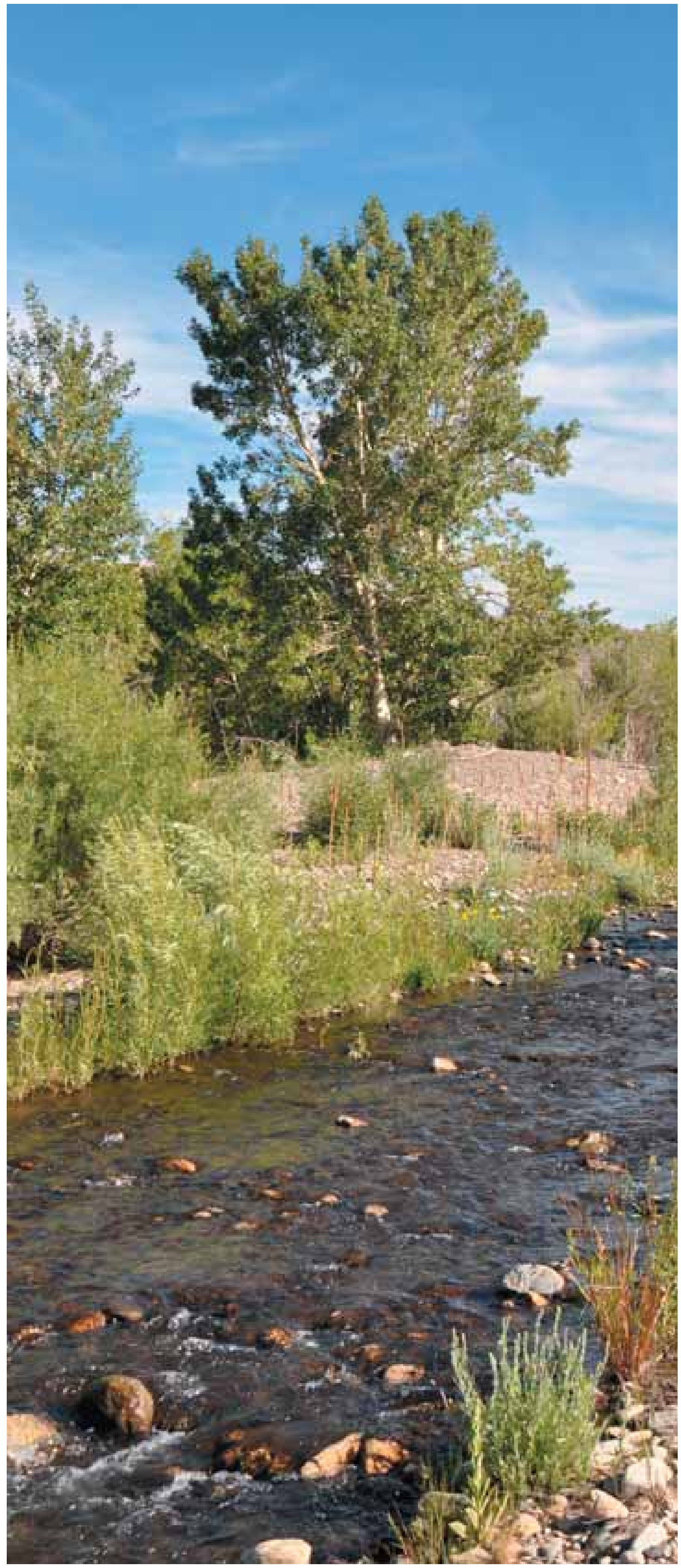
Mono Basin Stream Restoration and Monitoring Program:

Appendices to the Synthesis of Instream Flow Recommendations to the State Water Resources Control Board

and the

Los Angeles Department of Water and Power

FINAL REPORT



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APPENDIX A. HYDROLOGY

Hydrology of the Mono Basin has been a subject of numerous reports and analyses. Technical Appendix A summarizes hydrologic information relevant to the revised Stream Ecosystem Flow recommendations. For additional background information refer to the Grant Lake Operations and Management Plan (LALADWP 1996), Hasencamp (1994), Vorster (1985), and the Mono Basin EIR (Jones and Stokes 1993).

LADWP Mono Basin operations are governed by Runoff Year (RY), with each runoff year beginning April 1 and ending the next March 31 (e.g., RY2009 began April 1, 2009). Runoff Year forecasts are determined on April 1, and may be updated on May 1 each year. LADWP developed a Grant Lake Operations and Management Plan (LADWP 1996) to address four operational aspects of water management in Mono Basin: Grant Lake Reservoir (GLR) operations, Lee Vining Conduit diversions, water exports through the East Portal into the Owens Basin, and instream flow requirements for Rush, Parker, Walker, and Lee Vining creeks. LADWP also submits an annual Operations Plan to the SWRCB at the start of each runoff year.

The foundation of hydrologic analyses is the daily average annual hydrograph measured at specific locations within Mono Basin over many runoff years. Primary gaging locations are:

- Rush Creek Runoff (estimated unimpaired);
- Rush Creek at Damsite (LADWP station 5013);
- Rush Creek below the MGORD (LADWP station 5007);
- Rush Creek below the Narrows (estimated unimpaired and computed [additive] flow);
- Walker Creek above (LADWP station 5016) and below (LADWP station 5002) the Lee Vining Conduit;
- Parker Creek above (LADWP station 5017) and below (LADWP station 5003) the Lee Vining Conduit;
- Lee Vining Creek Runoff (estimated unimpaired);
- Lee Vining Creek above Intake (LADWP station 5008);
- Lee Vining Creek Spill at Intake (LADWP station 5009).

With exception of the estimated unimpaired data (described below), the daily average discharge data for these gaging sites are collected and published by LADWP, and can be found online at http://www.ladwp.com/ladwp/aqueduct. At some gaging locations the 15-minute streamflow data have also been acquired from LADWP for analysis.

Most analyses in this Synthesis Report used the 19-year period of record from RY1990 to RY2008 in which daily average flow data were available for all LADWP Mono Basin gaging stations. Analyses such as the flood frequency curves and annual yield summaries use the period of record back to RY1941 when LADWP began exporting.

The “estimated unimpaired” data are not measured streamflows, but are computed by estimating the inflow to SCE reservoirs from daily reservoir storage change, and then adding this inflow to the measured flow at the downstream LADWP gaging station. For Rush Creek, SCE reservoirs include Waugh, Gem, and Agnew lakes; the downstream station is the Rush Creek at Damsite gage (reported as 5013). For Lee Vining Creek, SCE reservoirs include Saddleback, Ellery, and Tioga lakes; the downstream gaging station is Lee Vining above Intake (reported as 5008). The estimated unimpaired flow is thus computed by summing the daily average streamflow captured in storage reservoirs and streamflow not captured, i.e., measured at the downstream gaging station. Estimated unimpaired data and annual hydrographs are referred to as "Rush Creek Runoff" and "Lee Vining Creek Runoff", and represent unimpaired flows at the downstream measurement station if SCE reservoirs and operations did not exist.

Archived records for daily reservoir storage change from SCE are not published prior to 1990, but unimpaired flows were computed for May 1 through August 31 for RY1941 to RY1994 by Hasencamp (1994). The analyses updated the unimpaired data using the published SCE reservoir storage changes for RY1990 to RY2008. Only the RY1990 to RY2008 data are presented in this Appendix. There can be considerable error in converting daily storage change in acre-feet (af) to a discharge inflow rate (in cubic feet per second, or cfs) particularly for low baseflows. However, this conversion works reasonably well for estimating unimpaired streamflows for the spring snowmelt hydrograph, including the annual maximum daily flood peak during the snowmelt runoff, the timing and duration of snowmelt peaks, and the snowmelt recession period (discussed below).

An alternative modeling approach was estimating unimpaired annual hydrographs for Rush Creek from USGS streamflow records measured in a nearby watershed – Buckeye Creek near Bridgeport – and scaling up to Rush Creek based on the ratio of annual water yields. Thus each modeled unimpaired runoff year from Buckeye Creek had the identical annual yield as the Rush Creek estimated unimpaired annual hydrograph. The modeled unimpaired data had slightly lower annual snowmelt peaks compared to the estimated unimpaired, but were a good representation of annual runoff, peak timing, and especially baseflows.

In this Appendix, the following data are presented:

A-1: A-1: Annual Hydrographs

- Annual hydrographs for Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (measured) daily average flows, for RY1990 to RY2008;
- Annual hydrographs for Rush Creek Runoff (estimated unimpaired) and Buckeye Creek (modeled unimpaired), for RY1990 to RY2008;
- Annual hydrographs for Parker and Walker creeks above Intake (measured unimpaired) daily average flows, for RY1990 to RY2008;
- Annual hydrographs for Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (measured) daily average flows, for RY1990 to RY2008;
- Annual hydrographs for Rush Creek below Narrows Actual and Rush Creek Recommended SEF below Narrows with spills simulated for RY1990 to RY2008;
- Annual hydrographs for Rush Creek below Narrows Actual and Rush Creek Recommended SEF below Narrows with spills simulated for RY1990 to RY2008 with SCE cooperation;
- Annual hydrographs for Lee Vining Creek above Intake and Lee Vining Creek SEF simulated for RY1990 to RY2008;

A-2: A-2: Composite Hydrographs (aka "Spaghetti Graphs") for RY1990 to RY2008

- Rush Creek Unimpaired;
- Rush Creek at Damsite;
- Rush Creek below Narrows Unimpaired;
- Rush Creek below Narrows simulating full GLR;
- Rush Creek below Narrows actual (additive) flow;
- Lee Vining Creek estimated unimpaired;
- Lee Vining Creek above Intake;
- Lee Vining Creek "spill" at Intake;
- Rush Creek SEF (Stream Ecosystem Flow) Recommendations;
- Lee Vining Creeks SEF (Stream Ecosystem Flow) Recommendations.

A-3: A-3: Hydrograph Component Analysis

The hydrograph component analysis presented in this Appendix includes summary tables of hydrograph components for Rush and Lee Vining creek estimated unimpaired streamflows. The hydrograph component analysis was reported in RY2003 Annual Report (M&T 2004) and updated through RY2008 for this Appendix. RY2003 Annual Report explains the analytical steps used to develop the summary information.

Charts of peak timing are presented for Rush Creek estimated unimpaired and at Damsite, and for Parker Creek.

A-4: A-4: Flood Frequency Analysis

A flood frequency analysis was presented in the RY2003 Annual Report (M&T 2004) for the available period of record and was updated through RY2008. This Appendix presents:

- Summary tables of annual peak discharge (daily average flow) for Rush Creek and Lee Vining Creek;
- Summary table of flood recurrences for Rush Creek and Lee Vining Creek;
- Flood frequency curves for Rush Creek estimated unimpaired and Rush Creek at Damsite, and for Rush Creek estimated unimpaired and actual below the Narrows;
- Flood frequency curves for Lee Vining Creek estimated unimpaired and Lee Vining Creek above Intake;

A-5: A-5 Summary Information

- Mono Basin and Tributary annual yields for RY1941 to RY2008;
- Mono Basin April 1 forecast vs. actual runoff;
- Rush Creek synoptic measurements of longitudinal flow gains and losses;

A-6: A-6: Ramping rate analysis and memorandum presented in RY2002

A-7: Literature Cited

LADWP. 1996. Grant Lake Operations and Management Plan: Mono Basin. Report prepared by Los Angeles Department of Water and Power. Prepared for the State Water Resources Control Board in response to Mono Lake Water Right Decision 1631. February 1996.

Hasencamp, B. 1994. Lower Rush Creek Flow Analysis. Los Angeles Department of Water and Power. 11 p.

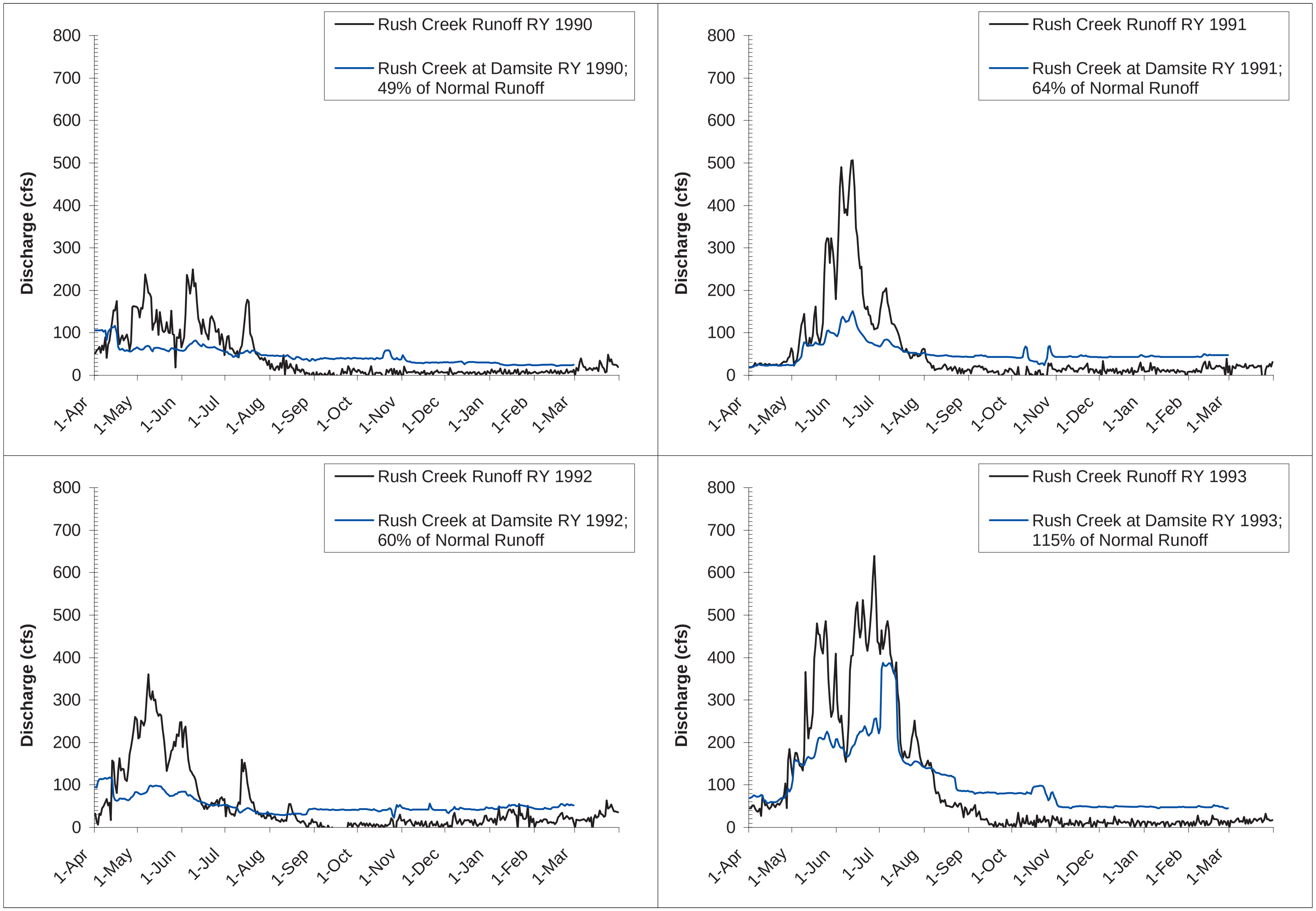
Jones and Stokes, Inc. 1993. Draft environmental impact report for the review of the Mono Basin Water Rights of the City of Los Angeles, Volumes 1 and 2 and Appendices, Los Angeles Department of Water and Power, Sacramento, CA.

McBain & Trush, Inc. 2004. Runoff Year 2003 Annual Report. Prepared for the Los Angeles Department of Water and Power, Los Angeles, CA.

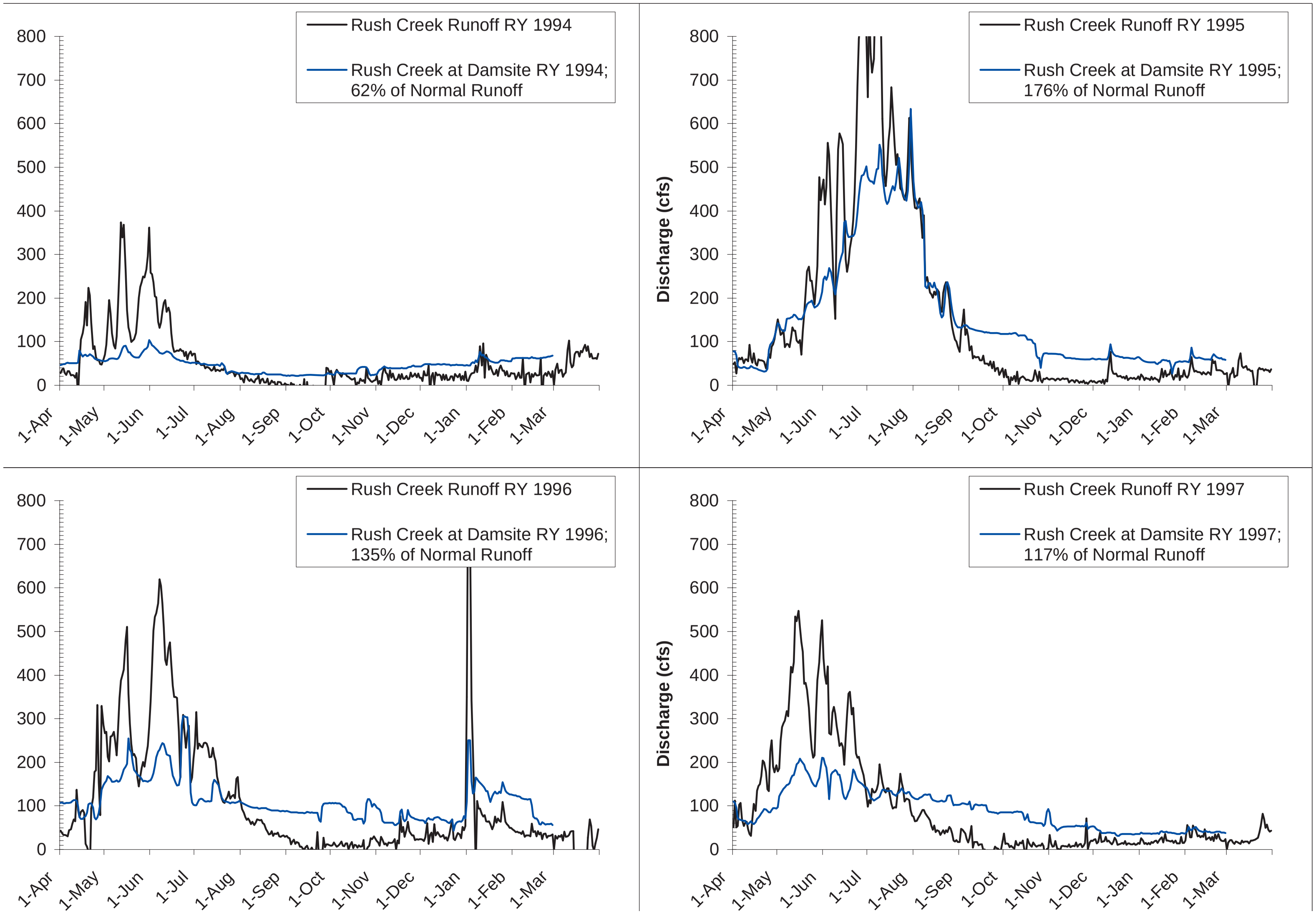
Ridenhour, R.L., C. Hunter, and B. Trush. 1995. Mono Basin Stream Restoration Work Plan. Los Angeles Department of Water and Power.

Vorster, P. 1985. A water balance forecast model for Mono Lake, California. California State University, Hayward. 341 p.

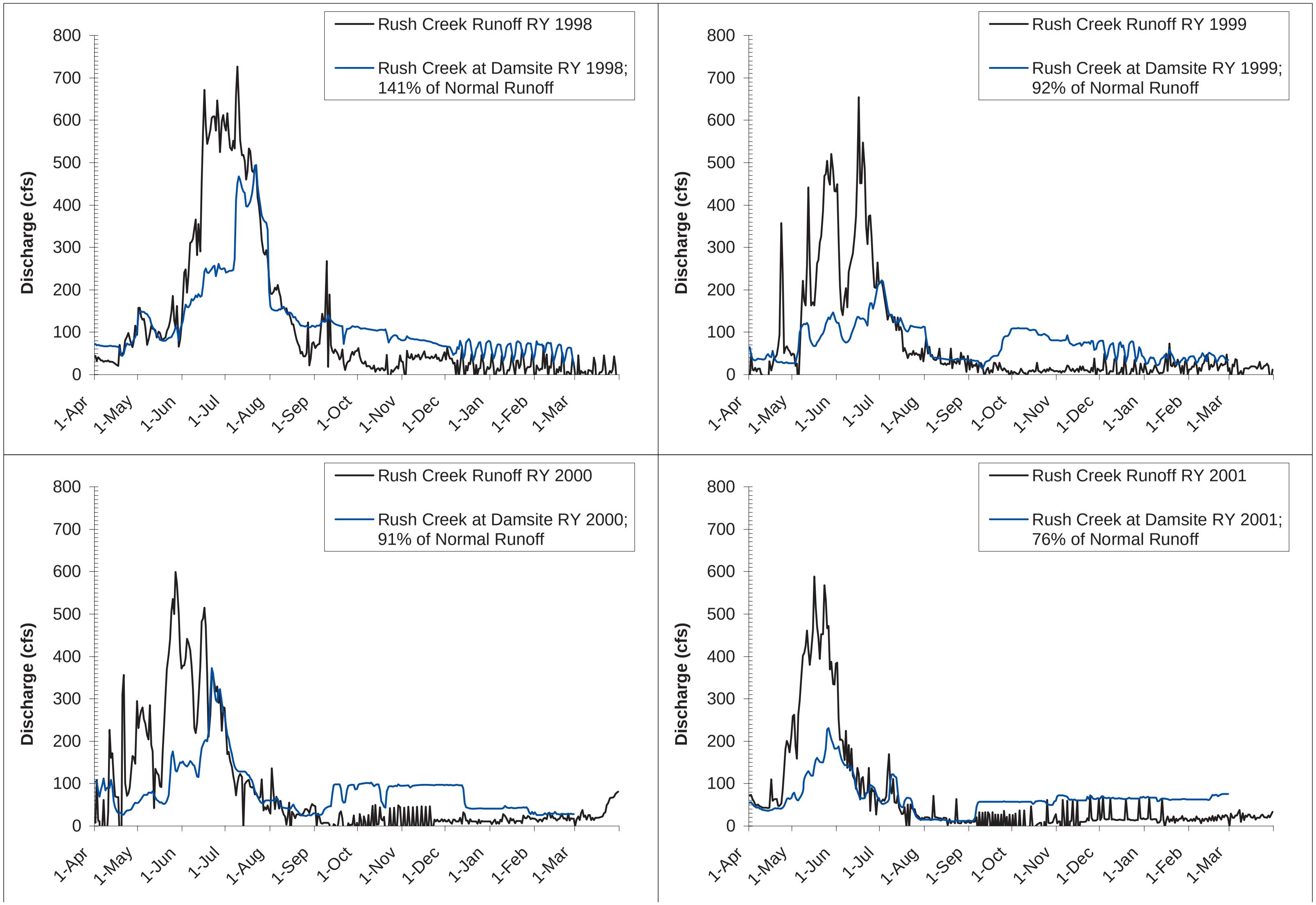
APPENDIX A-1. ANNUAL HYDROGRAPHS



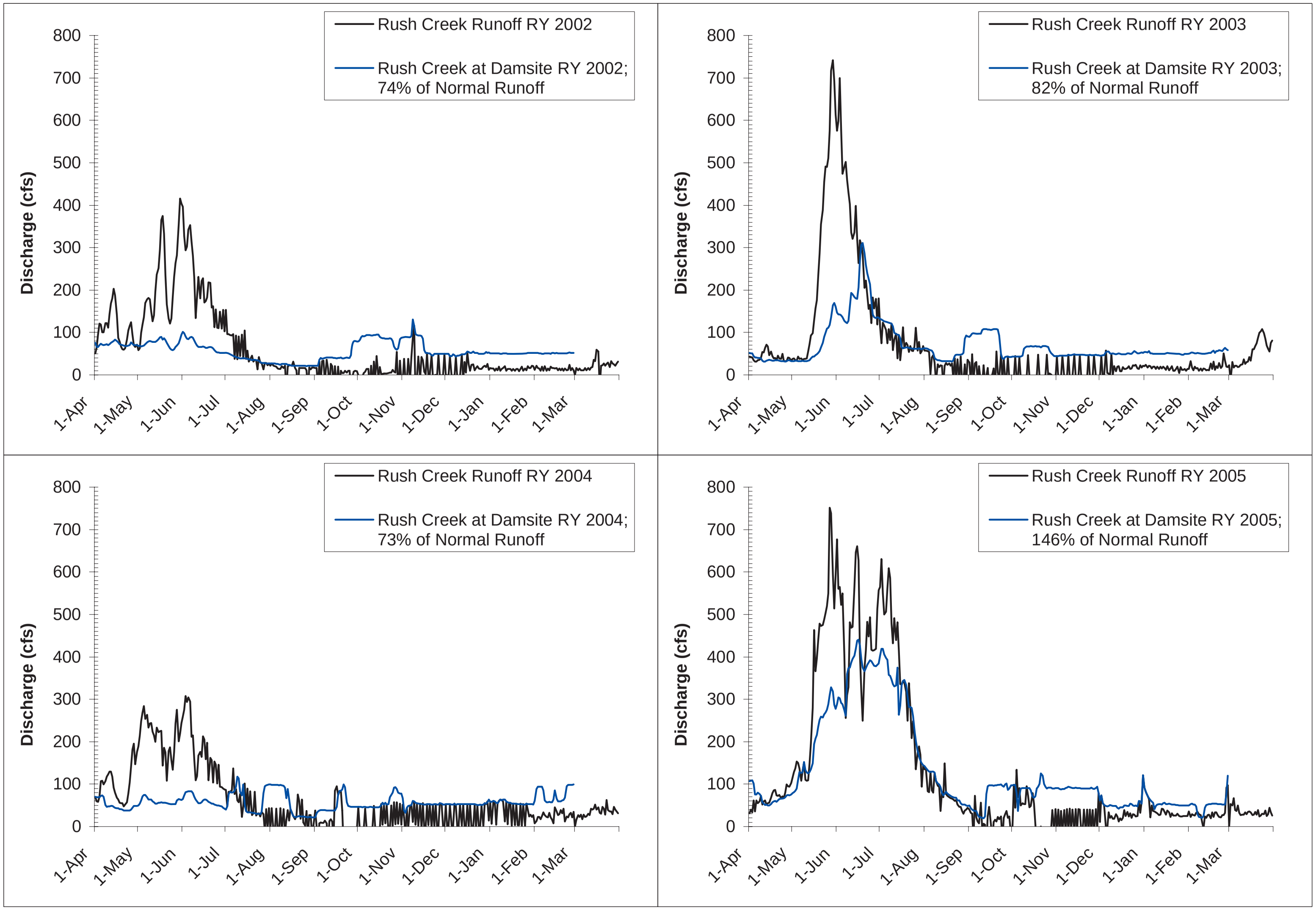
Appendix A-1. Figure 1A. Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (SCE impaired) annual hydrographs for 1990-1993.



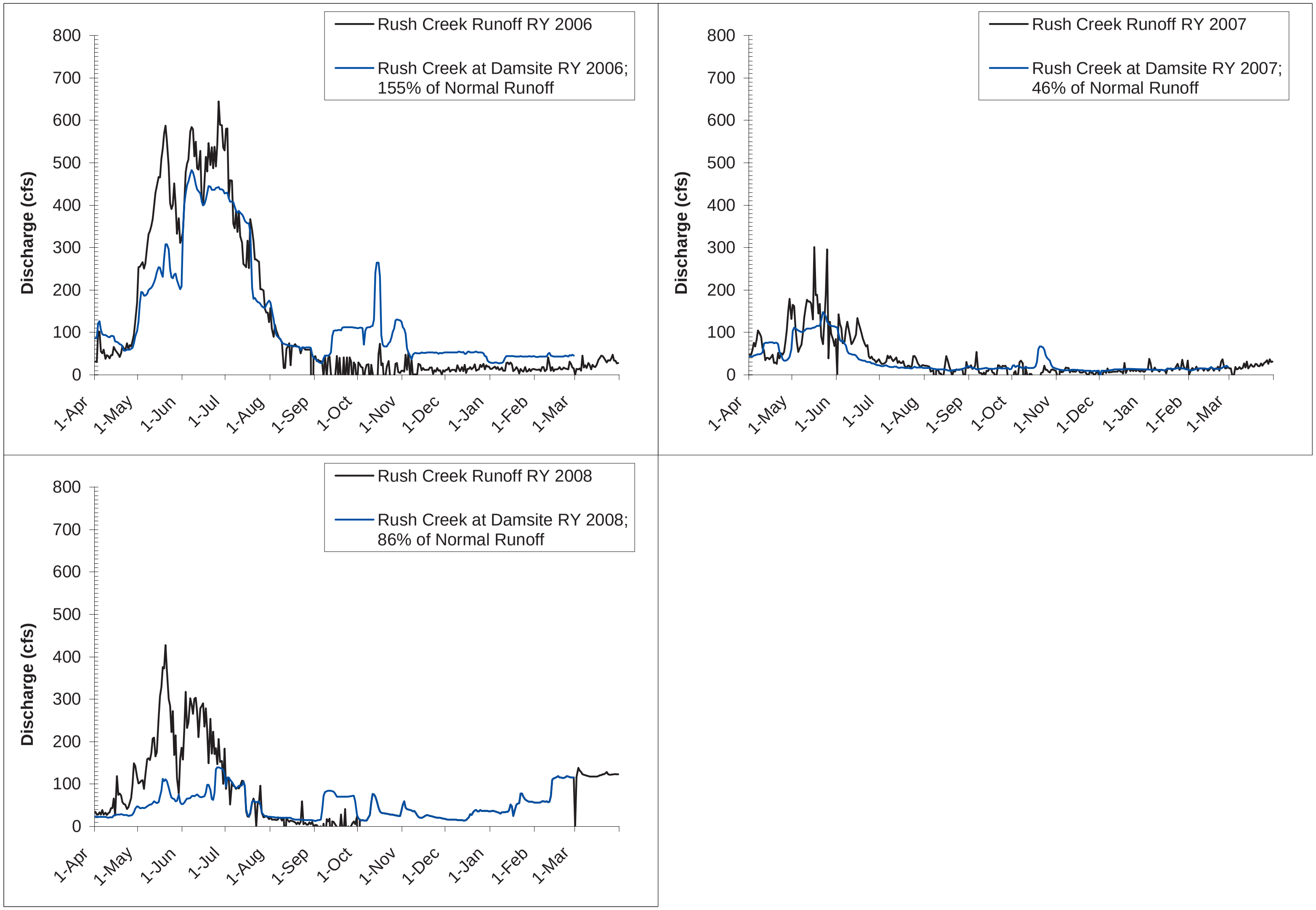
Appendix A-1. Figure 1B. Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (SCE impaired) annual hydrographs for 1994-1997.



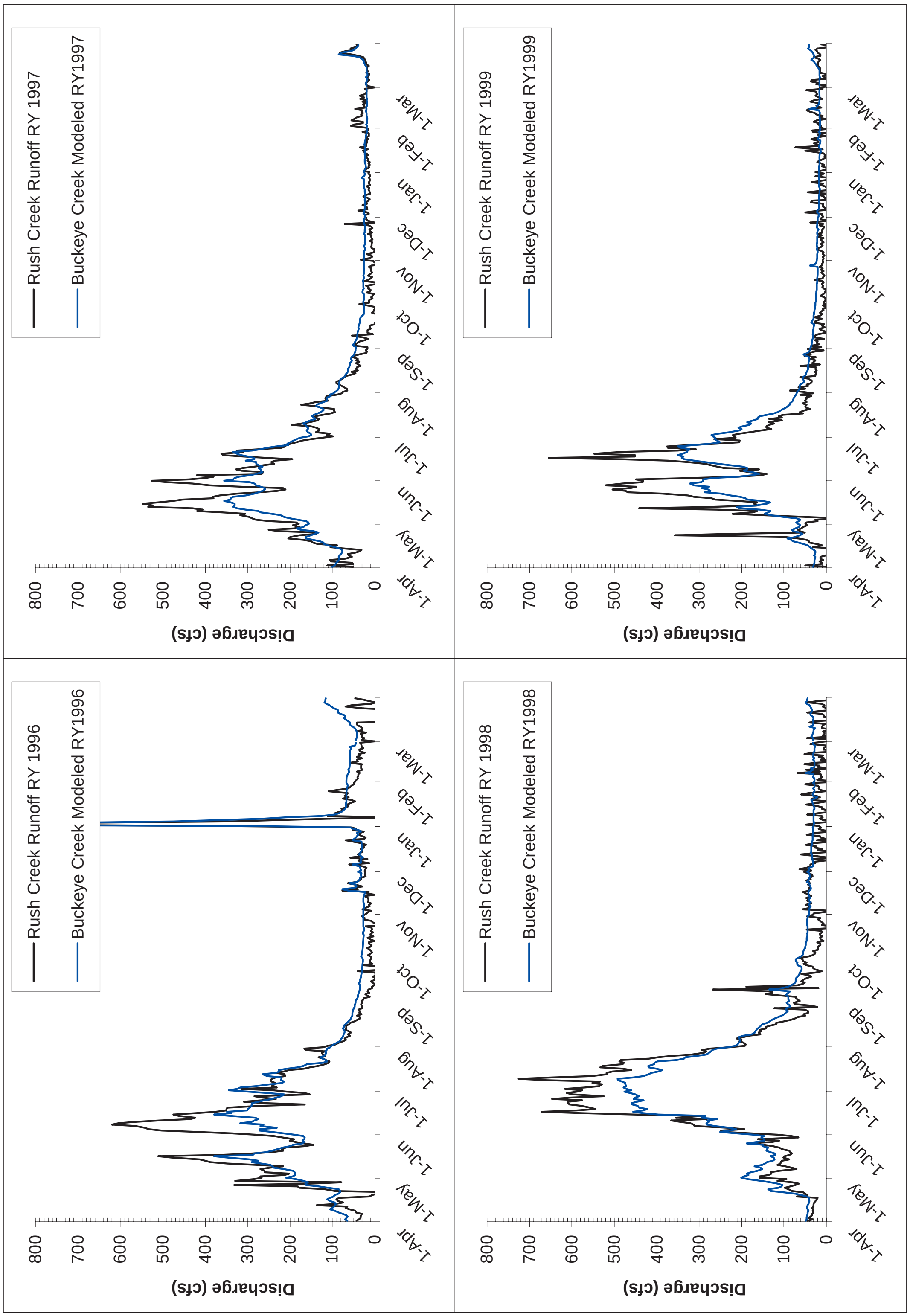
Appendix A-1. Figure 1C. Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (SCE impaired) annual hydrographs for 1998-2001.



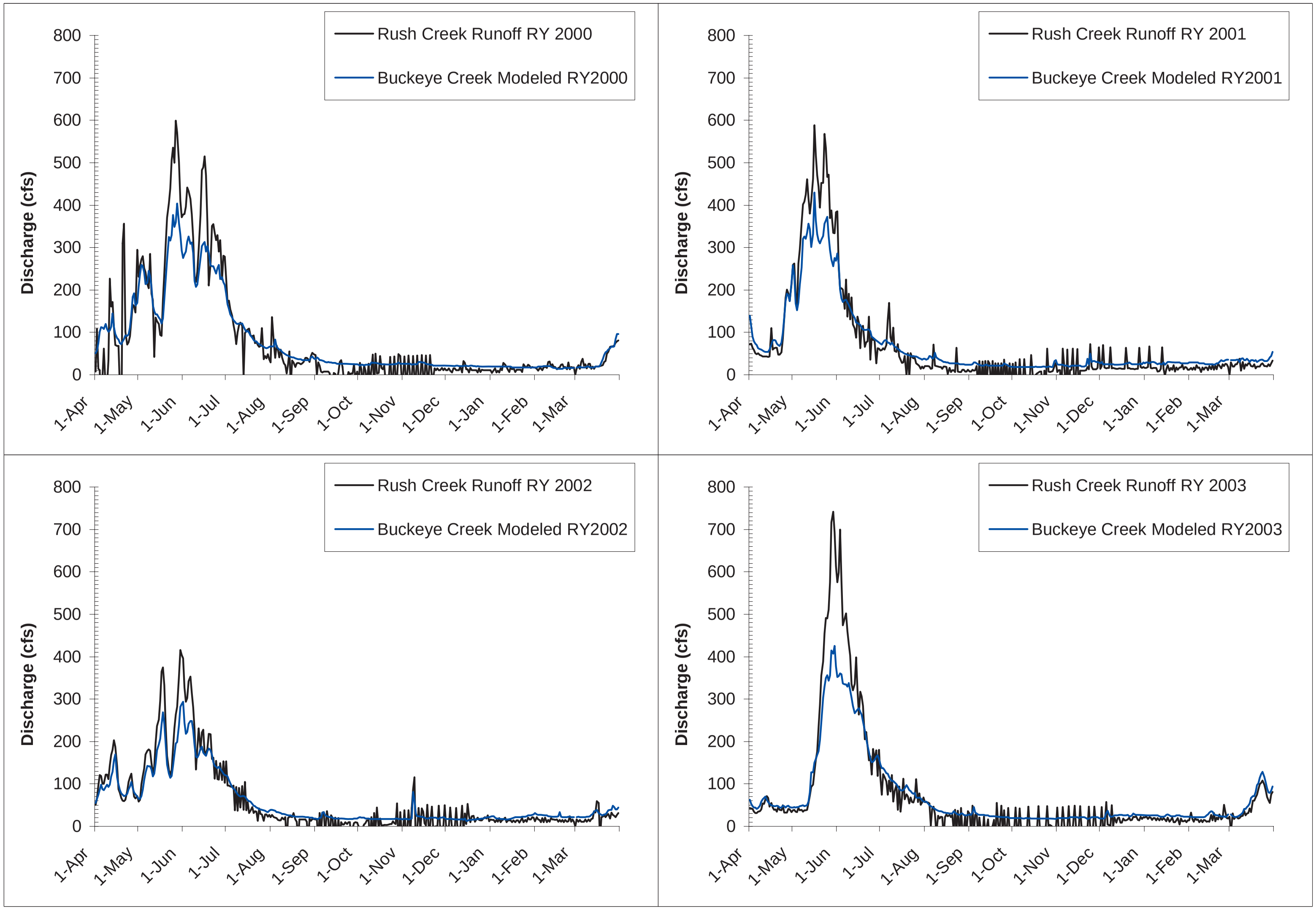
Appendix A-1. Figure 1D. Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (SCE impaired) annual hydrographs for 2002-2005.



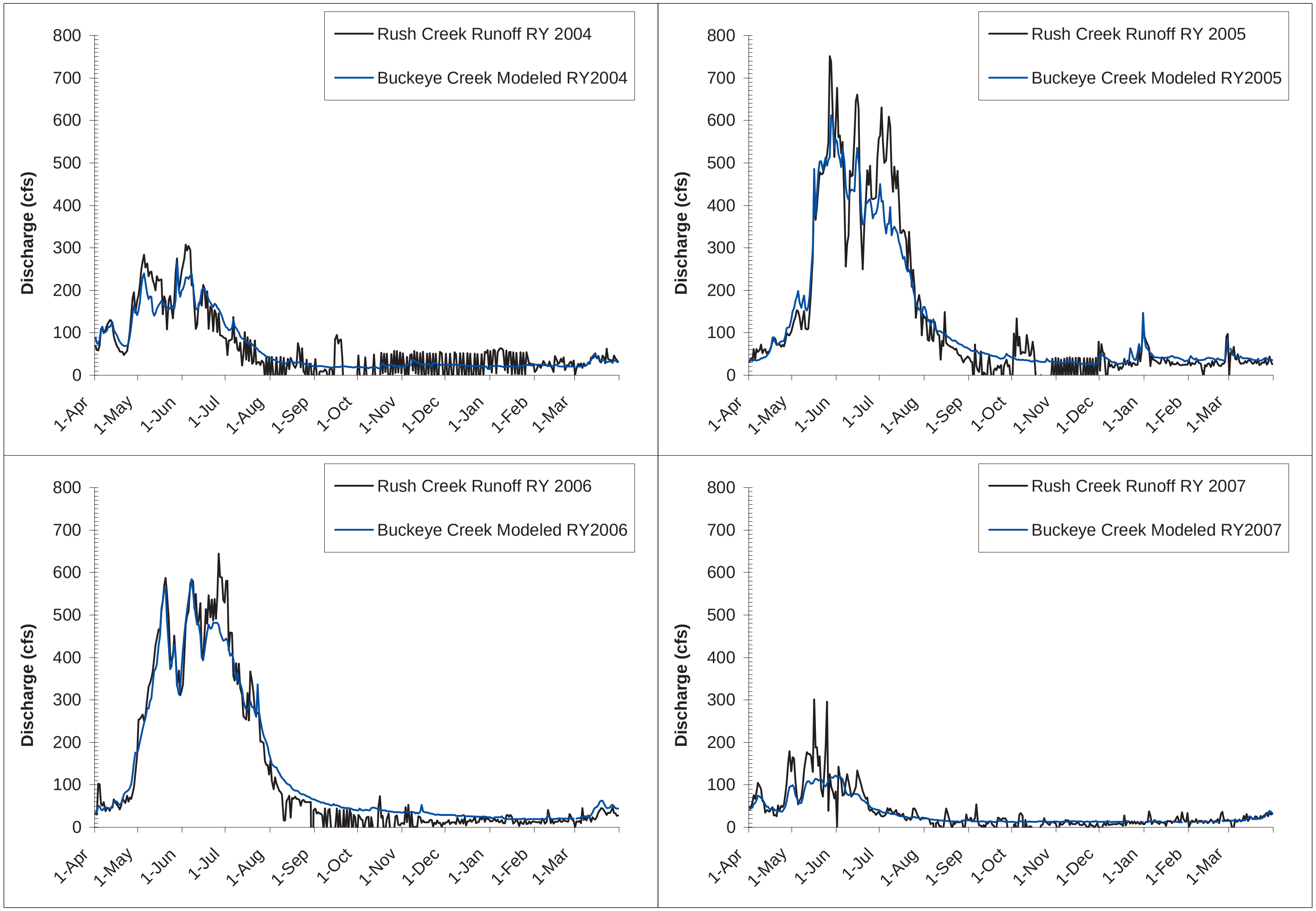
Appendix A-1. Figure 1E. Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (SCE impaired) annual hydrographs for 2006-2008.



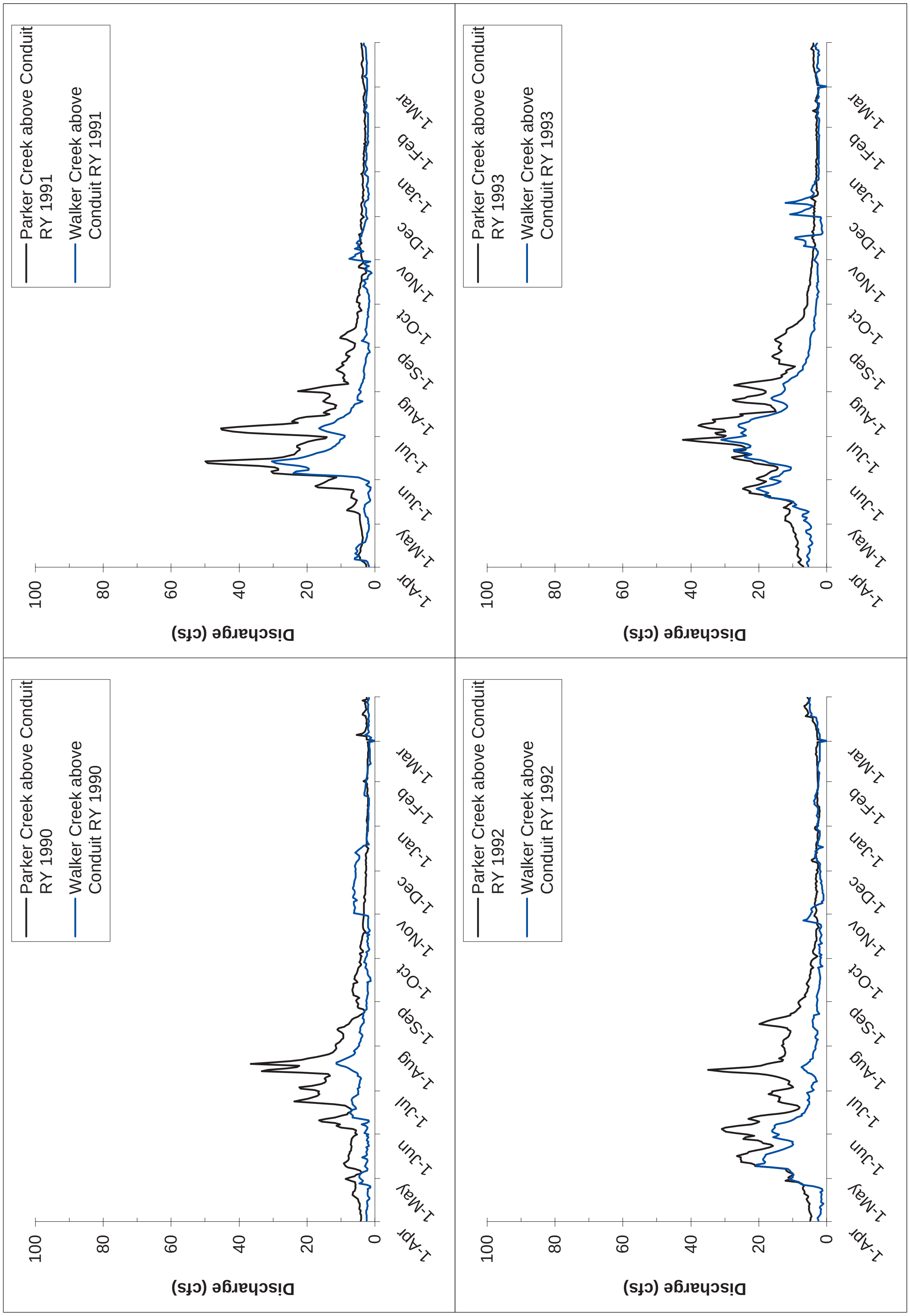
Appendix A-1. Figure 2A. Rush Creek Runoff (estimated unimpaired) and Buckeye Creek (modeled unimpaired) annual hydrographs for 1996-1999.



