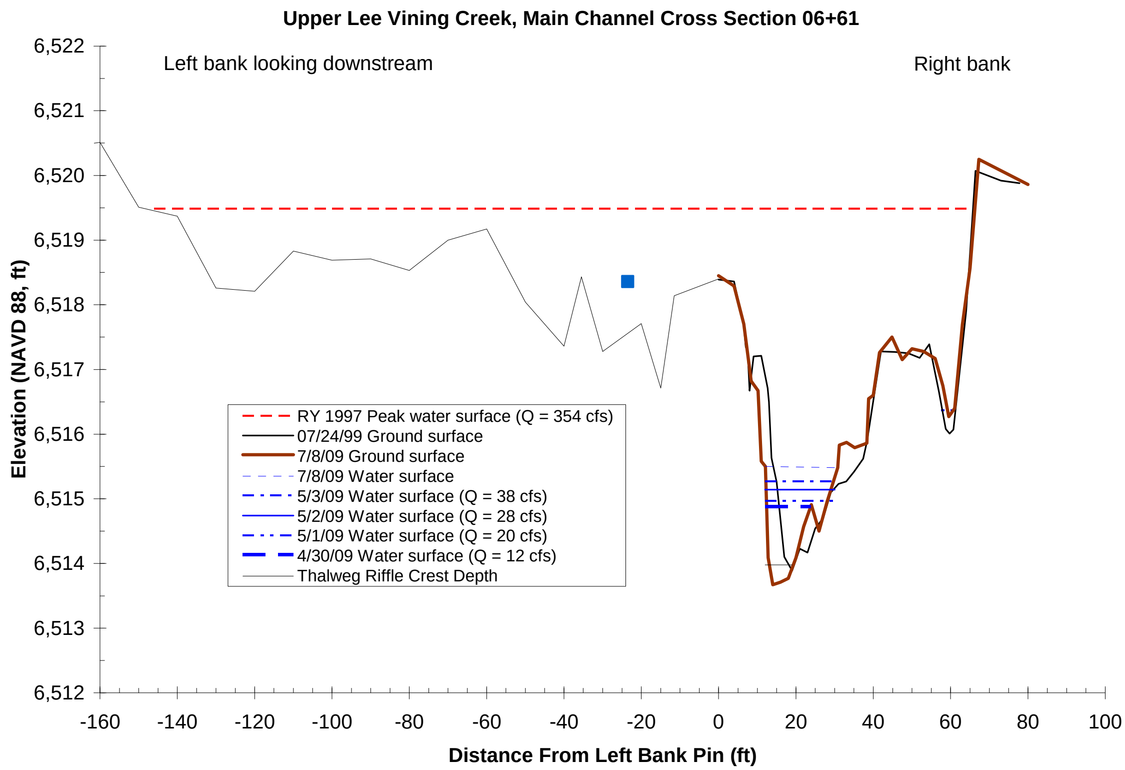

Upper Lee Vining Creek, Main Channel Cross Section 10+44
Left bank looking downstream
Right Bank
7/8/09 Ground surface
7/12/05 Ground surface
7/24/99 Ground surface
7/8/09 Water surface
Mainstem
Side Channel
Elevation (NAVD 88, ft)
6,535
6,534
6,533
6,532
6,531
6,530
6,529
6,528
6,527
6,526
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Distance From Left Bank Pin (ft)

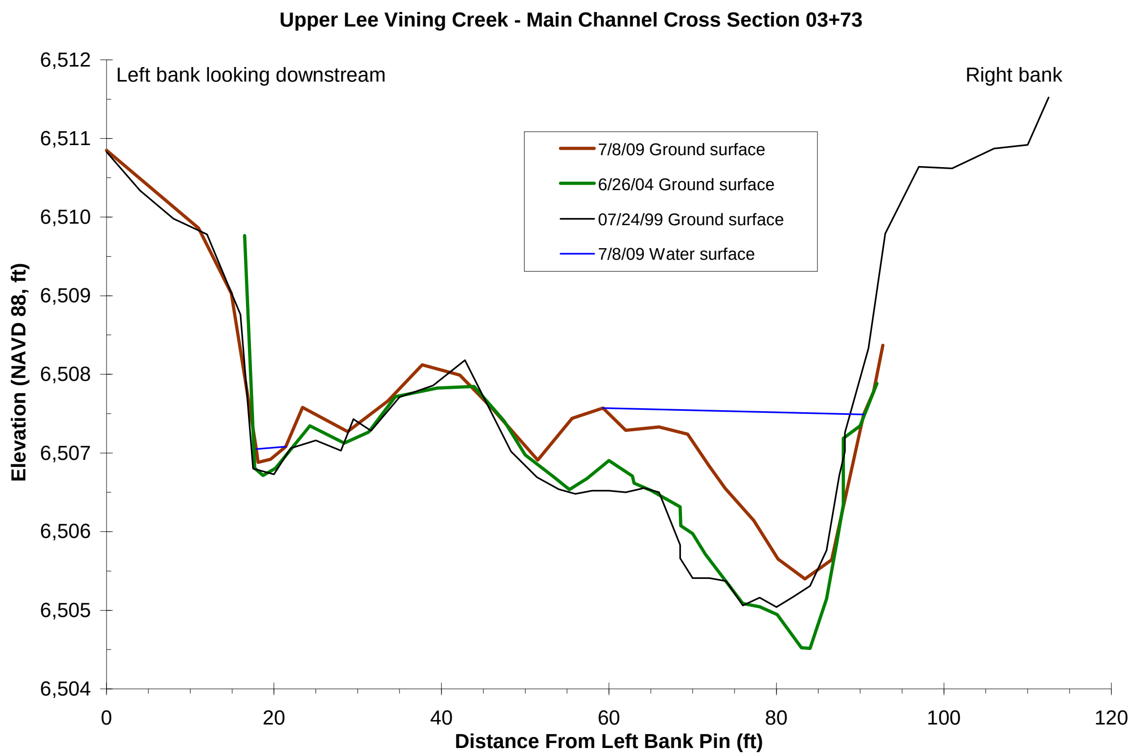

Upper Lee Vining Creek, Main Channel Cross Section 10+44
7/8/09 Ground surface
7/12/05 Ground surface
RY 1997 Peak water surface (Q = 354 cfs)
7/12/05 Water surface (Q = 272 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/8/09 Water surface
5/4/09 Water surface (Q = 38 cfs)
5/1/09 Water surface (Q = 20 cfs)
4/30/09 Water surface (Q = 12 cfs)
Left bank looking downstream
Mainstem
Side Channel
Elevation (NAVD 88, ft)
6,532
6,531
6,530
6,529
6,528
6,527
6,526
0
20
40
60
80
100
120
140
160
180
200
220
Distance From Left Bank Pin (ft)

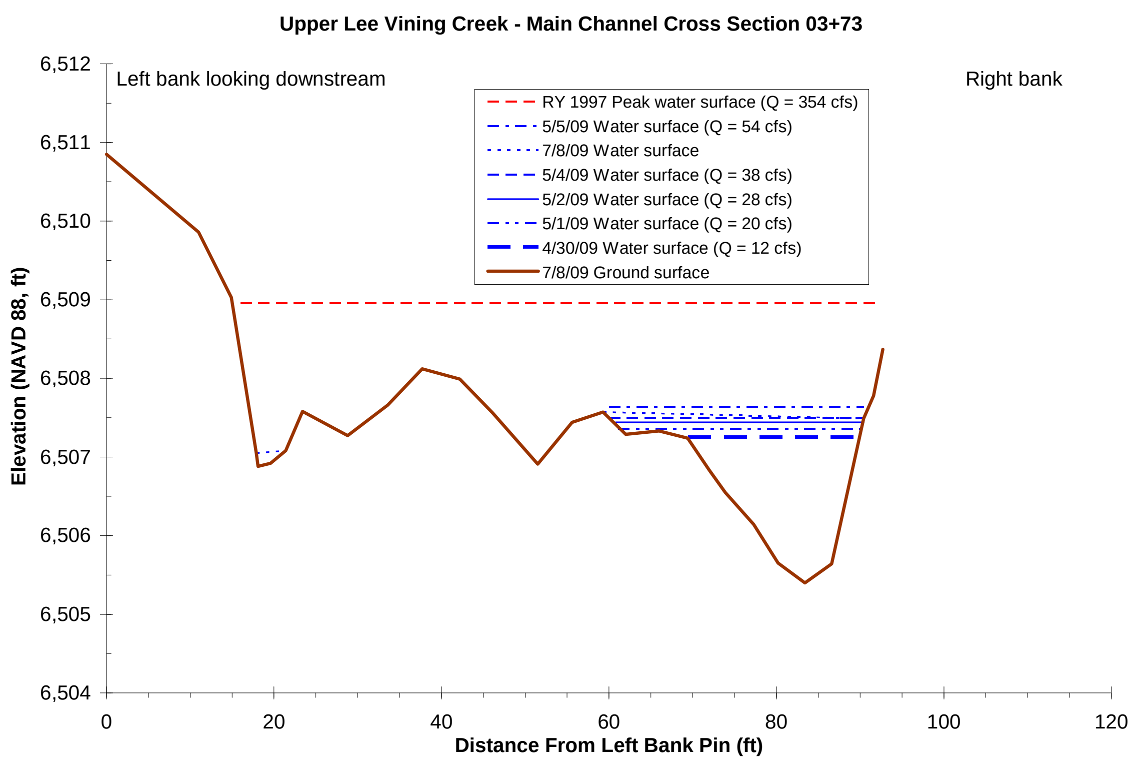

Upper Lee Vining Creek, Main Channel Cross Section 09+31
Left bank looking downstream
Right bank
7/8/09 Water surface
7/8/09 Ground surface
6/26/04 Ground surface
07/24/99 Ground surface
Main channel
Side channel
Elevation (NAVD 88, ft)
6,532
6,530
6,528
6,526
6,524
6,522
0
20
40
60
80
100
120
140
160
180
200
Distance From Left Bank Pin (ft)

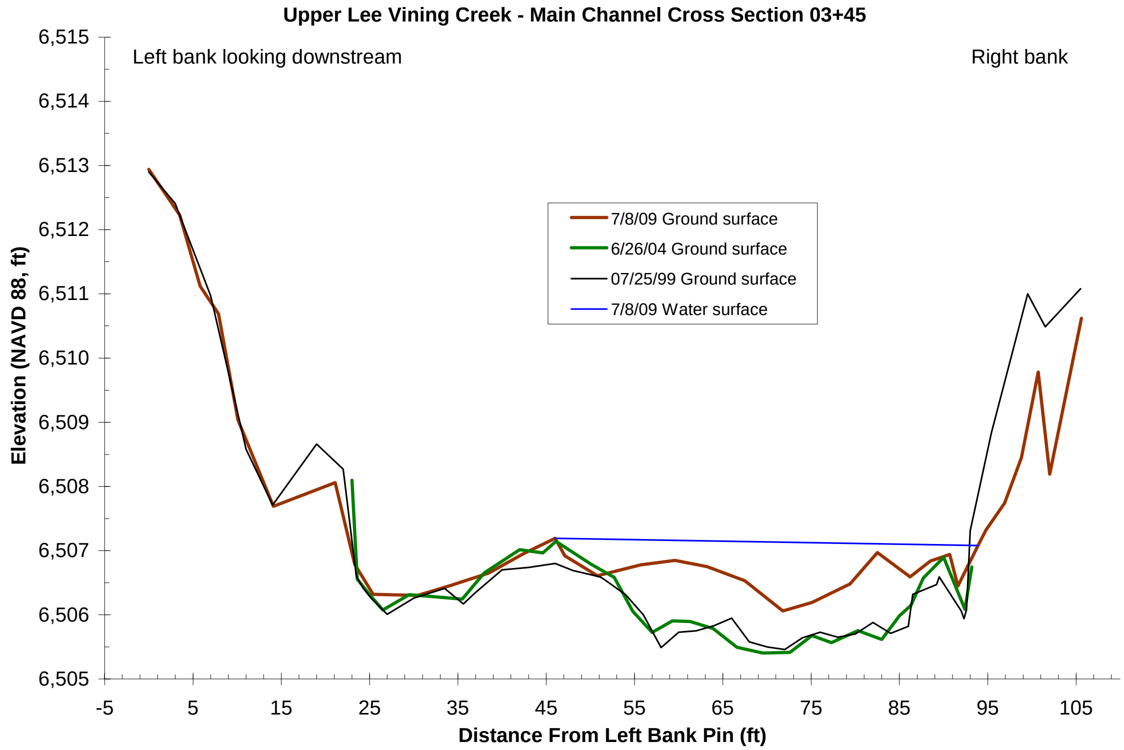

Upper Lee Vining Creek, Main Channel Cross Section 09+31
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
RY 2004 Peak water surface (Q = 103 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
6/26/04 Water surface (Q = 64 cfs)
5/5/09 Water surface (Q = 54 cfs)
5/4/09 Water surface (Q = 38 cfs)
5/2/09 Water surface (Q = 28 cfs)
5/1/09 Water surface (Q = 20 cfs)
4/30/09 Water surface (Q = 12 cfs)
7/8/09 Water surface
7/8/09 Ground surface
Main channel
side channel
Elevation (NAVD 88, ft)
6,532
6,530
6,528
6,526
6,524
6,522
0
20
40
60
80
100
120
140
160
180
200
Distance From Left Bank Pin (ft)

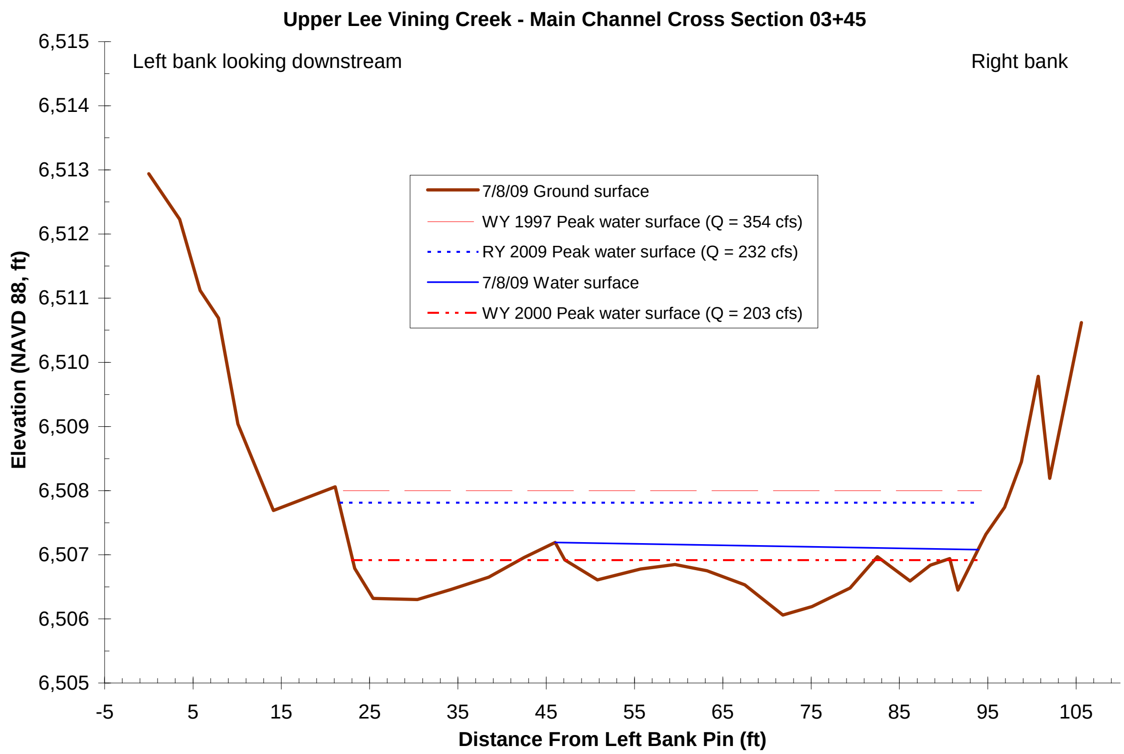

Upper Lee Vining Creek, Main Channel Cross Section 06+61
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,522
6,521
6,520
6,519
6,518
6,517
6,516
6,515
6,514
6,513
6,512
-20
0
20
40
60
80
100
Distance From Left Bank Pin (ft)
6/26/04 Ground surface
07/24/99 Ground surface
7/8/09 Ground surface
7/8/09 Water surface

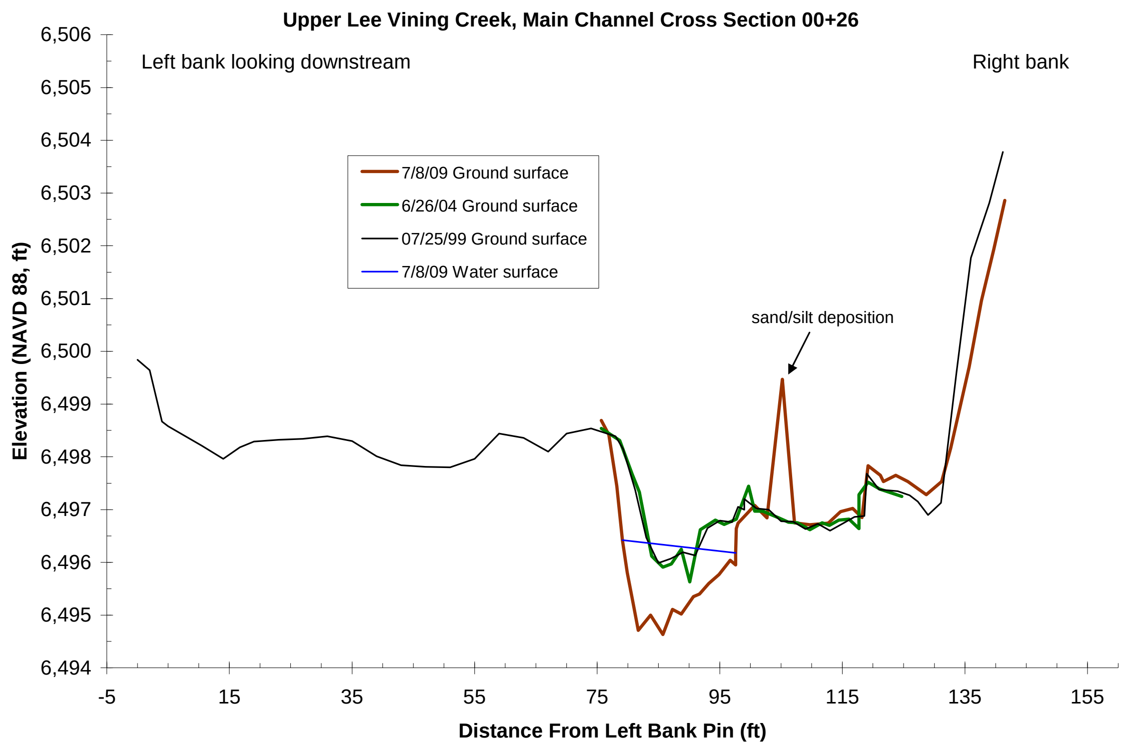

Upper Lee Vining Creek, Main Channel Cross Section 06+61
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,522
6,521
6,520
6,519
6,518
6,517
6,516
6,515
6,514
6,513
6,512
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
Distance From Left Bank Pin (ft)
RY 1997 Peak water surface (Q = 354 cfs)
07/24/99 Ground surface
7/8/09 Ground surface
7/8/09 Water surface
5/3/09 Water surface (Q = 38 cfs)
5/2/09 Water surface (Q = 28 cfs)
5/1/09 Water surface (Q = 20 cfs)
4/30/09 Water surface (Q = 12 cfs)
Thalweg Riffle Crest Depth

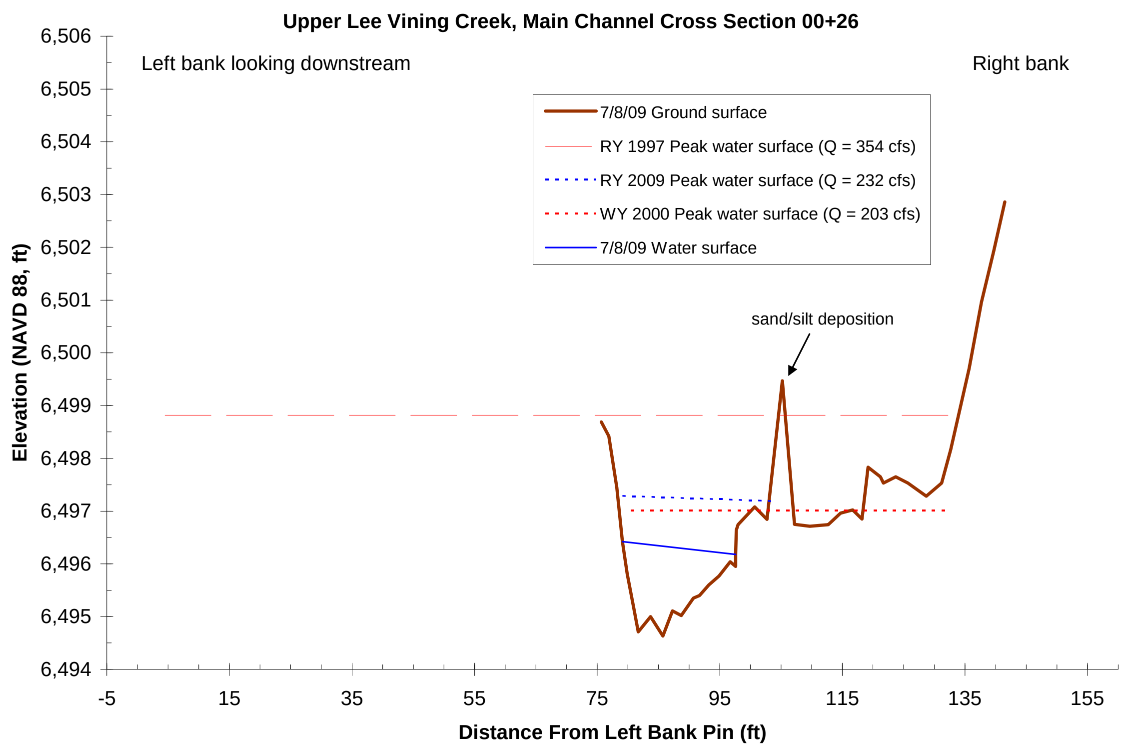

Upper Lee Vining Creek - Main Channel Cross Section 03+73
Left bank looking downstream
Right bank
7/8/09 Ground surface
6/26/04 Ground surface
07/24/99 Ground surface
7/8/09 Water surface
Elevation (NAVD 88, ft)
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
6,504
0
20
40
60
80
100
120
Distance From Left Bank Pin (ft)