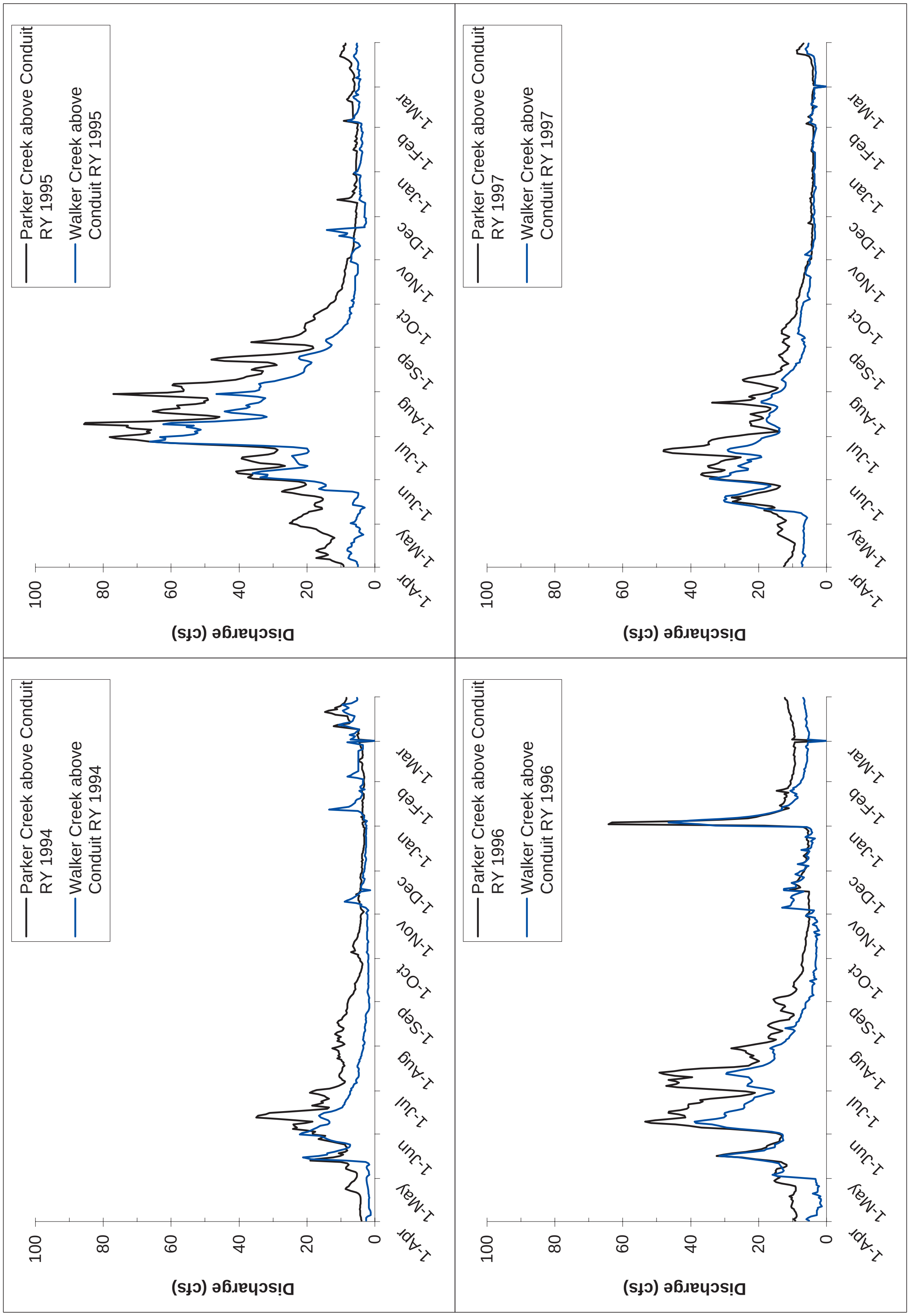
Appendix A-1. Figure 2B. Rush Creek Runoff (estimated unimpaired) and Buckeye Creek (modeled unimpaired) annual hydrographs for 2000-2003.



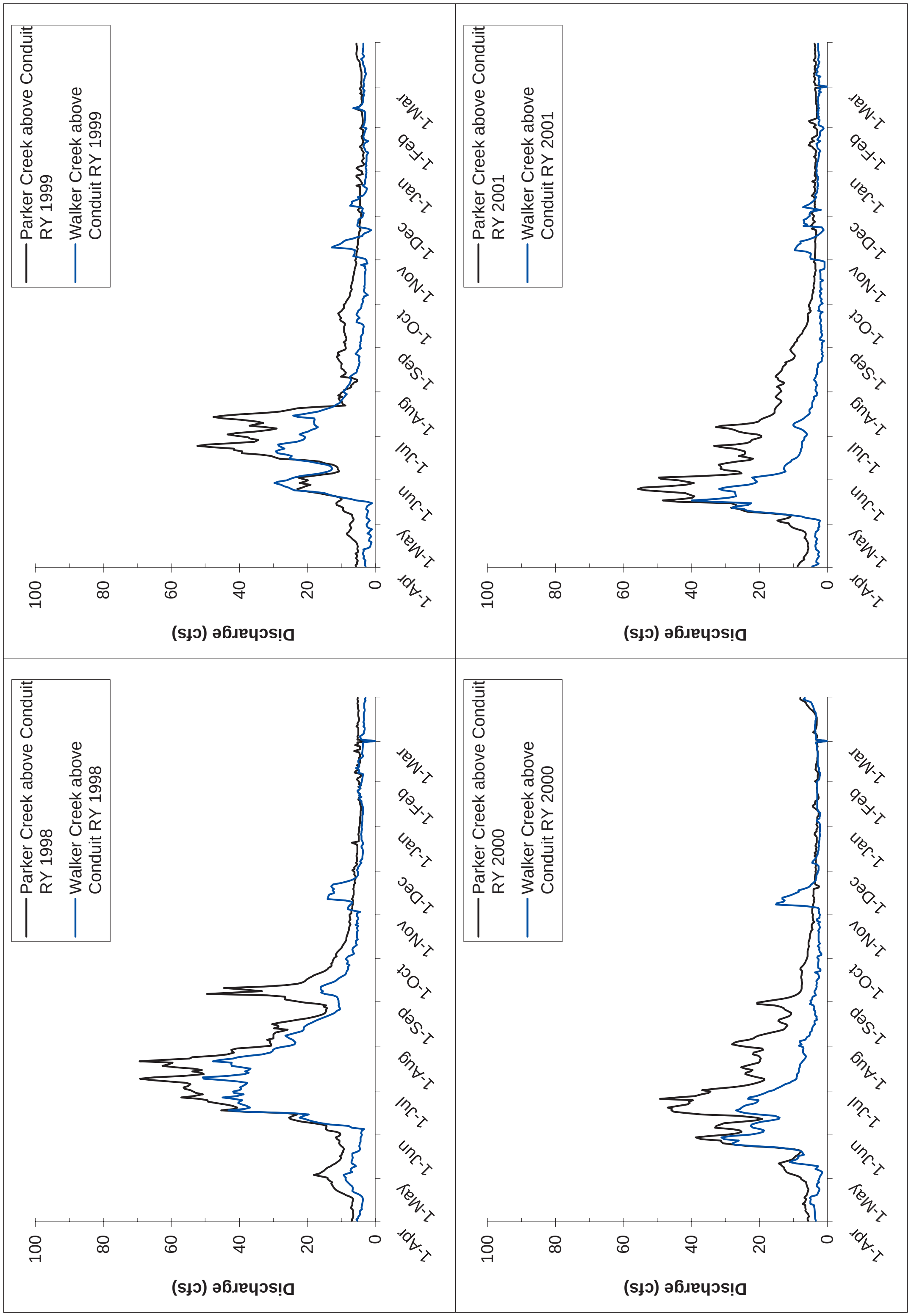
Appendix A-1. Figure 2C. Rush Creek Runoff (estimated unimpaired) and Buckeye Creek (modeled unimpaired) annual hydrographs for 2004-2007.



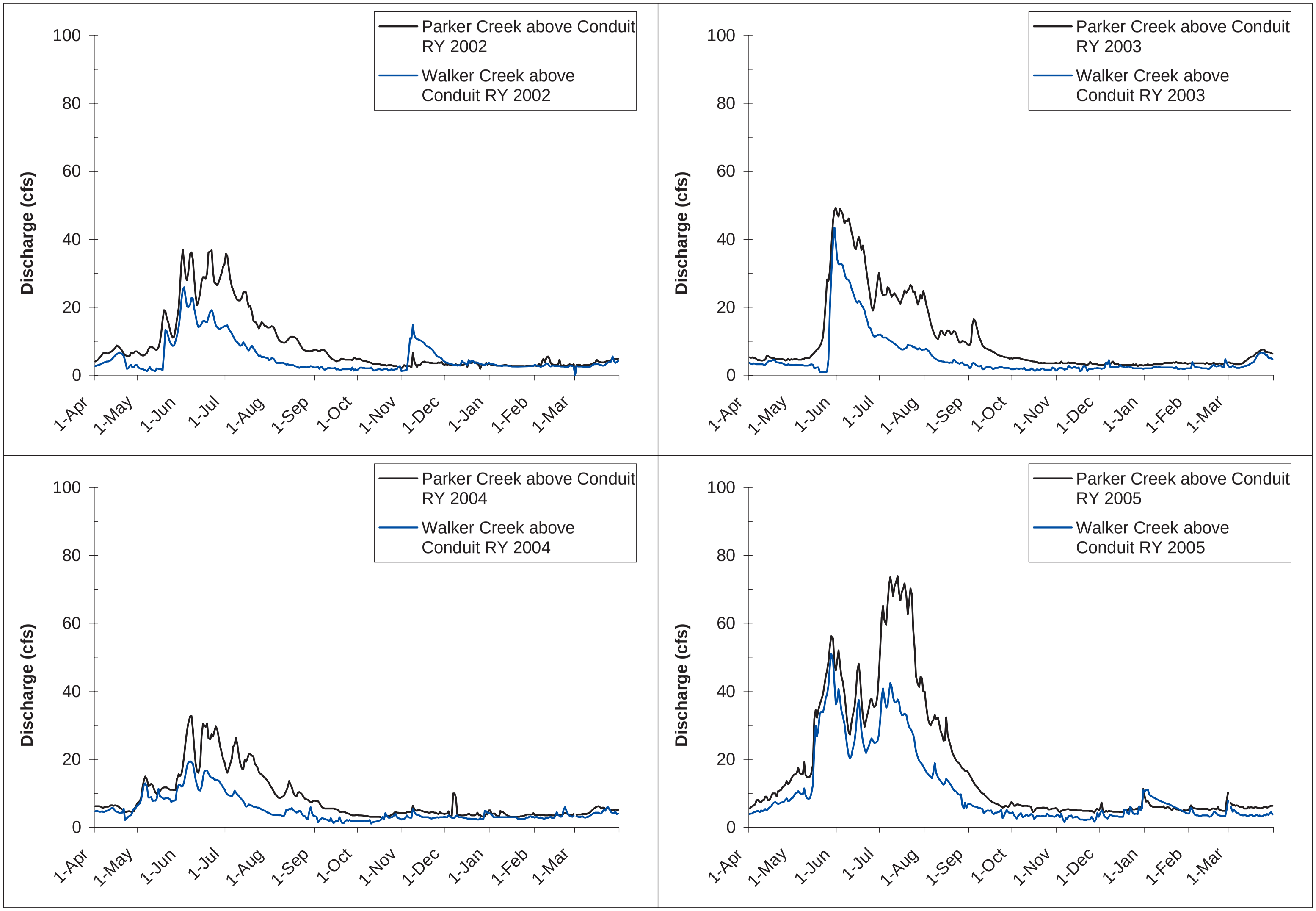
Appendix A-1. Figure 3A. Parker and Walker Creeks above Conduit annual hydrographs for 1990-1993.



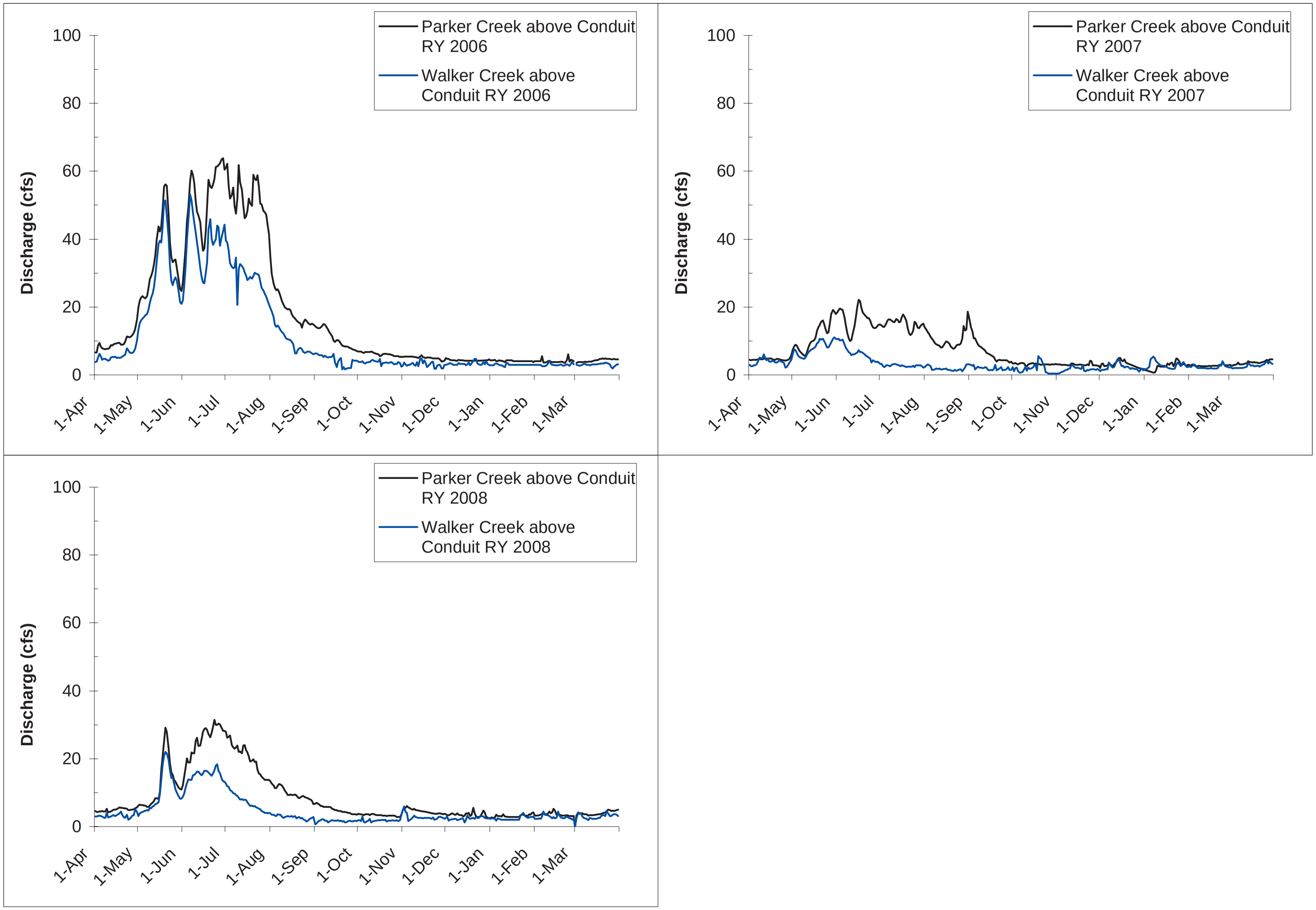
Appendix A-1. Figure 3B. Parker and Walker Creeks above Conduit annual hydrographs for 1994-1997.



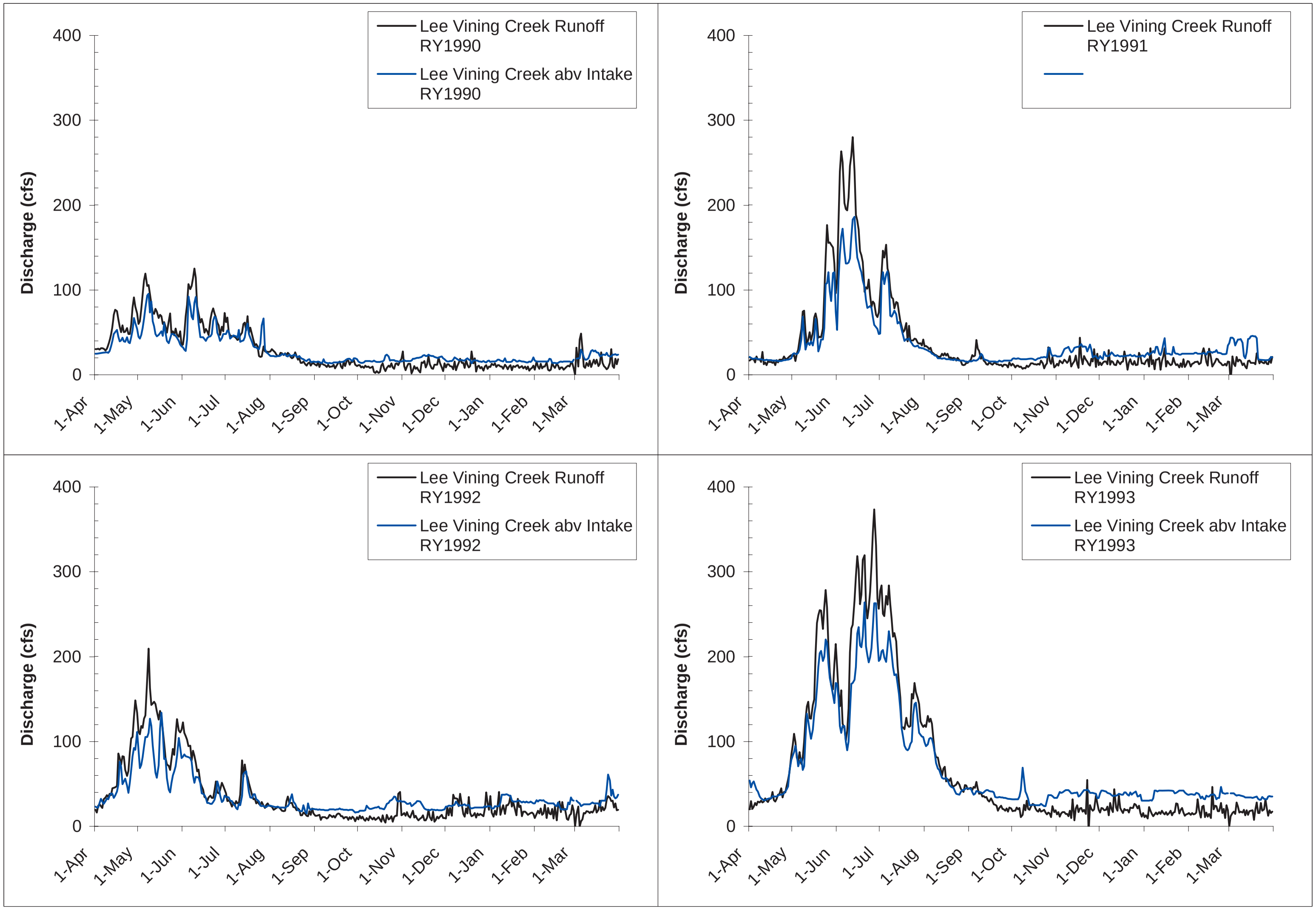
Appendix A-1. Figure 3C. Parker and Walker Creeks above Conduit annual hydrographs for 1998-2001.



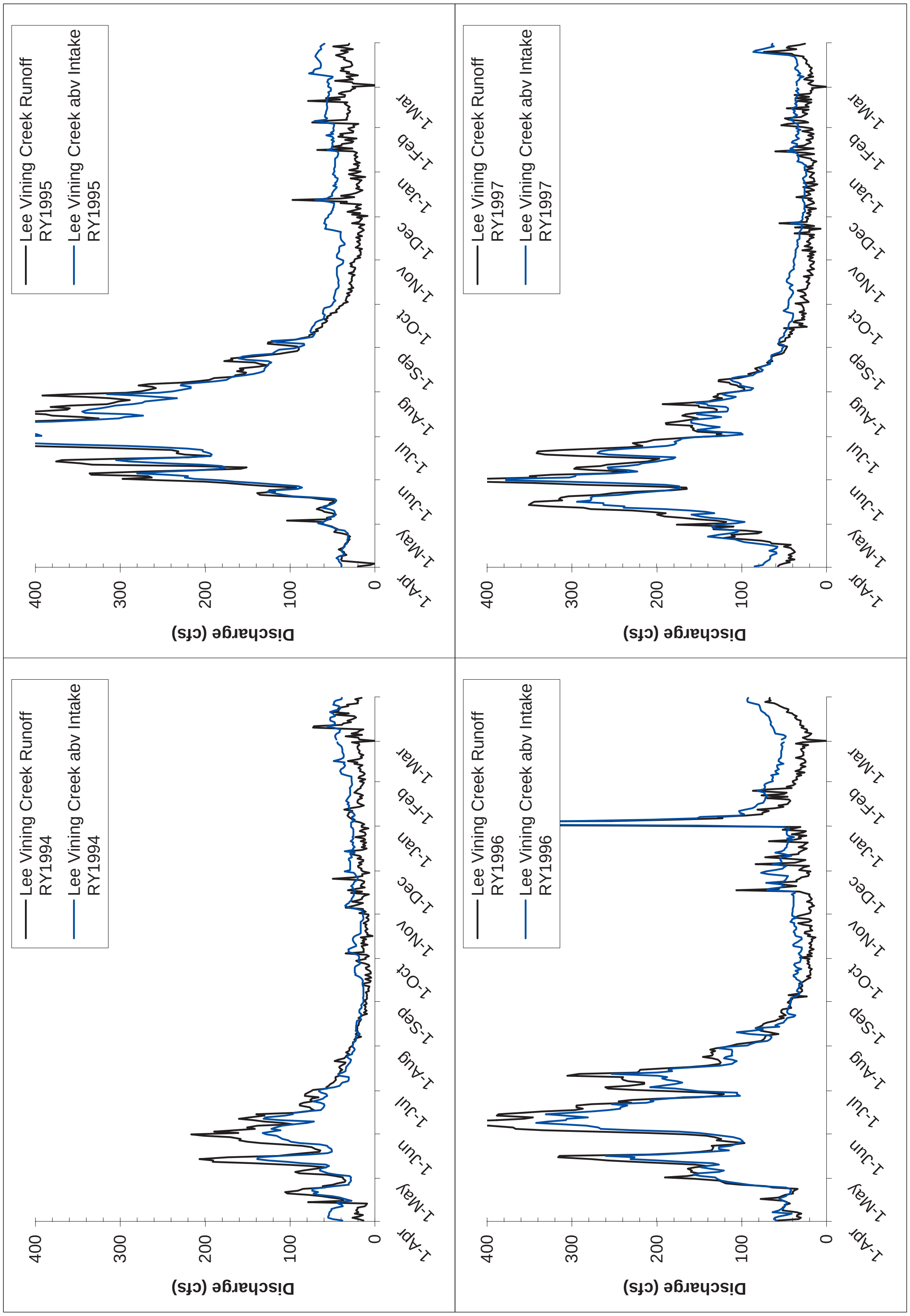
Appendix A-1. Figure 3D. Parker and Walker Creeks above Conduit annual hydrographs for 2002-2005.



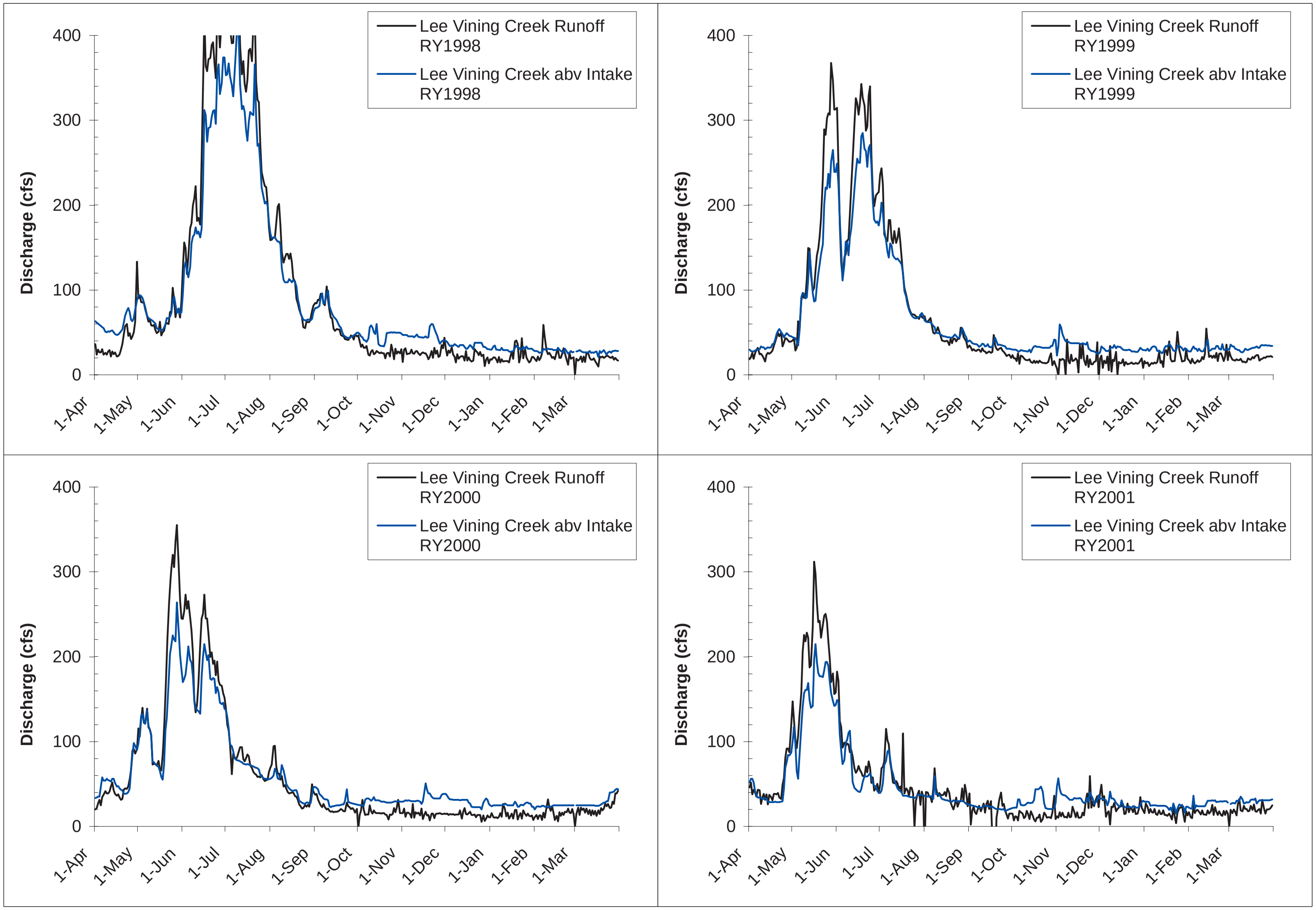
Appendix A-1. Figure 3E. Parker and Walker Creeks above Conduit annual hydrographs for 2006-2008.



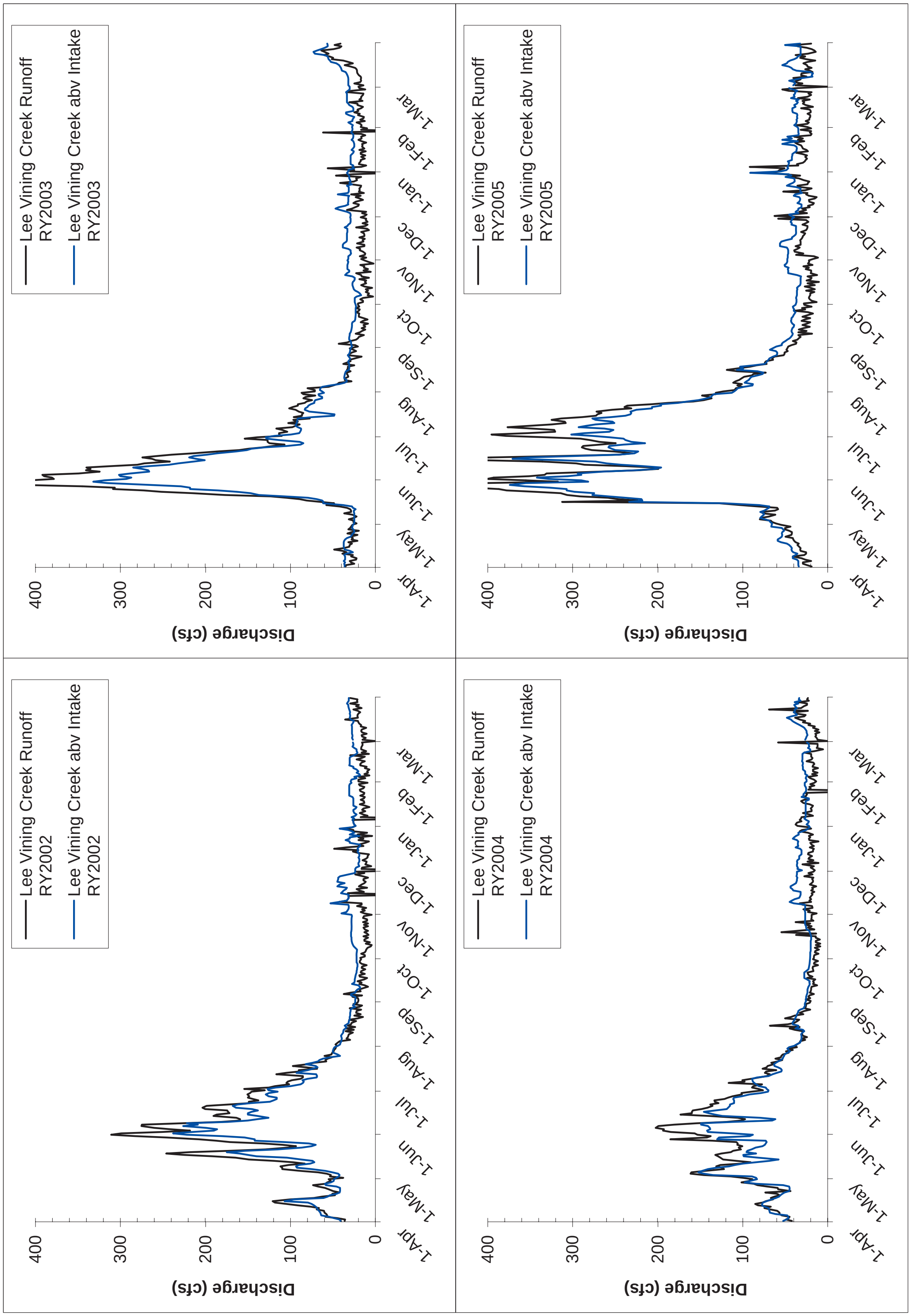
Appendix A-1. Figure 4A. Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (SCE impaired) annual hydrographs for 1990-1993.



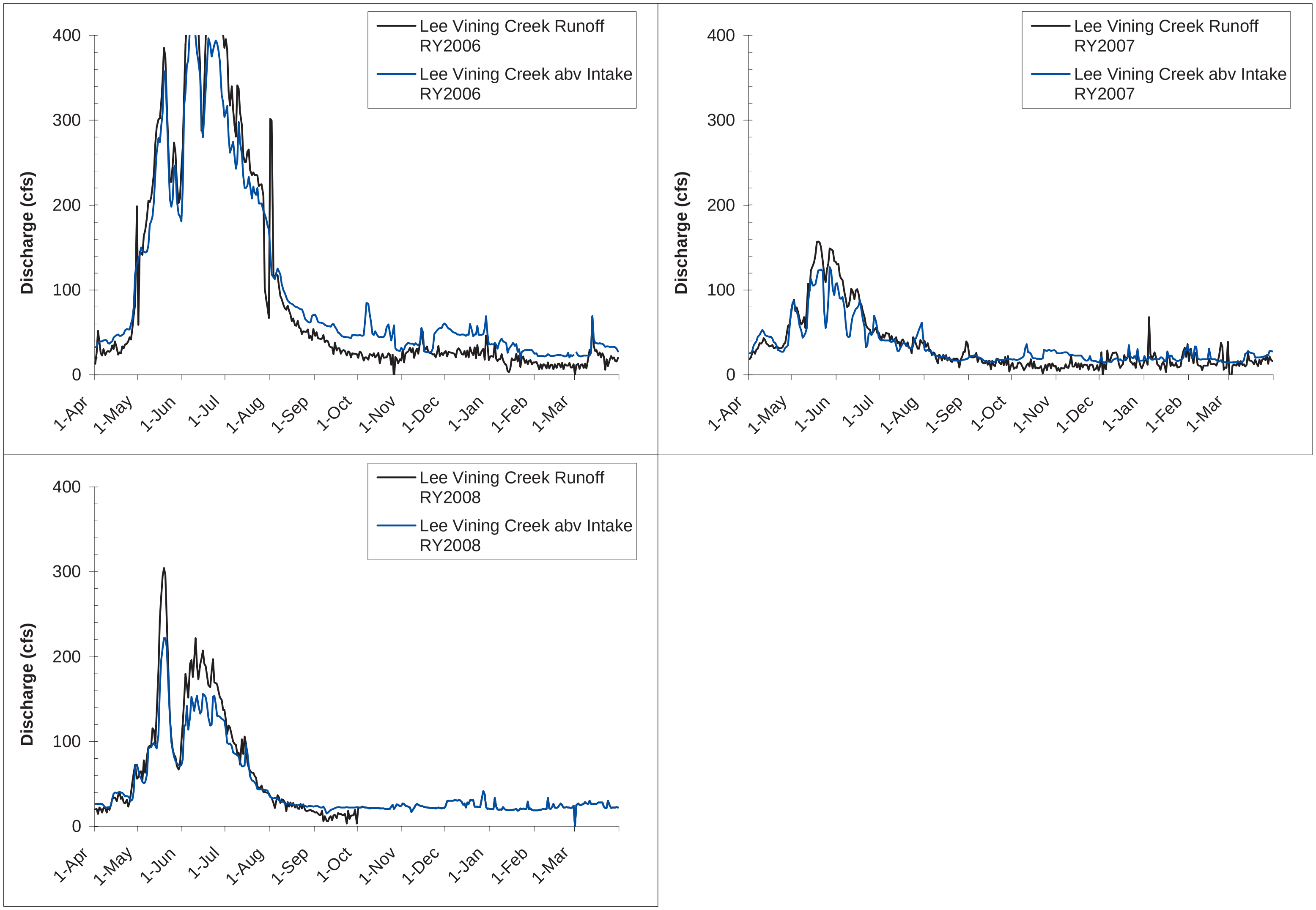
Appendix A-1. Figure 4B. Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (SCE impaired) annual hydrographs for 1994-1997.



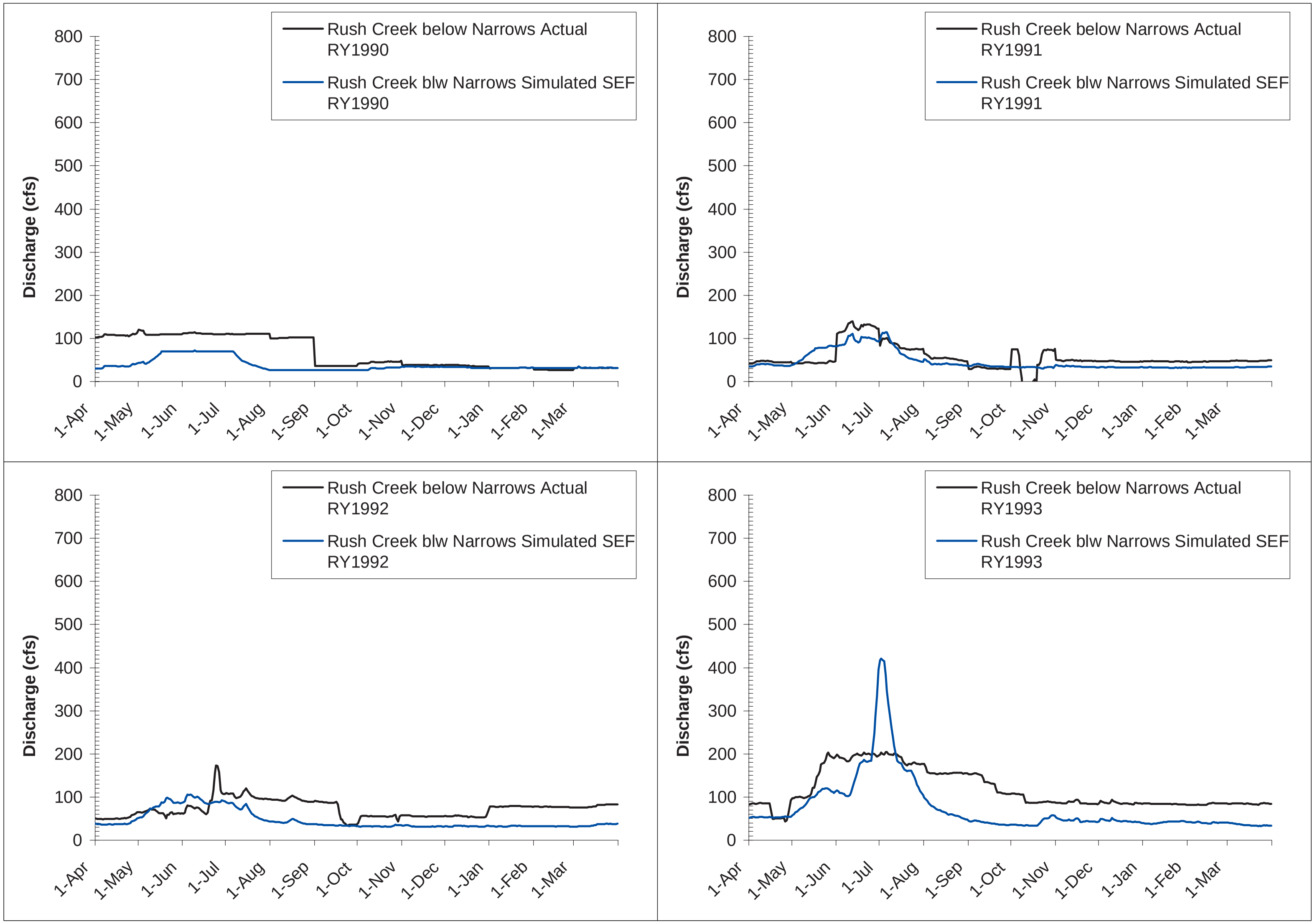
Appendix A-1. Figure 4C. Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (SCE impaired) annual hydrographs for 1998-2001.



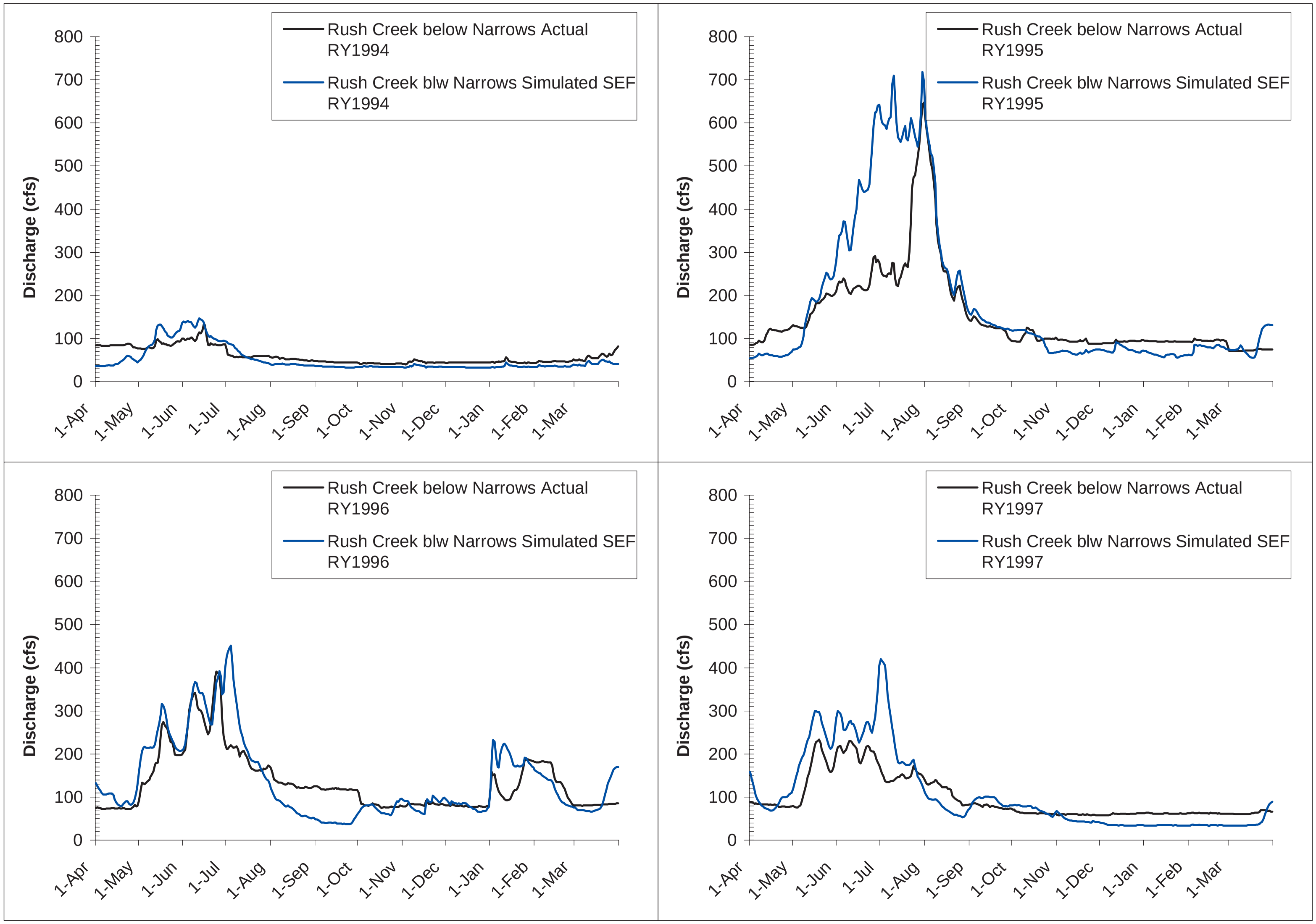
Appendix A-1. Figure 4D. Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (SCE impaired) annual hydrographs for 2002-2005.



Appendix A-1. Figure 4E. Lee Vining Creek Runoff (estimated unimpaired) and Lee Vining Creek above Intake (SCE impaired) annual hydrographs for 2006-2008.



Appendix A-1. Figure 5A. Rush Creek below Narrows (Actual) and Rush Creek below Narrows (Simulated SEF spills from GLR; no SCE peak release coordination; transition period) annual hydrographs for 1990-1993.