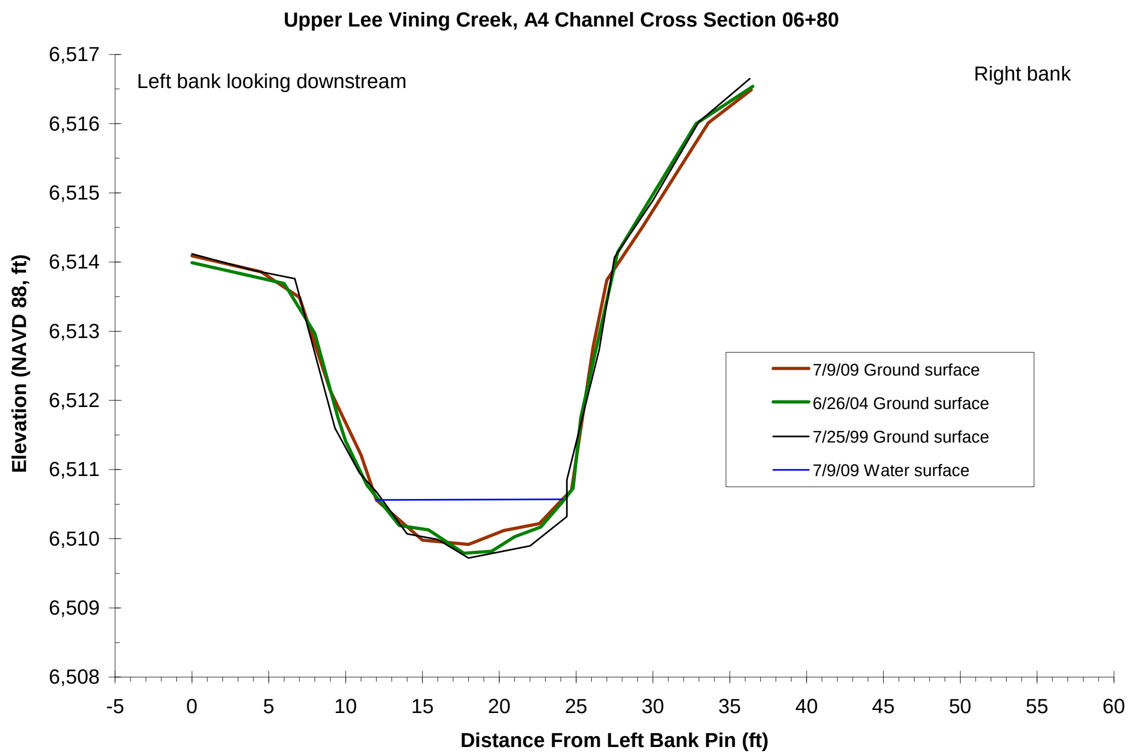

Upper Lee Vining Creek - Main Channel Cross Section 03+73
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
5/5/09 Water surface (Q = 54 cfs)
7/8/09 Water surface
5/4/09 Water surface (Q = 38 cfs)
5/2/09 Water surface (Q = 28 cfs)
5/1/09 Water surface (Q = 20 cfs)
4/30/09 Water surface (Q = 12 cfs)
7/8/09 Ground surface
Elevation (NAVD 88, ft)
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
6,504
0
20
40
60
80
100
120
Distance From Left Bank Pin (ft)

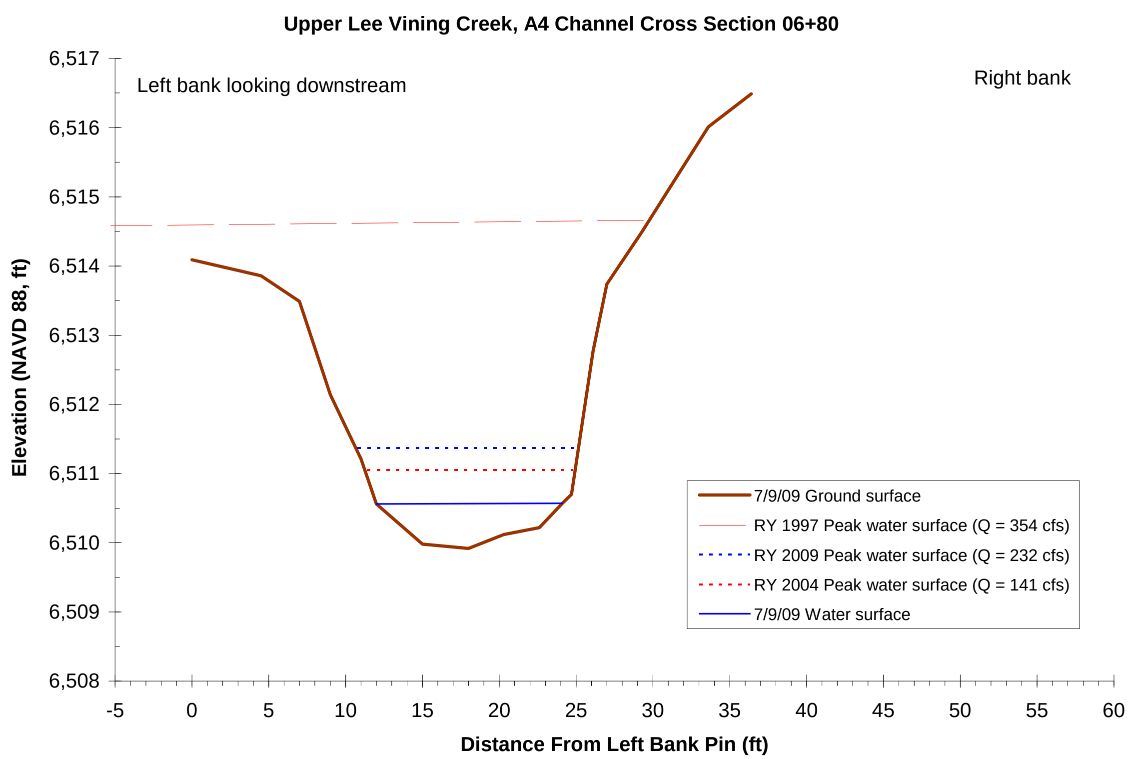

Upper Lee Vining Creek - Main Channel Cross Section 03+45
Left bank looking downstream
Right bank
7/8/09 Ground surface
6/26/04 Ground surface
07/25/99 Ground surface
7/8/09 Water surface
Elevation (NAVD 88, ft)
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
-5
5
15
25
35
45
55
65
75
85
95
105
Distance From Left Bank Pin (ft)

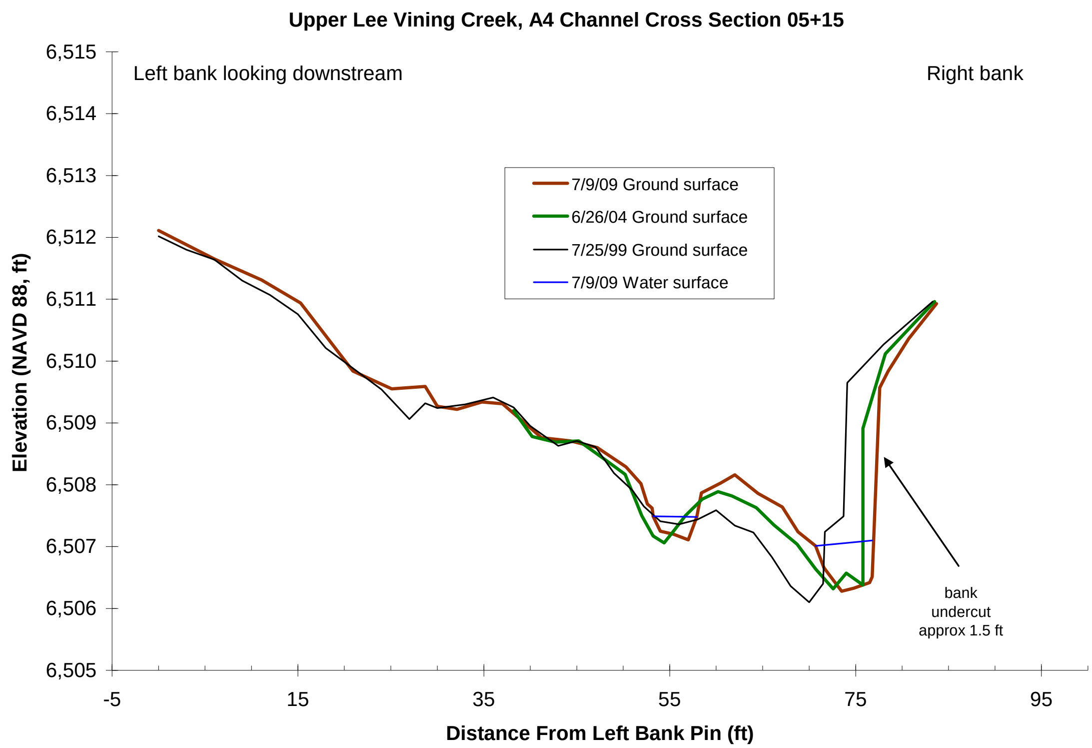

Upper Lee Vining Creek - Main Channel Cross Section 03+45
Left bank looking downstream
Right bank
7/8/09 Ground surface
WY 1997 Peak water surface (Q = 354 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/8/09 Water surface
WY 2000 Peak water surface (Q = 203 cfs)
Elevation (NAVD 88, ft)
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
-5
5
15
25
35
45
55
65
75
85
95
105
Distance From Left Bank Pin (ft)

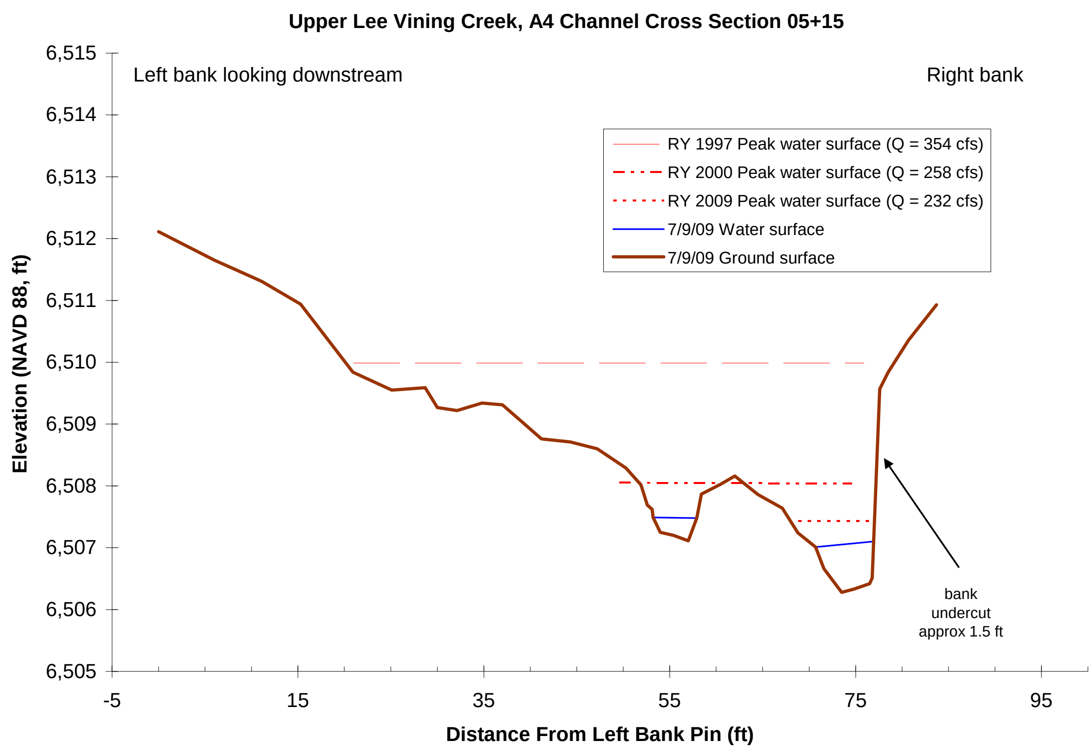

Upper Lee Vining Creek, Main Channel Cross Section 00+26
Left bank looking downstream
Right bank
7/8/09 Ground surface
6/26/04 Ground surface
07/25/99 Ground surface
7/8/09 Water surface
sand/silt deposition
Elevation (NAVD 88, ft)
6,506
6,505
6,504
6,503
6,502
6,501
6,500
6,499
6,498
6,497
6,496
6,495
6,494
-5
15
35
55
75
95
115
135
155
Distance From Left Bank Pin (ft)

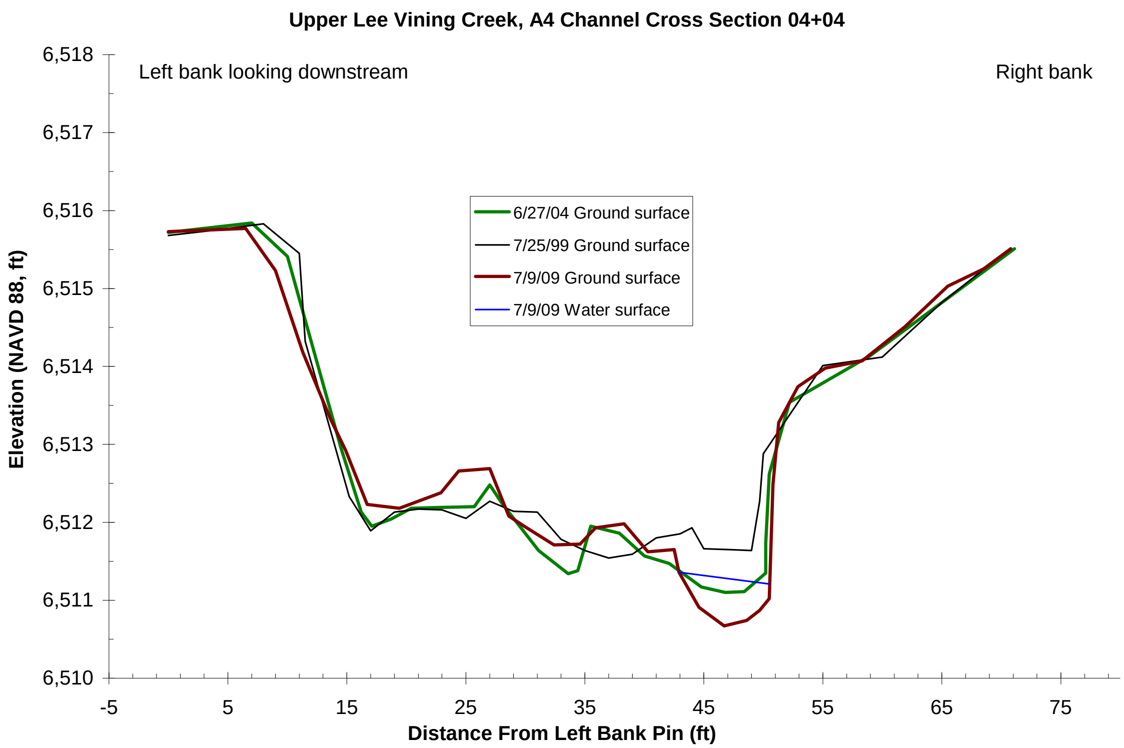

Upper Lee Vining Creek, Main Channel Cross Section 00+26
Left bank looking downstream
Right bank
7/8/09 Ground surface
RY 1997 Peak water surface (Q = 354 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
WY 2000 Peak water surface (Q = 203 cfs)
7/8/09 Water surface
sand/silt deposition
Elevation (NAVD 88, ft)
6,506
6,505
6,504
6,503
6,502
6,501
6,500
6,499
6,498
6,497
6,496
6,495
6,494
-5
15
35
55
75
95
115
135
155
Distance From Left Bank Pin (ft)


Upper Lee Vining Creek, A4 Channel Cross Section 06+80
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,517
6,516
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance From Left Bank Pin (ft)
7/9/09 Ground surface
6/26/04 Ground surface
7/25/99 Ground surface
7/9/09 Water surface

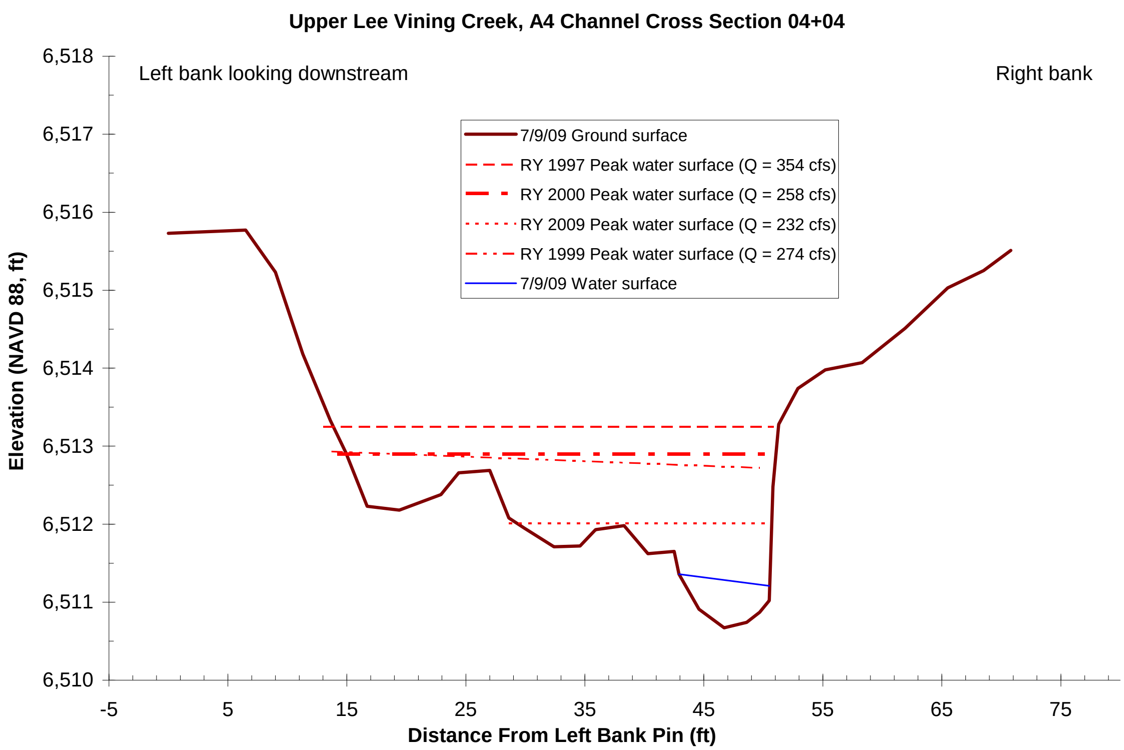

Upper Lee Vining Creek, A4 Channel Cross Section 06+80
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,517
6,516
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance From Left Bank Pin (ft)
7/9/09 Ground surface
RY 1997 Peak water surface (Q = 354 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
RY 2004 Peak water surface (Q = 141 cfs)
7/9/09 Water surface


Upper Lee Vining Creek, A4 Channel Cross Section 05+15
Left bank looking downstream
Right bank
7/9/09 Ground surface
6/26/04 Ground surface
7/25/99 Ground surface
7/9/09 Water surface
bank undercut approx 1.5 ft
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
-5
15
35
55
75
95

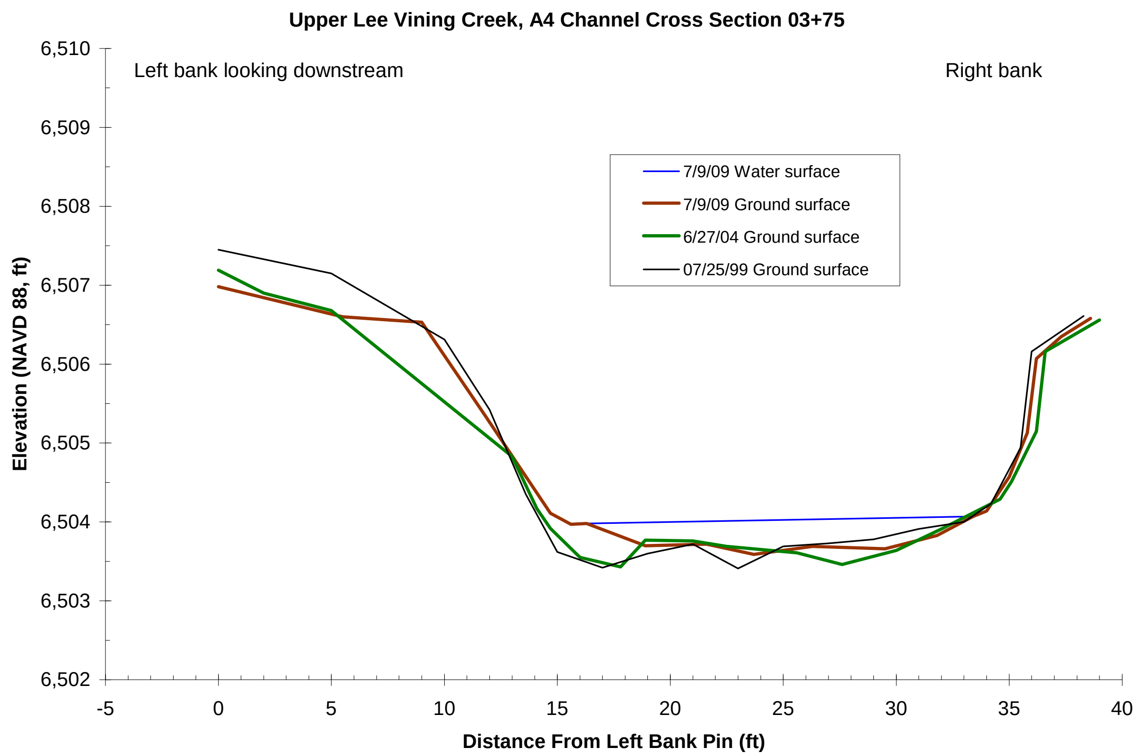

Upper Lee Vining Creek, A4 Channel Cross Section 05+15
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/9/09 Water surface
7/9/09 Ground surface
bank undercut approx 1.5 ft
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,515
6,514
6,513
6,512
6,511
6,510
6,509
6,508
6,507
6,506
6,505
-5
15
35
55
75
95