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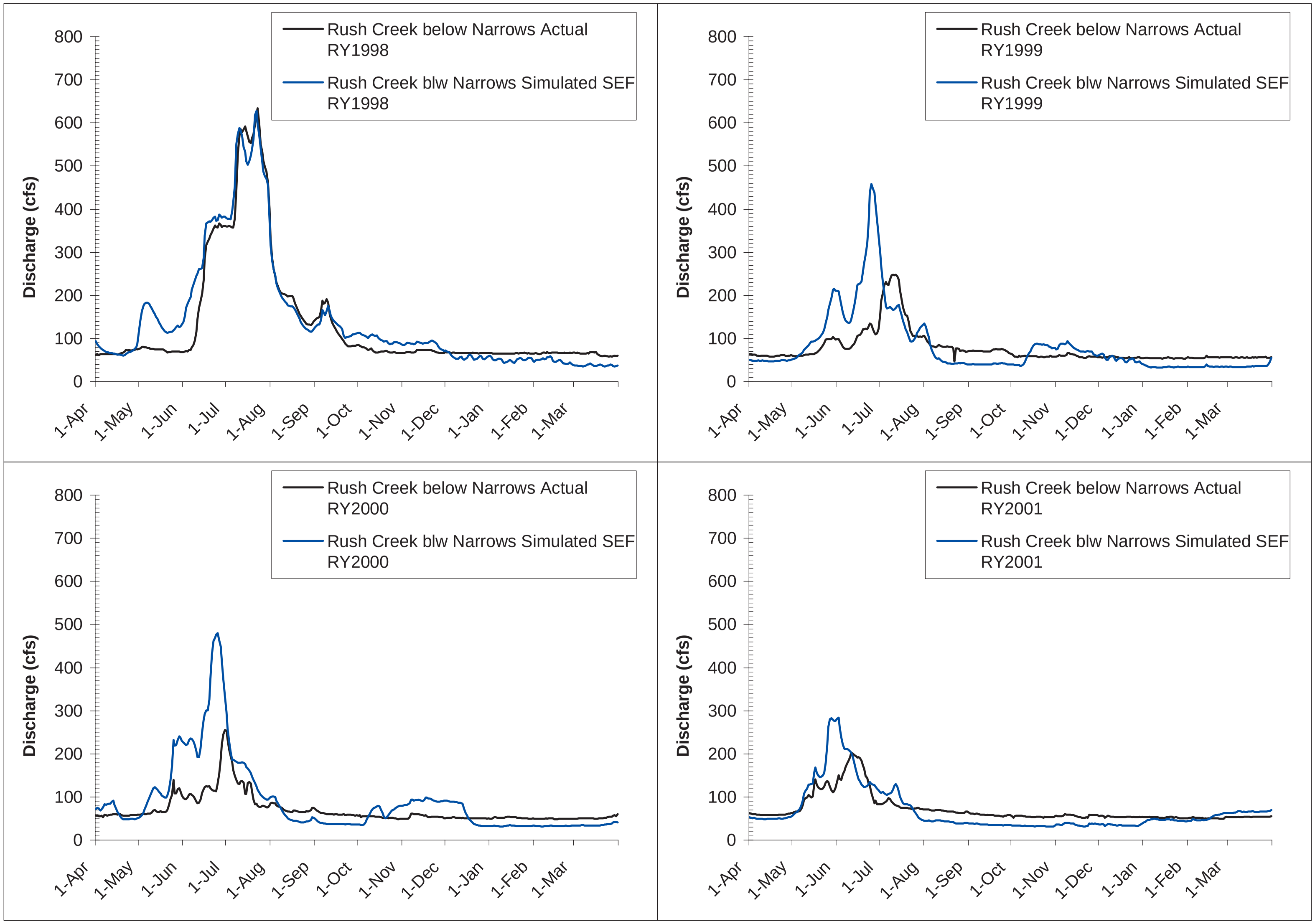

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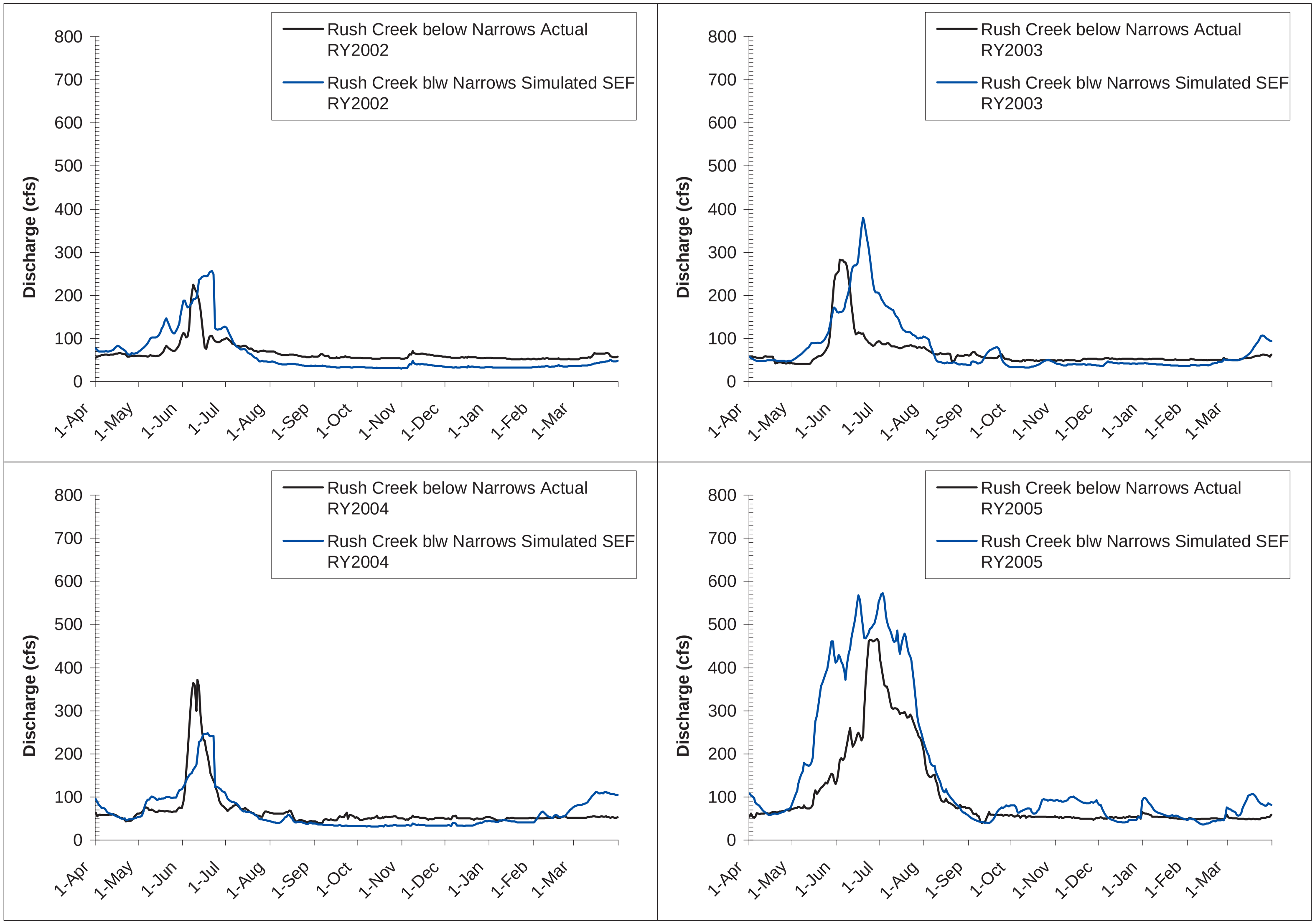

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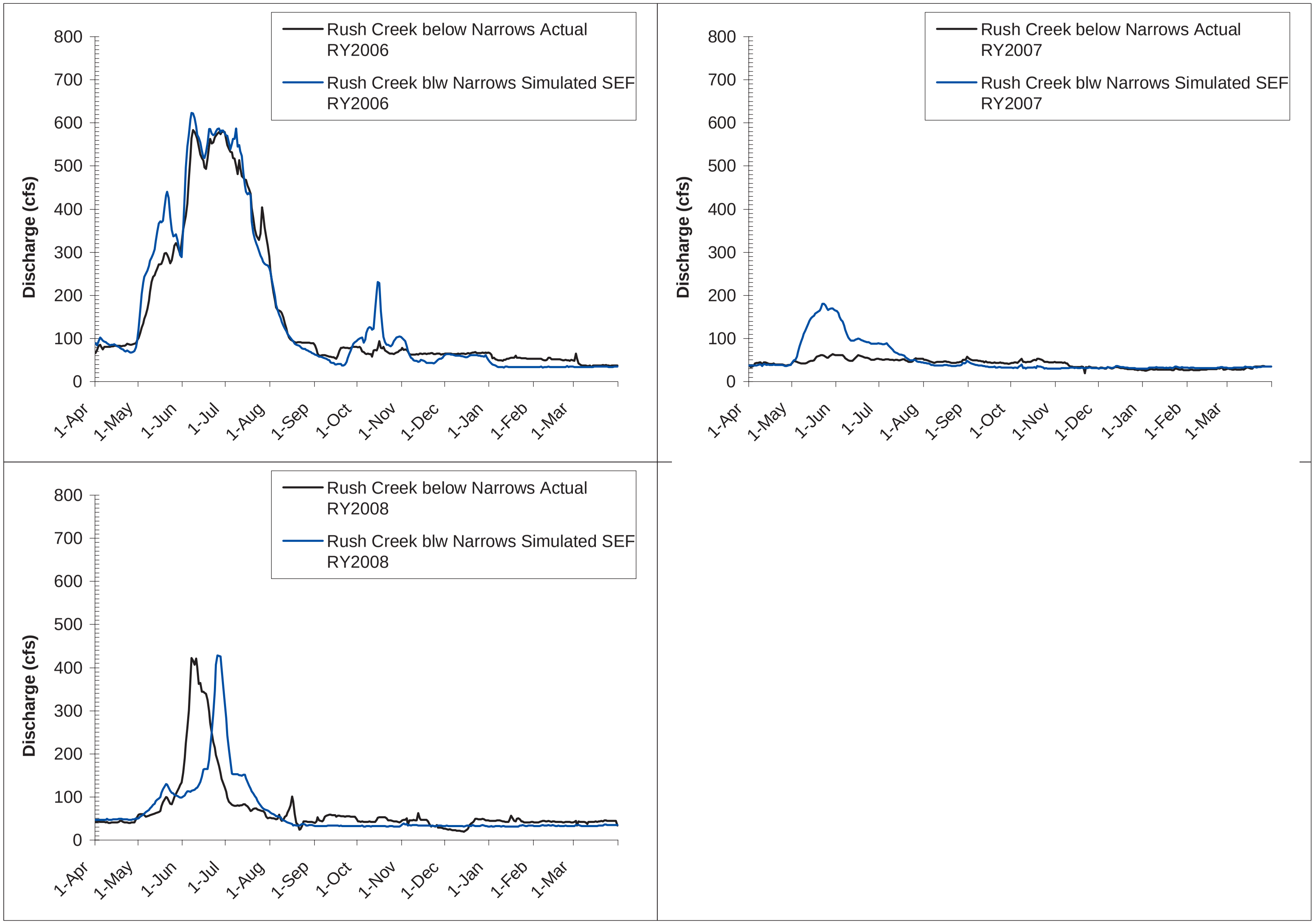

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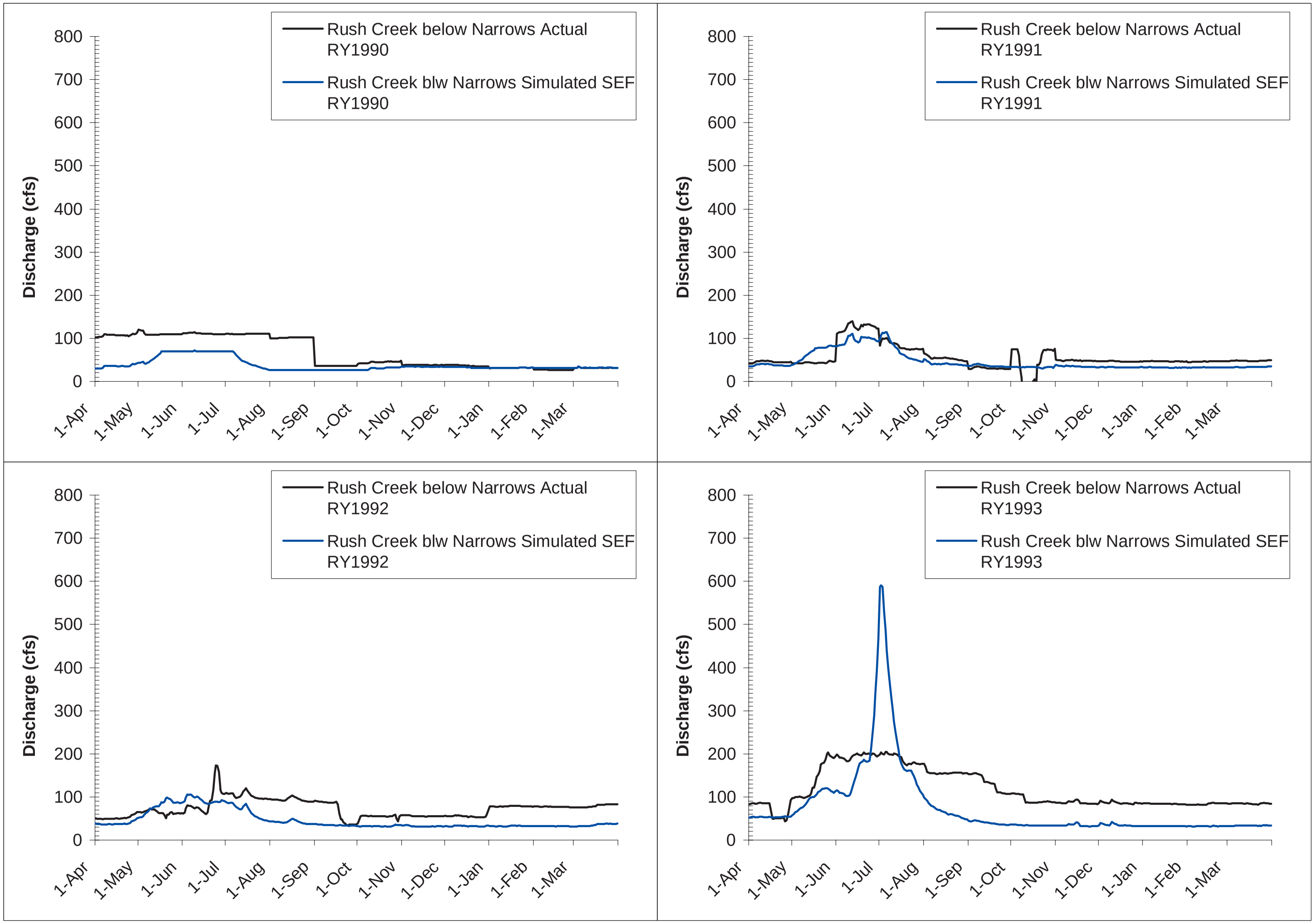
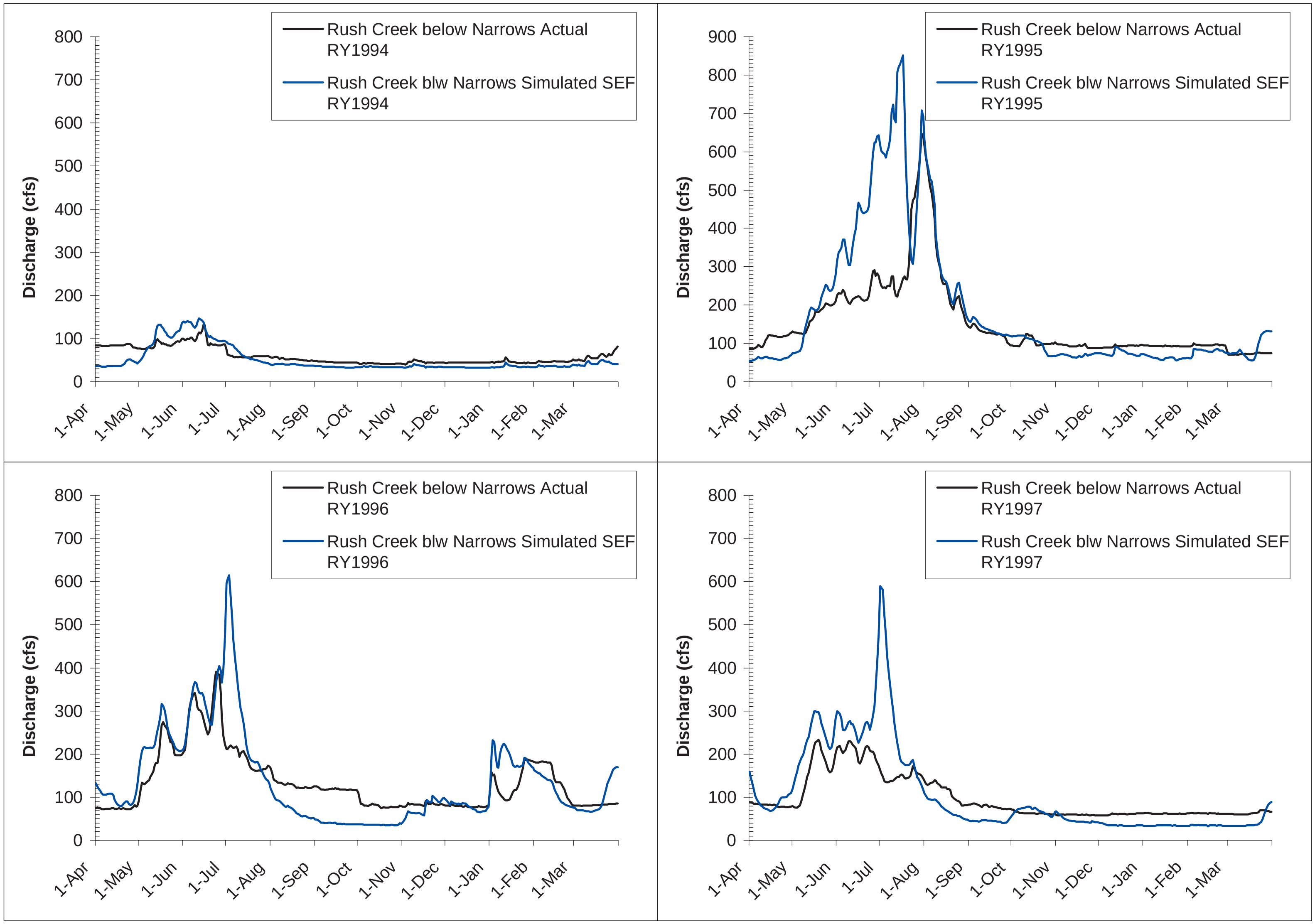
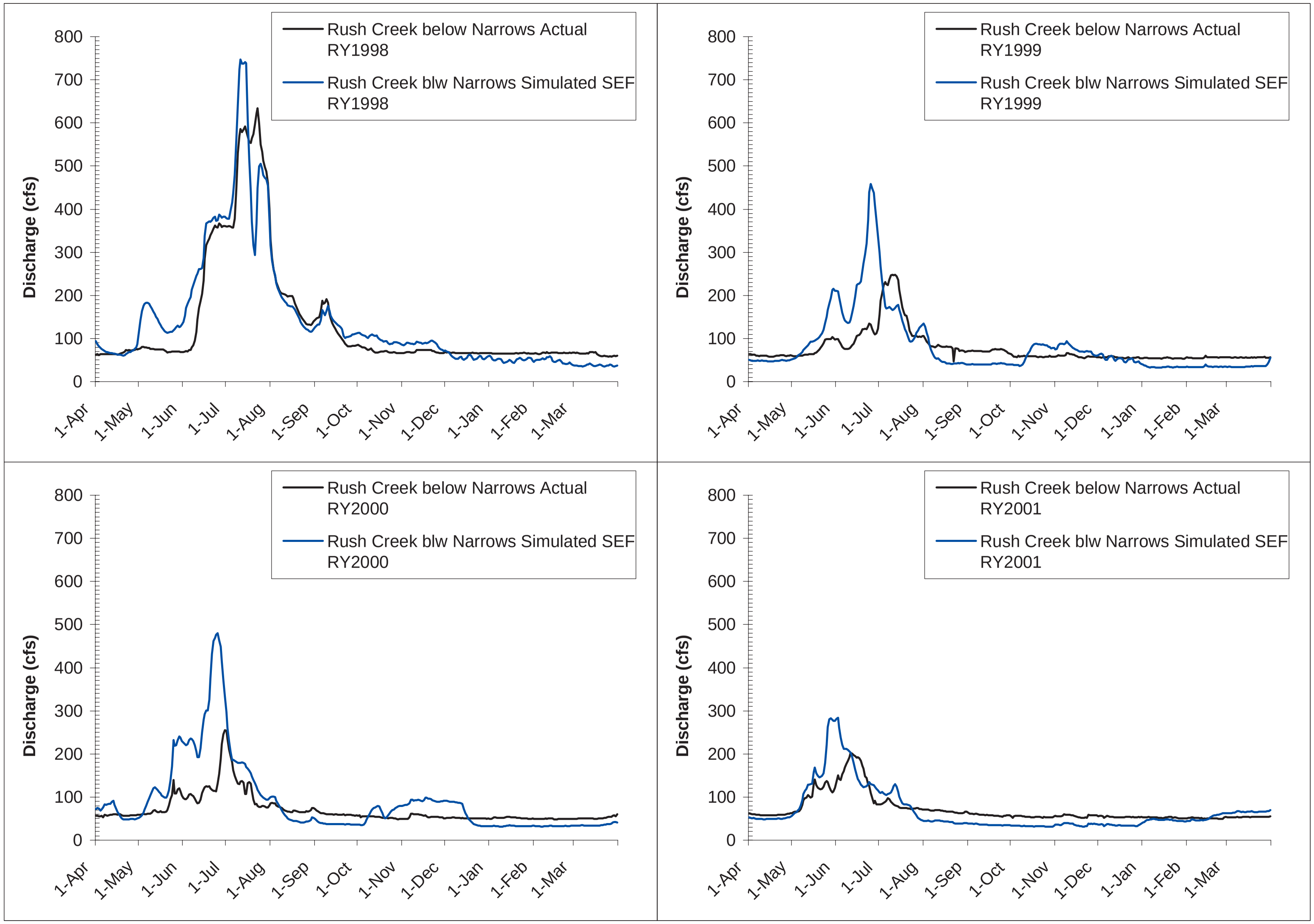


Appendix A-1. Figure 6A. Rush Creek below Narrows (Actual) and Rush Creek below Narrows (Simulated SEF spills from GLR; with SCE peak release coordination; transition period) annual hydrographs for 1990-1993.



Appendix A-1. Figure 6B. Rush Creek below Narrows (Actual) and Rush Creek below Narrows (Simulated SEF spills from GLR; with SCE peak release coordination; transition period) annual hydrographs for 1994-1997.



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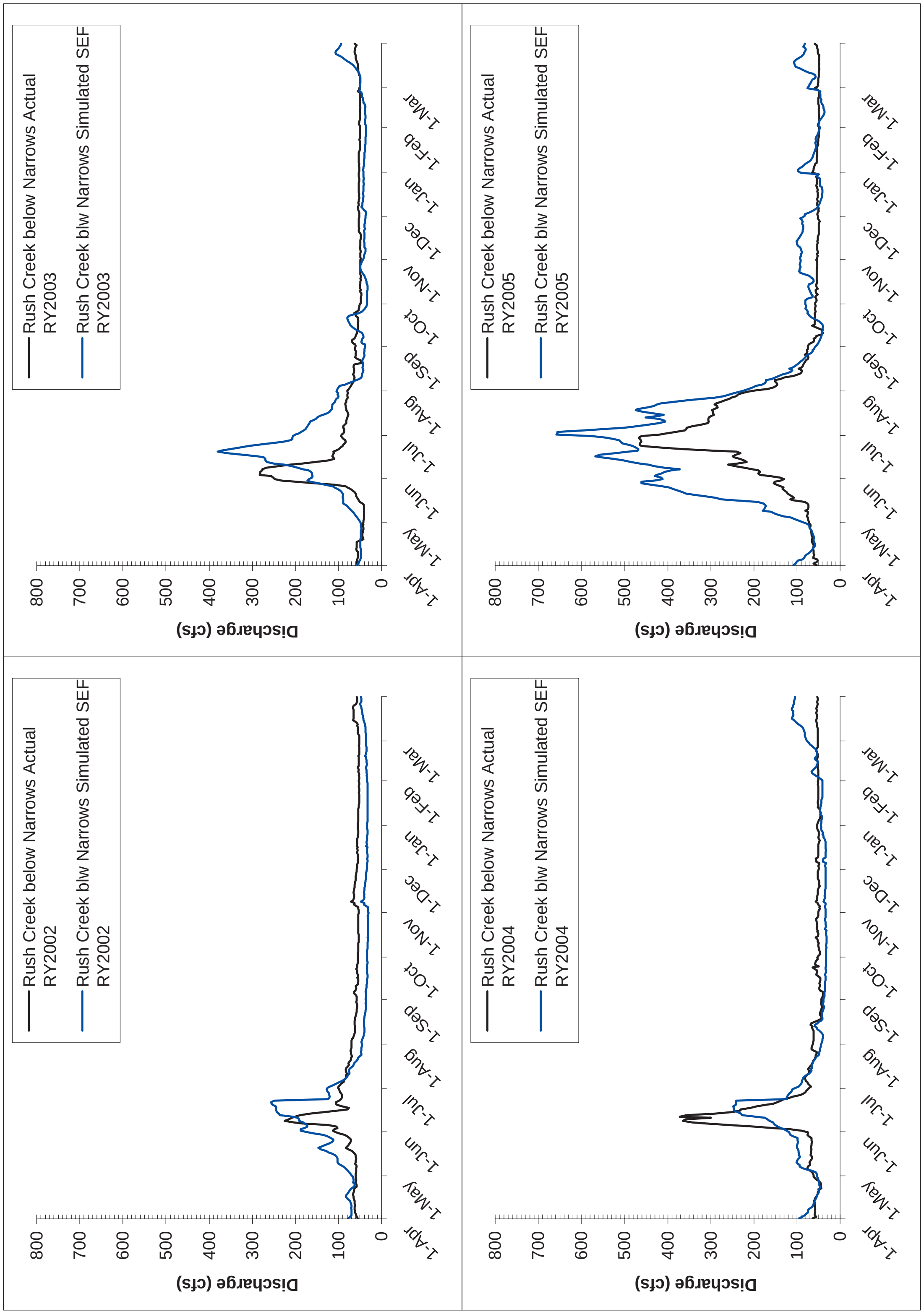
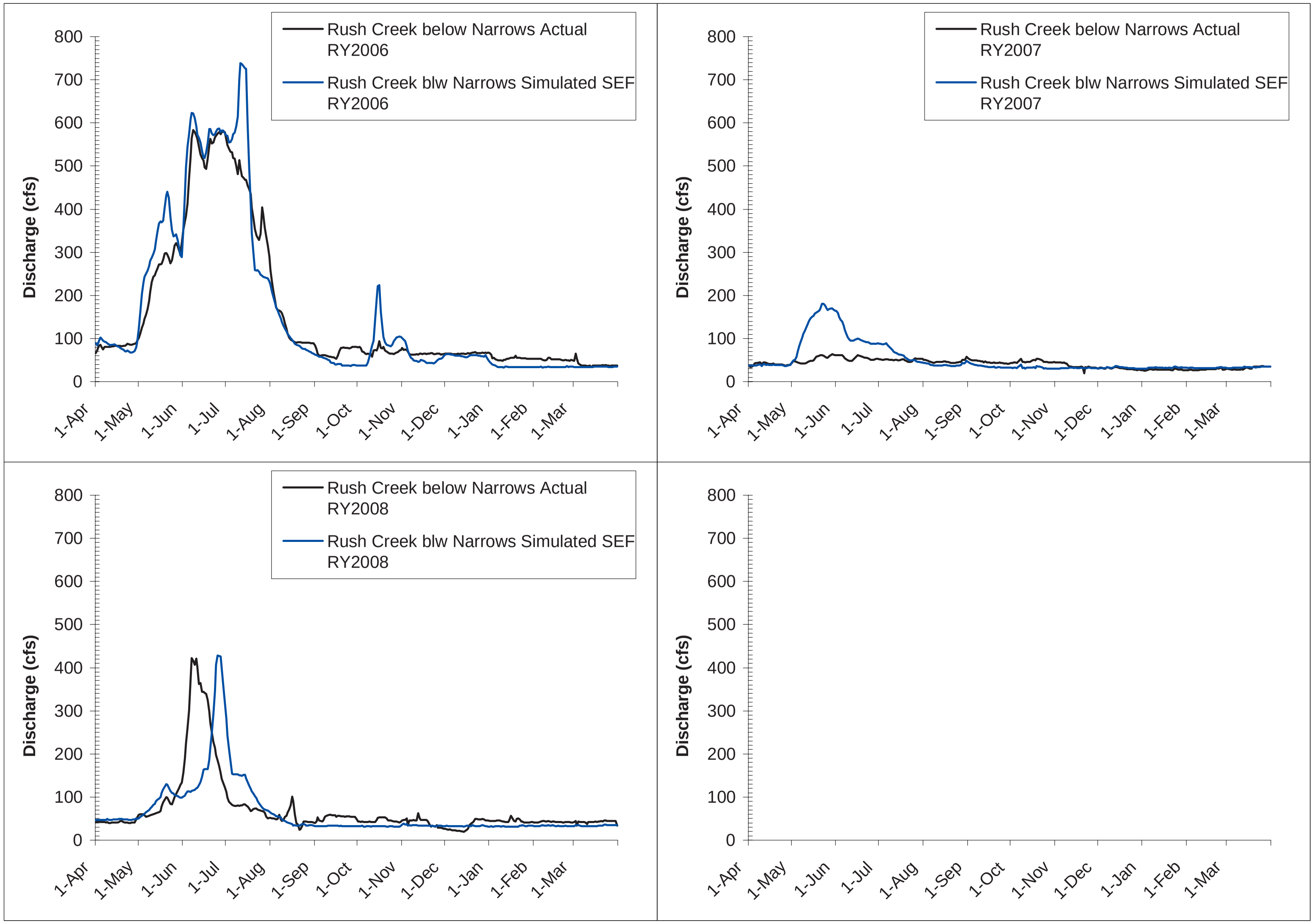
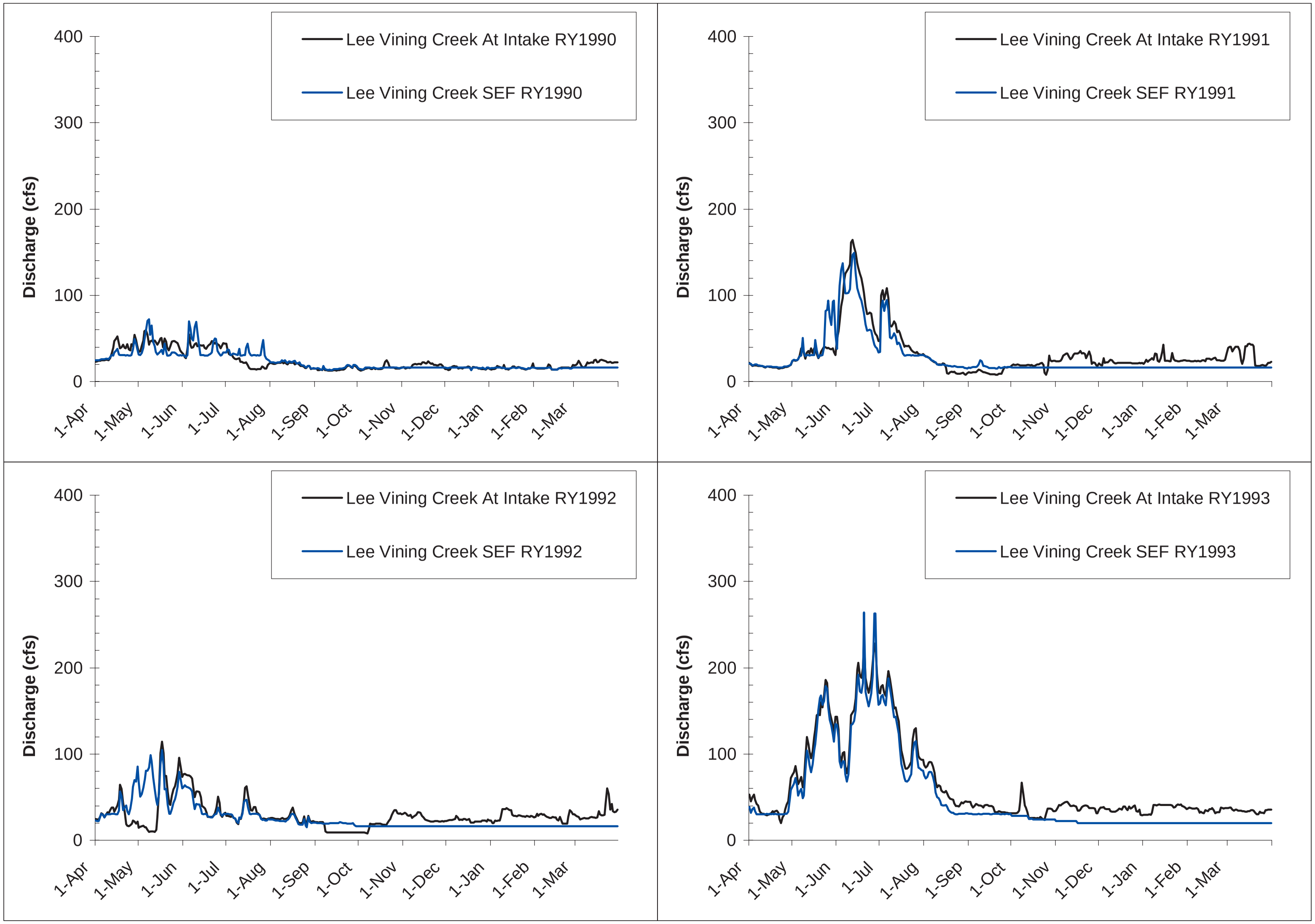


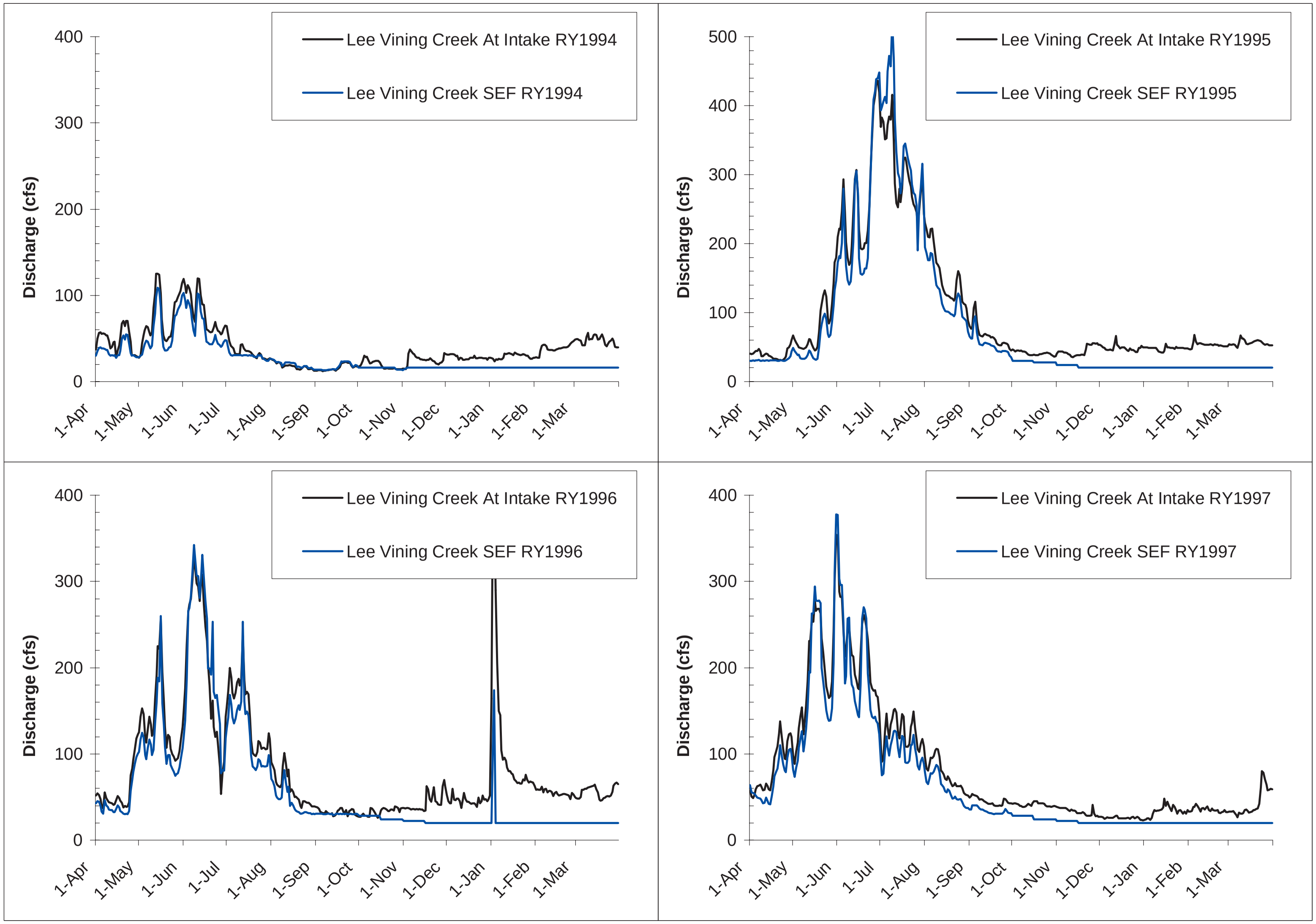
Appendix A-1. Figure 6D. Rush Creek below Narrows (Actual) and Rush Creek below Narrows(Simulated SEF spills from GLR; with SCE peak release coordination; transition period) annual hydrographs for 2002-2005.



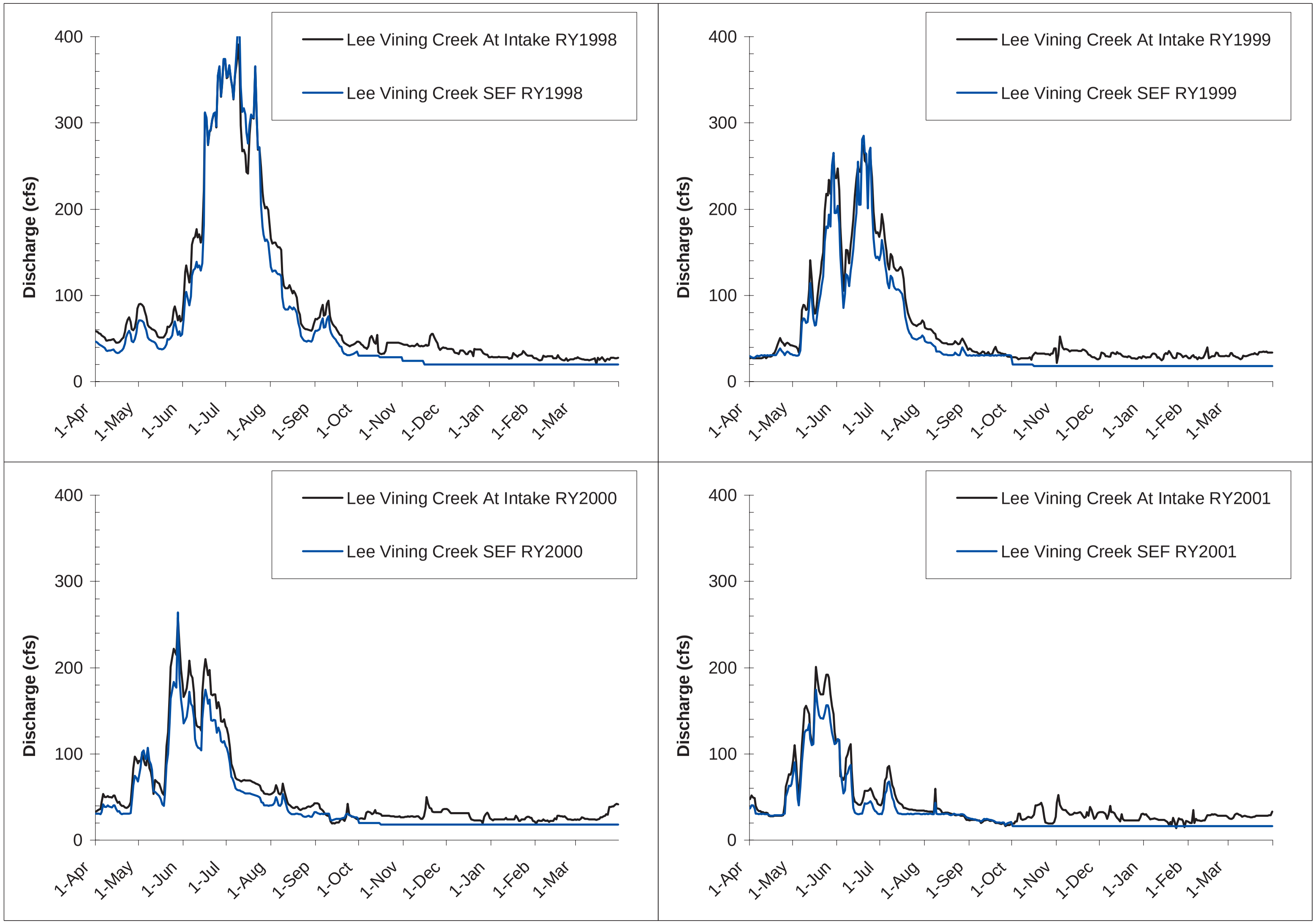
Appendix A-1. Figure 6E. Rush Creek below Narrows (Actual) and Rush Creek below Narrows (Simulated SEF spills from GLR; with SCE peak release coordination; transition period) annual hydrographs for 2006-2008.



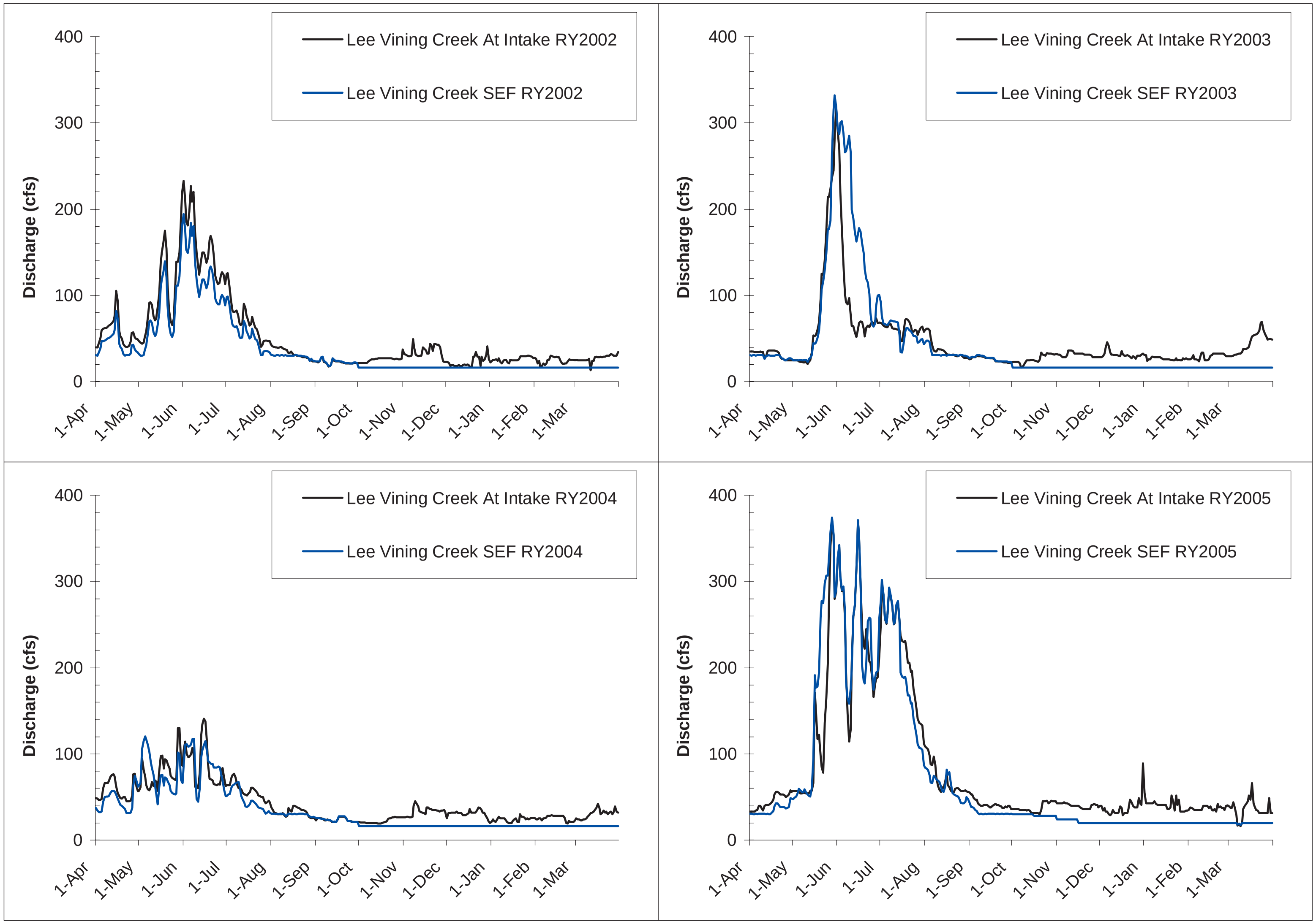
Appendix A-1. Figure 7A. Lee Vining Creek above Intake (SCE impaired) and Lee Vining Creek (SEF) annual hydrographs for 1990-1993.



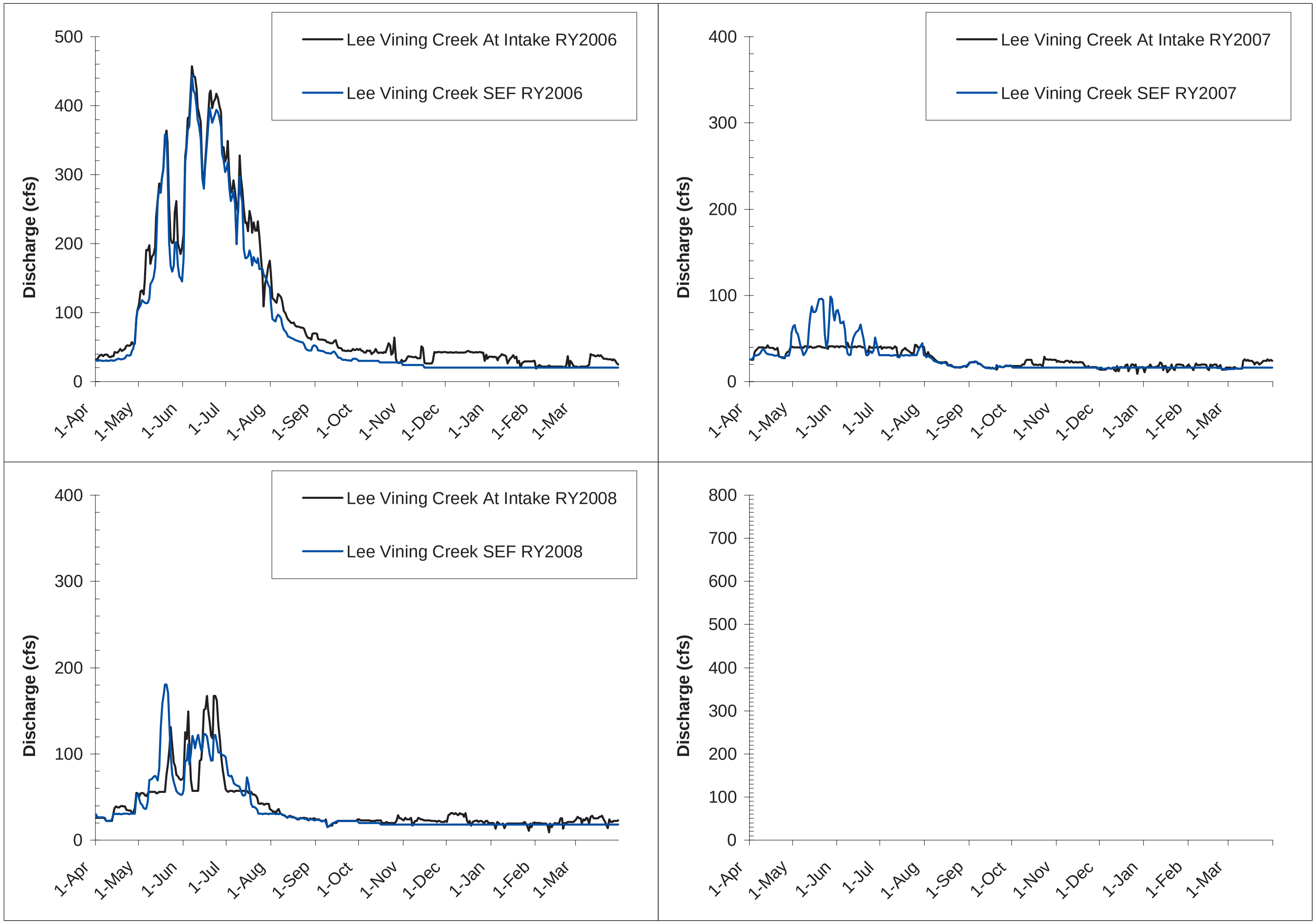
Appendix A-1. Figure 7B. Lee Vining Creek above Intake (SCE impaired) and Lee Vining Creek (SEF) annual hydrographs for 1994-1997.



Appendix A-1. Figure 7C. Lee Vining Creek above Intake (SCE impaired) and Lee Vining Creek (SEF) annual hydrographs for 1998-2001.

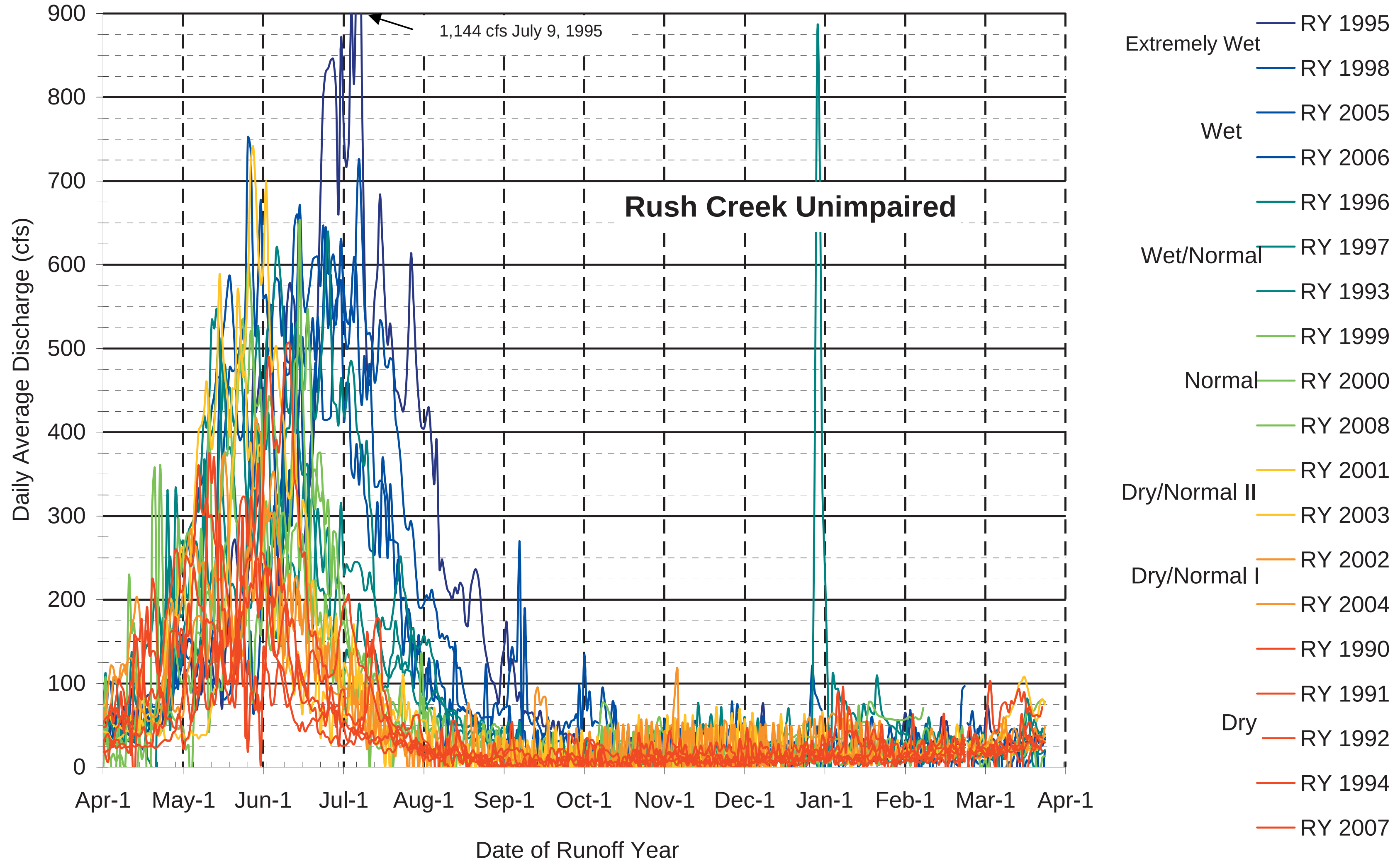


Appendix A-1. Figure 7D. Lee Vining Creek above Intake (SCE impaired) and Lee Vining Creek (SEF) annual hydrographs for 2002-2005.