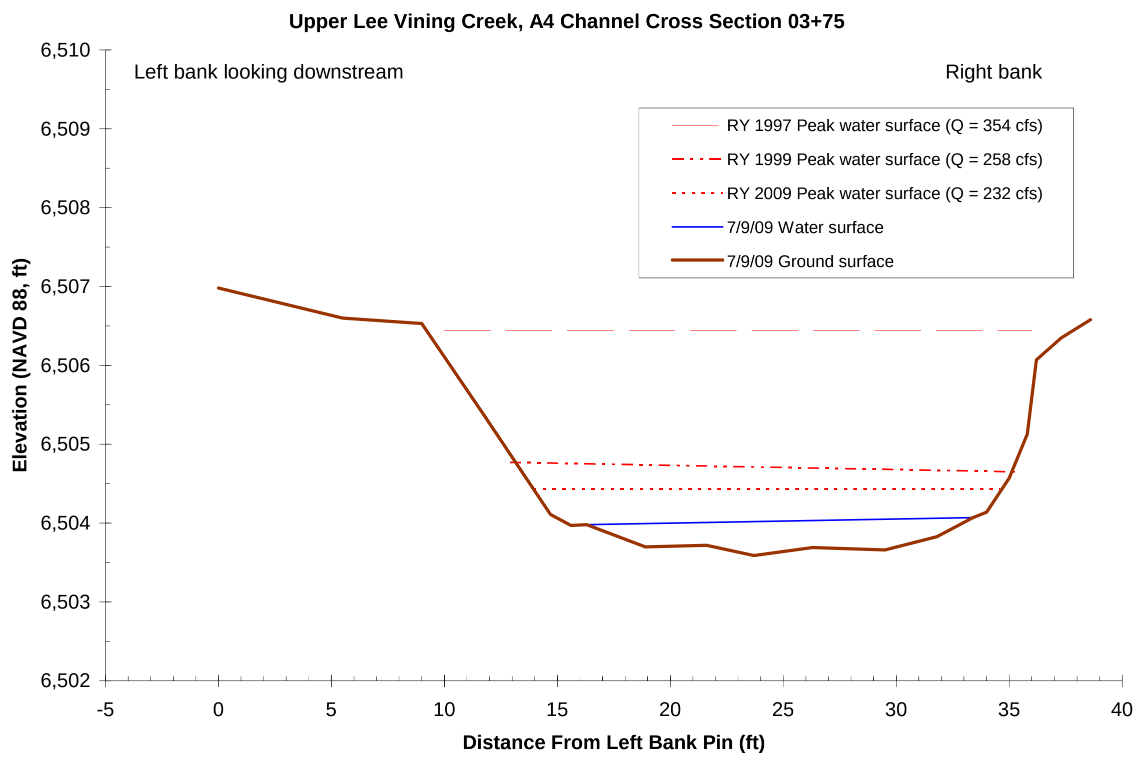


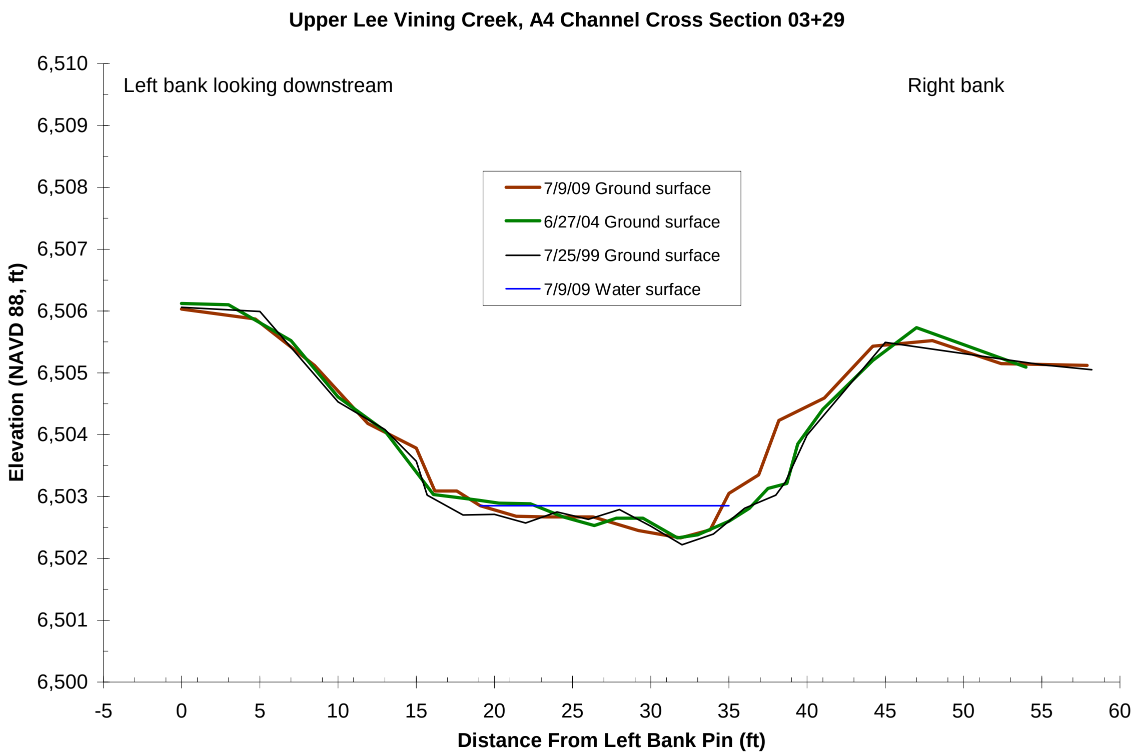
Upper Lee Vining Creek, A4 Channel Cross Section 04+04
Left bank looking downstream
Right bank
6/27/04 Ground surface
7/25/99 Ground surface
7/9/09 Ground surface
7/9/09 Water surface
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,518
6,517
6,516
6,515
6,514
6,513
6,512
6,511
6,510
-5
5
15
25
35
45
55
65
75

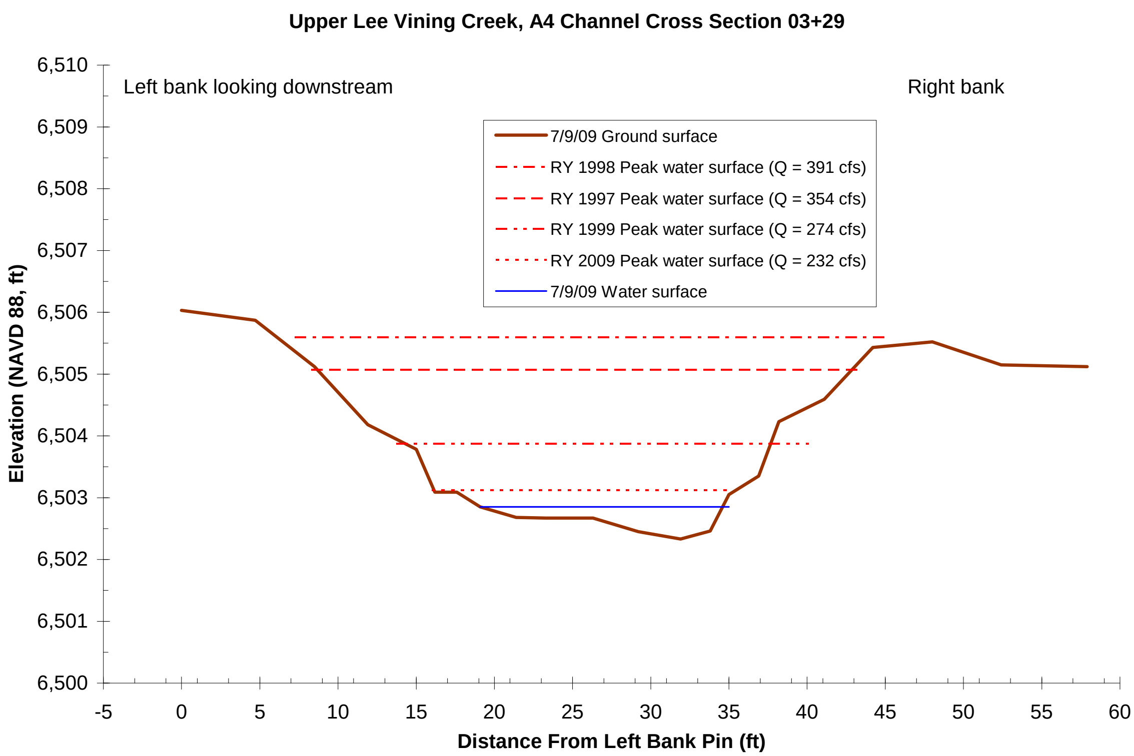


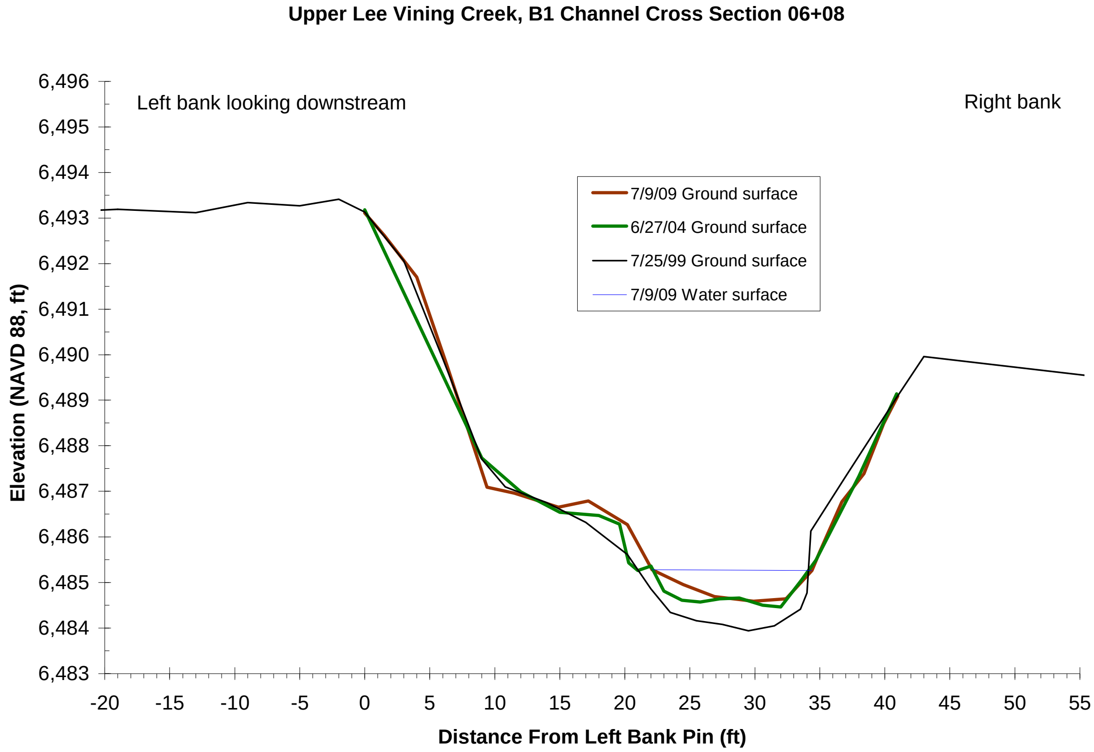
Upper Lee Vining Creek, A4 Channel Cross Section 04+04
Left bank looking downstream
Right bank
7/9/09 Ground surface
RY 1997 Peak water surface (Q = 354 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
RY 1999 Peak water surface (Q = 274 cfs)
7/9/09 Water surface
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,518
6,517
6,516
6,515
6,514
6,513
6,512
6,511
6,510
-5
5
15
25
35
45
55
65
75

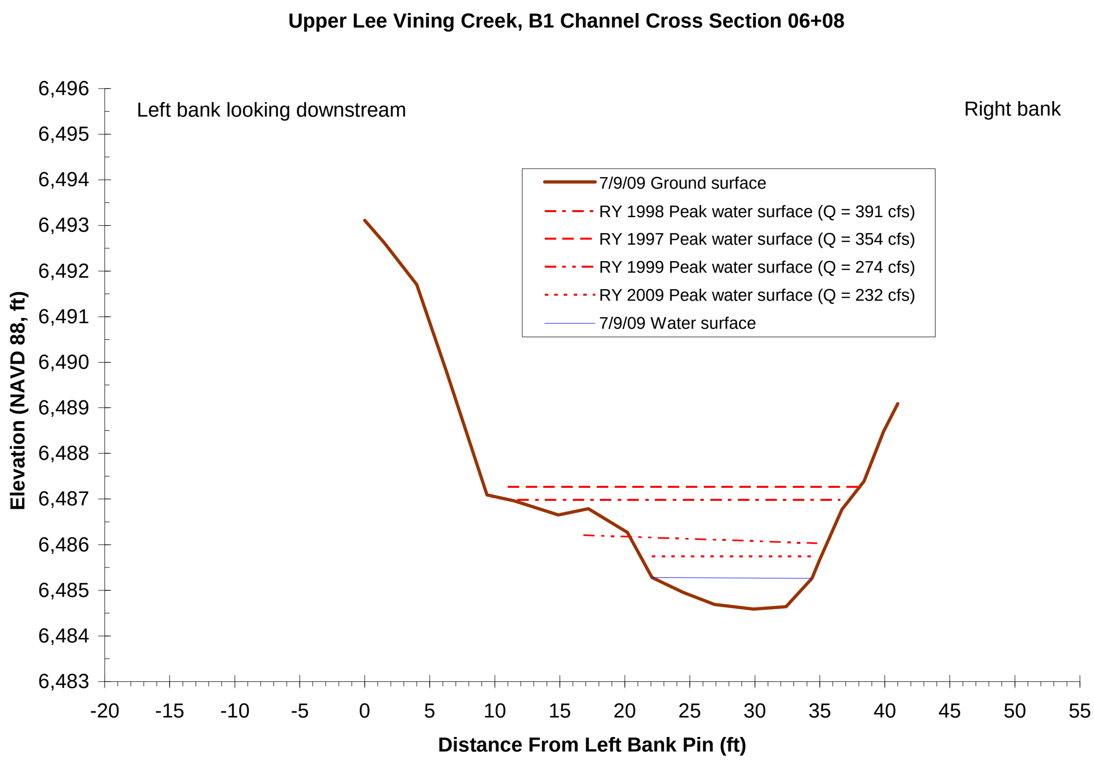

Upper Lee Vining Creek, A4 Channel Cross Section 03+75
Left bank looking downstream
Right bank
7/9/09 Water surface
7/9/09 Ground surface
6/27/04 Ground surface
07/25/99 Ground surface
Elevation (NAVD 88, ft)
6,510
6,509
6,508
6,507
6,506
6,505
6,504
6,503
6,502
-5
0
5
10
15
20
25
30
35
40
Distance From Left Bank Pin (ft)

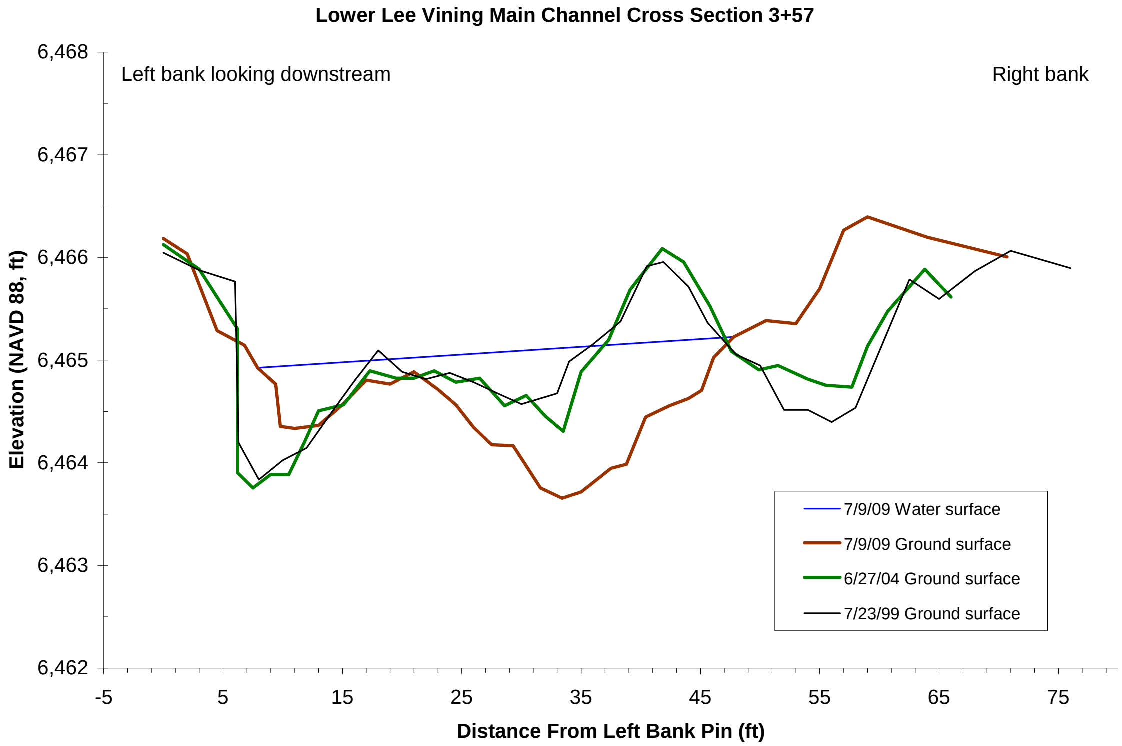

Upper Lee Vining Creek, A4 Channel Cross Section 03+75
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
RY 1999 Peak water surface (Q = 258 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/9/09 Water surface
7/9/09 Ground surface
Elevation (NAVD 88, ft)
6,510
6,509
6,508
6,507
6,506
6,505
6,504
6,503
6,502
-5
0
5
10
15
20
25
30
35
40
Distance From Left Bank Pin (ft)

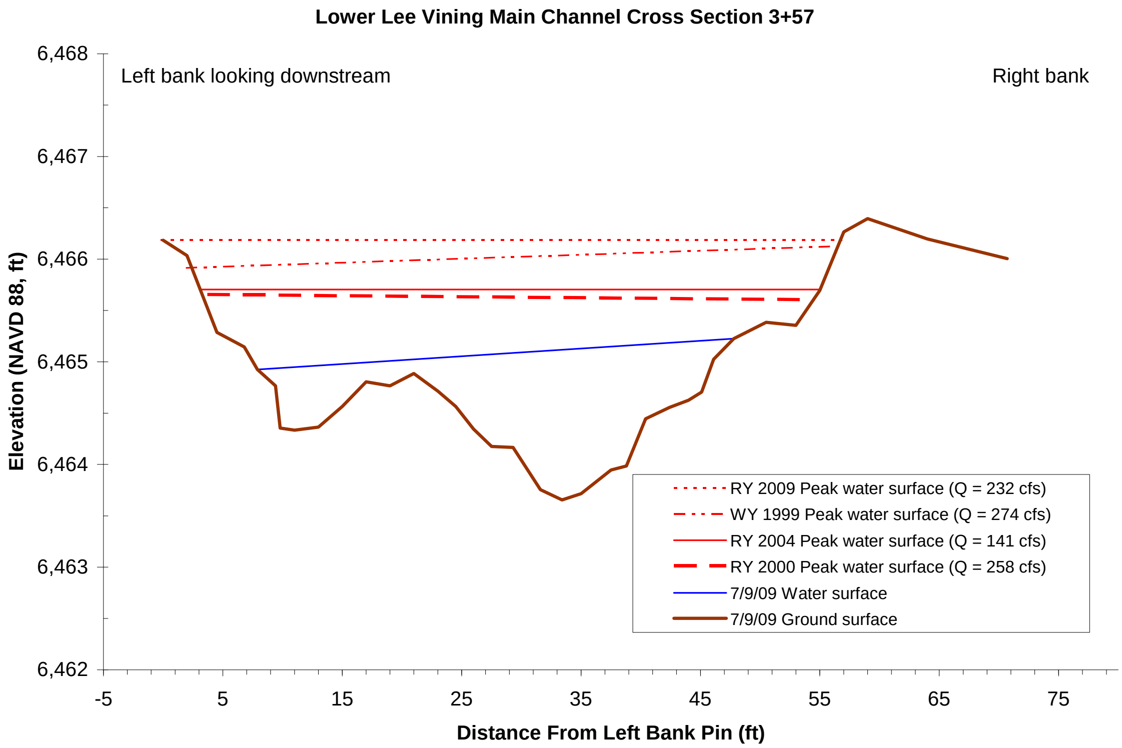

Upper Lee Vining Creek, A4 Channel Cross Section 03+29
Left bank looking downstream
Right bank
7/9/09 Ground surface
6/27/04 Ground surface
7/25/99 Ground surface
7/9/09 Water surface
Elevation (NAVD 88, ft)
6,510
6,509
6,508
6,507
6,506
6,505
6,504
6,503
6,502
6,501
6,500
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance From Left Bank Pin (ft)