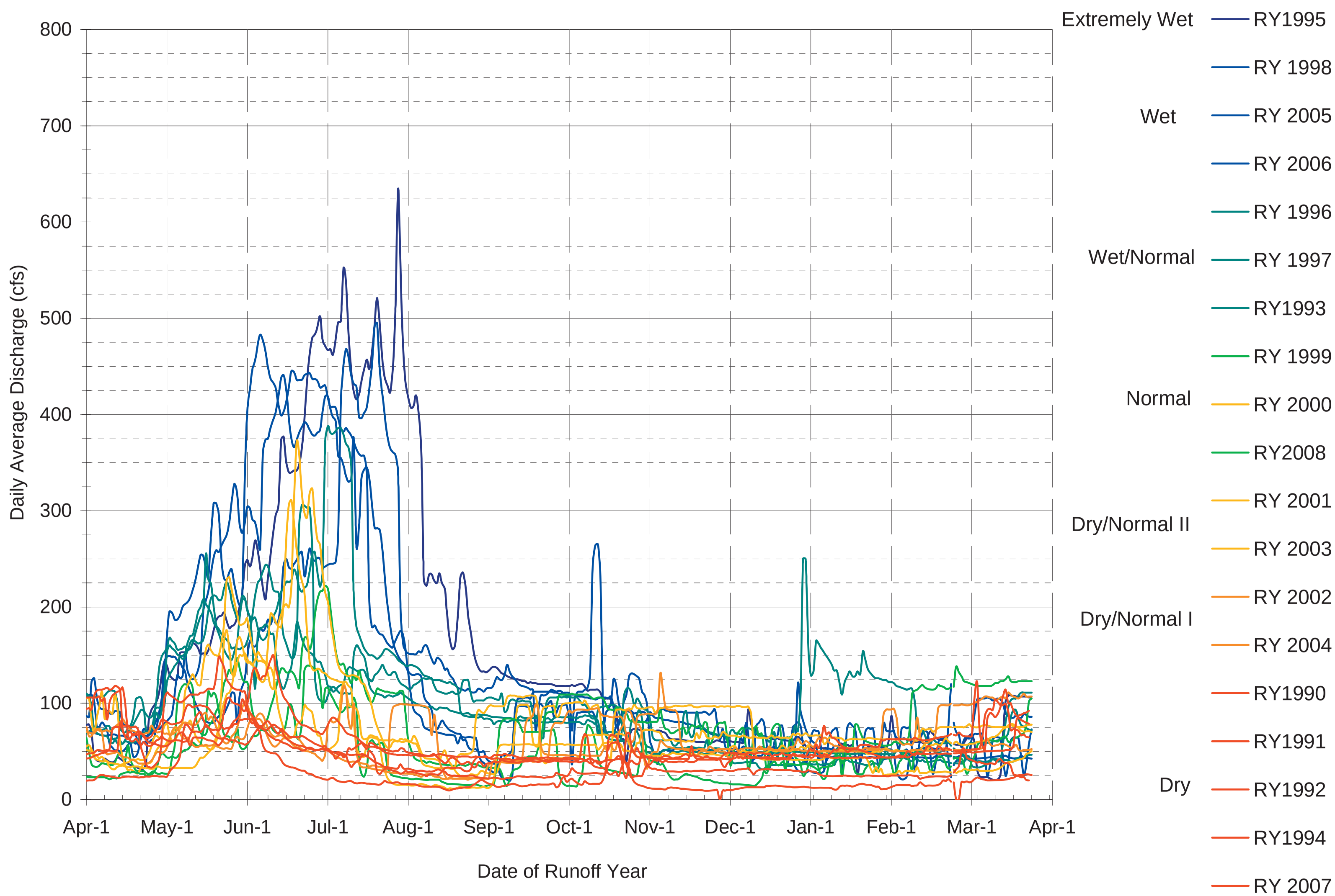


Appendix A-1. Figure 7E. Lee Vining Creek above Intake (SCE impaired) and Lee Vining Creek (SEF) annual hydrographs for 2006-2008.

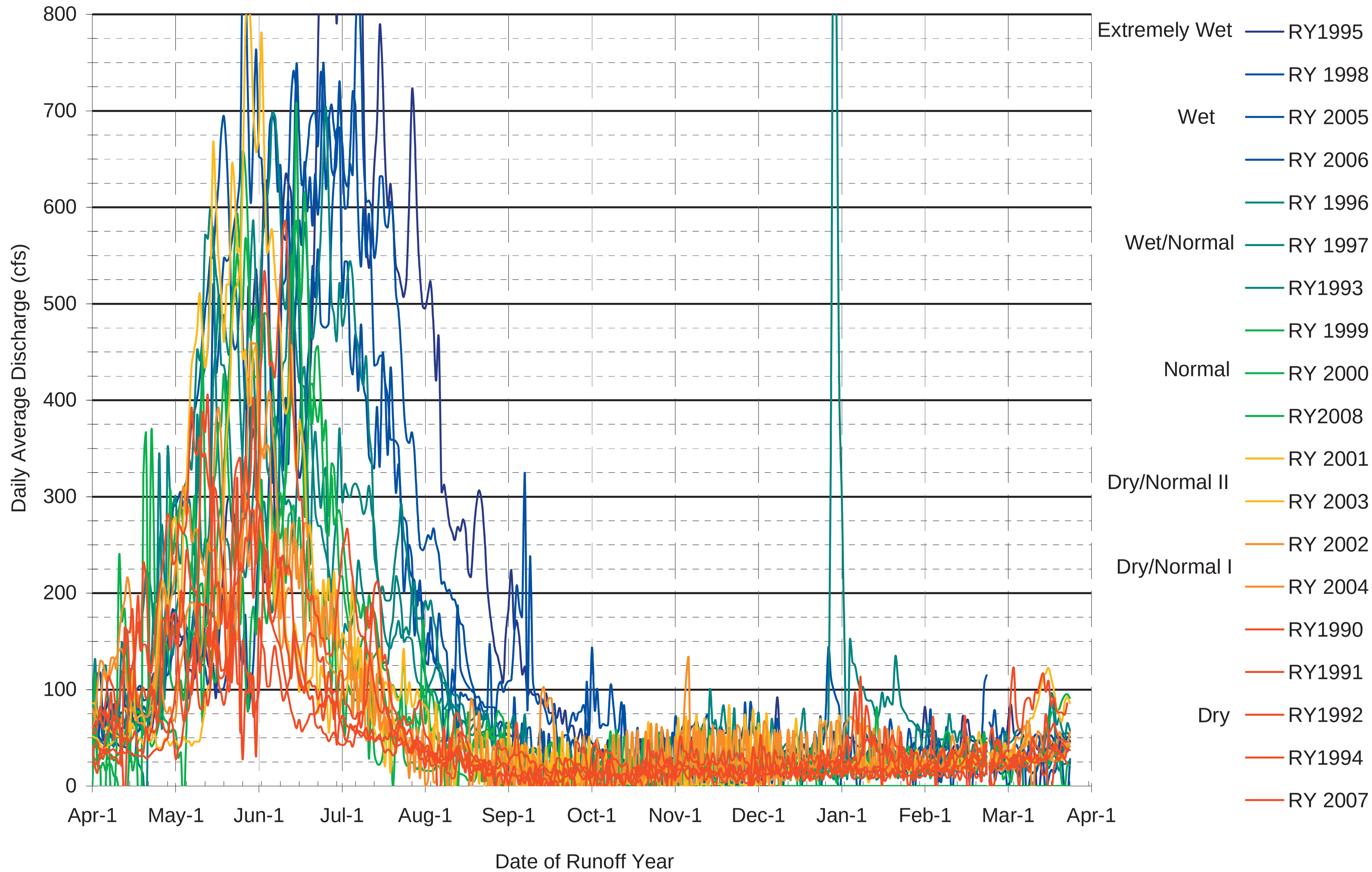
APPENDIX A-2. COMPOSITE HYDROGRAPHS (AKA "SPAGHETTI GRAPHS") FOR RY 1990-2008



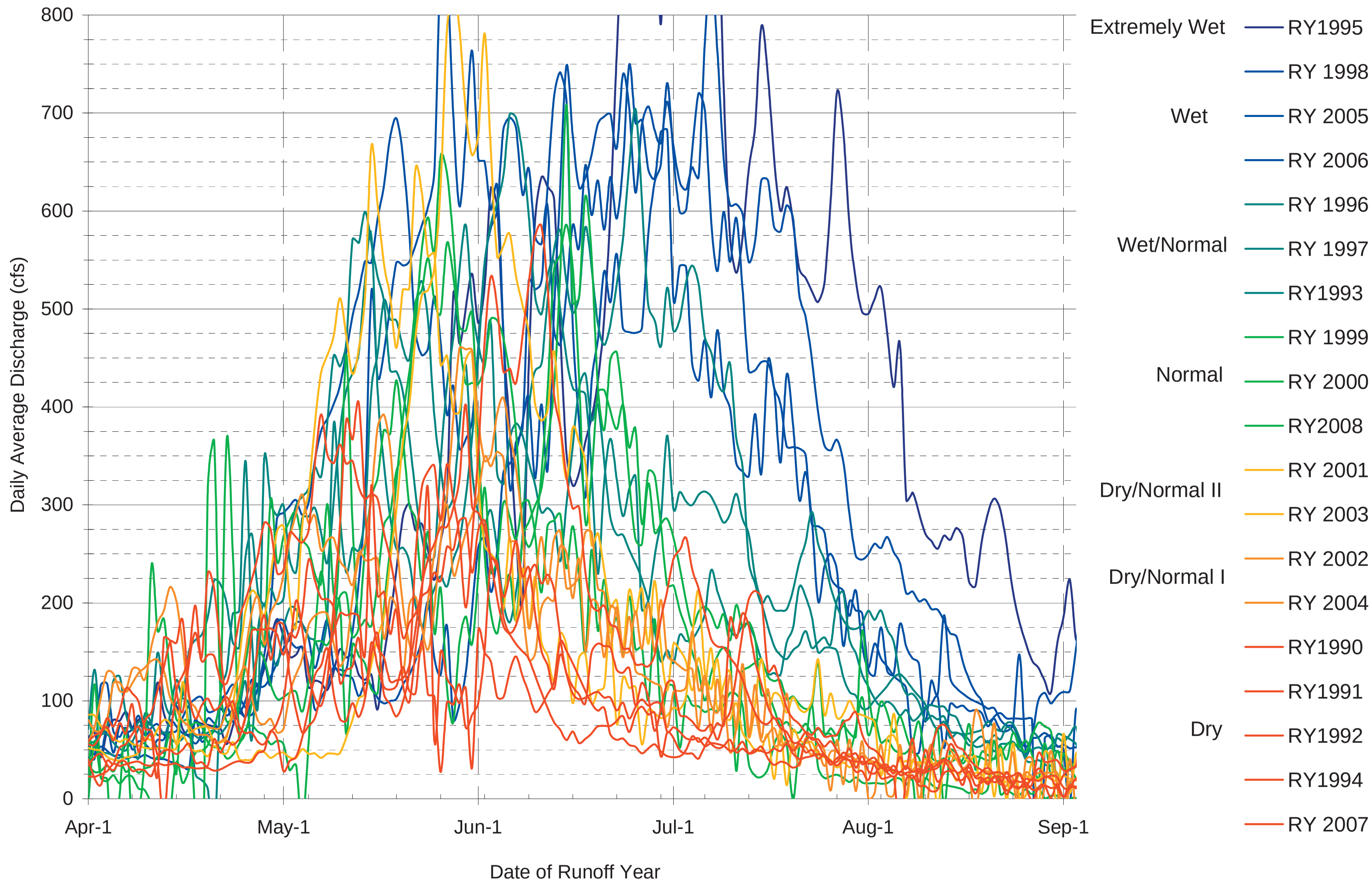
Appendix A-2. Figure 1. Rush Creek Unimpaired composite hydrographs for Runoff Years 1990-2008.



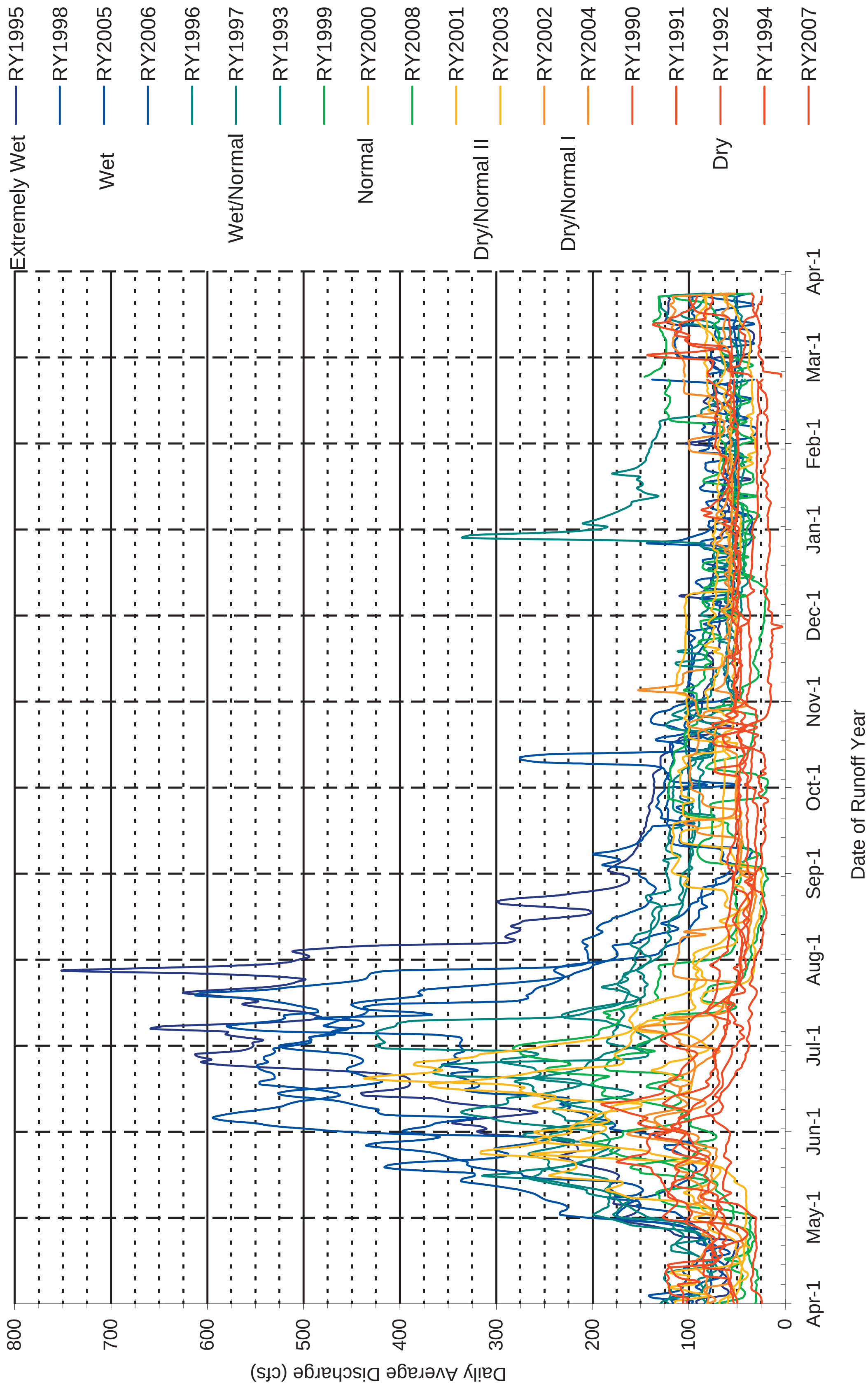
Appendix A-2. Figure 2. Rush Creek at Damsite composite hydrographs for Runoff Years 1990-2008.



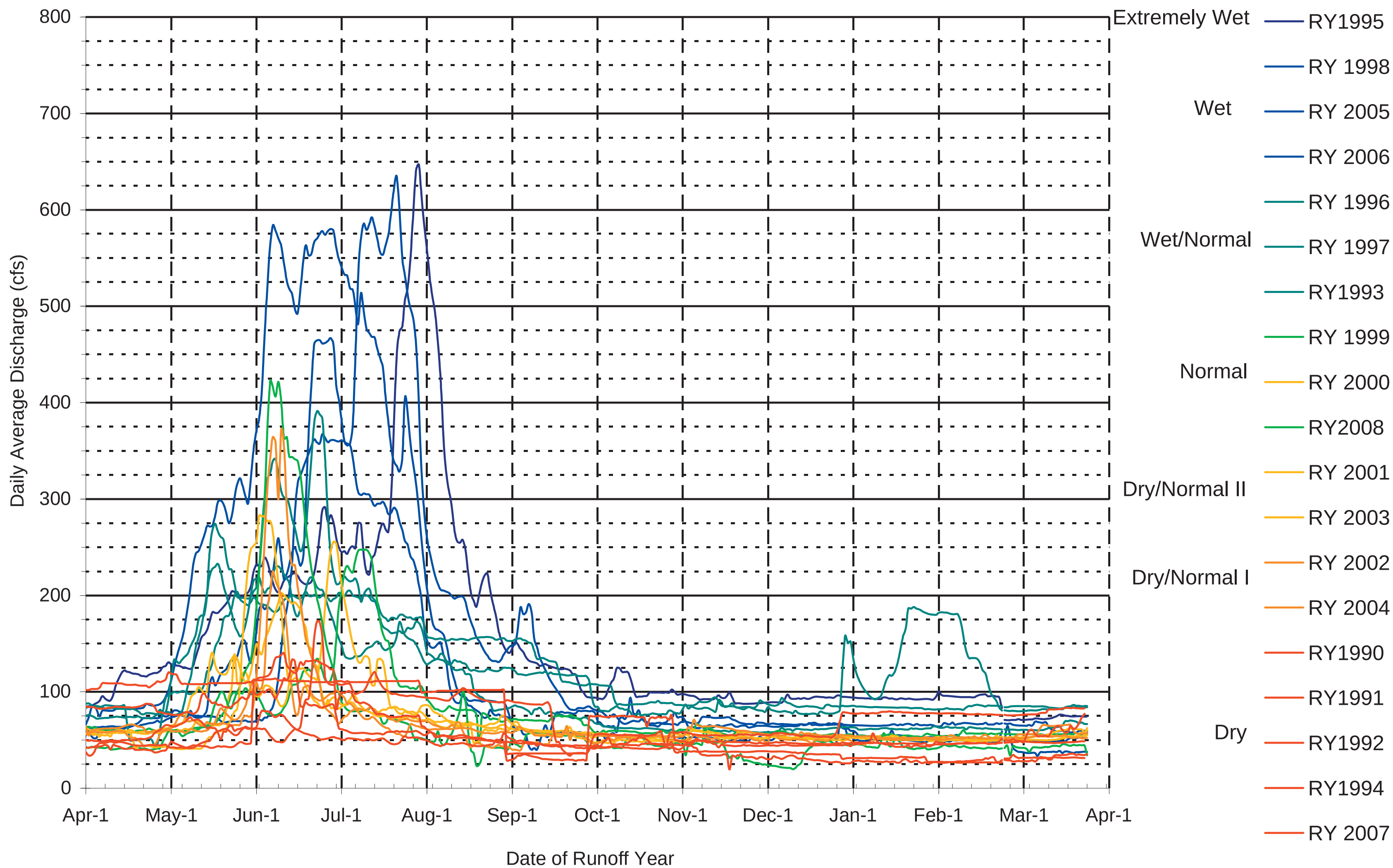
Appendix A-2. Figure 3a. Rush Creek below Narrows Estimated Unimpaired composite hydrographs for Runoff Years 1990-2008.



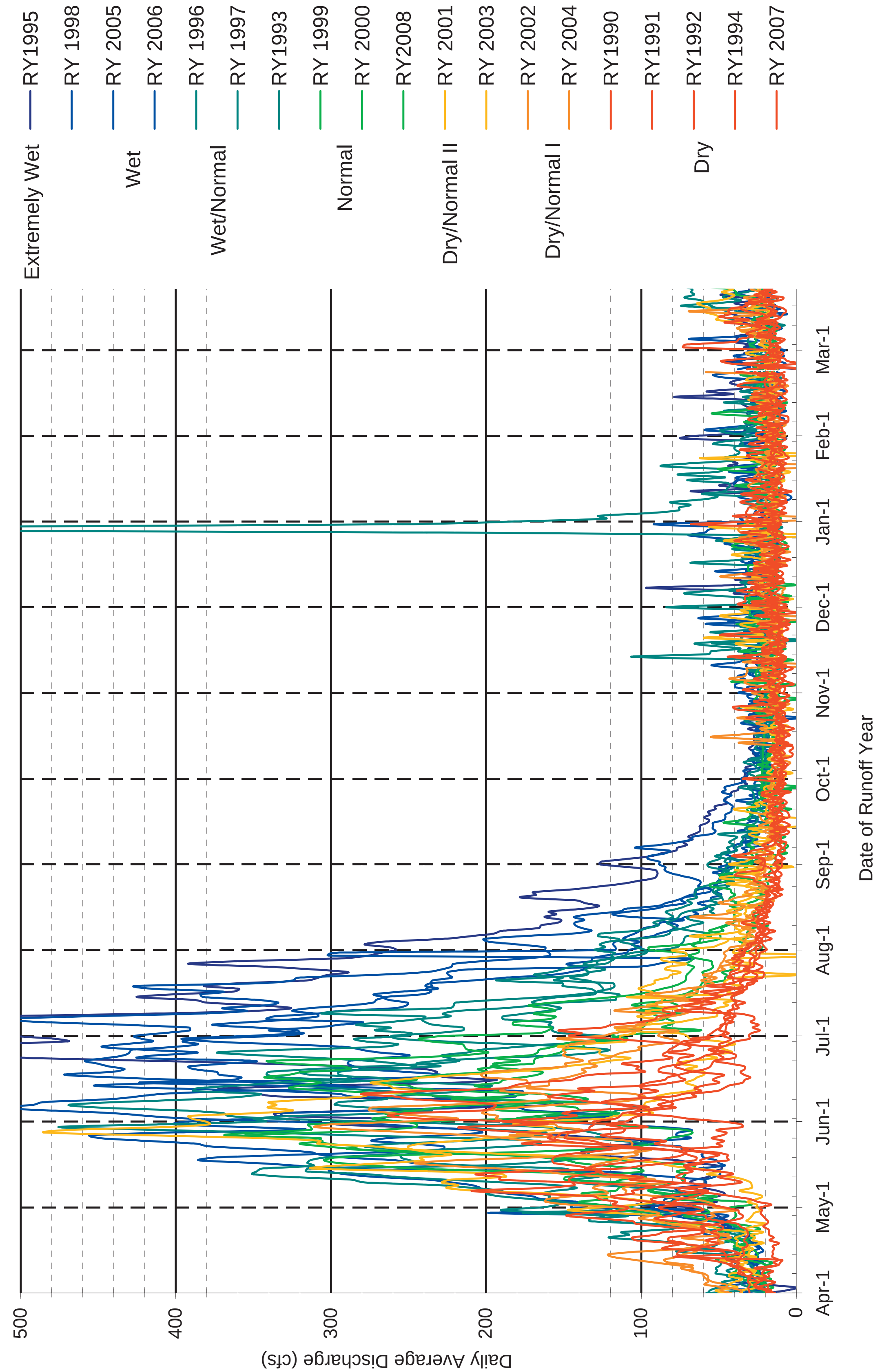
Appendix A-2. Figure 3b. Rush Creek below Narrows Estimated Unimpaired composite hydrographs for Runoff Years 1990-2008, enlarged to show flows from April to September of each runoff year.



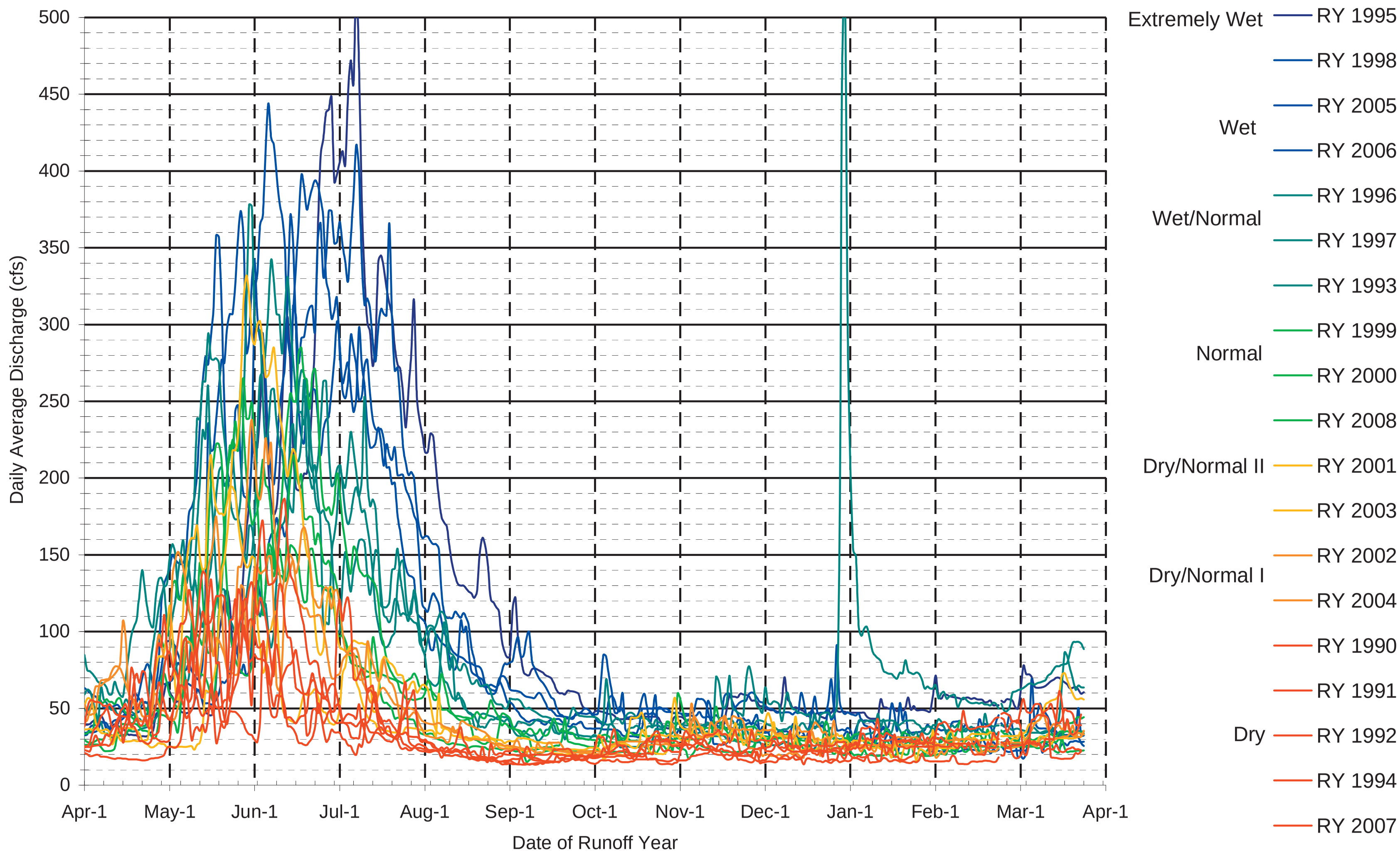
Appendix A-2. Figure 4. Rush Creek below Narrows simulated full GLR composite hydrographs for Runoff Years 1990-2008.



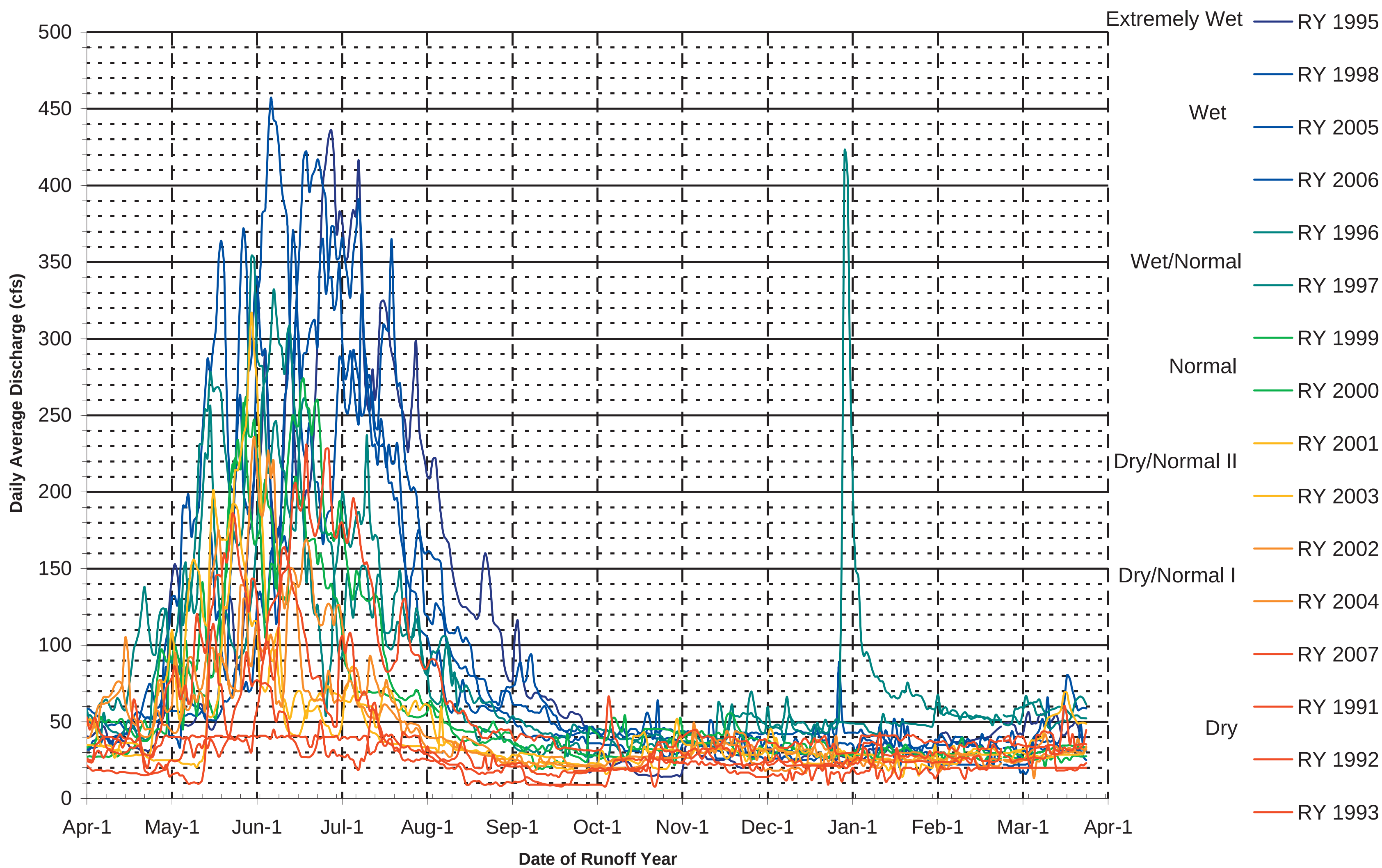
Appendix A-2. Figure 5. Rush Creek below Narrows Actual composite hydrographs for Runoff Years 1990-2008.



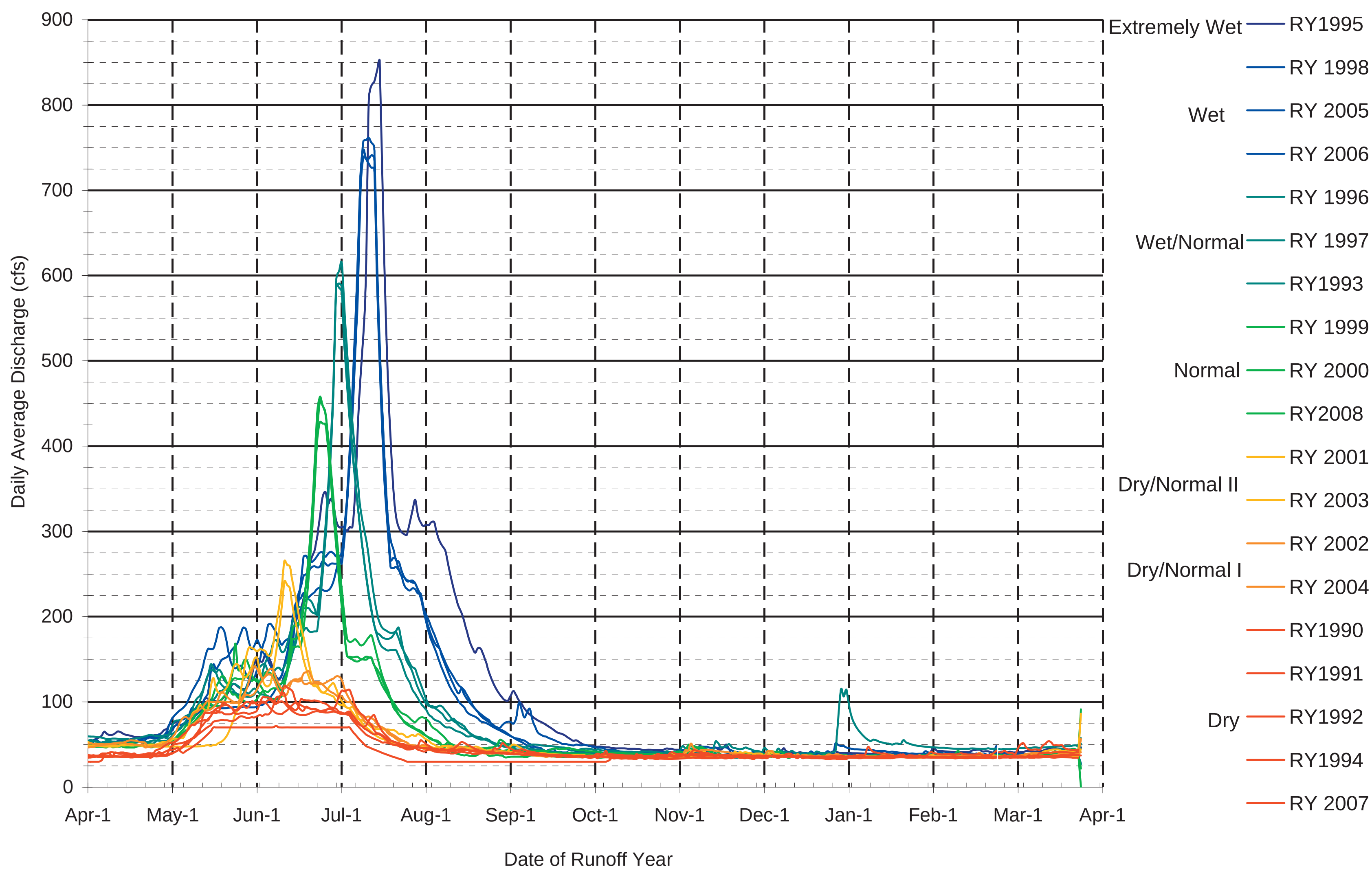
Appendix A-2. Figure 6. Lee Vining Creek Unimpaired composite hydrographs for Runoff Years 1990-2008.



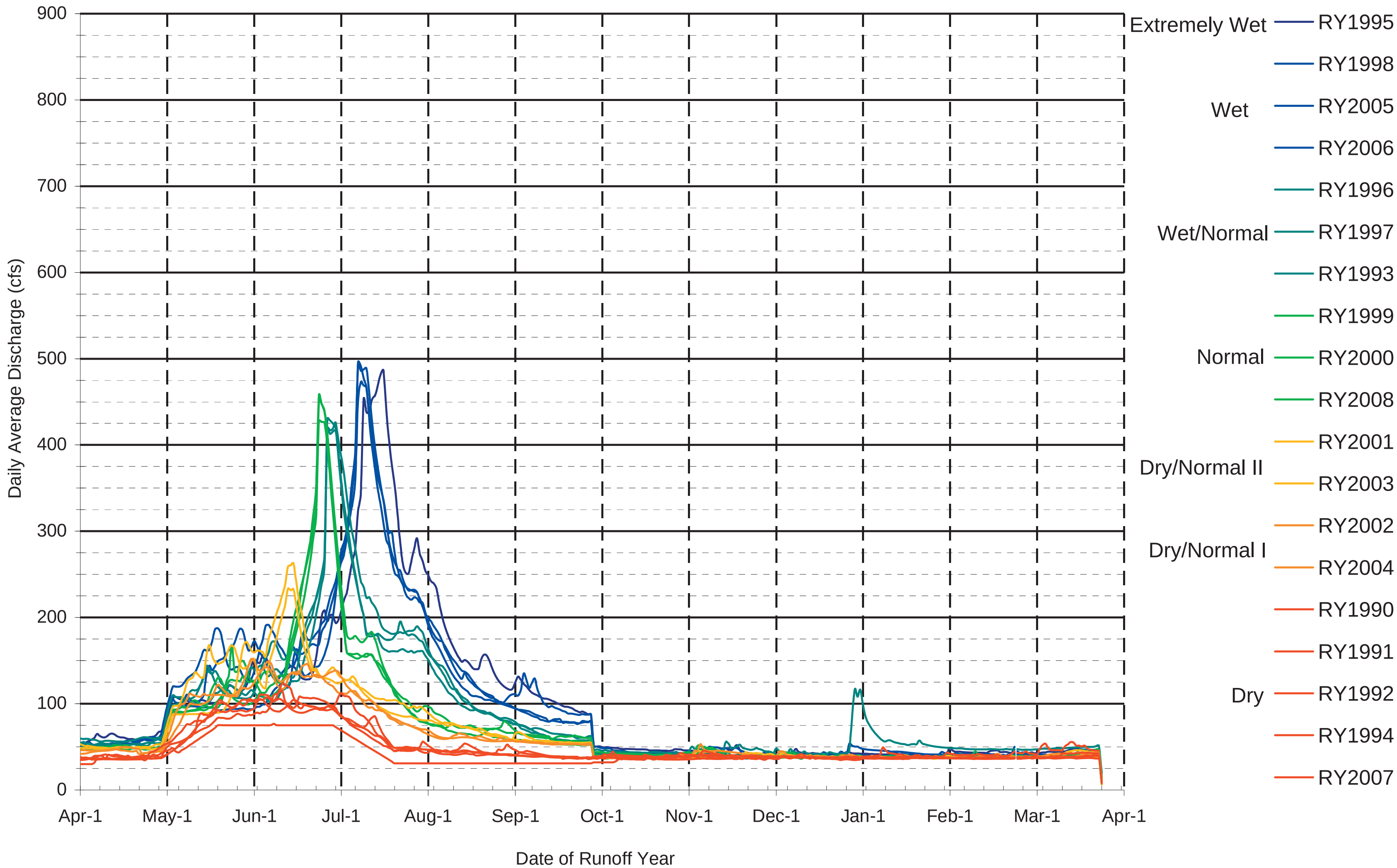
Appendix A-2. Figure 7. Lee Vining Creek above Intake composite hydrographs for Runoff Years 1990-2008.



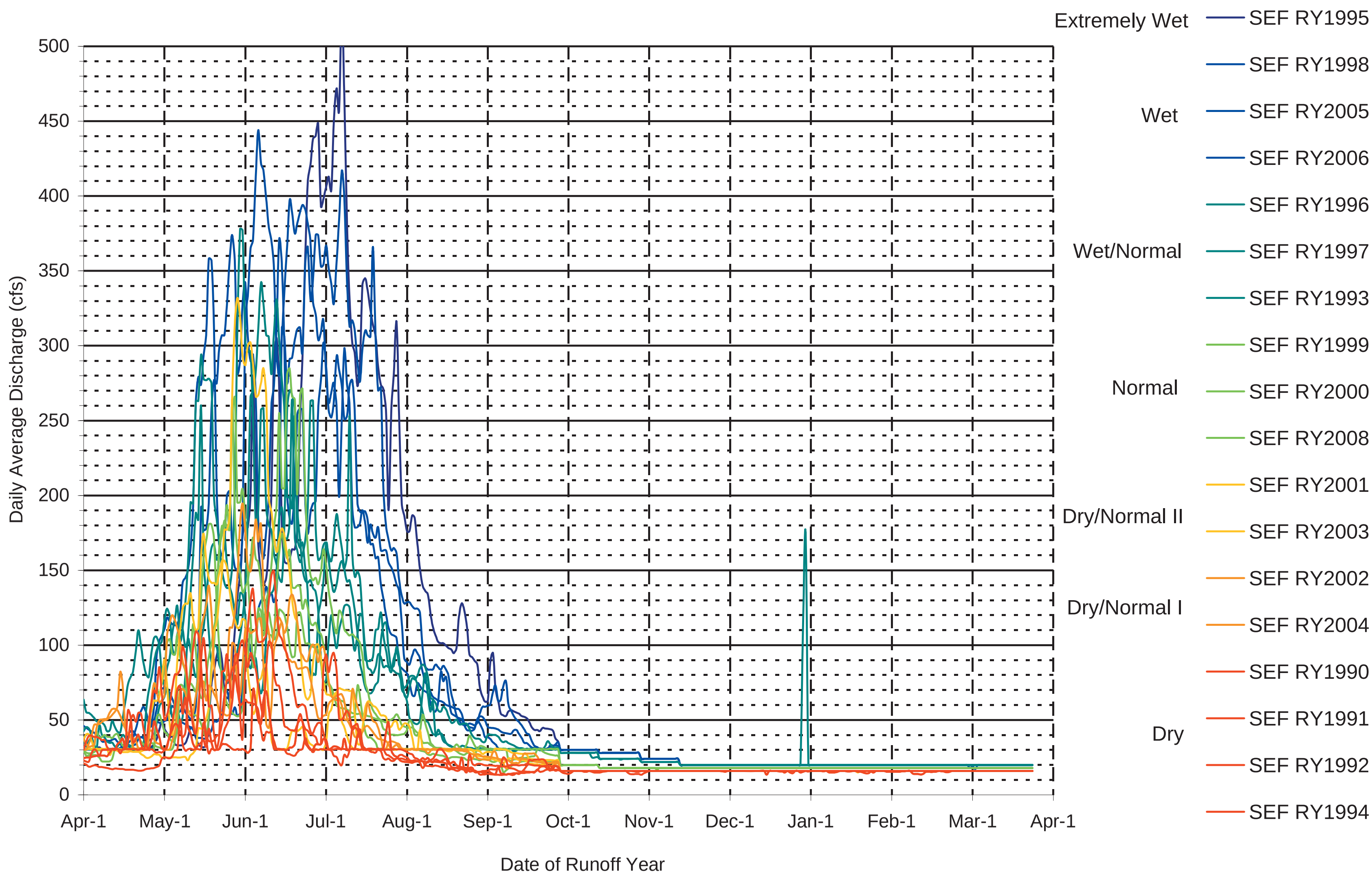
Appendix A-2. Figure 8. Lee Vining Creek below Intake composite hydrographs for Runoff Years 1990-2008.



Appendix A-2. Figure 9a. Rush Creek below Narrows SEF composite hydrographs for Runoff Years 1990-2008 with recommended SCE releases.



Appendix A-2. Figure 9b. Rush Creek below Narrows SEF composite hydrographs for Runoff Years 1990-2008 without recommended SCE releases.



Appendix A-2. Figure 10. Lee Vining Creek below Intake SEF composite hydrographs for Runoff Years 1990-2008.

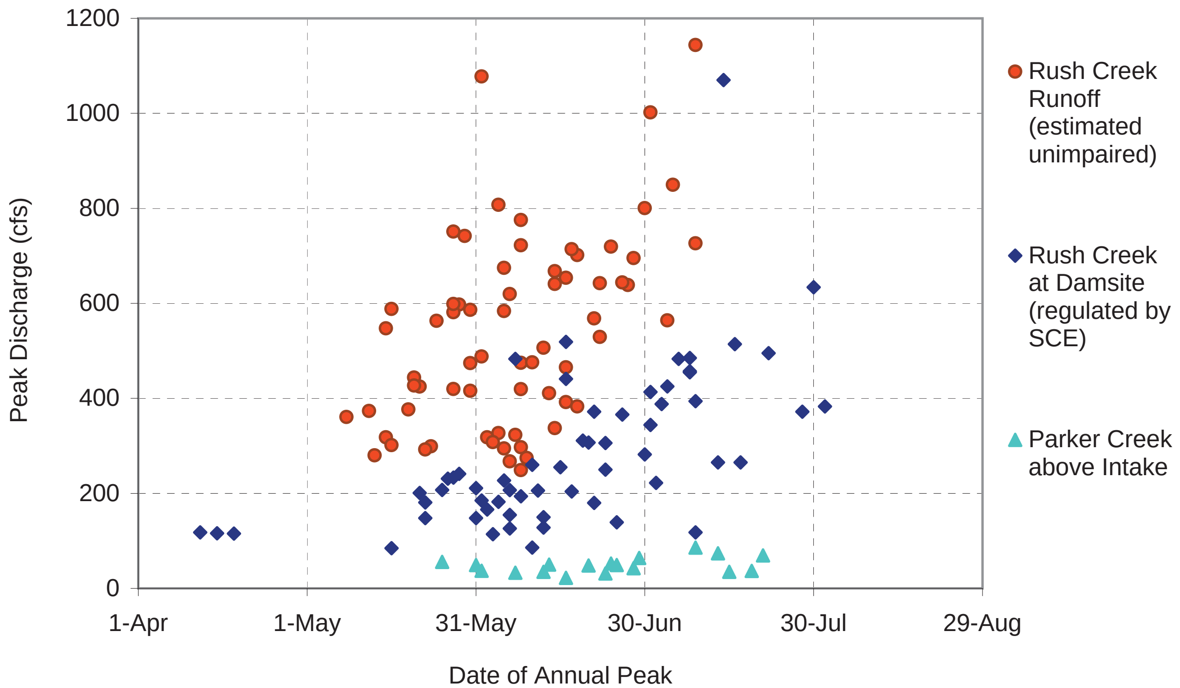
APPENDIX A-3. HYDROGRAPH COMPONENT ANALYSIS

Appendix A-3. Table 1. Rush Creek Runoff hydrograph components analysis. Modeled unimpaired analyses (top half of table) are based on Buckeye Creek data converted to Rush Creek drainage area. Computed unimpaired analyses (bottom half of table) are based on Rush Creek unimpaired computed from SCE storage changes in the upper Rush Creek watershed.

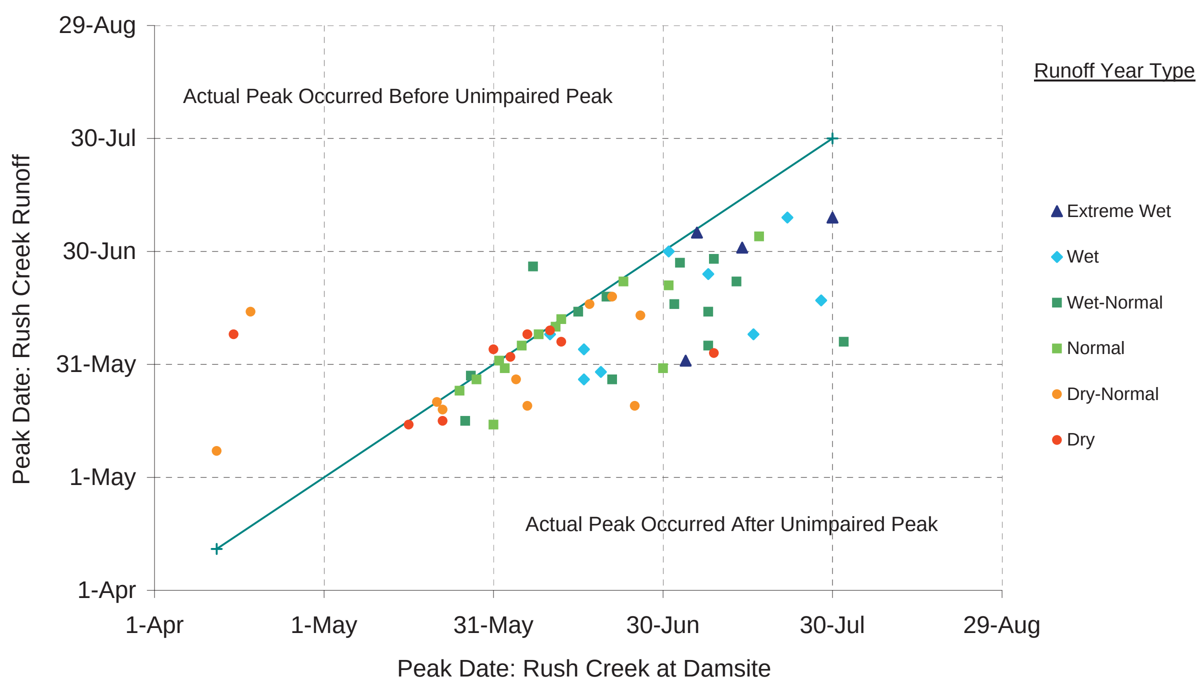
Hydrograph Component	RUNOFF YEAR TYPE					
	Extreme Wet	Wet	Wet-Normal	Normal	Dry-Normal	Dry
Number of Runoff Years for Modeled Unimpaired	1	4	9	8	6	5
Daily Average Annual Discharge (cfs)	269	117	94	76	61	60
Average Annual Yield (af)	100,411	84,666	68,160	54,902	44,340	31,549
Maximum Annual Yield (af)	100,411	91,617	76,709	58,487	47,173	39,016
Minimum Annual Yield (af)	100,411	80,151	63,078	49,000	41,855	24,397
Fall Baseflow (Oct 1 - Dec 20)						
Median	39	42	32	25	18	18
Minimum	39	32	23	18	14	14
Maximum	39	50	44	41	28	24
Winter Baseflow (Dec 21 - Mar 21)						
Median	35	30	29	26	23	17
Minimum	35	24	23	20	15	17
Maximum	35	36	56	35	35	21
Winter Floods (Dec 21 - Mar 30)						
Flood Magnitude (maximum)		491	1,048	169		
Flood Magnitude (average)		301	499	169		
Flood Duration (median number of days)		1	3	1		
Flood Frequency (number of winter storms)		2	6	1		
Earliest Flood Date		23-Dec	11-Nov	16-Jan		
Latest Flood Date		23-Mar	5-Feb	16-Jan		
Average Flood Volume (AF)		1,308	1,673	456		
Number of Runoff Years for Computed Unimpaired	*5*	*7*	*13*	*12*	*13*	*11*
Spring Early Snowmelt Peaks (Mar 21- May 31)						
Secondary Peak Magnitude (median)	*507*	*411*	*377*	*262*	*306*	*203*
Secondary Peak Duration (median)	*21*	*22*	*24*	*17*	*14*	*19*
Start of Snowmelt Ascension (median)	*15-May*	*6-May*	*2-May*	*1-May*	*3-May*	*4-May*
Secondary Snowmelt Peak Date (median)	*30-May*	*20-May*	*16-May*	*16-May*	*15-May*	*7-May*
End of Snowmelt Ascension (median)	*8-Jun*	*29-May*	*29-May*	*22-May*	*22-May*	*25-May*
Snowmelt Ascension Runoff Volume	*16,908*	*8,544*	*9,477*	*5,580*	*5,106*	*4,356*
Daily Ramping Rates (maximum)	33%	40%	33%	35%	33%	39%
Daily Ramping Rates (average)	12%	13%	12%	12%	13%	13%
Spring Snowmelt Flood (May 1 - July 15)						
Magnitude used to Compute Duration	*686*	*591*	*498*	*400*	*356*	*254*
Snowmelt Flood Magnitude (median)	*807*	*695*	*586*	*470*	*419*	*299*
Snowmelt Ascension Duration (median)	*22*	*13*	*13*	*16*	*11*	*8*
Snowmelt Flood Duration (median)	*3*	*4*	*9*	*6*	*10*	*4*
Start of Snowmelt Flood (median)	*8-Jun*	*29-May*	*29-May*	*22-May*	*22-May*	*25-May*
End of Snowmelt Flood (median)	*17-Jul*	*30-Jul*	*17-Jul*	*1-Jul*	*26-Jun*	*12-Jun*
Date of Flood Peak (median)	*1-Jul*	*14-Jun*	*21-Jun*	*7-Jun*	*8-Jun*	*5-Jun*
Snowmelt Runoff Volume (median)	*49,941*	*51,675*	*32,021*	*27,248*	*19,319*	*9,042*
Snowmelt Recession (July 15 - Sep 30)						
Start of Snowmelt Recession (median date)	*17-Jul*	*30-Jul*	*17-Jul*	*1-Jul*	*26-Jun*	*12-Jun*
End of Snowmelt Recession (median date)	*31-Aug*	*28-Aug*	*20-Aug*	*27-Jul*	*15-Jul*	*10-Jul*
Duration of Recession (median number of days)	*45*	*31*	*31*	*31*	*25*	*25*
Daily Ramping Rates (maximum)	10%	18%	12%	9%	10%	17%
Daily Ramping Rates (average)	5%	5%	5%	4%	5%	6%
Snowmelt Recession Runoff Volume (median)	18,924	7,503	7,192	4,606	3,238	2,614
Summer Baseflow						
Minimum (median)	77	72	35	28	23	14
Maximum (median)	77	103	49	50	31	25

Appendix A-3. Table 2. Lee Vining Creek Runoff hydrograph components analysis.

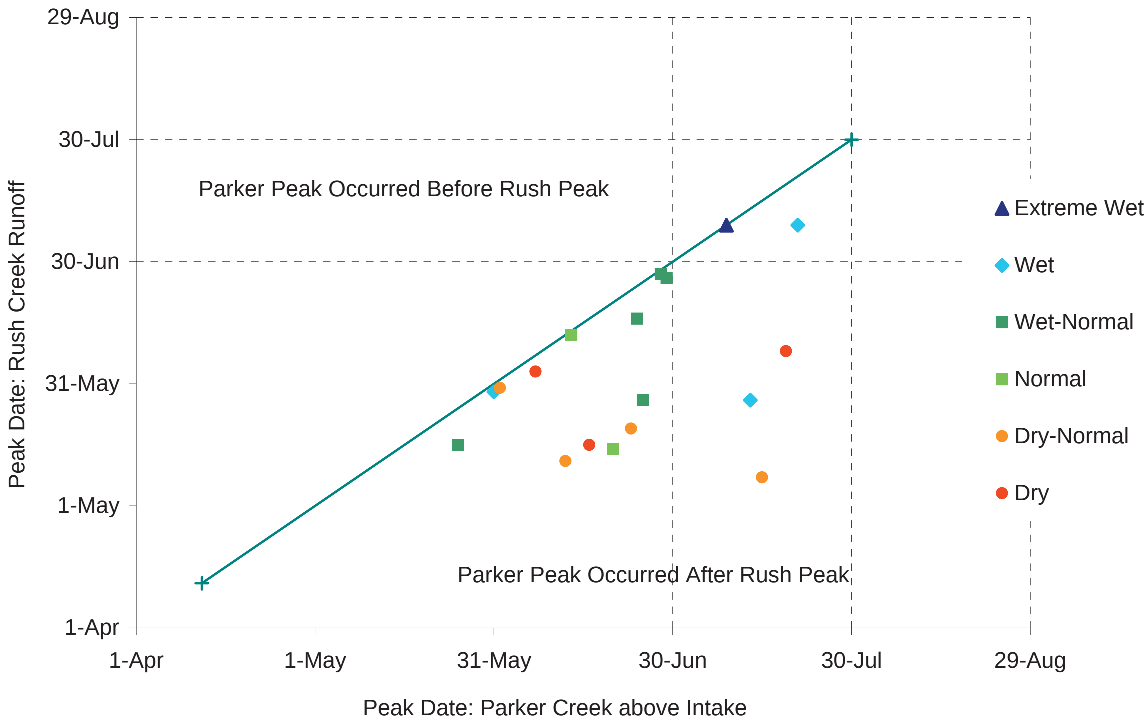
Hydrograph Component	RUNOFF YEAR TYPE					
	Extreme Wet	Wet	Wet-Normal	Normal	Dry-Normal	Dry
Number of Runoff Years for Computations	1 (+2 partial Rys)	6	6	6	6	9
Daily Average Annual Discharge (cfs)	171	123	105	73	58	40
Average Annual Yield (af)	77,899	67,779	58,900	40,488	36,824	24,701
Maximum Annual Yield (af)	77,899	72,057	65,280	45,910	41,884	27,367
Minimum Annual Yield (af)	77,899	65,111	50,785	35,557	32,757	20,259
Fall Baseflow (Oct 1 - Dec 20)						
Median	23	25	21	16	15	12
Minimum	23	24	19	15	13	10
Maximum	23	25	23	23	18	14
Winter Baseflow (Dec 21 - Mar 21)						
Median	29	20	21	17	18	14
Minimum	29	16	16	14	16	10
Maximum	29	26	35	22	20	18
Winter Floods (Dec 21 - Mar 30)						
Flood Magnitude (maximum)	79	92	677	54	69	73
Flood Magnitude (average)	79	73	266	46	51	52
Flood Duration (median # days >40 cfs)	15	4	11	1	9	2
Flood Frequency (number of winter storms)	1	3	3	3	4	5
Earliest Flood Date	19-Feb	4-Jan	2-Jan	27-Dec	29-Dec	4-Jan
Latest Flood Date	19-Feb	13-Mar	25-Mar	31-Mar	26-Mar	10-Mar
Average Flood Volume (AF)	0	2,725	1,368	311	0	0
Spring Early Snowmelt Peaks (Mar 21- May 31)						
Secondary Peak Magnitude (median)	385	281	284	172	179	91
Secondary Peak Duration (median)	37	39	20	27	30	13
Start of Snowmelt Ascension (median)	1-May	29-Apr	1-May	26-Apr	25-Apr	28-Apr
Secondary Snowmelt Peak Date (median)	30-May	20-May	14-May	15-May	3-May	29-Apr
End of Snowmelt Ascension (median)	7-Jun	27-May	23-May	19-May	22-May	10-May
Snowmelt Ascension Runoff Volume	12,782	7,580	7,326	3,435	6,083	2,144
Daily Ramping Rates (maximum)	54%	91%	72%	52%	53%	138%
Daily Ramping Rates (average)	14%	19%	18%	17%	18%	21%
Spring Snowmelt Flood (May 1 - July 15)						
Magnitude used to Compute Duration	498	437	359	307	260	167
Snowmelt Flood Magnitude (median)	585	514	423	361	306	196
Snowmelt Ascension Duration (median)	21	13	10	9	12	10
Snowmelt Flood Duration (median)	11	11	9	9	8	7
Start of Snowmelt Flood (median)	7-Jun	27-May	23-May	19-May	22-May	9-May
End of Snowmelt Flood (median)	12-Aug	2-Aug	13-Jul	3-Jul	27-Jun	17-Jun
Date of Flood Peak (median)	5-Jul	8-Jun	3-Jun	28-May	2-Jun	19-May
Snowmelt Runoff Volume (median)	40,601	39,030	26,529	17,436	10,188	5,910
Snowmelt Recession (July 15 - Sep 30)						
Start of Snowmelt Recession (median date)	12-Aug	2-Aug	13-Jul	3-Jul	27-Jun	16-Jun
End of Snowmelt Recession (median date)	21-Sep	26-Aug	21-Aug	3-Aug	28-Jul	5-Jul
Duration of Recession (median number of days)	29	21	37	38	29	19
Daily Ramping Rates (maximum)	72%	40%	31%	23%	29%	57%
Daily Ramping Rates (average)	42%	12%	9%	9%	10%	14%
Snowmelt Recession Runoff Volume (median)	5,947	4,188	7,290	5,665	4,351	2,676
Summer Baseflow (August 1 - Sep 30)						
Median	NA	36	33	20	21	19
Minimum (median)	NA	31	15	9	14	12
Maximum (median)	NA	63	38	32	27	26



Appendix A-3. Figure 1. Timing and magnitude of peak flows for Rush Creek Runoff (estimated unimpaired), Rush Creek at Damsite (regulated by SCE), and Parker Creek above Intake (unimpaired).



Appendix A-3. Figure 2. Comparison of snowmelt peak date for Rush Creek Runoff (estimated unimpaired) and Rush Creek at Damsite (actual) for Runoff Years 1941-2008.



Appendix A-3. Figure 3. Comparison of snowmelt peak date for Rush Creek Runoff (estimated unimpaired) and Parker Creek above Intake (unimpaired) for Runoff Years 1990-2008.

APPENDIX A-4. FLOOD FREQUENCY ANALYSIS

Appendix A-4. Table 1. Rush Creek flood peaks for Runoff Years 1973-2008.

Runoff Year	Rush Creek Unimpaired	Rush Creek At Damsite (5013)	Rush Creek Below MGORD (5007)	Rush Creek Below Narrows Unimpaired	Rush Creek Below Narrows Actual
1973	586	282			
1974	620	383			
1975	668	255			
1976	280	86			
1977	275	86			
1978	722	514			
1979	581	241			
1980	801	322			
1981	419	120			
1982	714	304			
1983	850	418			
1984	563	163			
1985	323	138			
1986	1078	307			
1987	318	83			
1988	295	66			
1989	338	94			
1990	249	116	113	263	120
1991	506	150	101	585	140
1992	361	118	154	392	173
1993	639	388	166	704	205
1994	374	122	99	404	133
1995	1144	634	548	1292	647
1996	874	306	333	976	391
1997	547	211	175	599	233
1998	726	495	538	846	635
1999	654	222	201	708	247
2000	599	372	204	656	256
2001	588	231	161	666	202
2002	416	131	168	460	225
2003	742	311	203	827	283
2004	308	118	343	354	372
2005	751	441	403	852	467
2006	644	483	477	749	584
2007	302	148	45	320	64
2008	427	139	388	478	423

Appendix A-4. Table 2. Lee Vining Creek flood peaks for Runoff Years 1973-2009.

Runoff Year	Unimpaired	Above Intake	Below Intake
1973	382		
1974	423		
1975	404		
1976	190		
1977	303		
1978	412		
1979	389		
1980	637		
1981	301		
1982	498		
1983	585		
1984	422		
1985	266		
1986	631		
1987	196		
1988	180		
1989	234		
1990	125	95	59.5
1991	280	186	164
1992	209	134	114
1993	373	264	231
1994	216	139	125
1995	691	522	436
1996	677	524	422
1997	476	378	354
1998	514	417	391
1999	367	285	274
2000	355	264	258
2001	312	215	201
2002	311	238	233
2003	484	332	317
2004	203	152	141
2005	455	374	372
2006	515	444	457
2007	157	127	45
2008	305	222	167
2009	NA	230	232

Appendix A-4. Table 3. Rush and Lee Vining creeks flood frequency analysis.

	1.5-YR		2.0-YR		2.33-YR		5-YR		10-YR		25-YR		50-YR	
(all data in cfs)	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit	Raw Data	Pearson III Fit
Rush Creek Runoff Unimpaired (1)	420	428	547	505	583	540	716	694	802	820	1,018	981	1,109	1,101
Rush Creek at Damsite (2)	176	173	224	221	250	244	387	363	485	476	643	641	858	780
Rush Creek below Narrows Unimpaired (6)	495	506	638	584	708	619	792	774	855	898	1,108	1,054	1,191	1,170
Lee Vining Creek Runoff (9)	311	305	382	366	408	394	512	515	643	611	683	729	na	814
Lee Vining Creek above Intake (10)	217	200	264	249	281	273	421	382	522	476	na	603	na	702

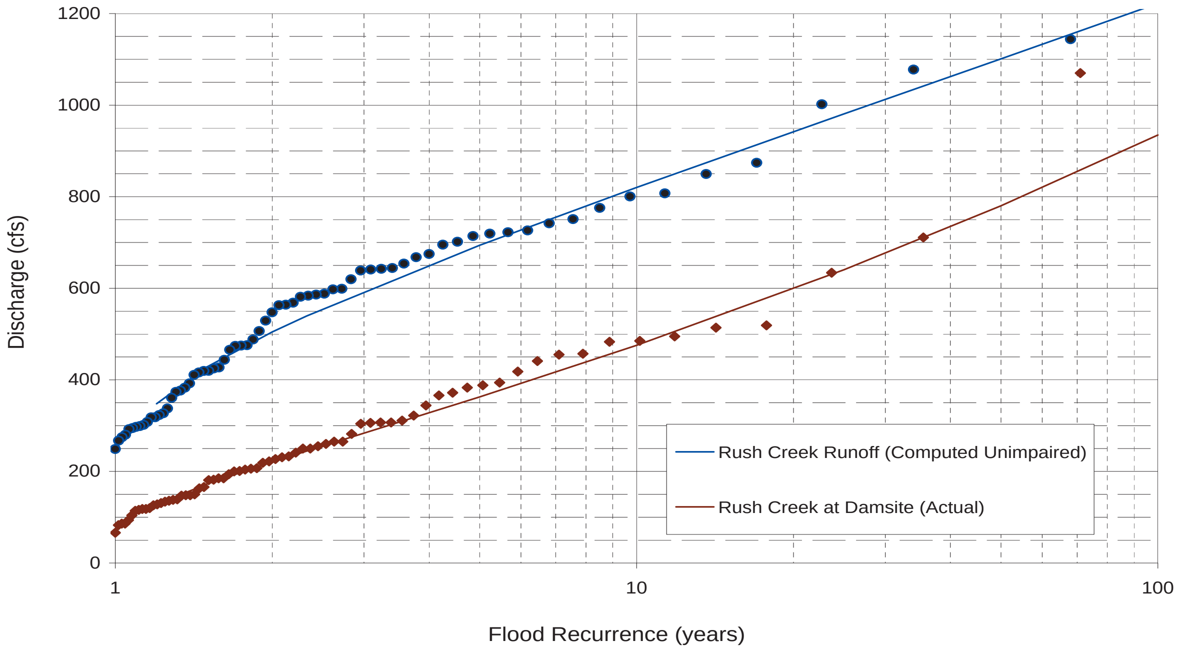
(1) Data Source: LADWP Rush Creek Computed Unimpaired or 'Rush Creek Runoff' (Rush Creek at Damsite + SCE Storage Change)

(2) Data Source: Data for 1937-1979 from USGS 'Rush Creek abv Grant Lake nr June Lake, CA (USGS 10287400)'; Data for 1980-2008 from DWP 'Rush Creek at Damsite'

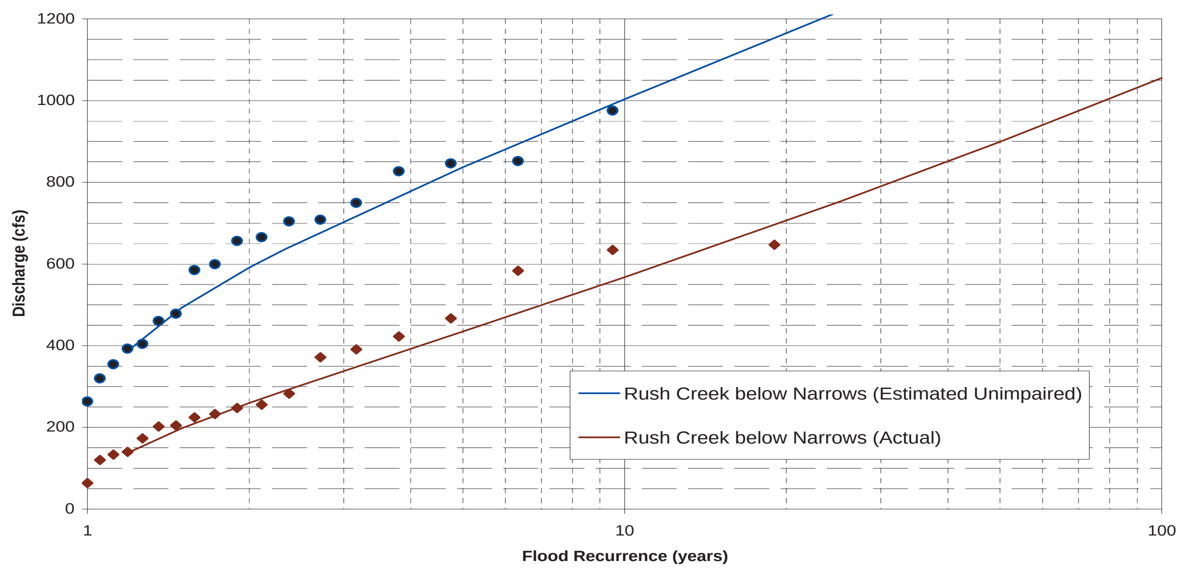
(6) Data Source: Uses 'Rush Creek Computed Unimpaired' for 1941-2008 and adds Parker and Walker Creek average peak flow for each water year class

(9) Data Source: LADWP Lee Vining Creek Computed Unimpaired or 'Lee Vining Creek Runoff' (Lee Vining above Intake + SCE Storage Change)

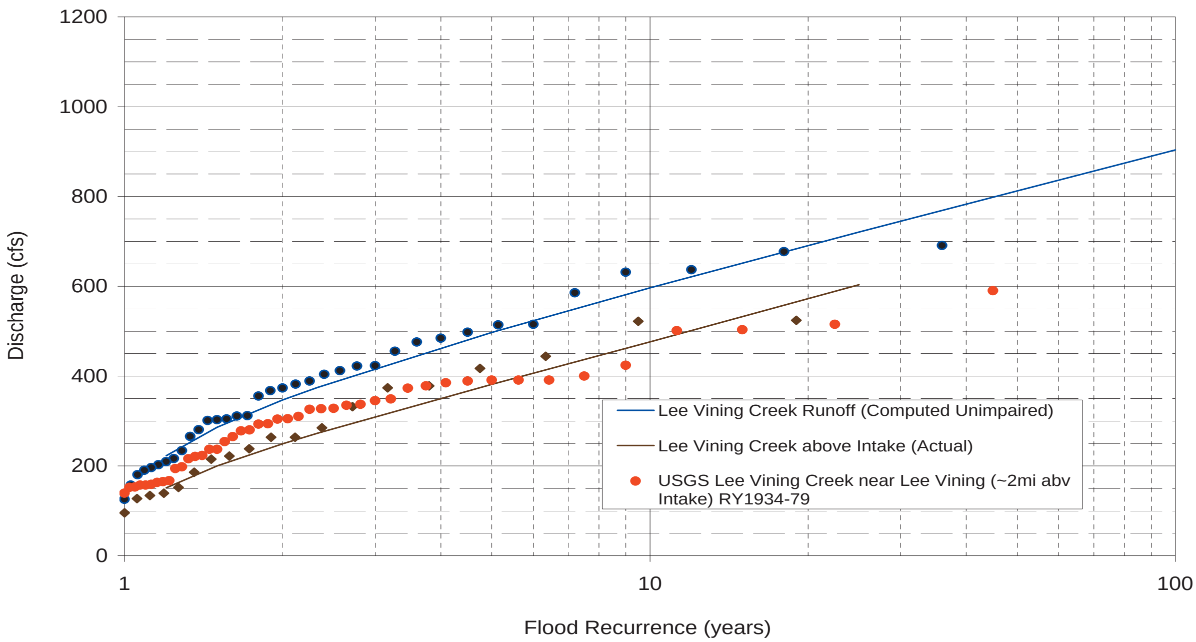
(10) Data Source: Data for 1990 - 2008 from LADWP 'Lee Vining Creek Above Intake'



Appendix A-4. Figure 1. Rush Creek at Damsite (actual) and Rush Creek Runoff (computed unimpaired) flood frequency analysis for Runoff Years 1941-2008.



Appendix A-4. Figure 2. Rush Creek below Narrows (actual) and Rush Creek below Narrows (computed unimpaired) flood frequency analysis.



Appendix A-4. Figure 3. Lee Vining Creek above Intake (actual) and Lee Vining Creek Runoff (computed unimpaired) flood frequency analysis for Runoff Years 1973-2008.

APPENDIX A-5. SUMMARY INFORMATION

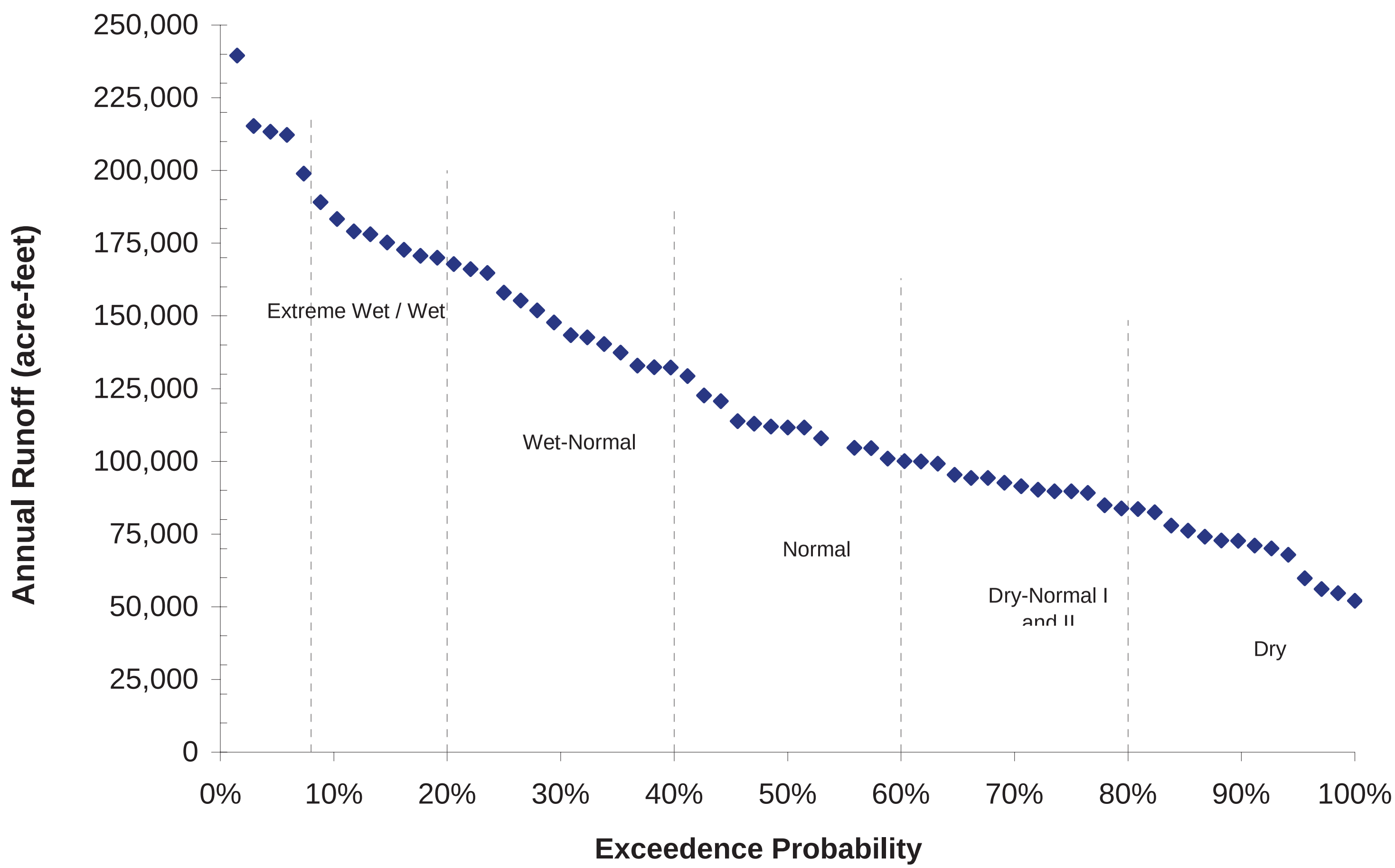
Appendix A-5. Table 1. Mono Basin annual yield for Runoff Years 1941-2008.

Runoff Year	April-1 Forecast (1950-90 from GLOMP; 1991-09 from LADWP)	May-1 Forecast (1950-90 from GLOMP; 1991-09 from LADWP)	Final Runoff Forecast	Final Runoff Year Type **	Mono Basin Unimpaired Yield ##	Actual Runoff
1950	82%	84.2%		Normal	111,973	91.7%
1951	94%	96.1%		Normal	111,651	91.4%
1952	1.52%	151.6%		Wet	175,249	143.5%
1953	78.8%	80.8%		Dry-Normal II	95,382	78.1%
1954	86.6%	83.8%		Normal	83,776	68.6%
1955	69.8%	72.3%		Dry-Normal II	99,234	81.3%
1956	13.9%	141.4%		Wet	167,862	137.5%
1957	77.8%	77.8%		Dry-Normal II	104,570	85.6%
1958	132.0%	133.9%		Wet-Normal	158,038	129.4%
1959	67.6%	66.1%		Dry	74,091	60.7%
1960	68.6%	66.5%		Dry	71,000	58.1%
1961	55.9%	55.3%		Dry	72,644	59.5%
1962	113.1%	110.0%		Wet-Normal	132,382	108.4%
1963	96.2%	103.5%		Normal	137,370	112.5%
1964	58.6%	59.0%		Dry	84,864	69.5%
1965	107.8%	108.5%		Wet-Normal	142,599	116.8%
1966	84.4%	83.1%		Normal	94,271	77.2%
1967	133.7%	141.8%		Wet	198,927	162.9%
1968	69.7%	66.7%		Dry	82,467	67.5%
1969	175.5%	174.2%		Extreme-Wet	213,384	174.7%
1970	92.2%	90.7%	92.2%	Normal	104,683	85.7%
1971	88.2%	86.4%	88.2%	Normal	113,861	93.2%
1972	72.0%	73.8%	72.0%	Dry-Normal I	91,468	74.9%
1973	111.0%	108.2%	111.0%	Wet-Normal	132,914	108.8%
1974	113.1%	113.6%	113.1%	Wet-Normal	132,217	108.3%
1975	97.3%	100.6%	97.3%	Normal	120,726	98.9%
1976	44.5%	43.3%	44.5%	Dry	54,719	44.8%
1977	35.9%	32.3%	35.9%	Dry	52,093	42.7%
1978	141.6%	145.8%	141.6%	Wet	179,090	146.6%
1979	109.0%	107.5%	109.0%	Wet-Normal	122,670	100.4%
1980	146.1%	146.9%	146.1%	Wet	170,001	139.2%
1981	82.5%	80.1%	82.5%	Normal	100,062	81.9%
1982	144.9%	158.4%	144.9%	Wet	212,296	173.8%
1983	184.5%	186.4%	184.5%	Extreme-Wet	239,529	196.1%
1984	118.5%	119.0%	118.5%	Wet-Normal	147,719	121.0%
1985	88.8%	85.9%	88.8%	Normal	107,892	88.3%
1986	155.1%	153.2%	155.1%	Wet	170,669	139.8%
1987	57.0%	54.5%	57.0%	Dry	67,911	55.6%
1988	57.3%	56.7%	57.3%	Dry	70,036	57.3%
1989	80.5%	79.2%	80.5%	Dry-Normal II	89,725	73.5%
1990	55.3%	54.1%	55.3%	Dry	59,782	49.0%
1991	64.0%		64.0%	Dry	77,935	64.0%
1992	68.0%		68.0%	Dry	72,766	60.0%
1993	134.0%		136.1%	Wet-Normal	140,291	115.0%
1994	51.0%		51.0%	Dry	76,218	62.0%
1995	165.0%		167.0%	Extreme-Wet	215,252	176.0%
1996	115.0%		116.2%	Wet-Normal	164,817	135.0%
1997	125.0%		118.1%	Wet-Normal	143,433	117.0%
1998	134.0%		134.1%	Wet	172,744	141.4%
1999	99.0%		96.5%	Normal	112,946	92.5%
2000	94.0%		94.7%	Normal	113,129	92.6%
2001	74.0%		74.4%	Dry-Normal I	93,438	76.5%
2002	76.0%		76.2%	Dry-Normal II	90,734	74.3%
2003	72.0%		72.4%	Dry-Normal I	106,012	86.8%
2004	79.0%		79.8%	Dry-Normal II	89,538	73.3%
2005	132.0%		132.2%	Wet-Normal	182,283	149.3%
2006	147.0%		136.7%	Wet	188,596	154.4%
2007	52.0%		52.3%	Dry	56,069	45.9%
2008	86.0%		86.1%	Normal	86,229	70.6%
2009	88.0%		88.4%	Normal		
1973-2008 Average Yield					120,919	
1990-2008 AverageYield $					118,011	
1997-2008 Average Yield @					119,596	
1941-1990 Average Yield t					122,124	

**Runoff Year Type is based latest Forecasted Runoff

Unimpaired Yield for Rush Creek and Lee Vining Creek is based on post Runoff Year estimate from SCE daily reservoir storage change, plus daily streamflow below SCE facilities;

$ The 1990-2008 runoff years were used for analyses and simulations in this Synthesis Report



Appendix A-5. Figure 1. Mono Basin annual yield for Runoff Years 1941-2008.

Appendix A-5. Table 2. Comparison of forecasted runoff year type and actual runoff for Runoff Years 1970-2009.

Year	Final Runoff Forecast	Year Type	Actual Runoff (April-March)	Year Type	Forecast Error
1970	92.2%	Normal	85.7%	Normal	-6.5%
1971	88.2%	Normal	93.2%	Normal	5.0%
1972	72.0%	Dry-Normal I	74.9%	Dry-Normal	2.9%
1973	111.0%	Wet-Normal	108.8%	Wet-Normal	-2.2%
1974	113.1%	Wet-Normal	108.3%	Wet-Normal	-4.8%
1975	97.3%	Normal	98.9%	Normal	1.6%
1976	44.5%	Dry	44.8%	Dry	0.3%
1977	35.9%	Dry	42.7%	Dry	6.8%
1978	141.6%	Wet	146.6%	Wet	5.0%
1979	109.0%	Wet-Normal	100.4%	Normal	-8.6%
1980	146.1%	Wet	139.2%	Wet	-6.9%
1981	82.5%	Normal	81.9%	Normal	-0.6%
1982	144.9%	Wet	173.8%	Extreme-Wet	**28.9%**
1983	184.5%	Extreme-Wet	196.1%	Extreme-Wet	**11.6%**
1984	118.5%	Wet-Normal	121.0%	Wet-Normal	2.5%
1985	88.8%	Normal	88.3%	Normal	-0.5%
1986	155.1%	Wet	139.8%	Wet	**-15.3%**
1987	57.0%	Dry	55.6%	Dry	-1.4%
1988	57.3%	Dry	57.3%	Dry	0.0%
1989	80.5%	Dry-Normal II	73.5%	Dry-Normal	-7.0%
1990	55.3%	Dry	49.0%	Dry	-6.3%
1991	64.0%	Dry	64.0%	Dry	0.0%
1992	68.0%	Dry	60.0%	Dry	-8.0%
1993	136.1%	Wet-Normal	115.0%	Wet-Normal	**-21.1%**
1994	51.0%	Dry	62.0%	Dry	**11.0%**
1995	167.0%	Extreme-Wet	176.0%	Extreme-Wet	9.0%
1996	116.2%	Wet-Normal	135.0%	Wet-Normal	**18.8%**
1997	118.1%	Wet-Normal	117.0%	Wet-Normal	-1.1%
1998	134.1%	Wet	141.4%	Wet	7.3%
1999	96.5%	Normal	92.5%	Normal	-4.1%
2000	94.7%	Normal	92.6%	Normal	-2.0%
2001	74.4%	Dry-Normal I	76.5%	Dry-Normal	2.2%
2002	76.2%	Dry-Normal II	74.3%	Dry-Normal	-1.9%
2003	72.4%	Dry-Normal I	86.8%	Normal	**14.4%**
2004	79.8%	Dry-Normal II	73.3%	Dry-Normal	-6.4%
2005	132.2%	Wet-Normal	149.3%	Wet	**17.0%**
2006	136.7%	Wet	154.4%	Wet	**17.8%**
2007	52.3%	Dry	45.9%	Dry	-6.4%
2008	86.1%	Normal	70.6%	Dry-Normal	**-15.5%**
2009	88.4%	Normal			

Appendix A-5. Table 3a. Rush Creek streamflow gains and losses.

Measurement Location	Stream Mile	CDFG (1987)				M&T and MLC FLOW DATA RY 2008											
		21-Aug	5-Sep	22-Oct	28-Nov	20-Mar	12-Jun	17-Jul	12-Aug	14-Aug	16-Aug	19-Aug	20-Aug	21-Aug	31-Aug	15-Sep	29-Sep
MGORD	1.4	18.2	61.0	12.8	20.4	26.2	323.4*	46.6*	**47.7**	**61.3**	**90.9**	**33.6**	**31.3**	**18.8**	34.4	50.4	48.5
Rush Creek at Old Hwy 395																	
Rush Creek abv Parker Creek	4.9	13.4	54.2	10.9	17.6	24.2		32.5									
Parker Creek below Conduit		4.8	0.0	0.0	0.0												
Parker Creek blw Hwy 395						3.0	23.0	21.7+									
Walker Creek below Conduit		2.4	0.0	0.0	0.0												
Walker Creek at confluence						6.2	16.1	6.1									
Rush below Narrows (Sum of Gaged Flows: MG	5.6	12.6	54.7	10.9	17.6	34.6 t	362.5 t	73.6 t	**57.4**	**69.1**	**98.0**	**39.7**	**40.3**	**24.2**	41.4	56.8	53.7
Rush below Narrows (Sum of Measured Flows)	5.6					33.4		60.3									
Rush Creek 4Bii Channelo																	
Rush Creek 8 Channel																	
Lower Rush Creek Mainstem blw 10 Falls	7.6	12.2	49.5	8.9		27.3	358.0	59.1	**45.7**	**57.6**	**77.3**	**27.1**	**28.8**	**14.1**	30.0	46.7	44.5
Rush Creek at County Road	9.1	9.0	49.4	8.1	13.5	27.3											
Net Loss MGORD to Parker		4.8	6.8	1.9	2.8	1.9		14.1									
Rate of Flow Loss (cfs/mi)		1.4	1.9	0.6	0.8	0.6		4.0									
Net Loss Narrows to Lower Rush		0.4	5.2	2.0	4.1	6.1		1.2									
Rate of Flow Loss (cfs/mi)		0.2	2.6	1.0	2.0	3.0		0.6									
Net Loss MGORD to Lower Rush		13.2	11.5	3.9	20.4	7.3	4.5	14.5	**11.8**	**11.5**	**20.7**	**12.6**	**11.5**	**10.1**	11.4	10.1	9.2
Rate of Flow Loss (cfs/mi)		2.1	1.9	0.6	3.3	1.2	0.7	2.3	**1.9**	**1.9**	**3.3**	**2.0**	**1.8**	**1.6**	1.8	1.6	1.5
Measured by:																	

*=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

Appendix A-5. Table 3b. Rush Creek streamflow gains and losses.

Measurement Location	Stream Mile	M&T, MLC, DWP FLOW DATA RY 2009												
		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: 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
@=Does not add up due to rounding

Appendix A-5. Table 5. Parker and Walker Creek streamflow gains and losses

	Monthly Average	RY1990	RY1991	RY1992	RY1993	RY1994	RY1995	RY1996	RY1997	RY1998	RY1999	RY2000	RY2001	RY2002	RY2003	RY2004	RY2005	RY2006	RY2007	RY2008
		Dry	Dry	Dry	Wet-Normal	Dry	Extreme-Wet	Wet-Normal	Wet-Normal	Wet	Normal	Normal	Dry-Normal I	Dry-Normal II	Dry-Normal I	Dry-Normal II	Wet-Normal	Wet	Dry	Normal
Oct	7.8	3.3	6	5.6	7.3	7.2	15.6	9.1	12.1	12.9	9.8	7.5	5.6	5	5.9	5.7	9.1	9.6	5.4	5
Nov	8.7	7.3	7.8	5.1	7.1	8.3	12.2	15.4	7.9	13.6	10.6	10.5	9.2	10.6	5.4	7.5	7.5	7.9	4.4	7.1
Dec	7.2	5.6	5.9	5.5	7.9	6.1	10	11.2	7.4	9.2	8.1	6.1	7.5	6.4	5.6	7.1	9	7.4	5.2	5.7
Jan	8.1	4.5	5.4	5.4	5.2	8.1	9.5	33.3	7.3	8.4	6.5	5.9	6.2	5.4	5.6	6.4	12.8	6.9	5.2	5.4
Feb	7.3	4.3	5.5	5.1	5.3	8.7	11.8	15.7	7.8	8.9	7.5	5.8	5.9	6	6.1	6.8	9.4	6.9	4.9	6.1
Mar	8.7	4.9	6.5	8.1	6.4	15.5	12.8	16.5	9.2	8.2	8	8.4	6.2	6.8	9.4	8.8	9.7	7.2	6.2	6.9
Average by Runoff Year	8	5	6.2	5.8	6.5	9	12	16.9	8.6	10.2	8.4	7.4	6.8	6.7	6.3	7.1	9.6	7.7	5.2	6

APPENDIX A-6. RAMPING RATE ANALYSIS AND MEMORANDUM PRESENTED IN RY2002

Exhibit A. Mono Lake Committee Comments on the Draft Synthesis of Instream Flow Recommendations

Comments
For the following errors in this 2002 memorandum, we suggest listing them in an errata sheet at the front: p. A65 - middle paragraph, 71% should be 76%. p. A66 - highest "natural" ramping rates - wrong word, use impaired. p. A66 - last paragraph, selected 2-day average for Convict as median - actually, median 0.775 is halfway between Convict and Parker. p. A67 - Error in second to last sentence of second to last paragraph - 0.6 and 0.7 ft per day should be 0.06 and 0.07.

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April 16, 2002

TO: Steve McBain
Los Angeles Department of Water and Power
111 N. Hope Street, RM1469
Los Angeles, Ca. 90012

RE: Comparison of snowmelt ascending limb ramping rates from unregulated hydrographs with regulated Grant Lake releases to Rush Creek

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The State Water Board Decision 1631 specified maximum rates of change in flow for the Mono Basin tributaries. These rates are determined based on a percentage of change in flow from the average flow over the preceding 24 hours. Currently the maximum ramping rates are (LADWP 2000):

- Lee Vining Creek: not to exceed 20% change during ascending streamflows and 15% during descending streamflows per 24 hours.
- Walker Creek: not to exceed 10% change during ascending or descending streamflows per 24 hours.
- Parker Creek: not to exceed 10% change during ascending or descending streamflows per 24 hours.
- Rush Creek: not to exceed 10% change during ascending or descending streamflows per 24 hours.

The April 1 Runoff Forecast for the Mono Basin was 71% of normal, projecting to approximately 93,000 acre-feet of runoff. This runoff forecast falls within the Mono Basin Operations-Planning Guideline C (forecasted runoff volume 92,207< - <100,750 acre-feet), which will require Rush Creek baseflows of 44 and 47 cfs, and a peak snowmelt release of 250 cfs for 5 consecutive days. During the ascending snowmelt hydrograph, to double the flow from a 47 cfs baseflow to 100 cfs, the current 10% maximum rate of change rule requires increasing flows from 4.7 to 9 cfs per day for 7 days; to achieve the targeted 250 cfs peak for RY 2002 would require 19 days (assuming 47 cfs baseflow).

The goal of this technical memorandum is to evaluate the natural range of variability in ascending limb ramping rates from unregulated streams draining the Eastern Sierra, then use this natural range as a basis for comparing existing or proposed regulated ramping rates for Rush Creek. LADWP is exploring alternative ramping rates for Rush Creek during the ascending limb of peak flow releases for the 2002 runoff season for several reasons. First, synchronizing peak flow releases with the peak in cottonwood seed dispersal may help promote cottonwood regeneration within the Rush Creek corridor. Presently, LADWP personnel rely on field observations to determine cottonwood seed development and seed dispersal timing. A long-duration ascending hydrograph limb makes it difficult to time the snowmelt peak to the ideal cottonwood seed dispersal period. Second, a shorter overall ramping period (ascending limb only) could allow Rush Creek peaks to be released concurrent with Parker and/or Walker Creek peaks, thus achieving a higher overall peak discharge, and more natural daily variation in discharge in Lower Rush Creek reaches (below the Narrows). Finally, the outlet works at the Mono Gate Control House does not provide real-time discharge for the portion of flows released to the Rush Creek Return Ditch when LADWP is diverting water. Maintaining maximum ramping rates within the existing 10% maximum daily change is difficult. Reducing the duration of the ascending limb would minimize operational difficulties.

We evaluated ascending limb ramping rates for several gaged streams draining the Eastern Sierra, including Convict Creek (Owens Basin), Lee Vining, Parker, and Walker Creeks in the Mono Basin, and Buckeye and Virginia Creeks (Walker Basin). Our approach was based on analysis of the ascending limb of each creeks' snowmelt hydrograph to determine a natural range of variability in the rate of change in daily average flows. For each of the creeks, we looked at the maximum daily change in discharge, the maximum 2-day average change in discharge, and the maximum 3-day average change in discharge during the snowmelt ascending limb. Maximum changes in discharge would be expected to be higher within a single day, and decrease when averaged over the course of several days (i.e., maximum rates of increase are generally not sustained for long periods). We converted these rates to unit runoff (cfs/day/mi^2) using drainage area to facilitate comparisons. We then examined how ramping rates would translate to changes in water surface elevation at Rush Creek study site cross sections. We did not assess other geomorphic or any biological implications of these ramping rates.

Lee Vining Creek had the highest natural ramping rates, occasionally exceeding 80 cfs/day (Table 1). These rates may also be due to SCE operations upstream. Walker Creek had the lowest overall ramping rates of the creeks evaluated, potentially due to flow dampening by Walker Lake. Convict Creek was nearest the median of the creeks evaluated, and because it is unregulated, was used as a model for additional analyses.

Table 1. Ramping rates measured during the ascending snowmelt hydrograph for selected streams in the Eastern Sierra vicinity of Rush Creek.

	Drainage Area (mi^2)	1-day avg ramp-up (cfs/sq mi)	2-day avg ramp-up (cfs/sq mi)	3-day avg ramp-up (cfs/sq mi)	1-day avg ramp-up (cfs)	2-day avg ramp-up (cfs)	3-day avg ramp-up (cfs)
Lee Vining Creek above Intake	35.2	2.34	1.78	1.36	82.4	62.7	47.9
Parker Creek	12.2	1.19	0.80	0.63	14.5	9.8	7.7
Walker Creek	7.8	0.46	0.34	0.27	3.6	2.7	2.1
Convict Creek at Mammoth	18.7	0.98	**0.75**	0.66	18.3	14.0	12.3
Buckeye Creek near Bridgeport	44.1	1.37	0.83	0.6	60.4	36.6	26.5
Virginia Creek near Bridgeport	63.6	0.93	0.66	0.46	59.1	42.0	29.3
Rush Creek at Damsite (modeling from Convict Creek)	51.2	0.98	0.75	0.66	50.2	38.4	33.8

We selected the 2-day average change in discharge (cfs) for Convict Creek as a median value within the range of natural variability for the streams we evaluated. This ramping rate was converted based on drainage area, then applied to the anticipated Rush Creek Operations Guideline C, which requires peak releases of 250 cfs for 5 days. The Convict Creek rate of 0.75 cfs/sq mi/day would allow ramping rates of approximately 38 cfs/day for Rush Creek releases. We plotted this "2-day average rate" as an annual hydrograph of daily average flows, along with the extended ramping rate required by the SWRCB "10%

maximum" rule (Figure 1). Compared to the existing 19 day ramping period with the 10% rule, the 2-day average rate (38 cfs/day) would require 7 days to attain the maximum discharge of 250 cfs on Rush Creek. We also compared this rate (38 cfs/day) to the Lee Vining Creek maximum allowed ramping rate of 20% during the ascending limb. These two rates (2-day average and 20% rule) produced very similar hydrograph limbs (Figure 1). With a 20% maximum ramping rule, Rush Creek would require 10 days to attain the targeted peak discharge of 250 cfs. The primary difference, however, is that the 20% rule softens the initial jump in discharge, then increases exponentially for 9 days instead of increasing linearly for 7 days (Figure 1).

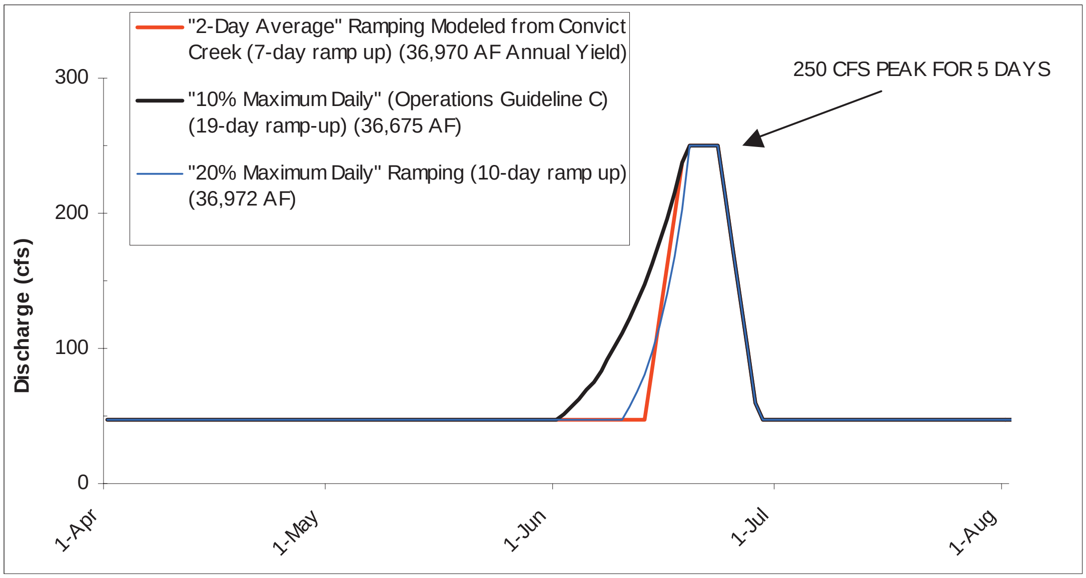


Figure 1. Three alternative Rush Creek snowmelt ascending limbs for RY 2002. Hydrographs would only change in the ascending limb; all other components to the hydrograph follow the SWRCB Operational Guideline C.