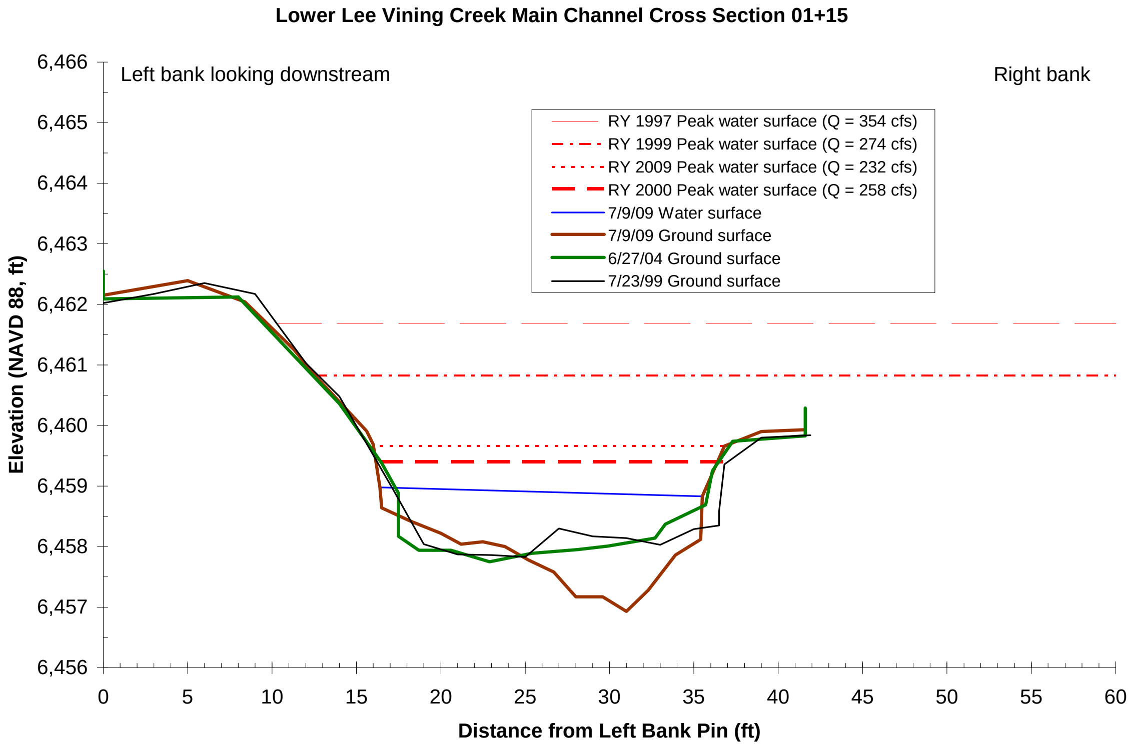

Upper Lee Vining Creek, A4 Channel Cross Section 03+29
Left bank looking downstream
Right bank
7/9/09 Ground surface
RY 1998 Peak water surface (Q = 391 cfs)
RY 1997 Peak water surface (Q = 354 cfs)
RY 1999 Peak water surface (Q = 274 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/9/09 Water surface
Elevation (NAVD 88, ft)
6,510
6,509
6,508
6,507
6,506
6,505
6,504
6,503
6,502
6,501
6,500
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance From Left Bank Pin (ft)

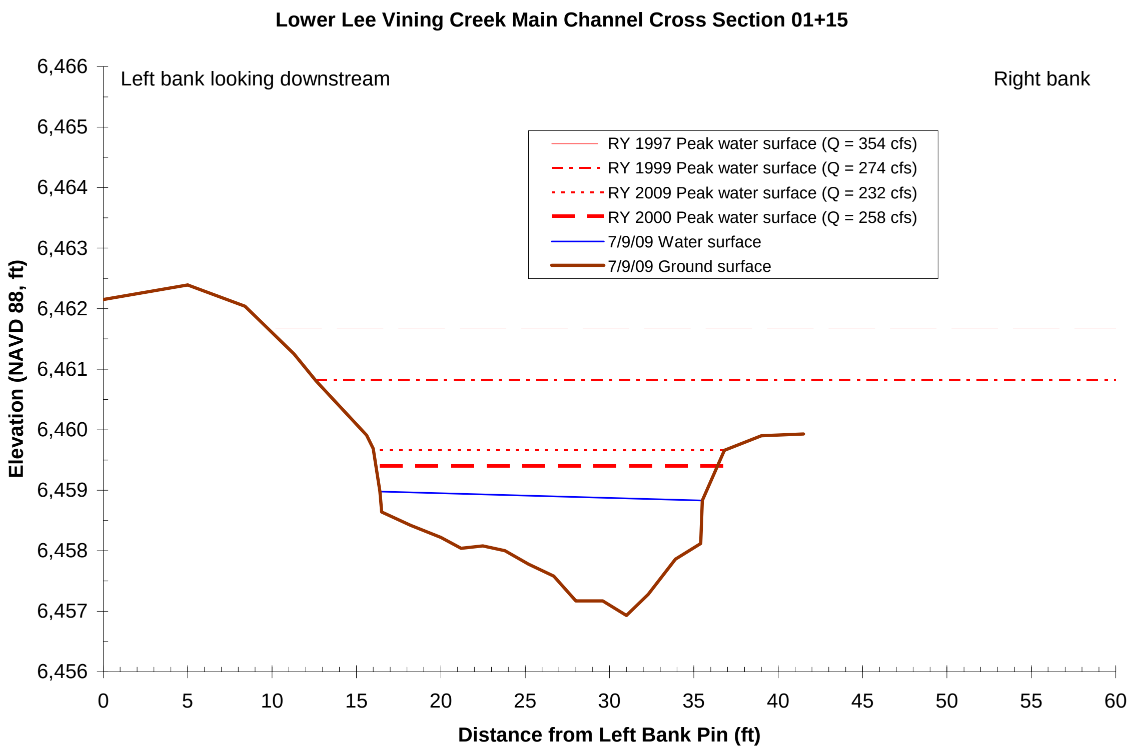

Upper Lee Vining Creek, B1 Channel Cross Section 06+08
Left bank looking downstream
Right bank
7/9/09 Ground surface
6/27/04 Ground surface
7/25/99 Ground surface
7/9/09 Water surface
Elevation (NAVD 88, ft)
6,496
6,495
6,494
6,493
6,492
6,491
6,490
6,489
6,488
6,487
6,486
6,485
6,484
6,483
-20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55
Distance From Left Bank Pin (ft)

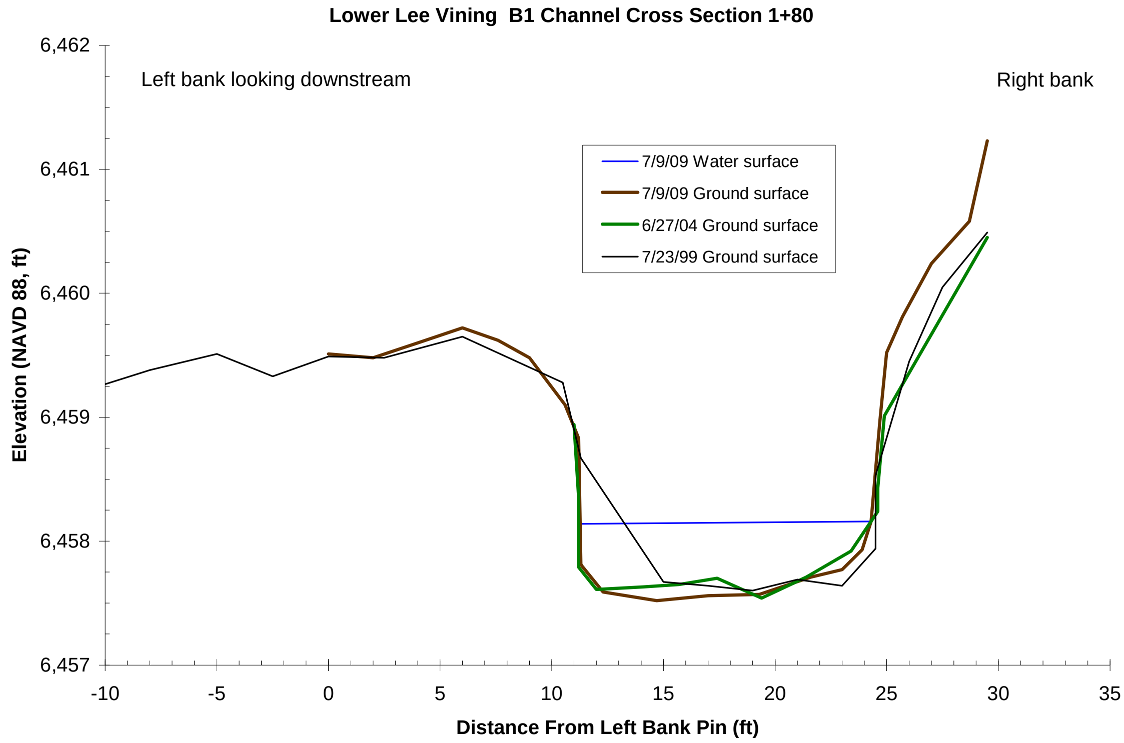

Upper Lee Vining Creek, B1 Channel Cross Section 06+08
Left bank looking downstream
Right bank
7/9/09 Ground surface
RY 1998 Peak water surface (Q = 391 cfs)
RY 1997 Peak water surface (Q = 354 cfs)
RY 1999 Peak water surface (Q = 274 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
7/9/09 Water surface
Elevation (NAVD 88, ft)
6,496
6,495
6,494
6,493
6,492
6,491
6,490
6,489
6,488
6,487
6,486
6,485
6,484
6,483
-20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55
Distance From Left Bank Pin (ft)