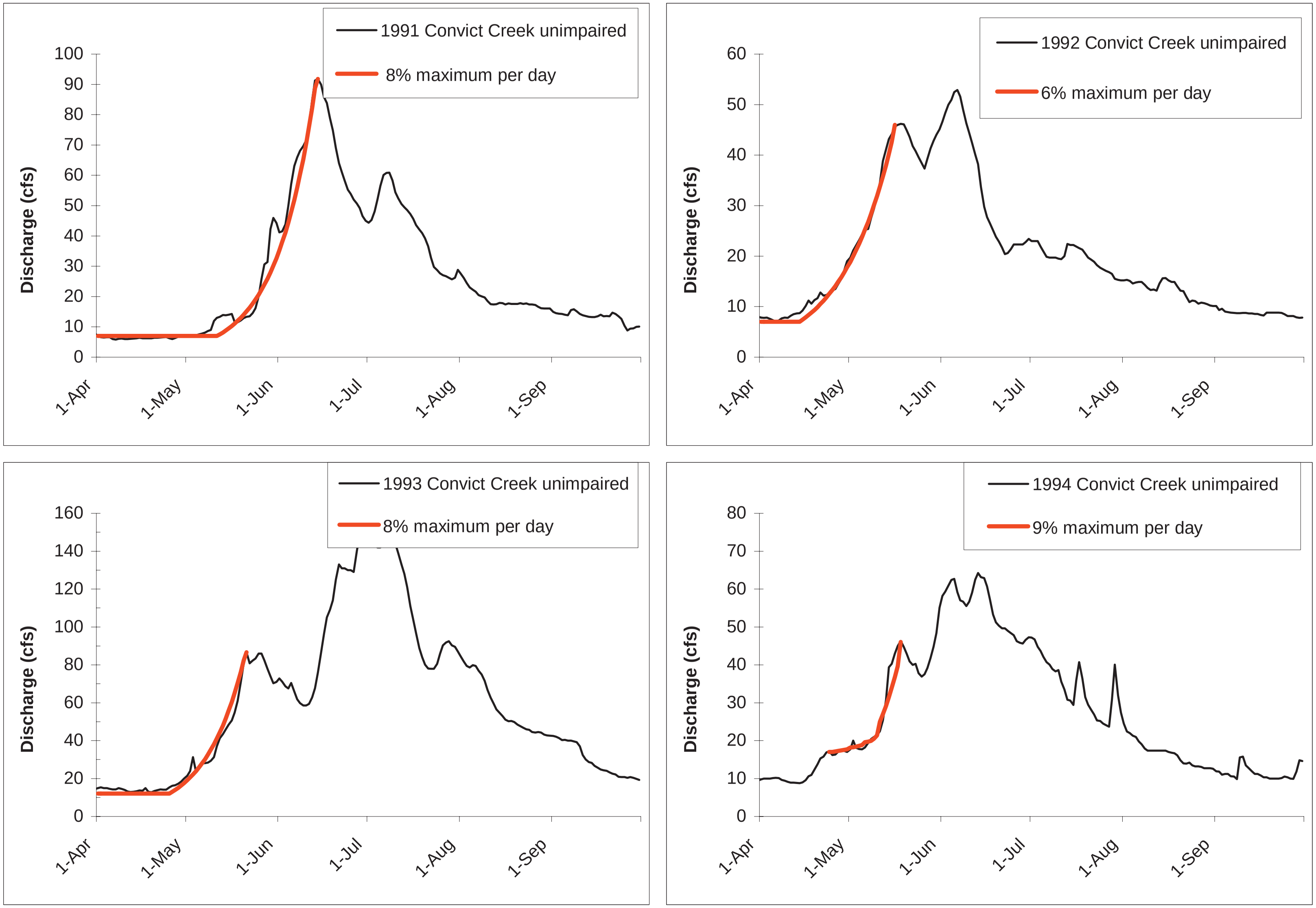
Using the modeled Rush Creek daily discharge changes for the 2-day average rule and the 20% maximum rule and stage-discharge rating curves developed for our study site cross sections, we evaluated potential changes in water surface elevation. We tested the different hydrographs at three cross sections in Lower Rush Creek and one cross section in Upper Rush Creek. For the 2-day average rule (modeled from Convict Creek), the maximum increase in water surface elevation of 0.36 ft (4 inches) would occur during the first day of ramping, and water surface elevation would increase by a maximum of 0.24 ft thereafter. Using the 20% rule, the maximum increase in elevation at our cross sections was only 0.16 ft (less than 2 inches), occurring on the last day of ramping (Table 2). Using the existing 10% maximum ramping rate for Rush Creek, water surface elevation changes ranged between 0.6 and 0.7 ft per day. Stage increases were quite consistent among the different cross sections (Table 2).

Next, we fit a curve to each of the Convict Creek ascending limbs, using a percentage daily increase to obtain a range of values for natural hydrographs (Figure 2). This task was somewhat challenging given the irregularities in natural hydrographs, and thus required some subjective curve fitting. We noted at least two patterns in the natural hydrographs. First, dryer water year types generally peak earlier in the season, and may have less steep ascending hydrographs, whereas wetter years generally appear steeper. Second, many Convict Creek hydrographs had slower ascending limbs leading to preliminary peaks, followed by descending discharge, then rapid ascent to the annual maximum. This two-stage ascending limb is more difficult to mimic with regulated hydrographs. Finally, we plotted each fitted curve on a single chart, along with curves using a 5%, 10%, and 20% maximum change per day rule (Figure 3). Using Convict Creek as a representative natural runoff pattern, most hydrographs were contained between the 5% and 10% maximum ramping rates. The 20% maximum ramping rate is considerably outside the natural rates from Convict Creek.

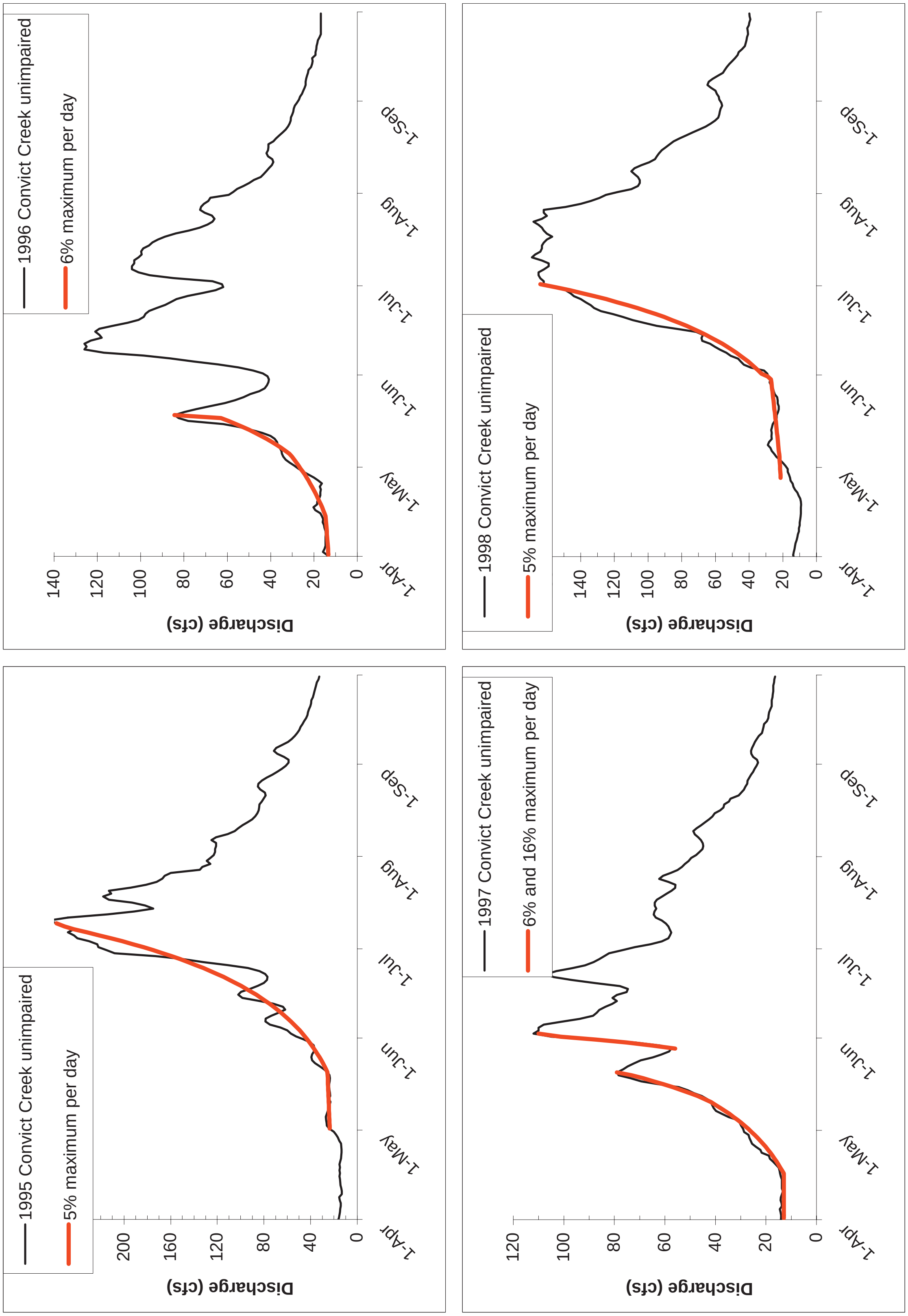
Table 2. Water surface elevation changes predicted at Rush Creek cross sections for the ascending hydrograph limb using the 20% and 10% maximum daily change rule, based on stage-discharge rating curves developed at each cross section.

	WATER SURFACE STAGE CHANGE (ft)			
ASCENDING HYDROGRAPH (CFS) USING 20% RULE	Lower Rush Creek XS 10+10	Lower Rush Creek XS 7+25	Upper Rush Creek XS 1+05	Lower Rush Creek XS -9+82
47				
56	0.09	0.10	0.09	0.11
68	0.09	0.10	0.09	0.11
81	0.09	0.11	0.09	0.11
97	0.09	0.11	0.10	0.12
117	0.10	0.11	0.10	0.12
140	0.10	0.12	0.10	0.12
168	0.10	0.12	0.10	0.13
202	0.10	0.12	0.11	0.13
250	0.12	0.15	0.13	0.16

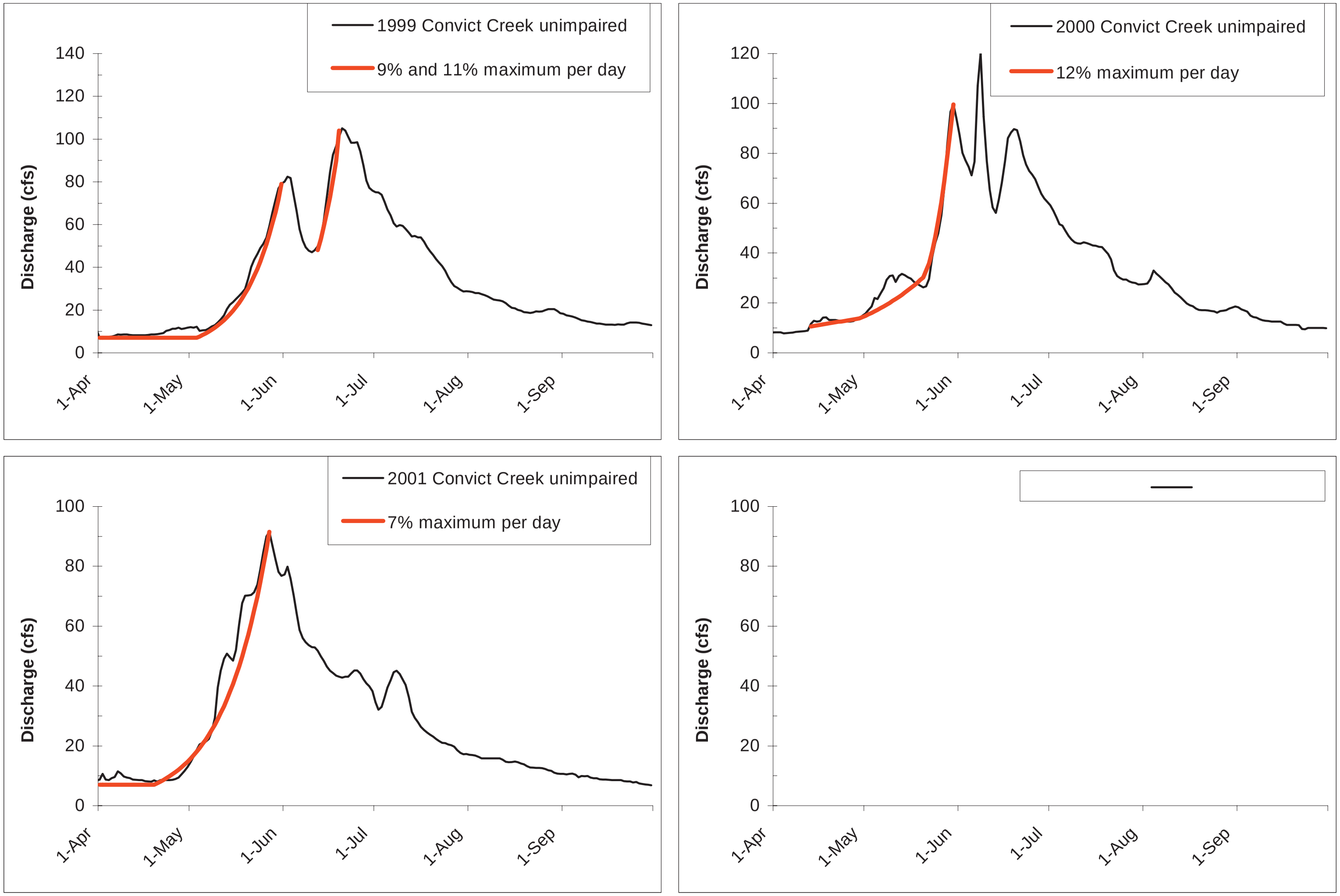
	WATER SURFACE STAGE CHANGE (ft)			
ASCENDING HYDROGRAPH (CFS) USING 10% MAX	Lower Rush Creek XS 10+10	Lower Rush Creek XS 7+25	Upper Rush Creek XS 1+05	Lower Rush Creek XS -9+82
47				
52	0.04	0.05	0.05	0.06
57	0.05	0.05	0.05	0.06
63	0.05	0.05	0.05	0.06
69	0.05	0.06	0.05	0.06
76	0.05	0.06	0.05	0.06
83	0.05	0.06	0.05	0.06
92	0.05	0.06	0.05	0.06
101	0.05	0.06	0.05	0.06
111	0.05	0.06	0.05	0.06
122	0.05	0.06	0.05	0.06
134	0.05	0.06	0.05	0.06
148	0.05	0.06	0.05	0.07
162	0.05	0.06	0.05	0.07
178	0.05	0.06	0.06	0.07
196	0.05	0.07	0.06	0.07
216	0.05	0.07	0.06	0.07
238	0.06	0.07	0.06	0.07
250	0.03	0.04	0.03	0.04



Convict Creek abv Hwy 395 (Station # 4014)



Convict Creek abv Hwy 395 (Station # 4014)



Convict Creek abv Hwy 395 (Station # 4014)

Figure 2. Convict Creek near Mammoth annual hydrographs during snowmelt runoff, with fitted curve superimposed to show the maximum rate of increase.

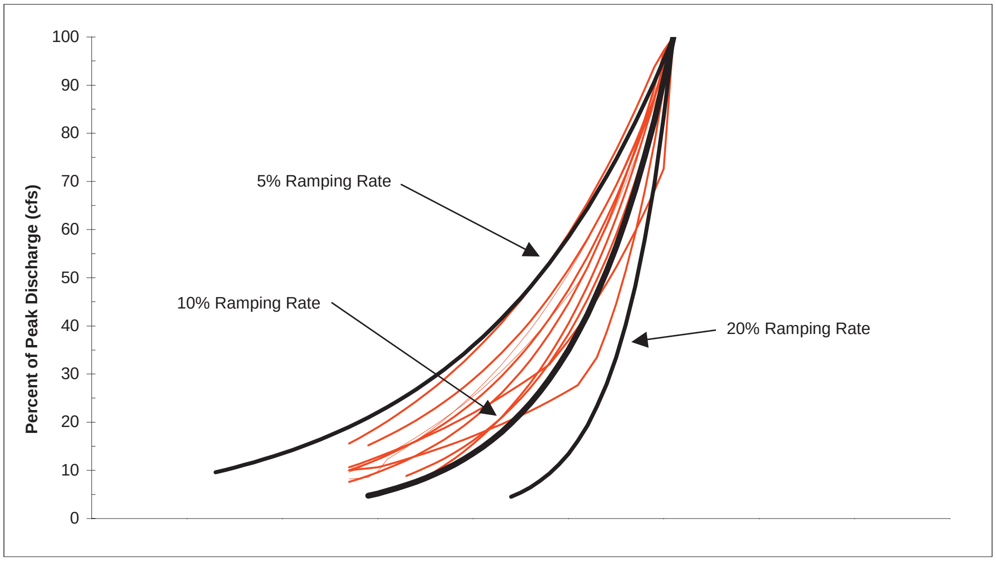


Figure 3. Ascending limb hydrographs from Convict Creek "standardized" based on the percentage of the annual peak magnitude, to compare the natural range in ramping rates to alternative regulated conditions.

APPENDIX B. GEOMORPHOLOGY

Geomorphic evaluations conducted during the past 12 runoff years in Rush and Lee Vining creeks for this synthesis report have included several data collection efforts quantifying the geomorphic responses to peak flood magnitude and duration, including:

- Cross section and longitudinal profile surveys
- Channelbed mobility and bed scour experiments
- Sediment transport measurements
- Floodplain inundation mapping
- Floodplain deposition measurements
- Large wood transport measurements

This Appendix describes data that have been collected and reported in previous annual reports, references specific sections of annual reports where specific data results and summaries are presented, and in some cases, re-presents entire sections of previous Annual Reports that presented detailed analyses that form the basis for conclusions and SEF flow recommendations contained in this Synthesis Report.

In this Appendix, we reference the following data and analyses:

B-1: B-1: Cross Section Surveys

There are 53 cross sections installed on Rush, Parker, Walker, and Lee Vining creeks monumented with rebar and referenced with X–Y–Z coordinates. These cross sections have been monitored to track changes in channelbed and water surface elevations through time and in relation to discharge and SRF flow releases. During initial years of monitoring, cross sections were typically resurveyed annually. All Rush Creek and Lee Vining Creek cross sections were resurveyed in 2004, and selected cross sections were re-surveyed in RY 2005 and 2006. In Rush Creek, cross sections were most recently resurveyed in October 2008 following the Rush Creek habitat mapping. In Lee Vining, cross sections were resurveyed in July 2009 following the Lee Vining Creek habitat mapping. The habitat mapping test flow releases provided opportunity to collect stage-discharge data for each cross section over the range of baseflows evaluated (15 to 90 cfs on Rush Creek; 12 to 54 cfs on Lee Vining Creek). Cross section survey and water surface elevation data were presented for Rush Creek in RY 2008 Annual Report (M&T 2009), and will be presented for Lee Vining Creek in the upcoming RY 2010 Annual Report.

B-2: B-2: Channelbed Mobility and Scour Experiments

Bed mobility and scour experiments were conducted on Rush and Lee Vining creeks for eight consecutive years, from RY 1997 through 2005 (excluding RY 2003). The bed mobility experiments were designed to test the effect of flood magnitude on surface particle mobility thresholds and scour depths. The RY 2001 Annual Report presented field methods and a description of targeted mobility thresholds. Mobility data span a wide range of snowmelt floods, and most tracer rock sets within the bankfull channel achieved near total mobility. Summary tables for bed mobility and scour from RY 2005 are re-presented in this Appendix for

Rush Creek (Tables B1 and B2) and Lee Vining Creek (Tables B-3 and B-4. Bed mobility charts are also presented for Rush Creek (Figure B1) and Lee Vining Creek (Figure B-2).

Three geomorphic features were targeted for estimating surface mobility thresholds: pool-tails, riffles, and point bars. In RY 2001 Annual Report (M&T 2002) we defined "total" mobility of those geomorphic features occurring at approximately 80% mobility of the tracer rock cross section. Mobility rating curves at Upper Rush Creek XS 12+95 and another at Lower Rush Creek XS 10+10 (both sites are pool tails) showed a consistent trend in increasing mobility with discharge. The mobility threshold for each site was different, however. In Upper Rush Creek, bed mobility occurred between approximately 450 and 550 cfs. In Lower Rush Creek, mobility occurred between approximately 200 and 250 cfs.

On Rush Creek, mobility thresholds were exceeded for 50-80% of D31 and D50 tracer rocks placed on pool tails at approximately 200 to 250 cfs. In many cases 100% of the tracers moved. Tracer rocks on riffles were generally mobilized (80% mobility) at flows of approximately 325-375 in Lower Rush Creek (3 sites), 440 cfs in the 10-Channel (one site), and at 400-625 cfs in Upper Rush Creek. Point bar and floodplain features were either mobilized by the highest flow observed during our study period, or not at all (2 sites). Lower Rush Creek XS -5+07 above the 10 Channel Falls is a good example of a lateral bar feature, that had more than 90% of D_{84}, D_{50}, and D_{31} particles mobilized by the RY 1998 flow of 635 cfs below the Narrows. The surface of the right bank bar feature at Rush Creek County Road reach XS 6+85 did not mobilize during the eight years of mobility studies.

On Lee Vining Creek, tracer rock sets were monitored for six years beginning 1999. Mobility data were more difficult to interpret than on Rush Creek: data were collected over a smaller range of flows capable of mobilizing the bed (the highest flows were 354 cfs in 1997; 391 cfs in 1998; 372 cfs in 2005), peak flows were distributed among several distributary channels and multiple channel reaches, and channel adjustments in many locations (e.g., headcuts) confounded interpretation of the bed mobility and scour data. Most bed mobility monitoring sites did not have 100% mobility across the range of flows observed. Several sites have had only limited mobility, and higher surface sites such as point bars and floodplains have had no mobility. Thresholds were identified for mobilizing pool tails at 275 cfs (A4 XS 5+15) to 390 cfs (mainstem XS 3+45). Riffles appeared to become mobilized at flows ranging between 25-325 cfs (e.g., sites at XS A4 6+80, mainstem XS 9+31, B1 XS6+08 and XS 1+80). Only one point bar, B1 XS 0+87 was observed, with mobility occurring at approximately 275-300 cfs.

B-3: B-3: Sediment Transport Measurements

Sediment transport rates were measured in Rush Creek during two runoff years: RY 2004 by Rick Poore of XX Hydrologics, and in RY 2005 by M&T. Only the RY 2005 data collected and analyzed by M&T were used in the Synthesis Report. These data were analyzed and reported in the RY 2005 Annual Report, Section 3.3 (M&T 2006). Given the detailed descriptions and relevance of the sediment transport monitoring to our final SEF flow recommendations, the entire Section 3.3 from RY 2005 Annual Report is re-presented in this Appendix.

B-4: B-4: Floodplain Inundation Mapping

During and after the RY 2004 and RY 2005 Rush Creek SRF releases, floodplains surrounding the 8, 4, and 3D channels were mapped to show (1) areas *inundated* by overbank and side channel flow that displayed standing water, and (2) areas *wetted* by groundwater or the capillary fringe intersecting the ground surface that displayed moisture but not standing water on the ground surface. We used the term *saturated* in the RY 2004 Annual Report to describe *inundated* or *wetted* areas, because mapping in 2004 did not distinguish between wetted and inundated.

The objective for floodplain mapping was to estimate the area of wetted and inundated floodplains and determine the duration that floodplain soils retained moisture. Laminated aerial photographs were used for field mapping. The 8 and 4 floodplains were mapped on June 28 and August 9, 2005. The 3D Floodplain was mapped on June 29 and August 9, 2005. Those maps are presented in this Appendix. Additional description of the extent and duration of floodplain inundation is provided in the RY 2005 Annual Report, Section 2.4.

In RY 2008, the extent of surface flow was mapped from the 8 Channel downstream to the 11-Channel (Figure 12). The inundation map is presented in this Appendix.

B-5: B-5: Floodplain Deposition Experiments

Similar to sediment transport measurements, floodplain deposition was also measured during two snowmelt floods, first in RY 2004, then again in RY 2005. Both runoff year Annual Reports present results of those field experiments (M&T 2005 and 2006). However, the bigger monitoring effort in RY 2005 summarized data and results from both years. Given the detailed descriptions and relevance of floodplain deposition to our final SEF flow recommendations, the entire Section 3.4 from RY 2005 Annual Report is re-presented in this Appendix.

B-6: B-6: Large Wood Transport Experiments

Experiments tracking mobilization and transport distances of large wood pieces were conducted during two consecutive runoff years in Rush Creek, RY 2004 and 2005, and during RY 2005 in Lee Vining Creek. The final maps from Appendix E of the RY 2005 Annual Report (M&T 2006) are reprinted in this Appendix.

APPENDIX B-1. CROSS SECTION SURVEYS

- Rush Creek cross section surveys and water surface elevations can be found in the RY 2008 Annual Report (McBain & Trush 2009)
- Lee Vining Creek cross section surveys and water surface elevations can be found in the 2009 Annual Report

APPENDIX B-2. CHANNELBED MOBILITY AND SCOUR EXPERIMENTS

Appendix B-2. Table 1. Rush Creek tracer rock mobility at given discharges.

Creek	Cross Section	Geomorphic Unit	Observation Date	Discharge at Cross Section	Percent D_{84} Moved	Percent D_{50} Moved	Percent D_{31} Moved
Lower Rush Creek	10+10	Pool Tail	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	10%	10%
			7/3/1998	224 cfs	90%	80%	80%
			9/10/1998	387 cfs	100%	100%	100%
			7/20/1999	151 cfs	20%	30%	50%
			8/12/2000	153 cfs	23%	62%	77%
			8/5/2001	102 cfs	0%	38%	63%
			6/8/2002	142 cfs	60%	100%	100%
			6/11/2004	224 cfs	80%	90%	90%
			8/19/2005	286 cfs	90%	100%	100%
				maximum mobility =	100%	100%	100%
Lower Rush Creek	07+70	Riffle	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	0%	0%
			7/3/1998	224 cfs	88%	100%	100%
			9/10/1998	387 cfs	100%	100%	100%
			7/20/1999	151 cfs	43%	71%	86%
			8/12/2000	153 cfs	50%	70%	100%
			8/5/2001	102 cfs	0%	20%	50%
			6/8/2002	142 cfs	40%	10%	60%
			6/11/2004	224 cfs	90%	90%	90%
			8/19/2005	286 cfs	80%	80%	90%
				maximum mobility =	100%	100%	100%
Lower Rush Creek	07+70	Floodplain	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	0%	0%
			7/3/1998	224 cfs	0%	0%	0%
			9/10/1998	387 cfs	0%	14%	29%
			7/20/1999	151 cfs	0%	0%	0%
			8/12/2000	153 cfs	0%	0%	0%
			8/5/2001	102 cfs	0%	0%	0%
			6/8/2002	142 cfs	0%	0%	0%
			6/11/2004	224 cfs	0%	0%	0%
			8/19/2005	286 cfs	0%	0%	0%
				maximum mobility =	0%	14%	29%
Lower Rush Creek	07+25	Riffle	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	0%	14%
			9/10/1998	387 cfs	0%	14%	29%
			7/21/1999	151 cfs	13%	75%	75%
			8/12/2000	153 cfs	0%	13%	13%
			8/5/2001	102 cfs	20%	50%	60%
			6/8/2002	142 cfs	40%	70%	40%
			6/11/2004	224 cfs	60%	60%	100%
			8/19/2005	286 cfs	90%	100%	100%
				maximum mobility =	90%	100%	100%
Lower Rush Creek	07+25	Floodplain	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	0%	0%
			7/3/1998	224 cfs	0%	0%	0%
			9/10/1998	387 cfs	0%	0%	0%
			7/21/1999	151 cfs	0%	0%	0%
			8/12/2000	153 cfs	0%	0%	0%
			8/5/2001	102 cfs	0%	0%	0%
			6/8/2002	142 cfs	0%	0%	0%
			6/11/2004	224 cfs	0%	0%	0%
			8/19/2005	286 cfs	0%	0%	0%
				maximum mobility =	0%	0%	0%
Lower Rush Creek	04+08	Pool Tail	10/3/1997	54 cfs	0%	0%	0%
			6/1/1998	65 cfs	0%	0%	14%
			7/3/1998	224 cfs	100%	100%	100%
			9/10/1998	387 cfs	100%	100%	100%
			7/20/1999	151 cfs	29%	43%	57%
			8/12/2000	153 cfs	20%	20%	60%
			8/5/2001	102 cfs	0%	0%	10%
			6/8/2002	142 cfs	20%	40%	40%
			6/11/2004	224 cfs	100%	100%	100%
			8/19/2005	286 cfs	90%	90%	100%
				maximum mobility =	100%	100%	100%
Lower Rush Creek	-05+07	Point Bar	6/4/1998	56 cfs	0%	0%	0%
			7/3/1998	224 cfs	36%	57%	71%
			9/10/1998	387 cfs	93%	93%	93%
			7/20/1999	151 cfs	14%	36%	29%
			8/12/2000	255 cfs	0%	20%	30%
			8/5/2001	102 cfs	0%	0%	20%
			6/8/2002	142 cfs	10%	20%	40%
			6/11/2004	224 cfs	30%	30%	40%
			8/19/2005	286 cfs	30%	70%	90%
				maximum mobility =	93%	93%	93%

Appendix B-2. Table 2. Rush Creek scour and re-deposition at given discharges.

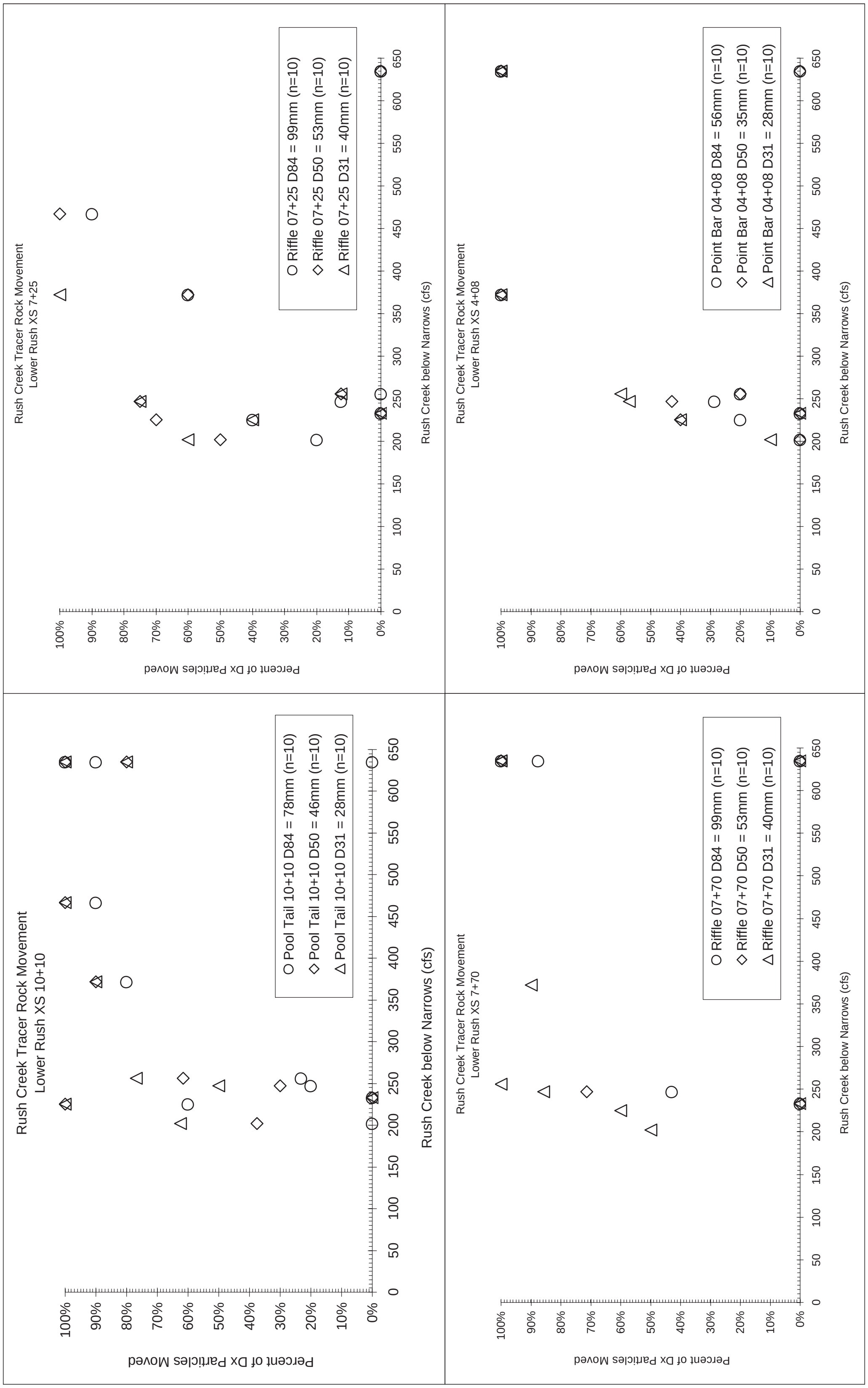
Reach	Cross Section	Year	Discharge at Cross Section (cfs)	Core #	Scour depth (ft)	Redeposition depth (ft)	Geomorphic feature
Lower Rush Creek	00+86	1998	396	1	0.00	0.00	Upper point bar / floodplain
				2	0.03	0.00	Middle of point bar
				3	0.21	1.14	Point bar within low water channel
				4	0.30	0.77	Point bar within low water channel
		1999	155	1	0.01	0.00	Upper point bar / floodplain
				2	0.03	0.00	Middle of point bar
				3	0.00	0.00	Point bar within low water channel
				4	-	-	Point bar within low water channel
		2000	161	1	0.01	0.00	Upper point bar / floodplain
				2	0.01	0.00	Middle of point bar
				3	0.05	0.00	Point bar within low water channel
				4	-	-	Point bar within low water channel
				5	0.00	0.00	Pool tail
		2001	128	1	0.00	0.00	Upper point bar / floodplain
				2	0.00	0.00	Middle of point bar
				3	0.00	0.00	Point bar within low water channel
				4	-	-	Point bar within low water channel
				5	0.00	0.00	Pool Tail
		2002	144	1	0.00	0.00	Upper point bar / floodplain
				2	0.00	0.00	Middle of point bar
				3	0.00	0.00	Point bar within low water channel
				5	0.00	0.00	Pool Tail
		2004	241 (281)	5	0.47	0.00	Upper point bar / floodplain
				4	0.10	0.21	Middle of point bar
				3	0.00	0.00	Point bar within low water channel
				2	0.00	0.00	Point bar within low water channel
				1	0.00	0.00	Pool Tail
		2005	286	5	N/A	NO DATA	Upper point bar / floodplain
				4	0.05	0.11	Middle of point bar
				3	0.03	0.00	Point bar within low water channel
				2	0.02	0.07	Point bar within low water channel
				1	0.01	0.00	Pool Tail
Lower Rush Creek	03+30	1998	396	1	0.47	0.31	Pool tail at low flow, transverse bar at high flow
				2	>0.55	>0.55	Pool tail at low flow, transverse bar at high flow
				3	>0.75	>0.50	Pool tail at low flow, transverse bar at high flow
		1999	155	1	0.05	0.14	Pool tail at low flow, transverse bar at high flow
				2	0.14	0.14	Pool tail at low flow, transverse bar at high flow
				3	-	-	Not surveyed; assume completely scoured.
		2000	161	1	0.00	0.03	Pool tail at low flow, transverse bar at high flow
				2	0.00	0.00	Pool tail at low flow, transverse bar at high flow
				3	-	-	Not surveyed in 1999; assume completely scoured.
		2001	128	1	0.18	0.00	Pool tail at low flow, transverse bar at high flow
				2	0.00	0.02	Pool tail at low flow, transverse bar at high flow
				3	-	-	Not surveyed in 1999; assume completely scoured.
		2002	144	1	0.18	0.00	Pool tail at low flow, transverse bar at high flow
				2	0.16	0.13	Pool tail at low flow, transverse bar at high flow
		2004	241 (281)	1	0.07	0.75	Pool tail at low flow, transverse bar at high flow
				2	0.06	0.00	Pool tail at low flow, transverse bar at high flow
		2005	286	1	0.10	0.12	Pool tail at low flow, transverse bar at high flow
				2	0.05	0.06	Pool tail at low flow, transverse bar at high flow
Lower Rush Creek	04+08	1998	396	1	>0.46	>0.46	Low-gradient riffle
				2	>0.67	>0.67	Low-gradient riffle
		1999	155	1	0.17	0.20	Low-gradient riffle
				2	0.13	0.00	Low-gradient riffle
		2000	161	1	0.00	0.00	Low-gradient riffle
				2	0.00	0.00	Low-gradient riffle
		2001	128	1	0.02	0.12	Low-gradient riffle
				2	0.00	0.00	Low-gradient riffle
		2002	144	1	0.09	0.00	Low-gradient riffle
				2	0.00	0.00	Low-gradient riffle
		2004	241 (281)	1	0.01	0.00	Low-gradient riffle
				2	0.16	0.25	Low-gradient riffle
		2005	286	1	0.30	0.25	Low-gradient riffle
				2	0.09	0.16	Low-gradient riffle
Lower Rush Creek	05+49	1998	396	1	0	0.00	Riffle (transverse bar), within low water channel
				2	0	0.00	Riffle (transverse bar), within low water channel
				3	0	0.00	Riffle (transverse bar), within low water channel
				4	0	0.00	Riffle (transverse bar), within low water channel
		1999	155	1	0.00	0.00	Riffle (transverse bar), within low water channel
				2	0.00	0.00	Riffle (transverse bar), within low water channel
				3	0.00	0.00	Riffle (transverse bar), within low water channel
				4	0.00	0.00	Riffle (transverse bar), within low water channel
		2000	161	1	0	0.00	Riffle (transverse bar), within low water channel
				2	0	0.00	Riffle (transverse bar), within low water channel
				3	0.00	0.00	Riffle (transverse bar), within low water channel
				4	0	0.00	Riffle (transverse bar), within low water channel
		2001	128	1	0.00	0.00	Riffle (transverse bar), within low water channel
				2	0.00	0.00	Riffle (transverse bar), within low water channel
				3	0.00	0.00	Riffle (transverse bar), within low water channel
				4	0.00	0.00	Riffle (transverse bar), within low water channel
		2002	144	1	-0.03	0.15	Riffle (transverse bar), within low water channel
				2	0.05	0.15	Riffle (transverse bar), within low water channel
				3	-0.02	0.14	Riffle (transverse bar), within low water channel
				4	-0.04	0	Riffle (transverse bar), within low water channel
		2004	241 (281)	1	0.02	0.00	Riffle (transverse bar), within low water channel
				2	0.23	0.22	Riffle (transverse bar), within low water channel
				3	0.02	0.48	Riffle (transverse bar), within low water channel
				4	0.21	0.20	Riffle (transverse bar), within low water channel
		2005	286	1	0.43	0.34	Riffle (transverse bar), within low water channel
				2	0.33	0.52	Riffle (transverse bar), within low water channel
				3	0.57	0.60	Riffle (transverse bar), within low water channel
				4	0.31	0.60	Riffle (transverse bar), within low water channel
Lower Rush Creek	07+25	1998	396	1	0.00	0.00	Upper point bar / floodplain
		1999	155	1	0.01	0.00	Upper point bar / floodplain
		2000	161	1	0.00	0.00	Upper point bar / floodplain

Appendix B-2. Table 3. Lee Vining Creek tracer rock mobility at given discharges.

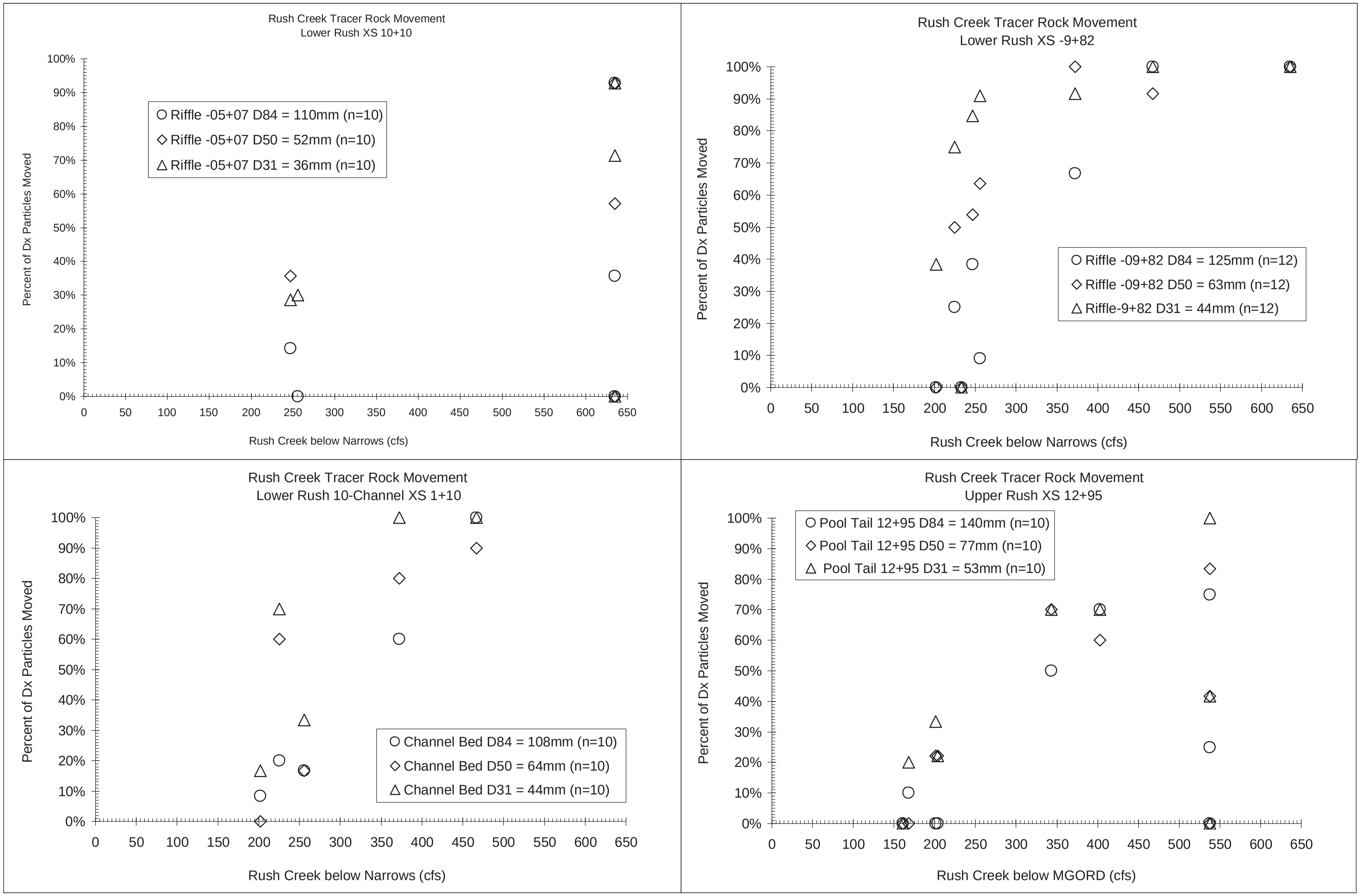
Cross Section	Geomorphic Unit	Observation Date	Discharge at Cross Section	Percent D_{84} Moved	Percent D_{50} Moved	Percent D_{31} Moved
13+92	Riffle	10/3/1997	17 cfs	0%	0%	0%
		6/2/1998	90 cfs	0%	0%	0%
		6/18/1998	193 cfs	0%	0%	8%
		9/10/1998	242 cfs	0%	25%	42%
		6/5/1999	162 cfs	0%	0%	17%
		7/24/1999	170 cfs	0%	8%	25%
		6/4/2000	204 cfs	0%	0%	0%
		8/3/2001	66 cfs	0%	9%	18%
		4/24/2002	164 cfs	0%	18%	9%
		6/27/2004	45 cfs	0%	9%	9%
		8/18/2005	289 cfs	36%	36%	64%
			maximum mobility =	36%	36%	64%
03+45	Pool Tail	10/3/1997	17 cfs	0%	0%	0%
		6/2/1998	90 cfs	0%	0%	0%
		7/2/1998	193 cfs	8%	17%	80%
		9/10/1998	242 cfs	47%	60%	80%
		6/5/1999	162 cfs	7%	27%	40%
		7/24/1999	170 cfs	7%	33%	60%
		6/4/2000	204 cfs	21%	14%	7%
		8/3/2001	152 cfs	7%	13%	20%
		4/24/2002	164 cfs	13%	7%	13%
		6/27/2004	105 cfs	0%	0%	0%
		8/18/2005	289 cfs	80%	80%	87%
			maximum mobility =	80%	80%	87%
06+61	Point Bar	10/3/1997	17 cfs	0%	0%	0%
		6/2/1998	90 cfs	0%	0%	0%
		7/2/1998	193 cfs	0%	0%	8%
		9/10/1998	242 cfs	0%	0%	17%
		6/5/1999	162 cfs	0%	0%	0%
		7/24/1999	170 cfs	0%	0%	0%
		6/4/2000		0%	0%	0%
		8/3/2001	152 cfs	0%	0%	0%
		4/24/2002	164 cfs	0%	0%	0%
		6/27/2004	105 cfs	0%	0%	0%
		8/18/2005	289 cfs	0%	0%	0%
			maximum mobility =	0%	0%	17%
09+31	Riffle	10/3/1997	17 cfs	0%	0%	0%
		6/2/1998	90 cfs	0%	0%	0%
		9/10/1998	242 cfs	45%	82%	91%
		6/5/1999	162 cfs	27%	36%	36%
		7/24/1999	170 cfs	45%	64%	55%
		6/4/2000	204 cfs	0%	18%	18%
		8/3/2001	152 cfs	0%	0%	18%
		4/24/2002	164	27%	82%	82%
		6/27/2004	105 cfs	0%	0%	0%
		8/18/2005	289 cfs	100%	100%	100%
			maximum mobility =	100%	100%	100%
09+31	Floodplain	10/3/1997	17 cfs	0%	0%	0%
		6/2/1998	90 cfs	0%	0%	0%
		7/2/1998	193 cfs	0%	0%	0%
		9/10/1998	242 cfs	0%	0%	0%
		6/5/1999	162 cfs	0%	0%	0%
		7/24/1999	170 cfs	0%	0%	25%
		6/4/2000	204 cfs	0%	45%	55%
		8/3/2001	152 cfs	18%	27%	55%
		4/24/2002	164 cfs	0%	0%	0%
		6/27/2004	105 cfs	0%	0%	0%
		8/18/2005	289 cfs	no recovery data	0%	0%
			maximum mobility =	18%	45%	55%
06+80	Riffle	10/3/1997	12 cfs	0%	0%	0%
		6/2/1998	37 cfs	0%	0%	0%
		7/2/1998	118 cfs	17%	83%	100%
		9/10/1998	149 cfs	17%	100%	100%
		6/5/1999	100 cfs	33%	33%	83%
		7/24/1999	104 cfs	20%	60%	80%
		6/4/2000	109 cfs	0%	0%	38%
		8/3/2001	66 cfs	0%	0%	0%
		4/24/2002	82 cfs	13%	0%	13%
		6/27/2004	45 cfs	0%	0%	0%
		8/18/2005	83 cfs	25%	75%	63%
			maximum mobility =	33%	100%	100%

Appendix B-2. Table 4. Lee Vining Creek scour and re-deposition at given discharges.

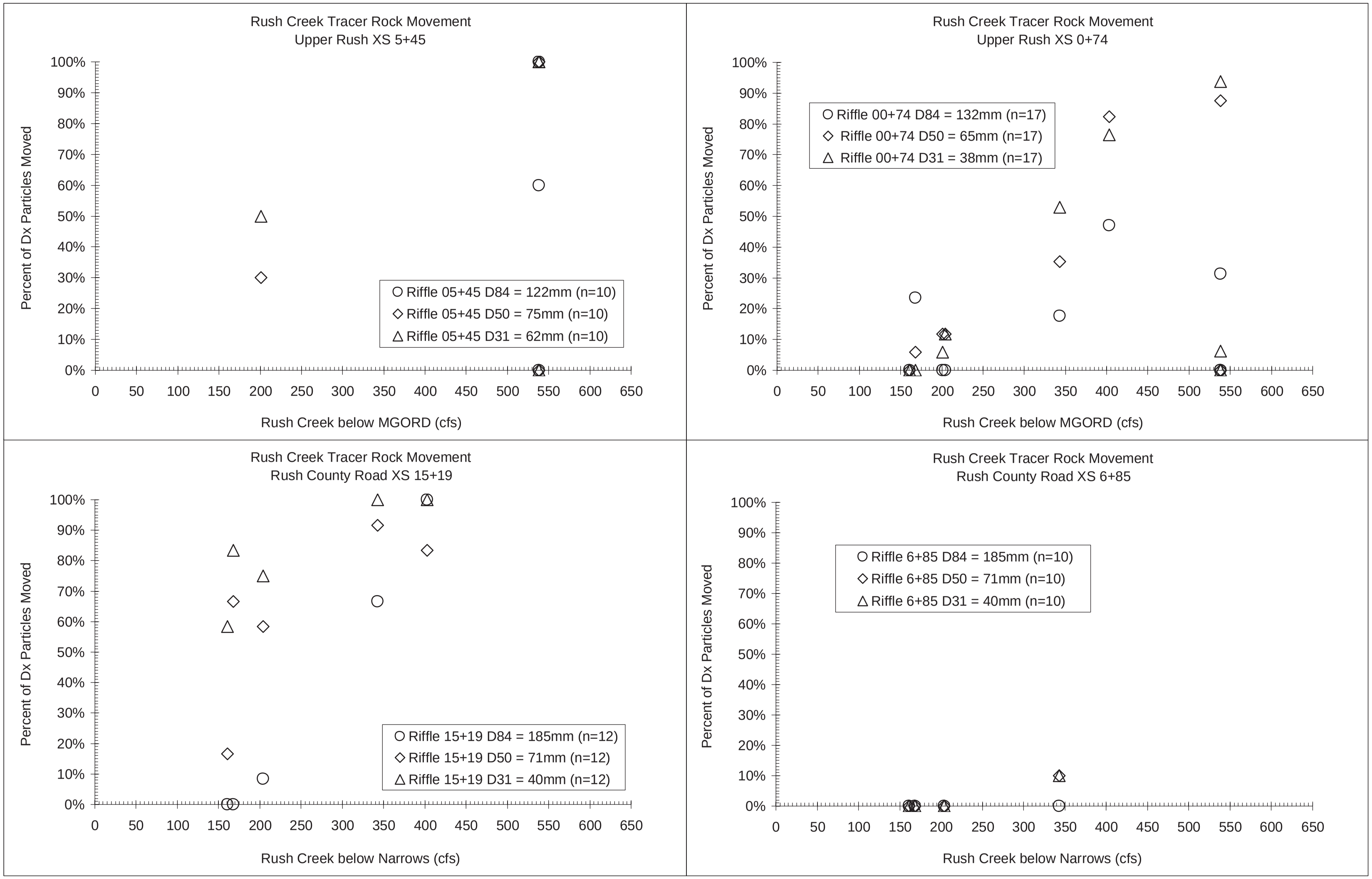
Reach	Cross Section	Year	Discharge at Cross Section (cfs)	Core #	Scour depth (ft)	Redeposition depth (ft)	Geomorphic feature
Lower Lee Vining Creek B-1 Channel	00+87	1999	122	1	0.10	0.04	Point bar, pea gravels
		2000	115	1	0.05	0.04	Point bar, pea gravels
		2001	89	1	0.00	0.04	Point bar, pea gravels
		2002	105	1	0.04	0.04	Point bar, pea gravels
		2004	62	1	0.00	0.00	Point bar, pea gravels
				2	0.16	0.11	
		2005	100	1	0.10	0.00	Point bar, pea gravels
				2	not installed		
Upper Lee Vining Creek	13+92	1998	270	1	0.00	0.11	Eddy deposit, coarse sand
				2	0.20	0.19	Eddy deposit, medium gravels
		1999	190	1	0.08	0.13	Eddy deposit, coarse sand
				2	0.05	0.21	Eddy deposit, medium gravels
		2000	179	1	0.04	0.11	Eddy deposit, coarse sand
				2	0.00	0.07	Eddy deposit, medium gravels
		2001	140	1	0.03	0.12	Eddy deposit, coarse sand
				2	0.01	0.12	Eddy deposit, medium gravels
		2002	164	1	NO DATA		Eddy deposit, coarse sand
				2			Eddy deposit, medium gravels
		2004	103	1	0.02	0.01	Eddy deposit, coarse sand
				2	0.03	0.02	Eddy deposit, medium gravels
		2005	289	1	0.03	0.19	Eddy deposit, coarse sand
				2	0.14	0.14	Eddy deposit, medium gravels
Upper Lee Vining Creek	10+44	1999	190	1	23.11	0.06	Eddy deposit, coarse sand
				2	23.02	0.00	Eddy deposit, medium gravels
		2000	179	1	0.05	0.32	Eddy deposit - spawning gravels
				2	0.21	0.00	Eddy deposit - exposed bar
		2001	140	1	0.04	0.46	Eddy deposit - spawning gravels
				2	0.03	0.42	Eddy deposit - exposed bar
		2002	164	1	0.01	0.16	Eddy deposit - spawning gravels
				2	0.02	0.04	Eddy deposit - exposed bar
		2004	103	1	0.01	0.12	Eddy deposit - exposed bar
				2	0.10	0.08	Eddy deposit - exposed bar
		2005	289	1	0.42	0.64	Eddy deposit - exposed bar
				2	0.37	1.11	Eddy deposit - exposed bar
Upper Lee Vining Creek	03+73	1998	270	1	0.00	0.04	Point bar - pea gravels
				2	0.57	0.05	Point bar - pea gravels
		1999	190	1	0.30	0.00	Point bar - pea gravels
				2	0.30	0.17	Point bar - pea gravels
		2000	179	1	0.00	0.00	Point bar - pea gravels
				2	0.00	0.15	Point bar - pea gravels
		2001	140	1	0	0.00	Point bar - pea gravels
				2	0	0.18	Point bar - pea gravels
		2002	164	1	0.11	0.24	Point bar - pea gravels
				2	0.16	0.16	Point bar - pea gravels
		2004	103	1	0.09	0.30	Point bar - pea gravels
				2	0.14	0.24	Point bar - pea gravels
		2005	289	1	0.03	0.06	Point bar - pea gravels
				2	0.32	0.19	Point bar - pea gravels



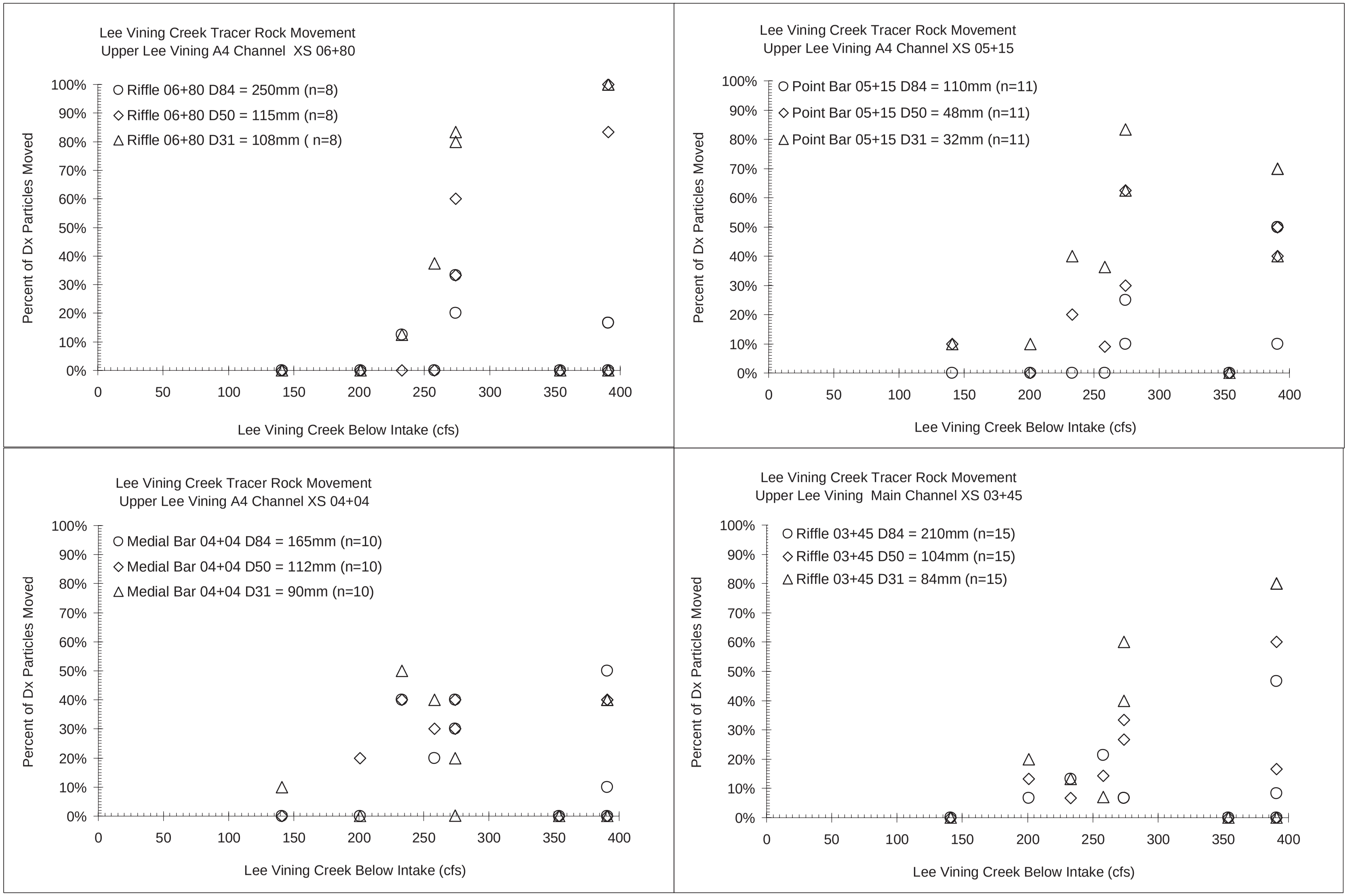
Appendix B-2. Figure 1a. Rush Creek tracer rock experiments.



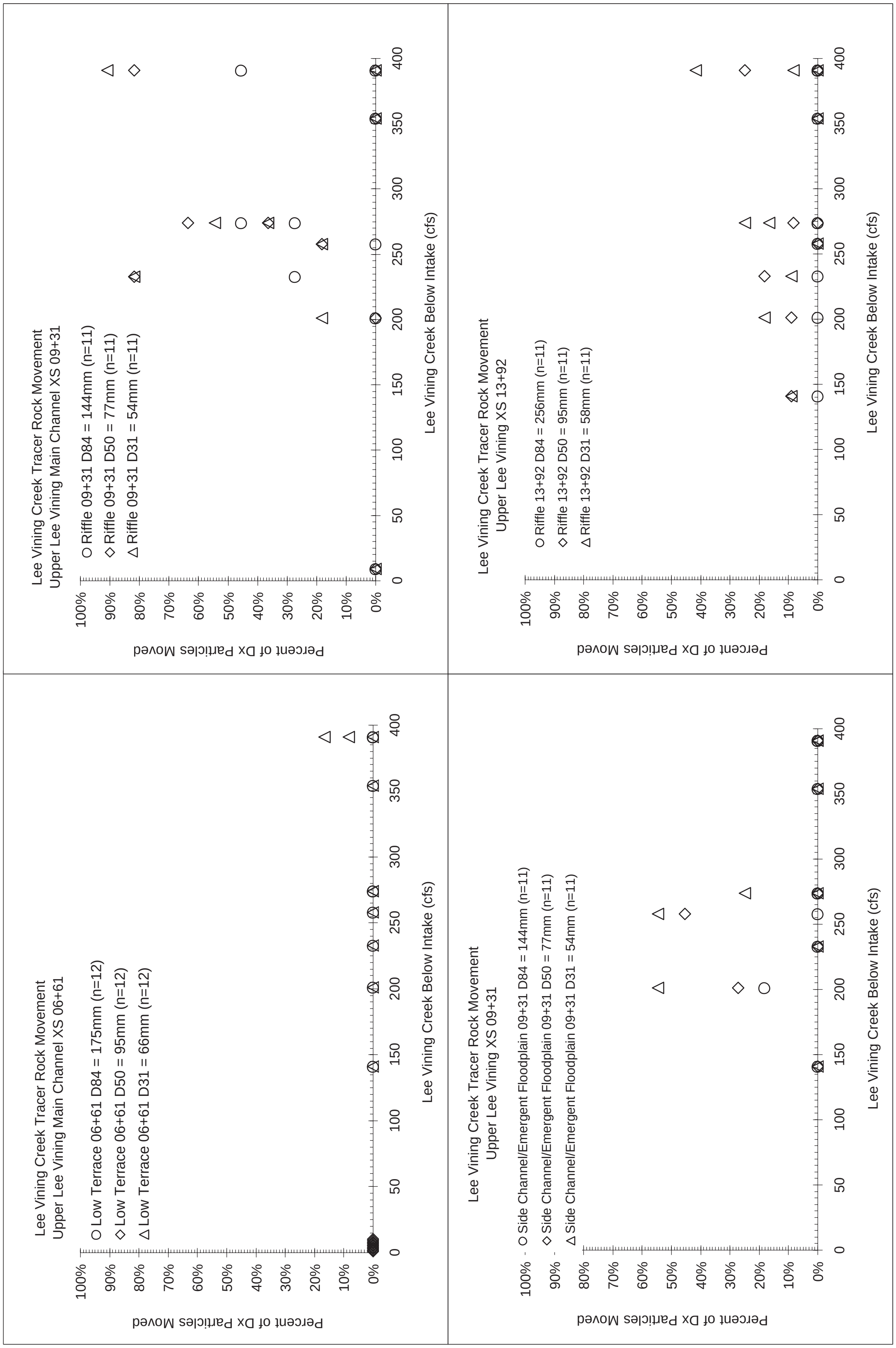
Appendix B-2. Figure 1b. Rush Creek tracer rock experiments.



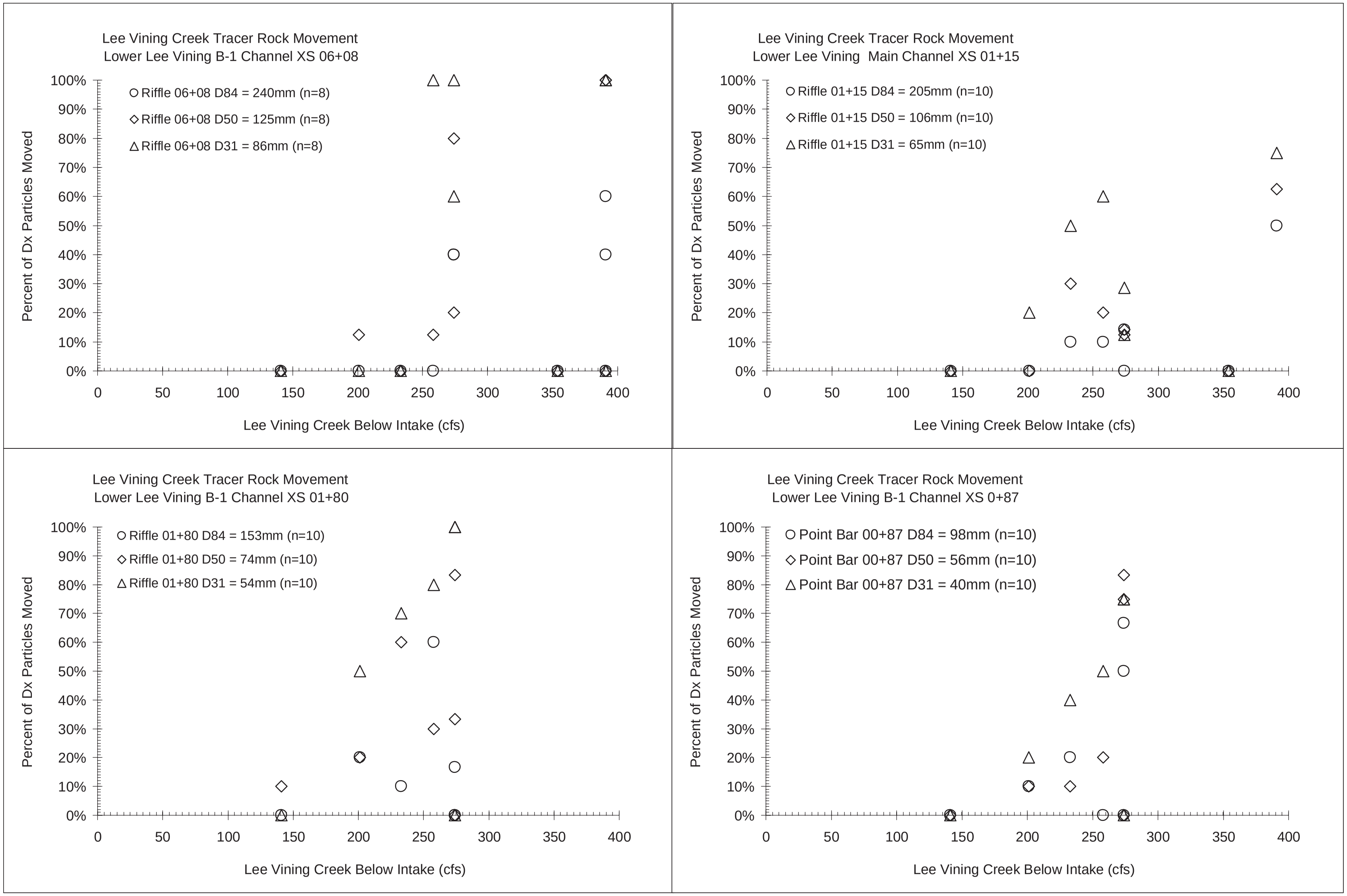
Appendix B-2. Figure 1c. Rush Creek tracer rock experiments.



Appendix B-2. Figure 2a. Lee Vining Creek tracer rock experiments.



Appendix B-2. Figure 2b. Lee Vining Creek tracer rock experiments.



Appendix B-2. Figure 2c. Lee Vining Creek tracer rock experiments.

APPENDIX B-3. SEDIMENT TRANSPORT MEASUREMENTS

3.3 Sediment Transport Measurements

3.3.1 Background and Objectives

Between June 20 and 30, 2005, sediment transport was measured on the ascending limb and during the peak of the SRF releases on Rush Creek. Sediment transport measurements were focused on bedload (the portion of total sediment load moving on or near the streambed). However, some suspended load (the portion of the total load transported in the water column) was measured.

Previous sediment sampling on Rush Creek included bedload transport measurements by StreamWise (2004), as well as fine sediment bedload sampling for floodplain aggradation studies (McBain and Trush 2004 and Section 3.3 of this report). The StreamWise study was conducted during the 2004 SRF flow releases and measured bedload transport but not suspended sediment. Bedload sampling was performed at floodplain study sites as part of ongoing field experimentation to expand our understanding of floodplain aggradation rates and pathways.

Given that Grant Lake historically (glacial moraine lake) and contemporarily (man-made reservoir) has trapped most sediment supplied from the watershed, and flood magnitudes have been reduced, we hypothesized that:

- H-1: Fine and coarse sediment supply to Rush Creek is near zero below Grant Lake;
- H-2: Fine and coarse sediment transport increases downstream from Grant Lake due to increasing sediment supply, and;
- H-3: Sediment transport rates decrease with duration of a high flow release (of constant magnitude) as sediment supply becomes limited.

The 2005 SRF had a planned release of 400 cfs for eight days. Previous bed mobility monitoring had shown that mobility thresholds of active alluvial features were exceeded by 300 to 400 cfs at both study sites. We estimated eight days would exceed the duration required to observe a decline in transport rates. These estimates assumed total bed mobility when 80 percent of the D_{84} size class was mobilized (McBain and Trush 2002). Based on our hypotheses and the scheduled 2005 SRF releases, our objectives for sediment sampling were:

(1) Measure sediment transport rates on the ascending limb and during the sustained peak of the 2005 SRF releases (assesses hypotheses #2 and #3);

(2) Compare sediment transport rates at upper and lower sampling sites (assess Hypothesis #1);

To address Hypothesis 1, sediment transport was measured in upper and lower Rush Creek mainstem reaches. Two of the three sites sampled by StreamWise in 2004 were reoccupied: Upper Rush Creek, approximately 60 ft upstream of cross section 01+05, and Lower Rush Creek at cross section -9+82 (Figure 22). Sampling sites experienced most of the SRF releases (i.e., no major side channels bypassed the sampling sites, and only minor floodplain inundation occurred). We measured flow in the two small side channels at the upper site, which had 4.7 cfs and 8.8 cfs on 6-24-05, which represented a small percentage of the total release of 402 cfs).

3.3.2 Sampling Methods

The Rush Creek SRF releases provided a ramp-up and steady flows of 400 cfs (Figure 23). McBain and Trush partnered with Graham Matthews and Associates (GMA) for field work and laboratory analyses. Sampling was performed from catarafts designed specifically for sediment sampling. Two catarafts were used, each dedicated to a site. A two-member crew traveled between sites to collect sediment samples; one crew member was certified by the U.S. Geological Survey (USGS) for sediment sampling. Sampling cross sections remained fixed during the entire sampling period (Figure 24).

Bedload samples were collected on eight sample days (June 20 to 25, 27, and 30) over the eleven day sampling period. Samples were collected using the ‘single equal-width-increment’ (SEWI) method (Edwards and Glysson 1999), and used a Toutle River-2 (TR-2) bedload sampler with a 6 inch by 12-inch nozzle and a 0.5 mm mesh collection bag. The TR-2 was sufficient at the Upper Rush Creek site to sample the entire width of the moving bed, but the Lower Rush Creek site required a 3-inch hand-held Helley-Smith sampler to sample the left edge of the moving bed. Using the SEWI method, bedload samples were collected at equal-width intervals (verticals) across the cross section, with the TR-2 sampler resting on the bed surface for three minutes at each vertical. The USGS generally recommends a one minute sampling duration, but we increased sample times to three minutes

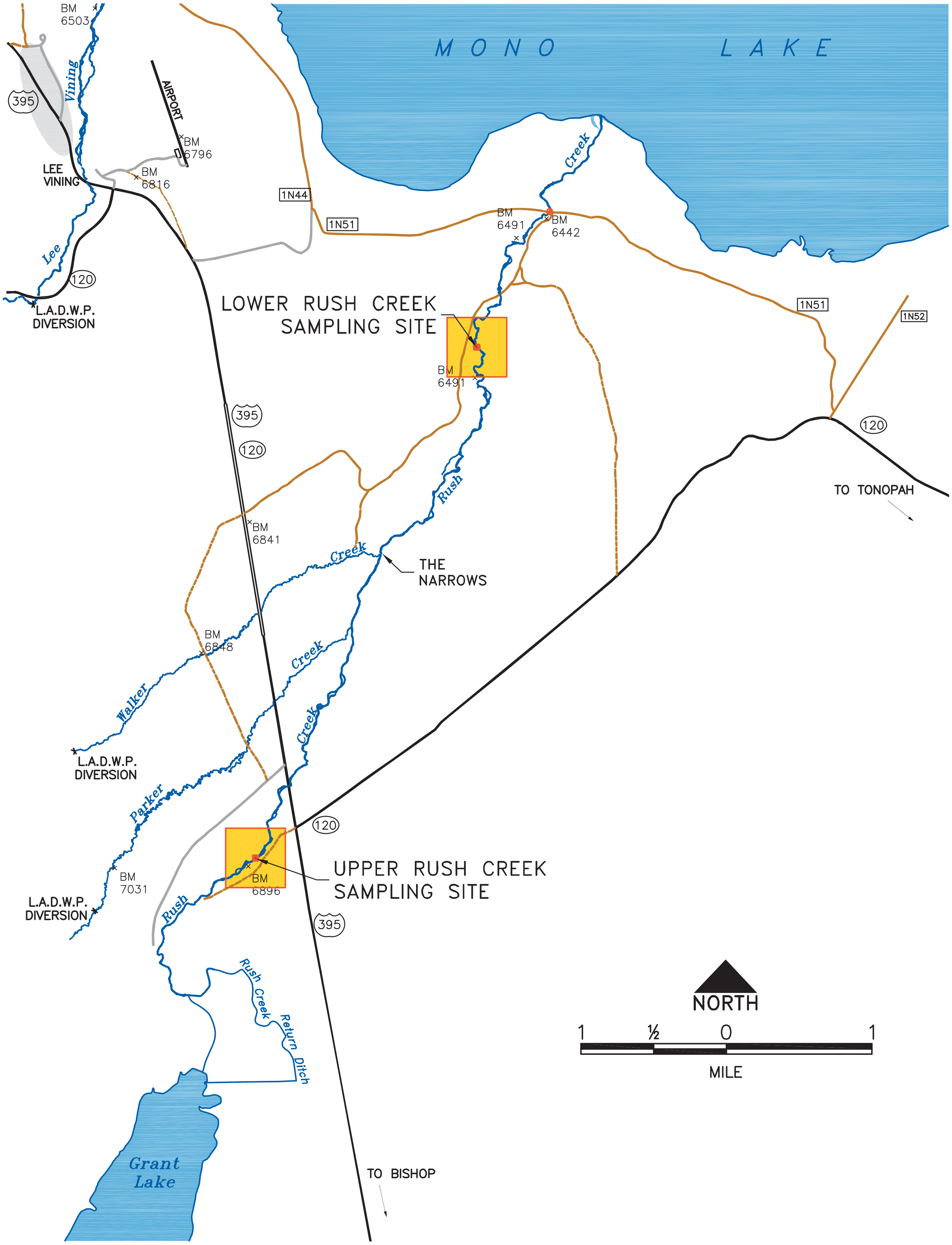


Figure 22. Upper and lower bedload sampling sites on Rush Creek.

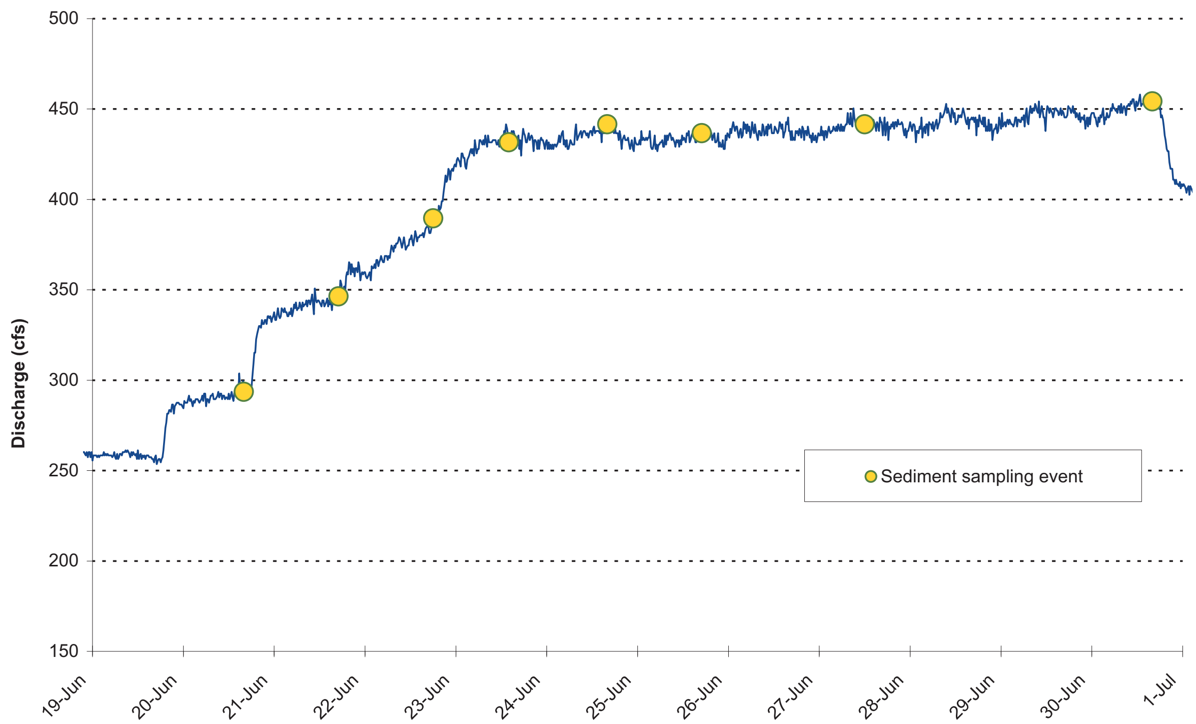


Figure 23. Preliminary 15-minute hydrograph at lower Rush Creek XS -9+82 with sediment sampling events plotted from June 20 – June 30, 2005.

duration to reduce variability in our bedload samples. Verticals were spaced every two feet (with a 1 ft wide nozzle), allowing 50 percent of the moving bed width to be sampled. This spacing provided high sampling precision. Three passes across the channel were made for each flow release. Starting at one bank and proceeding to the opposite bank (1 pass), individual samples were collected at each vertical, and then combined into a single sediment transport volume. The three passes were then averaged into one sample to compute the bedload transport rate for each discharge.

Suspended sediment samples were collected using a cable-deployed D-74 sampler; a hand-held DH-48 sampler was used at the Lower Rush Creek site to sample the channel margins. Sampling transit rates and sampler nozzle sizes were determined from measurements of maximum mean water velocity for each flow release. Depth-integrated (isokinetic) suspended sediment samples were collected for a single pass at each site, as there was less variability in suspended sediment transport.

To summarize, sediment sampling at each study site consisted of one bedload sample (three passes) and one suspended sediment sample (one pass). Each site was sampled once on each designated sampling day. Bedload transport rates were computed using the average of the three passes. Suspended sediment concentration was represented by a single pass.

Streamflows were obtained from either direct measurement by field crews or from LADWP gages (Figure 23). Water surface elevations in the reaches upstream of bedload sampling cross sections were measured for each sampled flow release using rebar stakes and staff plates. These reference marks were surveyed so water surface slopes could be computed for each sampling day.

After field sampling was completed, sediment samples were transported to a laboratory, then dried, weighed, and sieved for particle-size analyses. Samples were sieved in half-phi increments to -1

Figure 24a. Sediment sampling from the cataraft at the Upper Rush Creek site on June 25, 2005. The cataraft is attached to a cable that spans the channel, and is maneuvered between banks to collect sediment samples at discrete locations along the streambed and in the water column. One crew member operates a reel which raises and lowers the sampler, while the other crew member controls the sampler as it is lowered and raised through the water column. View is from the right bank, flow is from left to right and is approximately 400 cfs.

phi (2 mm) and then at whole-phi increments to 4 phi (0.063 mm). Suspended sediment samples were filtered, dried, and weighed to determine sediment concentration (mg/L). Concentrations were determined for 1 phi (0.5 mm), 4 phi (0.063 mm), and material passing 4 phi (finer than 0.063 mm).

3.3.3 Analysis and Results

Total sediment load is the mass of all sediment passing through a given cross section per unit time, including the coarsest material moving as bedload down to the finest particles traveling in suspension. An estimate of total sediment load was made from the data collected, because the estimate is not entirely additive (bedload + suspended sediment ≠ total sediment load) and requires several assumptions.

3.3.3.1 Bedload and suspended sediment transport computations

Bedload transport rates were calculated following Edwards and Glysson (1999) for each sampling date based on (1) the average mass collected during each sampling event, and (2) the total time the sampler was on the bed. Transport rates were calculated for total bedload transport, bedload transport finer than 8.0 mm, and bedload transport finer than 2.0 mm (Tables 12a and 12b;Figures 25a and 25b). Suspended sediment concentrations were determined for total suspended sediment, and for

Figure 24b. Cataraft set-up at the Lower Rush Creek site, June 25, 2005. Bank configuration on the left channel margin and vegetation along the right channel margin prevented the reel-operated samplers (TR-2 and D-74) to be used along the edges, so sampling along both channel edges was performed with hand-held samplers (3-inch Helley-Smith and DH-48). View is from the left bank, flow is from lower right and is approximately 465 cfs.

concentrations greater than 0.5 mm, greater than 0.063 mm, and finer than 0.063 mm. Suspended sediment concentrations measured for each flow release (Tables 13a and 13b;Figures 26a and 26b).

3.3.3.2 Measured sediment transport

The 400 cfs peak SRF releases began on June 23 and was held constant through June 30, 2005. Suspended sediment concentrations at both sites peaked on June 23 (Figures 26a and 26b), while bedload transport at both sites peaked on June 24 (Figures 25a and 25b). These data suggested suspended sediment responded more rapidly than bedload to changes in flow magnitude on the ascending hydrograph limb.

Following peak transport rates, both suspended sediment concentration and bedload transport showed similar trends in declining transport. Suspended sediment transport tapered off at both upper and lower sites, but the average rate of decline through June 25 (two day total) was much greater at Upper Rush Creek than at Lower Rush Creek: 3.57 mg/L/d at Upper Rush Creek compared to 0.6 mg/L/d at the Lower Rush Creek site. Suspended sediment supply became limited at Upper Rush Creek faster than at Lower Rush Creek, supporting our hypothesis that fine sediment supply increased with distance downstream.

Table 12a. Computed bedload transport rates (Qb, tons/day) for the Upper Rush Creek sampling site.

Date	Streamflow (cfs)[1]	Qb total (tons/day)	Qb < 8mm (tons/day)	Qb < 2mm (tons/day)	D84 (mm)	D50 (mm)
6/21/2005	314	4.26	3.6	2.16	7.5	2
6/22/2005	362	7.24	5	2.93	30.3	2.8
6/23/2005	402	12.05	8.1	4.23	25.4	3.6
6/24/2005	402	13.51	8	3.49	46.5	5.1
6/25/2005	401	5.95	4.5	2.57	17	2.5
6/27/2005	402	4.93	3.9	2.08	13.3	2.5
6/30/2005	389	7.87	3.8	1.71	67.3 [2]	8.8 [2]

[1] Daily average streamflow for Rush Creek below Mono Ditch.

[2] Results skewed due to anomalously large volume sampled during first sampling pass (Pass #1 of 3). Also see discussion in text.

Table 12b. Computed bedload transport rates (Qb, tons/day) for the Lower Rush Creek sampling site.

Date	Streamflow (cfs)[1]	Qb total (tons/day)	Qb < 8mm (tons/day)	Qb < 2mm (tons/day)	D84 (mm)	D50 (mm)
6/20/2005	298	2.1	2.0	1.64	2.7	0.9
6/21/2005	367	3.8	2.9	2.15	20.0	1.6
6/22/2005	418	7.6	5.1	3.18	65.5	3.3
6/23/2005	461	13.0	6.1	4.28	73.7	9.5
6/24/2005	465	18.2	9.1	5.57	103.5	8.4
6/25/2005	465	12.0	8.2	5.74	41.6	2.3
6/27/2005	462	8.0	5.7	3.73	23.2	2.5
6/30/2005	461	6.9	5.0	3.48	34.1	2.0

[1] Daily average streamflow for Rush Creek below Narrows.

The interpretation of limiting sediment supply in the upper river was also supported by the bedload data. Although the measured bedload transport peaked on June 24, a pronounced change in transport rate occurred on the ascending limb at Upper Rush Creek on June 23; Lower Rush Creek transport rates continued to rise at the same rate of approximately 5 tons/day, but daily Upper Rush Creek transport rates slowed from a rate of approximately 4 tons/day to 1.4 tons/day. This rate decrease implied that bedload supply became limited at Upper Rush Creek faster than Lower Rush Creek.

3.3.3.3 Transport trend deviations

Although both sites showed an overall decline in sediment transport rate following their peaks, two deviations were observed on June 30: bedload transport increased at the Upper Rush Creek site and suspended sediment concentration increased slightly at the Lower Rush Creek site. We noted that the first pass collected on June 30 was four times heavier and captured more large rocks than the subsequent two passes, skewing the three-pass average. Although previous sampling at both sites collected consistent sample masses, we attributed the large sample to an episodic pulse in bedload transport.

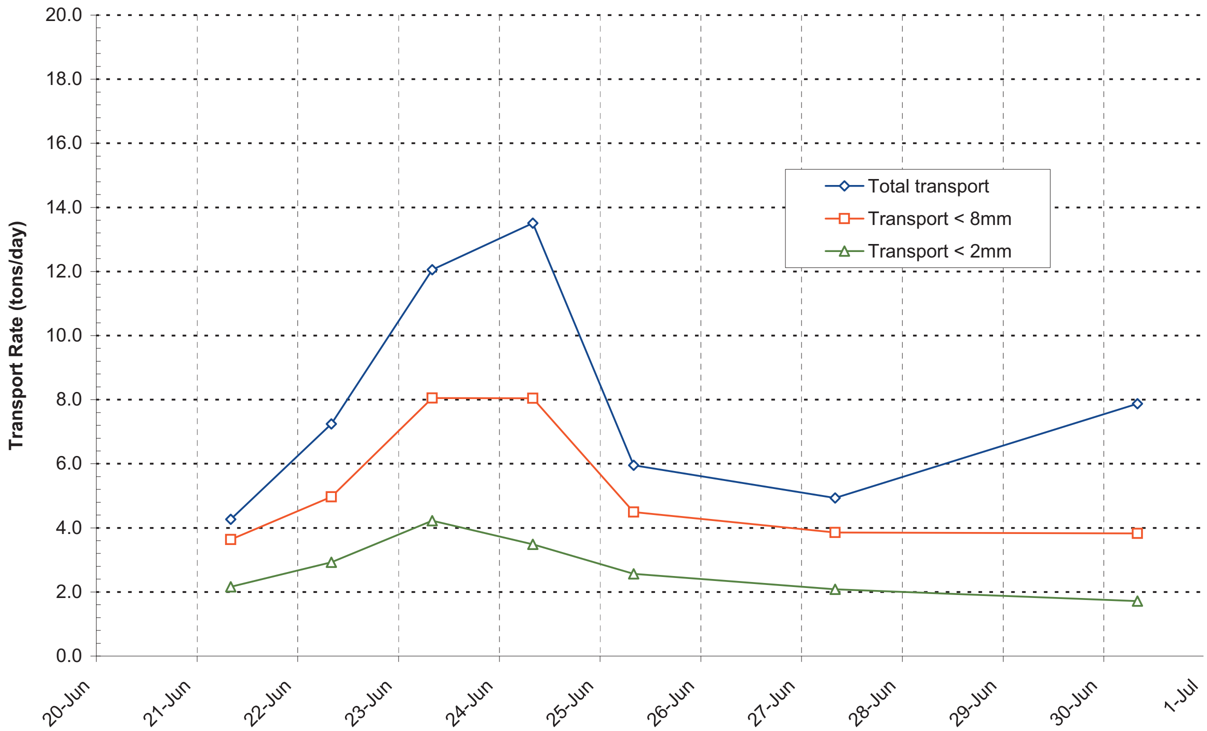


Figure 25a. Upper Rush Creek bedload transport (tons/day), June 20 to July 1, 2005.

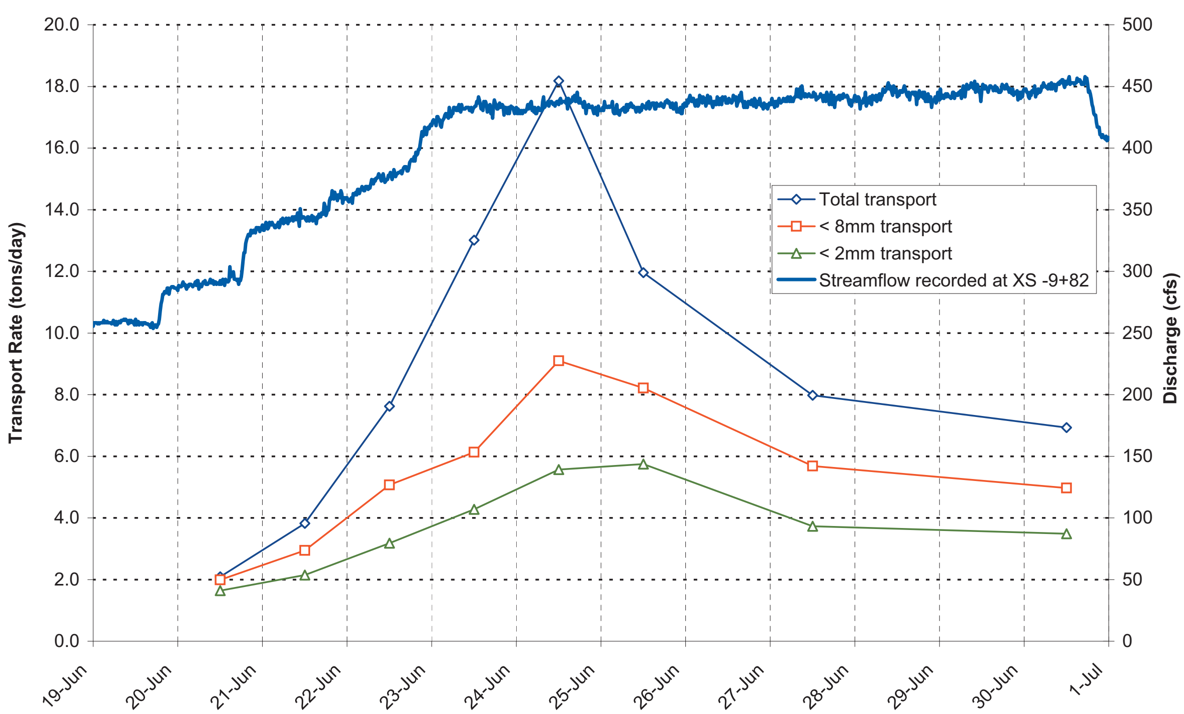


Figure 25b. Lower Rush Creek bedload transport (tons/day) and preliminary 15-minute hydrograph, June 19 to July 1, 2005.

Table 13a. Suspended sediment concentrations (SSC, mg/L) measured at the Upper Rush Creek sampling site.

Date	Streamflow (cfs)[1]	Total SSC (mg/L)	SSC > 0.5 mm (mg/L)	SSC > 0.063 mm (mg/L)	SSC < 0.063 mm (mg/L)
6/21/2005	314	10.7	0.98	4.88	4.83
6/22/2005	362	10.6	1.82	4.51	4.31
6/23/2005	402	15.7	5.24	5.66	4.74
6/24/2005	402	11.4	4.18	3.74	3.49
6/25/2005	401	8.56	2.4	3.07	3.09
6/27/2005	402	5.37	1.05	1.75	2.57
6/30/2005	389	3.96	<0.5	1.61	1.93

[1] Daily average streamflow for Rush Creek below Mono Ditch

Table 13b. Suspended sediment concentrations (SSC mg/L) measured at the Lower Rush Creek sampling site.

Date	Streamflow (cfs)[1]	Total SSC (mg/L)	SSC > 0.5 mm (mg/L)	SSC > 0.063 mm (mg/L)	SSC < 0.063 mm (mg/L)
6/21/2005	367	26	1.2	14.7	10.2
6/22/2005	418	29.1	3.64	16.8	8.7
6/23/2005	461	32.7	4.37	16.9	11.4
6/24/2005	465	31.6	5.58	16.4	9.64
6/25/2005	465	31.5	4.91	19.2	7.34
6/27/2005	462	18.7	2.18	10.4	6.16
6/30/2005	461	21.7	3.74	10.5	7.5

[1] Daily average streamflow for Rush Creek below Narrows.

A similar condition existed for the Lower Rush Creek suspended sediment sample collected on June 30, where suspended sediment concentration increased slightly from 18.7 mg/L on June 27 to 21.7 mg/L. Nothing in the data analysis or in the field notes suggested an anomalous condition, and we interpreted this increase as a perturbation in an overall decreasing trend. This perturbation was not observed at the Upper Rush Creek site.

3.3.4 Discussion

Trends in sediment transport occurred as expected (i.e., sediment transport rates increased on the ascending limb of the SRF release hydrograph and then tapered off after the flow was sustained at 400 cfs). However, sample volumes at the Upper Rush Creek site were much larger than expected. The following sections focus on results as they related to our hypotheses.

3.3.4.1 Sediment transport gradient (Hypotheses #1 and #2)

We hypothesized that sediment supply immediately below Grant Lake should be near zero (Hypothesis #1), but as drainage area increased below the dam, sediment supply would increase (Hypothesis #2). We expected to measure relatively little sediment at the Upper Rush Creek site compared to the lower site. Although lower transport rates were measured at the upper site, transport rates were much higher than expected, indicating a large volume of sediment was being transported

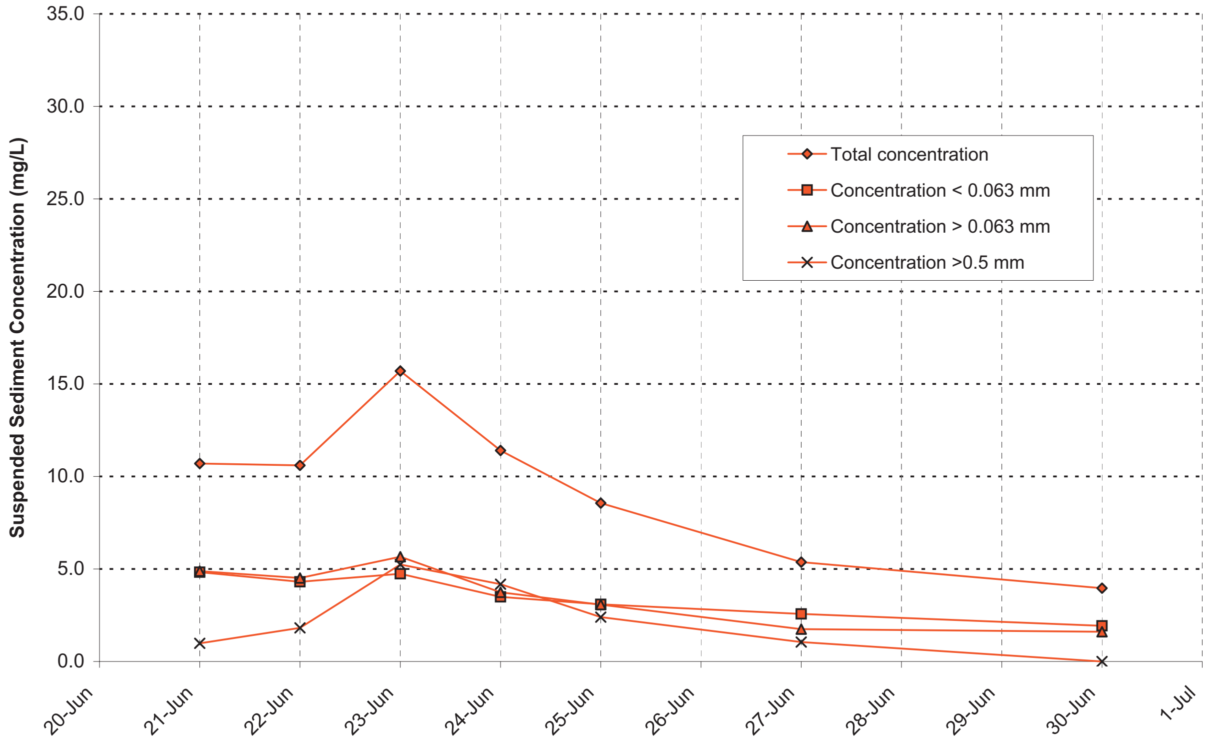


Figure 26a. Upper Rush Creek suspended sediment concentrations (mg/L), June 20 to July 1, 2005.