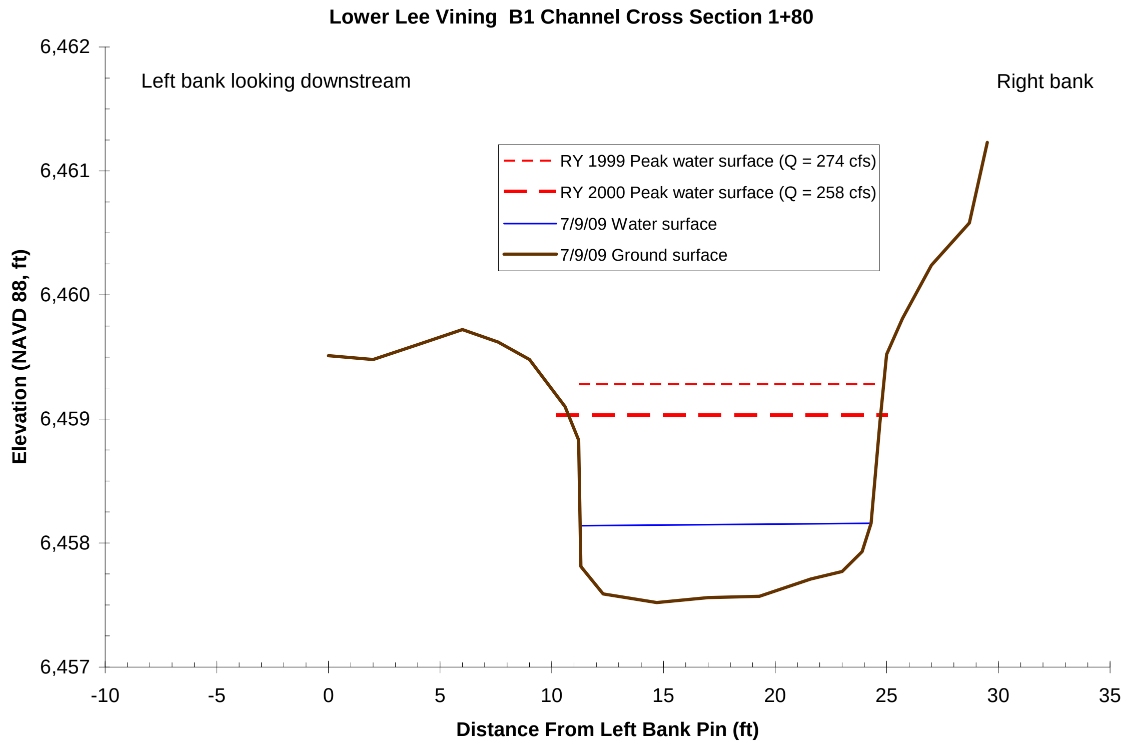

Lower Lee Vining Main Channel Cross Section 3+57
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,468
6,467
6,466
6,465
6,464
6,463
6,462
-5
5
15
25
35
45
55
65
75
Distance From Left Bank Pin (ft)
7/9/09 Water surface
7/9/09 Ground surface
6/27/04 Ground surface
7/23/99 Ground surface

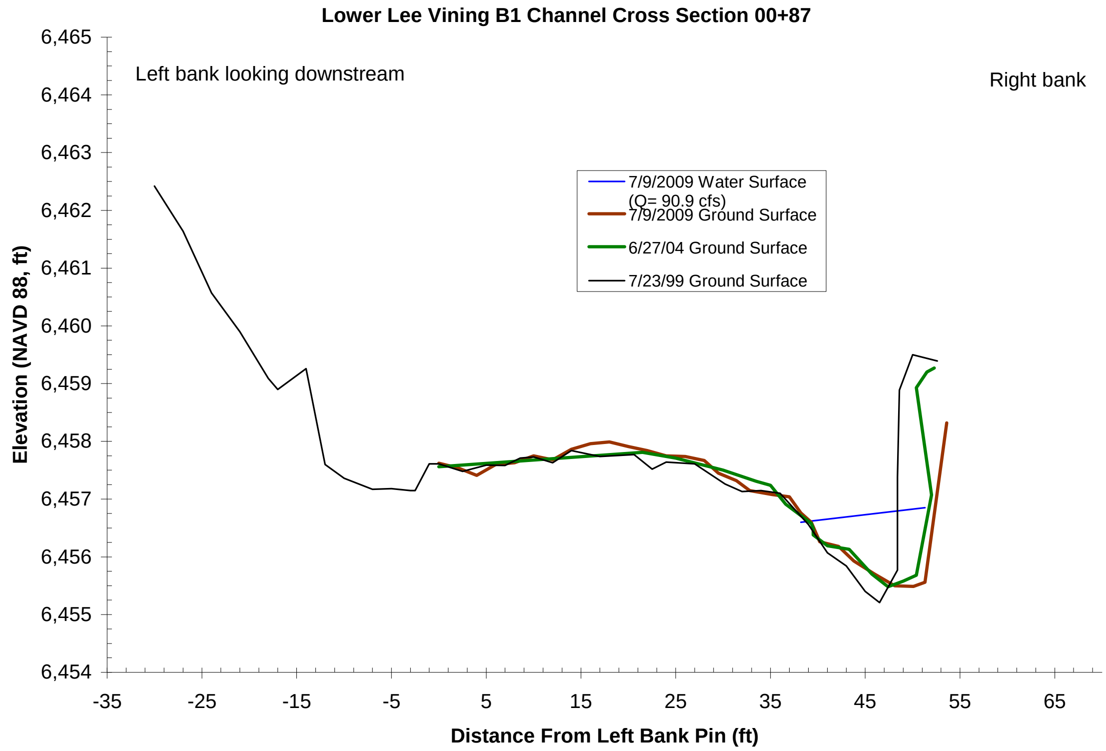

Lower Lee Vining Main Channel Cross Section 3+57
Left bank looking downstream
Right bank
Elevation (NAVD 88, ft)
6,468
6,467
6,466
6,465
6,464
6,463
6,462
-5
5
15
25
35
45
55
65
75
Distance From Left Bank Pin (ft)
RY 2009 Peak water surface (Q = 232 cfs)
WY 1999 Peak water surface (Q = 274 cfs)
RY 2004 Peak water surface (Q = 141 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
7/9/09 Water surface
7/9/09 Ground surface

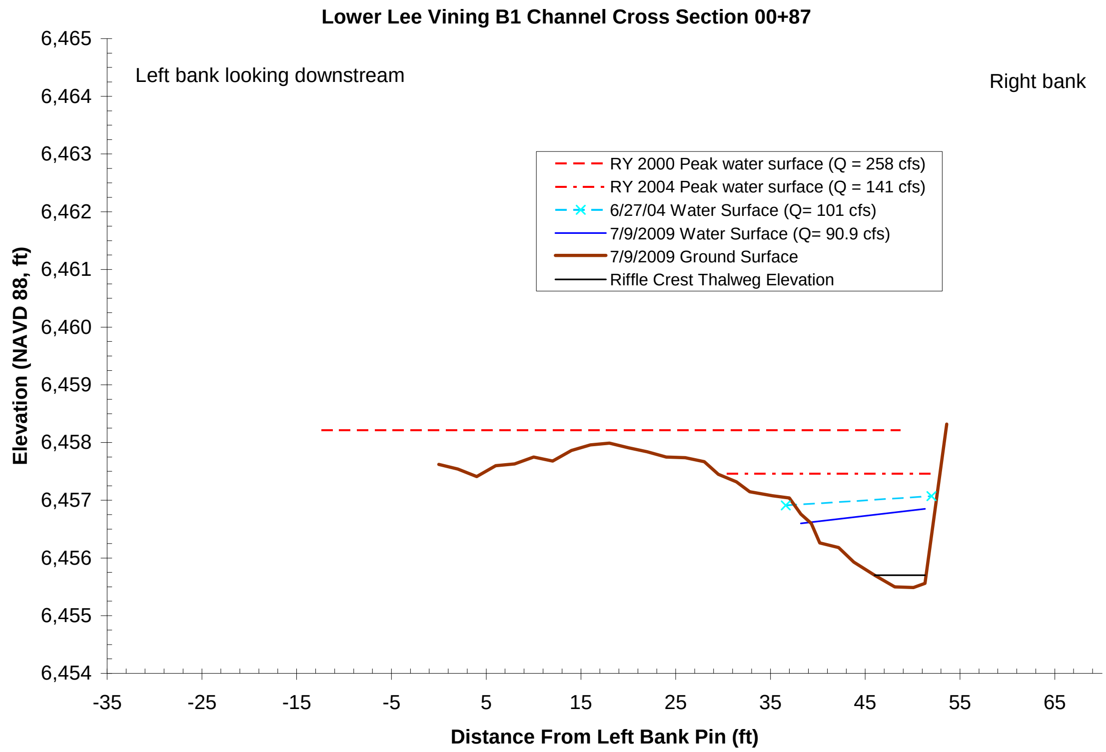

Lower Lee Vining Creek Main Channel Cross Section 01+15
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
RY 1999 Peak water surface (Q = 274 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
7/9/09 Water surface
7/9/09 Ground surface
6/27/04 Ground surface
7/23/99 Ground surface
Elevation (NAVD 88, ft)
6,466
6,465
6,464
6,463
6,462
6,461
6,460
6,459
6,458
6,457
6,456
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance from Left Bank Pin (ft)


Lower Lee Vining Creek Main Channel Cross Section 01+15
Left bank looking downstream
Right bank
RY 1997 Peak water surface (Q = 354 cfs)
RY 1999 Peak water surface (Q = 274 cfs)
RY 2009 Peak water surface (Q = 232 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
7/9/09 Water surface
7/9/09 Ground surface
Elevation (NAVD 88, ft)
6,466
6,465
6,464
6,463
6,462
6,461
6,460
6,459
6,458
6,457
6,456
0
5
10
15
20
25
30
35
40
45
50
55
60
Distance from Left Bank Pin (ft)


Lower Lee Vining B1 Channel Cross Section 1+80
Left bank looking downstream
Right bank
7/9/09 Water surface
7/9/09 Ground surface
6/27/04 Ground surface
7/23/99 Ground surface
Elevation (NAVD 88, ft)
6,462
6,461
6,460
6,459
6,458
6,457
-10
-5
0
5
10
15
20
25
30
35
Distance From Left Bank Pin (ft)


Lower Lee Vining B1 Channel Cross Section 1+80
Left bank looking downstream
Right bank
RY 1999 Peak water surface (Q = 274 cfs)
RY 2000 Peak water surface (Q = 258 cfs)
7/9/09 Water surface
7/9/09 Ground surface
Elevation (NAVD 88, ft)
6,462
6,461
6,460
6,459
6,458
6,457
-10
-5
0
5
10
15
20
25
30
35
Distance From Left Bank Pin (ft)


Lower Lee Vining B1 Channel Cross Section 00+87
Left bank looking downstream
Right bank
7/9/2009 Water Surface (Q= 90.9 cfs)
7/9/2009 Ground Surface
6/27/04 Ground Surface
7/23/99 Ground Surface
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,465
6,464
6,463
6,462
6,461
6,460
6,459
6,458
6,457
6,456
6,455
6,454
-35
-25
-15
-5
5
15
25
35
45
55
65


Lower Lee Vining B1 Channel Cross Section 00+87
Left bank looking downstream
Right bank
RY 2000 Peak water surface (Q = 258 cfs)
RY 2004 Peak water surface (Q = 141 cfs)
6/27/04 Water Surface (Q= 101 cfs)
7/9/2009 Water Surface (Q= 90.9 cfs)
7/9/2009 Ground Surface
Riffle Crest Thalweg Elevation
Elevation (NAVD 88, ft)
Distance From Left Bank Pin (ft)
6,465
6,464
6,463
6,462
6,461
6,460
6,459
6,458
6,457
6,456
6,455
6,454
-35
-25
-15
-5
5
15
25
35
45
55
65