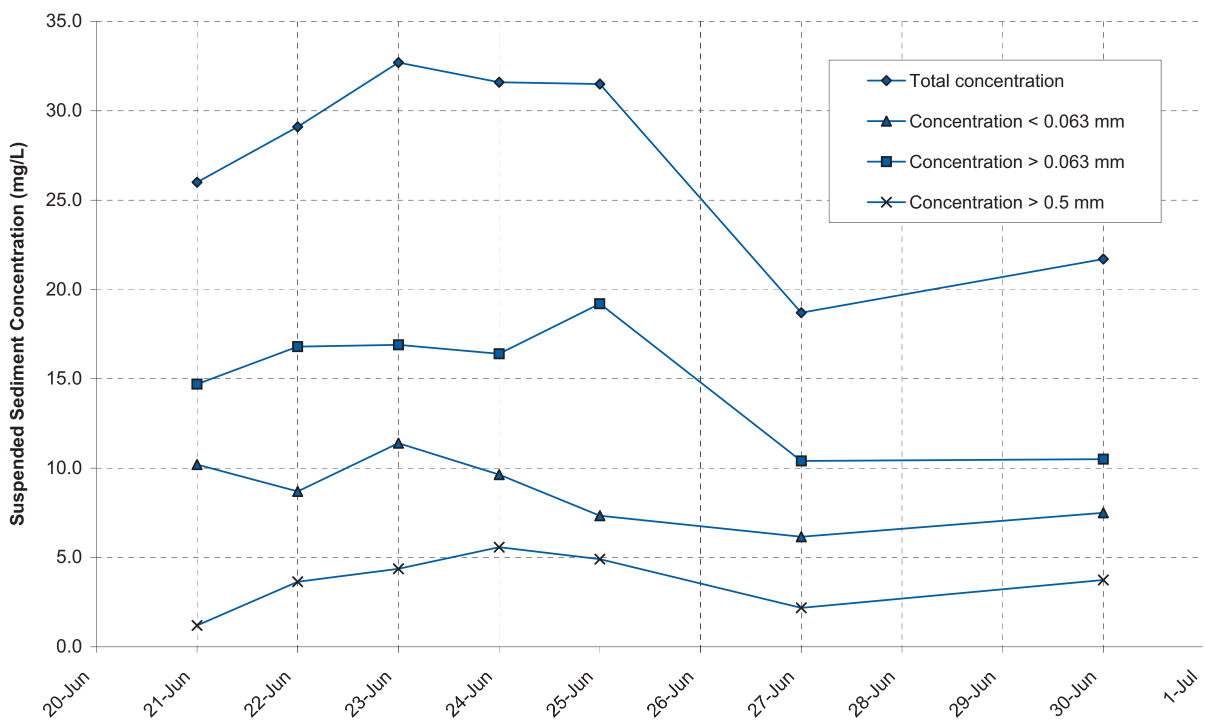


Figure 26b. Lower Rush Creek suspended sediment concentrations (mg/L), June 20 to July 1, 2005.

from the reach above the upper site, which includes approximately 8,130 ft of historic channel and approximately 7,850 ft of the Return Ditch. We were not able to determine the source of sediment delivered to the upper sampling site (i.e., is sediment being supplied by the Return Ditch, by the channel below the Return Ditch, or both?). One possibility is that recent Return Ditch construction may have increased sediment supply, which would likely be temporary.

3.3.4.2 Effectiveness of Flow Magnitude and Duration on Sediment Transport Rates (Hypothesis #3)

Do sediment transport rates decrease with flow duration? To evaluate the effect of flow duration at the Lower Rush Creek site, we plotted cumulative bedload transport during the 400 cfs release period (Figure 27a). We expected transport rates to approach an asymptote as an equilibrium was reached between sediment supply and sediment transport. This trend was observed at Lower Rush Creek, where over 75 percent of the total bedload transported over the 8-day bench was transported the first three days (Figure 27a). The remaining 25 percent was transported the last five days. For a 400 cfs release, two to three days may therefore be a sufficient duration to transport the majority of available bedload. A similar trend was observed in the Upper Rush Creek bedload data (Figure 28a), with 71 percent of the total bedload transported within the first three days.

Suspended sediment concentration curves at the Upper and Lower Rush Creek sites also had inflections at the third sampling day, corroborating the cumulative bedload transport curves (Figures 27b and 28b). At both upper and lower sites, 70 and 79 percent of the total suspended sediment transported over the 8-day bench were transported within the first three days. Therefore a 400 cfs

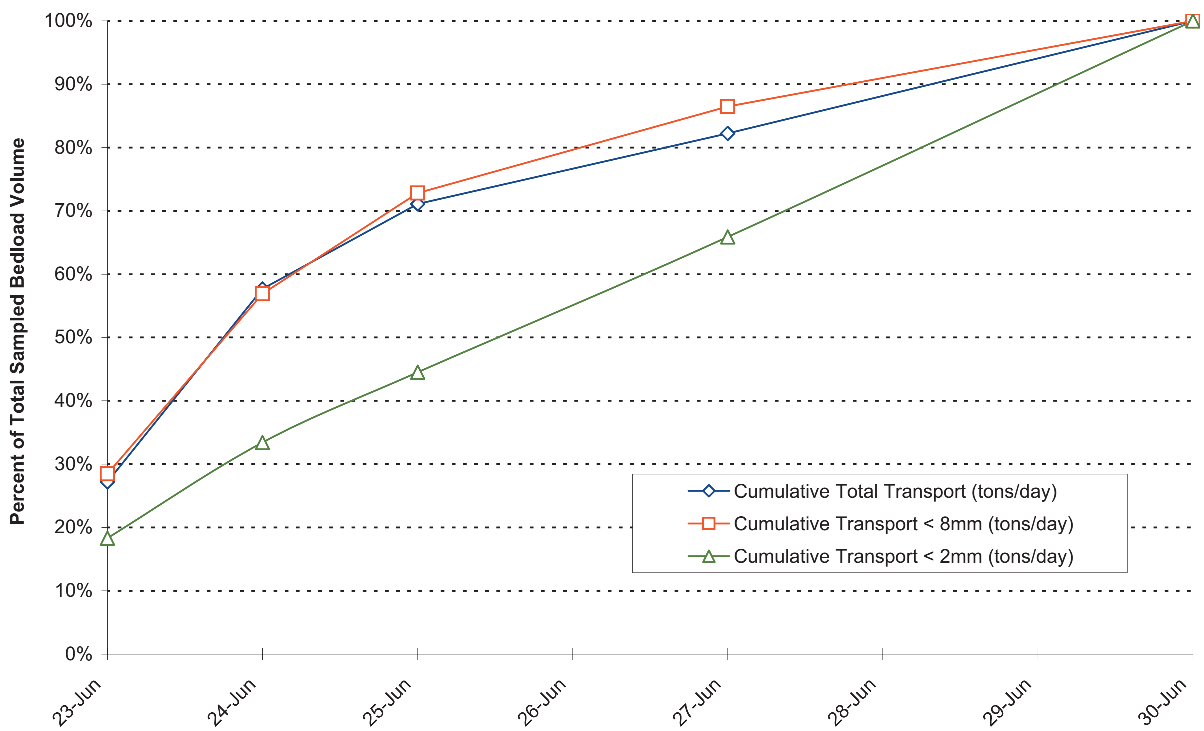


Figure 27a. Lower Rush Creek cumulative bedload transport volume for the scheduled 400 cfs SRF release period. An inflection in the percent of total bedload sampled occurred on June 25, 2005, with approximately 75 percent of the total bedload transported within the first three days.

release of two to three days may be sufficient to transport most available suspended sediment.

One notable difference was in the cumulative bedload transport between the upper and lower sites for the < 2.0 mm particle size range. Only 45 percent of the < 2.0 mm bedload fraction for Upper Rush Creek was transported within the first three days, and cumulative transport continued to increase in a linear trend through the final day of sampling. This cumulative transport rate did not asymptote similar to the < 8.0 mm curve or the total cumulative transport curves, suggesting that an equilibrium was not reached between sediment supply and sediment transport (i.e., the coarse sand supply did not approach a limiting condition). In addition, the Upper Rush Creek suspended sediment cumulative concentration curve showed a limiting trend, bracketing the non-limited particle size range between 0.5 mm and 2.0 mm (coarse sand). A large volume of coarse sand supply must have existed upstream of the upper sampling site.

3.3.4.3 Sediment Rating Curves

Sediment rating curves are used to estimate transport rates as a function of streamflow. Transport rates predicted from 2005 sampling would be specific to the 2005 SRF releases; for example, a similar-shaped hydrograph may not yield the same transport rates. Sediment transport estimates based on a rating curve from the 2005 SRF releases must therefore consider effects of flow duration, because our data demonstrated that bedload transport rates increased with flow magnitude, then decreased with duration. (Figure 29). Different portions of the hydrograph (e.g., rising limb or falling limb) had demonstrably different sediment transport rates, confounding the development of rating curves.

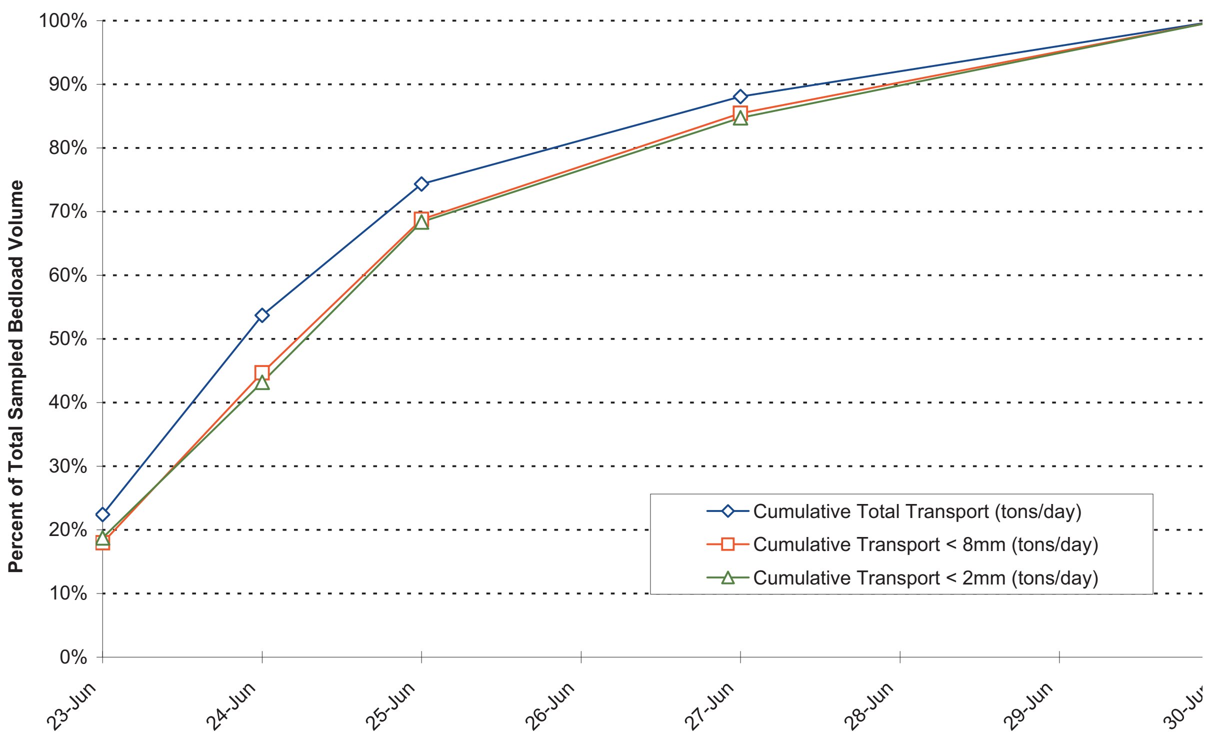


Figure 27b. Upper Rush Creek cumulative bedload transport volume for the scheduled 400 cfs SRF release period. An inflection in the percent of total bedload sampled occurred on June 25, 2005, with approximately 71 percent of the total bedload transported within the first three days.

APPENDIX B

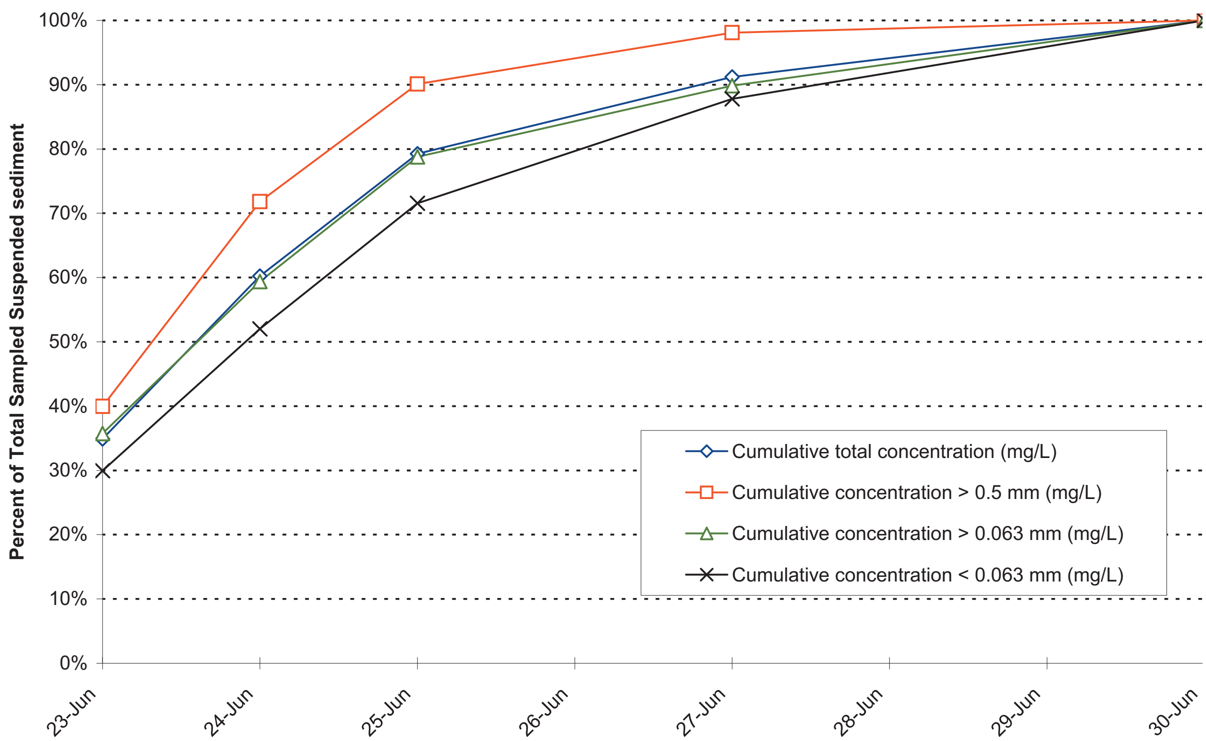


Figure 28a. Upper Rush Creek cumulative suspended sediment concentration for the scheduled 400 cfs SRF release period. An inflection in the percent of suspended sediment sampled occurred on June 25, 2003, with approximately 79 percent of the total suspended sediment (and up to approximately 90 percent of suspended sediment > 0.5mm) was transported within the first three days.

Hysteresis loops, a common effect in sediment transport versus discharge plots (e.g., Dunne and Leopold 1978; GMA 2005), graphically portray the variation of bedload transport with streamflow during a single storm or flood hydrograph. The hysteresis loop (Figure 29) demonstrated bedload transport was greatest on the rising limb of the hydrograph and then tapered off during the 400 cfs bench. The decrease in transport rates following the first day of the 400 cfs peak may be attributed to depletion of sediment supply following the rising limb of the SRF releases hydrograph (i.e., supply available for transport becomes limited). For the Rush Creek bedload transport data (Figure 29), a hysteresis loop would be better defined if additional sampling followed the 400 cfs bench. We added a hypothetical data point to demonstrate the expected hysteresis loop.

3.3.4.4 Summary

Our field equipment and methods yielded high quality bedload transport data and good quality suspended sediment data. Sediment transport was higher in Lower Rush Creek, but the difference was less than expected and does not necessarily support all our hypotheses. These results provided evidence to support Hypotheses #1 and #2, but more information would be needed to determine the cause for the greater-than-expected sediment transport at the upper sampling site. The sediment supply from the Return Ditch may be temporarily high due to reconstruction in 2003.

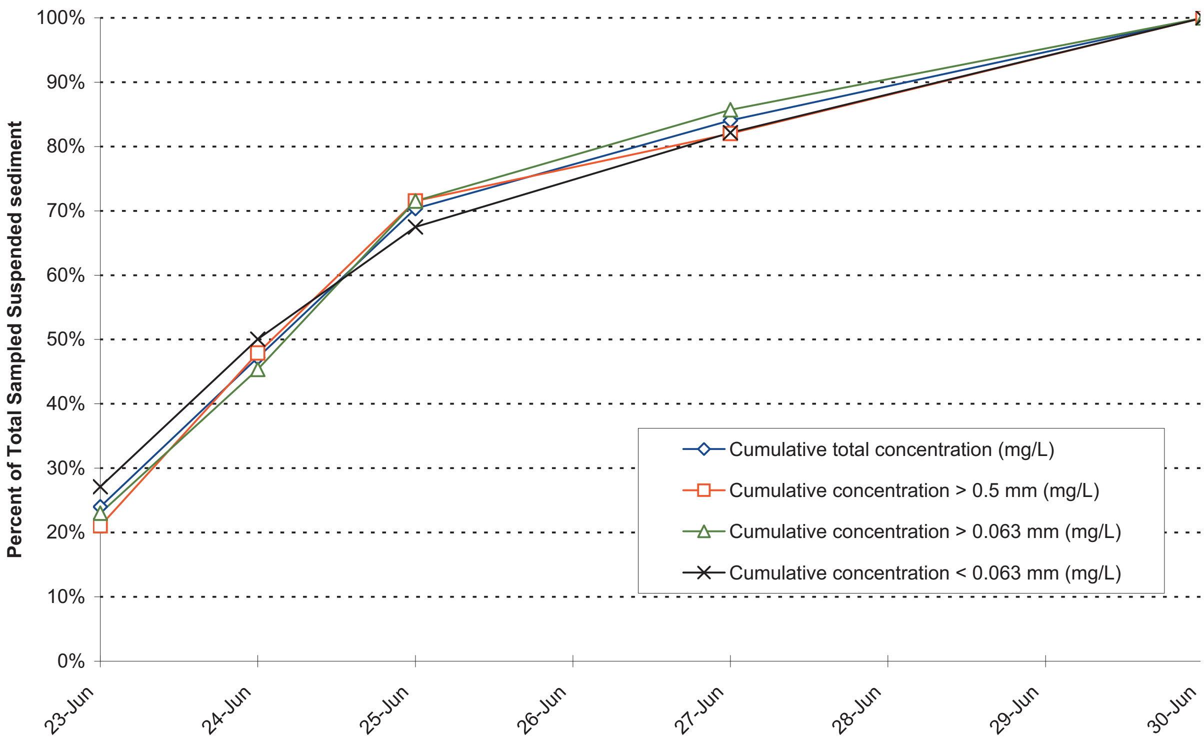


Figure 28b. Lower Rush Creek cumulative suspended sediment concentration for the scheduled 400 cfs SRF release period. An inflection in the percent of suspended sediment sampled occurred on June 25, 2003, indicating approximately 70 percent of the total suspended sediment was transported within the first three days.

Sediment transport decreased with increasing duration of constant flow magnitude, supporting Hypothesis #3. The first two to three days of the 400 cfs release transported a substantial portion of the total bedload and suspended sediment transported by the 2005 release. Shorter duration, higher magnitude high flow releases may be more water-efficient in accomplishing geomorphic work (using sediment transport flux as an index of "geomorphic work") than longer duration moderate flow releases. Other measures of geomorphic work, such as bed mobility, bed scour, channel migration, and sediment recruitment need to be considered in the magnitude and duration of future high flow releases. There are several possible high flow management implications from these findings, which will be explored in subsequent reports.

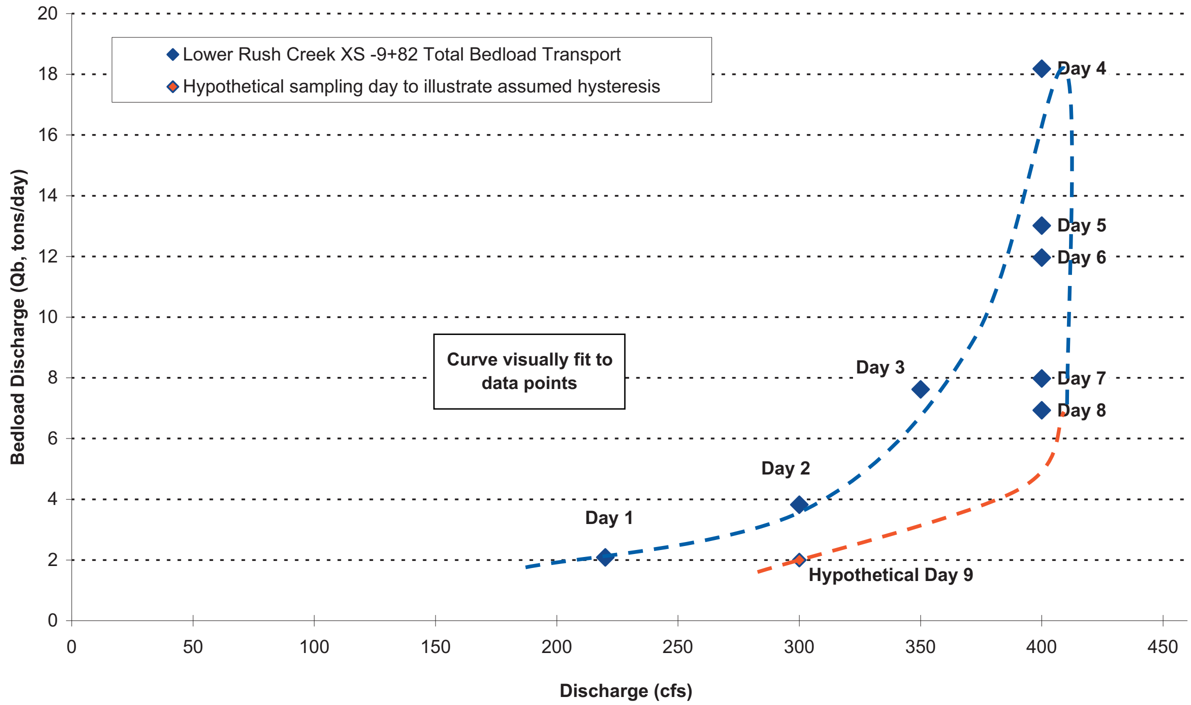
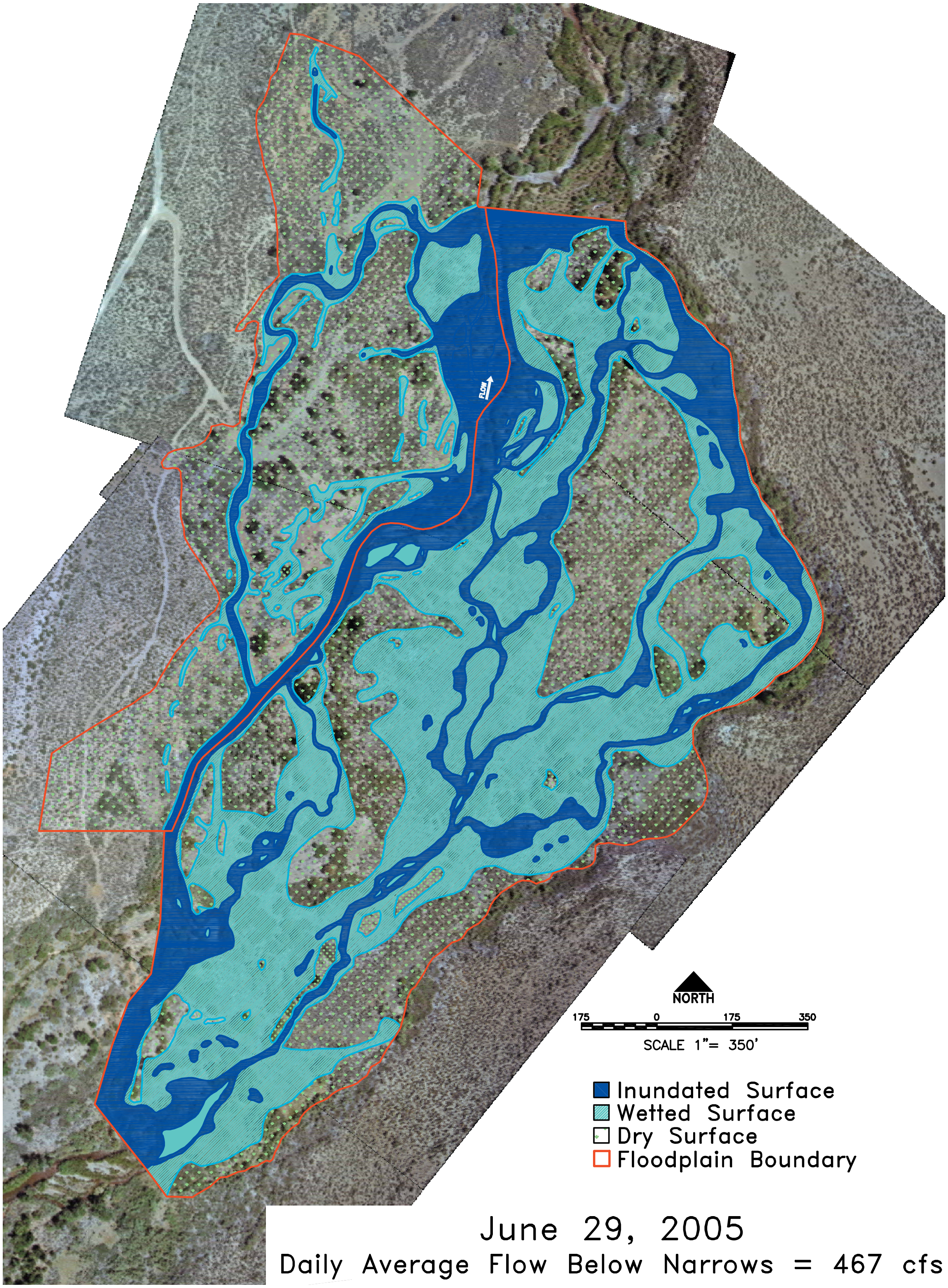
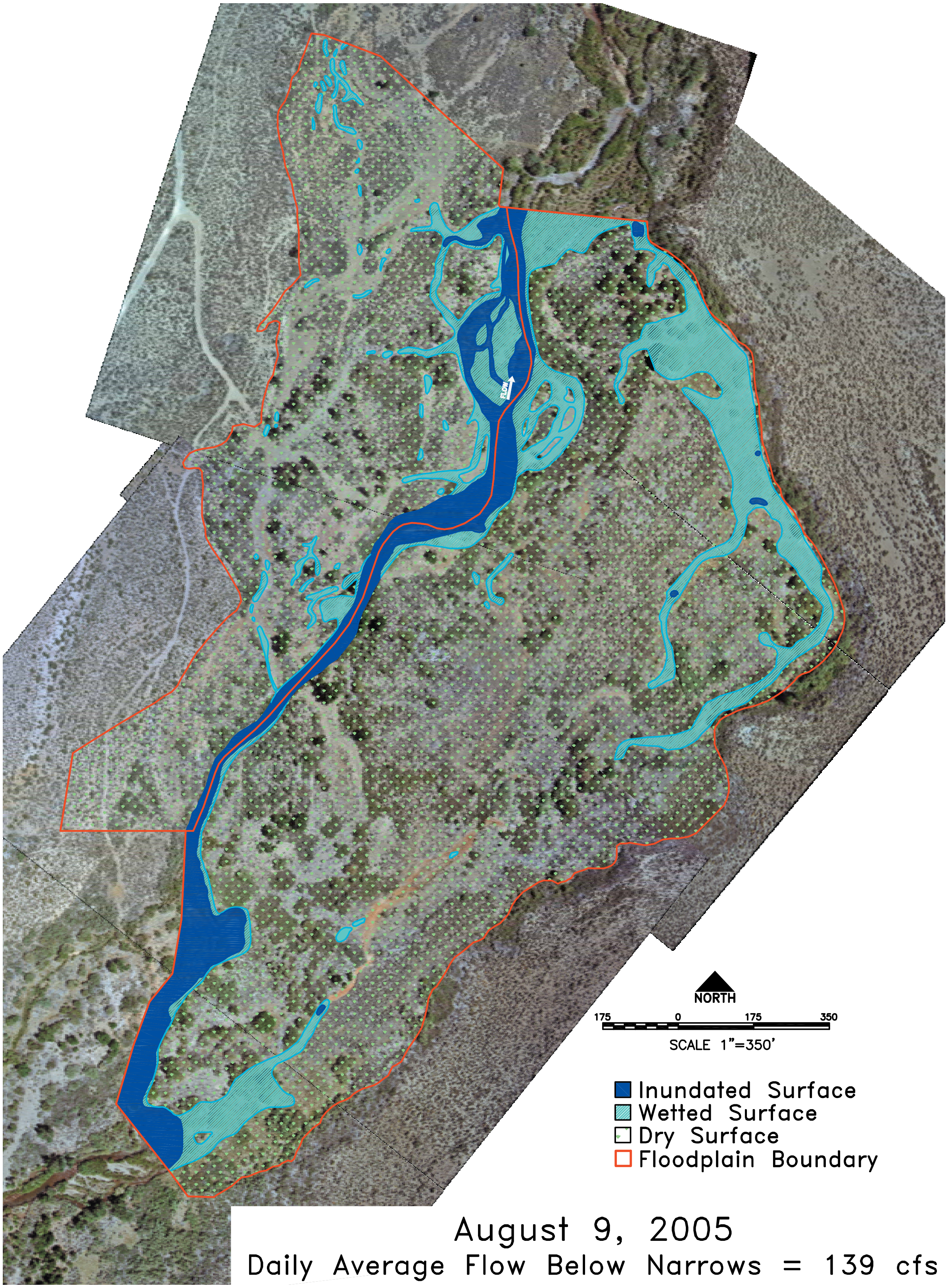


Figure 29. Lower Rush Creek total bedload discharge as a function of streamflow, with increasing transport rate on ascending limb of hydrograph, and then decreasing transport rate following the first day of the 400 cfs bench.

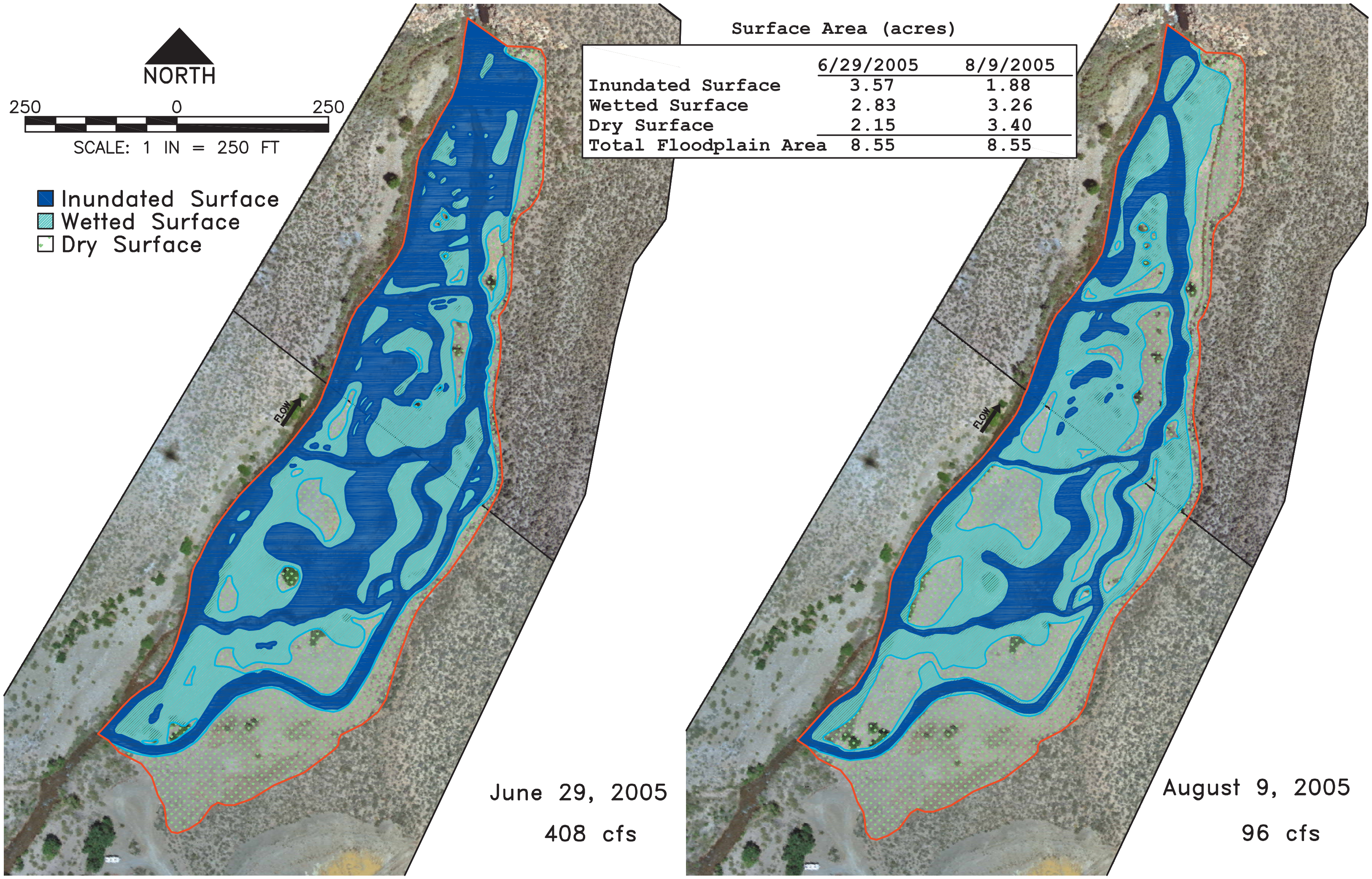
APPENDIX B-4. FLOODPLAIN INUNDATION MAPPING



Appendix B-4. Figure 1. The 8 and 4bii floodplain with the extent of wetted and inundated areas on June 28, 2005, resulting from flow entering the 8 Channel and 4bii Channel.



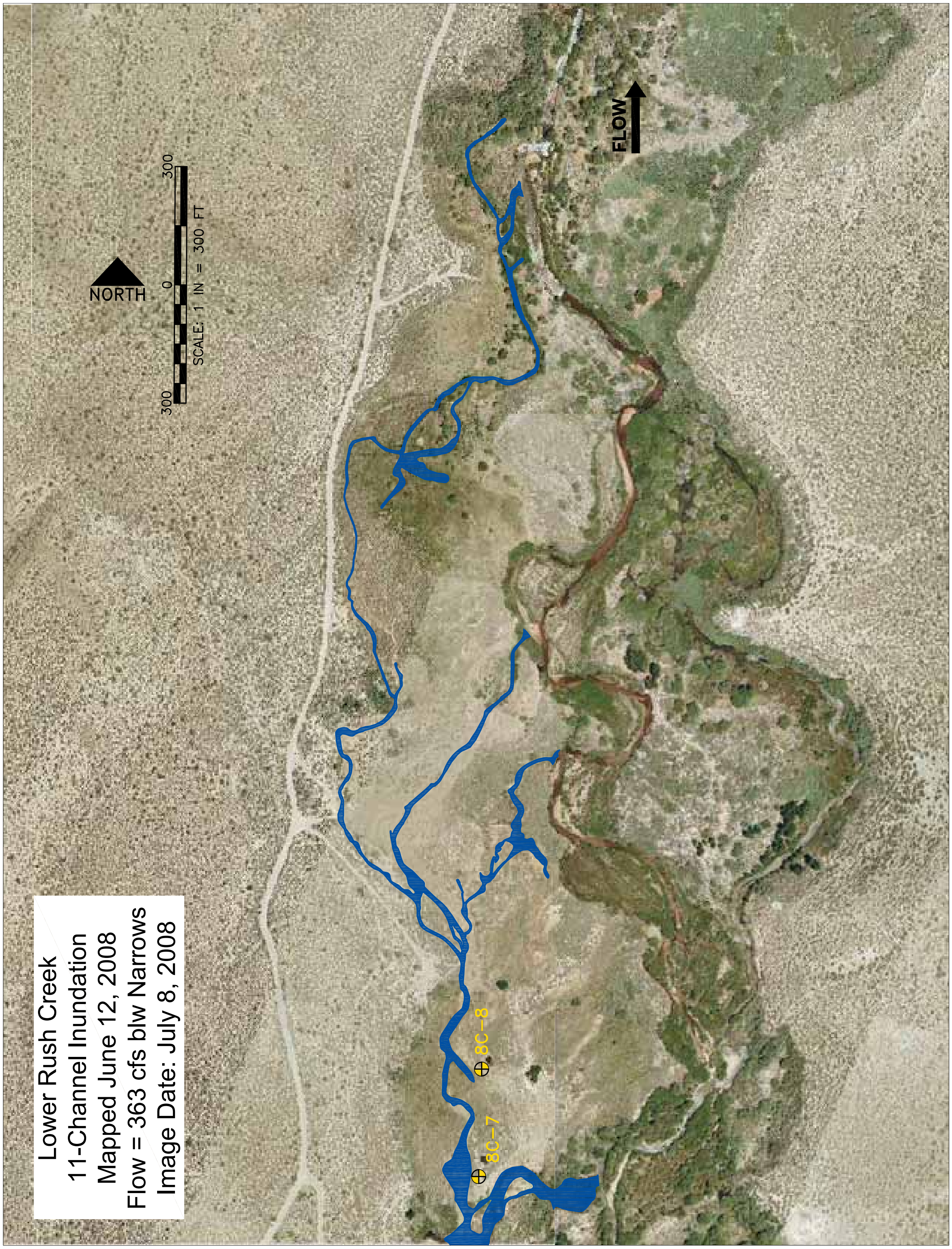
Appendix B-4. Figure 2. The 8 and 4bii floodplain with the extent of wetted and inundated areas on August 9, 2005, resulting from flow entering the 8 Channel and 4bii Channel.



Surface Area (acres)

	6/29/2005	8/9/2005
Inundated Surface	3.57	1.88
Wetted Surface	2.83	3.26
Dry Surface	2.15	3.40
Total Floodplain Area	8.55	8.55

Appendix B-4. Figure 3. Reconstructed 3D floodplain with the extent of wetted and inundated areas on June 29, 2005, and August 9, 2005.



Appendix B-4. Figure 4. Pathway of 8 Channel surface flow during the peak Rush Creek SRF releases, mapped on July 12, 2008.

APPENDIX B-5. FLOODPLAIN DEPOSITION EXPERIMENTS

3.4 Floodplain Deposition Experiments

In RY 2004, we began field experiments to evaluate the role of streamflow magnitude and duration on reconfinement of the lower Rush Creek channel via natural floodplain construction processes (coarse and fine sediment deposition during high flows). In RY 2004, the SRF releases fluctuated between 240 cfs and 384 cfs over a three-day period. The duration of the 384 cfs peak was less than one day (the daily average peak was 354 cfs) (McBain & Trush, 2005). This peak flow release deposited small volumes of fine sediment at our floodplain study sites. The short peak duration combined with flow fluctuations ruled out any evaluation of duration in deposition rates and volumes.

Wet-Normal runoff conditions in RY 2005, (see Section 2.1) provided an opportunity to evaluate the role of peak flow magnitude and duration on floodplain deposition and channel reconfinement processes. The Rush Creek SRF releases were modified, in part, to accommodate floodplain deposition experimental objectives. The higher magnitude snowmelt runoff anticipated on Lee Vining Creek also allowed us to plan and implement floodplain sediment deposition studies on Lee Vining Creek. Experimental sites were installed on the B-1 channel and main channel of Lee Vining Creek.

Previous annual reports describe historical floodplain conditions and the importance of channel confinement to stream recovery, as well as provide conceptual models describing floodplain processes that lead to confinement (McBain and Trush 2000, 2005). Objectives for RY 2005 monitoring were to address two primary questions:

(1) Do floodplain deposition rates decrease with increasing peak flow duration? Or rephrased, what additional deposition "work" is accomplished with each additional day of peak flow duration? Does fine sediment supply to the floodplains decrease with duration?

(2) How much floodplain deposition results from successive days of a 400 cfs peak flow release?

These questions address the sufficiency of the magnitude and duration of SRF peak flows to re-confine the bankfull channel, rebuild geomorphically active floodplain elevations, and re-create healthy aquatic habitat.

3.4.1 Sampling methods

Five cross sections were selected on lower Rush Creek for RY 2005 experiments (Figure 30): XS -25+00, XS 319+62, XS 321+02, XS 239+00, and XS 1+10. Several cross sections used in RY 2004 were abandoned in RY 2005 in favor of sites we anticipated to be more dynamic and responsive to the

2005 peak flow magnitude. Cross section 1+10 was located at the upstream end of the 10 Channel, while the remaining four cross sections were located on the main channel. Cross sections 319+62 and 321+02 were new locations not sampled in RY 2004, and were selected in part because they were located on a large developing floodplain where all the flow was in a single channel (compared to several RY 2004 cross sections adjacent to channels that only conveyed a portion of the total flow in the stream). Cross section 239+00 was selected because it traverses a recently constructed floodplain at the 3D site that is at a very low elevation relative to the channel (and therefore susceptible to deposition).

Four cross sections were selected on lower Lee Vining Creek for RY 2005 experiments (Figure 31): XS 0+87, XS 1+28, XS 4+31, and XS 3+45. Cross section 3+45 i on the main channel, and the remaining three are on the lower B-1 channel. All experiments were located on existing cross sections and were not sampled in RY2004.

In 2004, one-foot wide strips of indoor-outdoor carpet were installed on several cross sections to clearly detect deposition directly attributable to the 2004 SRF releases. This method proved successful, and carpet strips were installed at the four cross sections on Lee Vining Creek and the five cross sections on Rush Creek (Table 14). The carpets were installed upside down with a rough fabric surface facing upwards, and nailed onto the floodplain with 12" long spikes flush to the existing floodplain surface. Following the peak flow release, local deposition depths were measured at frequent intervals on the carpets with a metal ruler, and samples of deposited sediment were collected and transported to a laboratory to be dried, sieved, and weighed.

Bedload transport rates were measured at consistent stations on Rush Creek cross sections 319+62 and -25+00 during Day 1, 2, 3, 4, 6, and 8 of the 400 cfs peak SRF release (June 23, 24, 25, 26, 28, and 30). A 3-inch square Helley-Smith bedload sampler was used. Most samples were collected with the sampler held on the bed surface for 10 minutes. Bedload samples were also transported home for particle size analysis. Bedload sampling was initiated at cross section 1+10 and 321+02, but because transport rates were small, we stopped sampling after the first day of the peak flow release. Bedload sampling was not conducted on Lee Vining Creek due to uncertainty whether there would be adequate inundation and transport.

To address Question #1 (does deposition rate decrease with peak flow duration?), we attempted to use colored sand as a tracer. Colored sand was sprinkled immediately upstream of the carpet in places where there was noticeable deposition, with the expectation that it would settle in discrete horizontal layers on the carpet. With multiple layers of colored sand interspersed with naturally deposited sand, the distance between colored sand lenses could be measured, and that depth divided by the duration of flow (in days) that caused that deposition depth would yield a deposition rate. Colored sand was distributed as follows:

- Day 0-add yellow sand to signify initial conditions when Q=400 cfs;
- Day 1-add red sand to signify sand deposition after 1 day of 400 cfs;
- Day 2-add blue sand to signify sand deposition after 2 days of 400 cfs;
- Day 8-measure top of natural sand deposition to signify sand deposition after 8 days of 400 cfs.

The bedload and suspended sediment sampling on the mainstem of Rush Creek was closely coordinated with the floodplain deposition studies to correlate floodplain deposition rates and volumes with the mainstem sediment transport rates in Rush Creek as a function of longitudinal location (upstream versus downstream) and duration. This integrated monitoring addressed whether fine sediment supply was near zero at the outlet of Grant Lake, and significantly increased downstream of the Highway 395 Bridge where glacial outwash terraces may provide a higher sediment supply to Rush Creek.

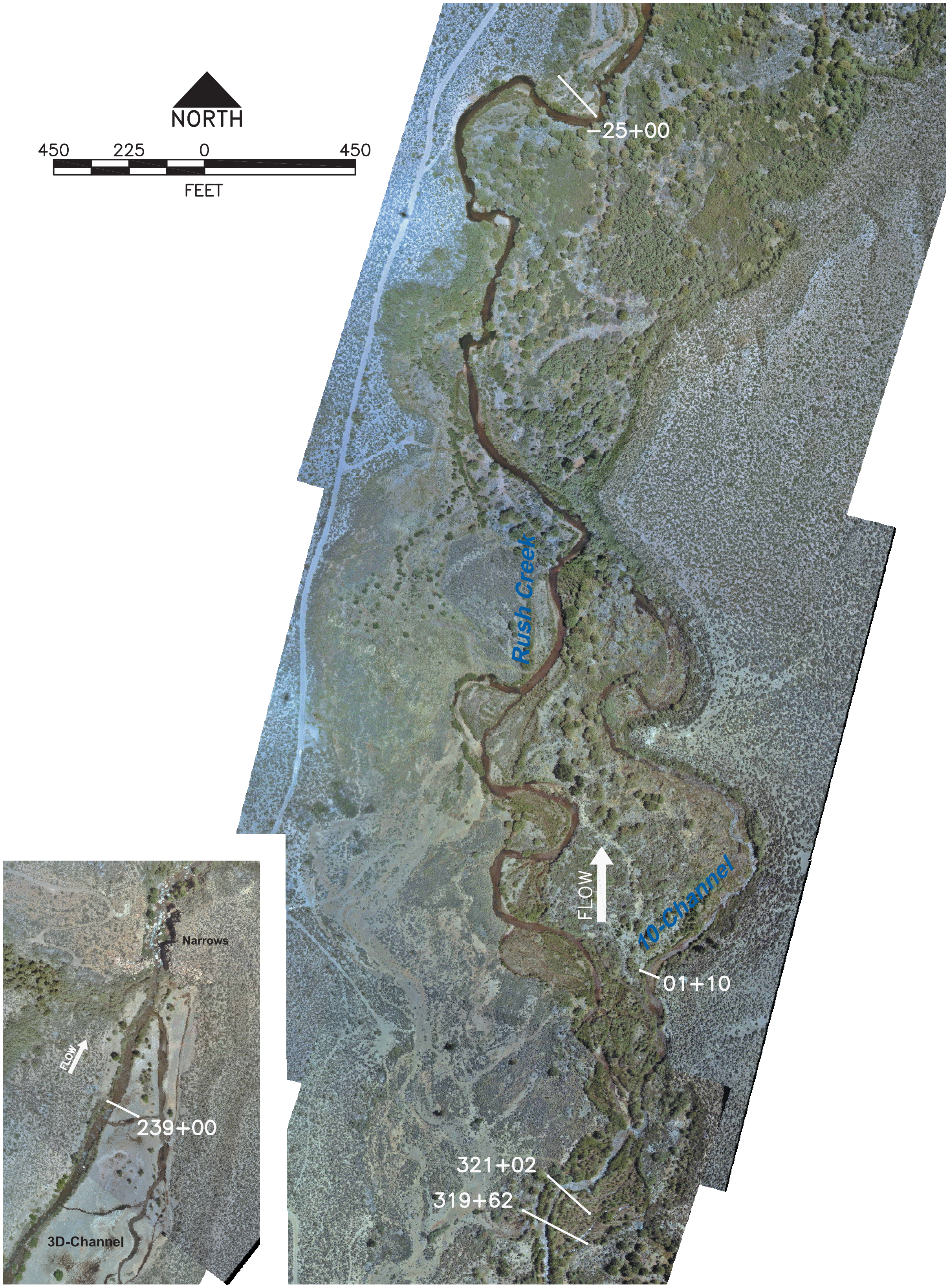


Figure 30. Location of Rush Creek floodplain deposition monitoring cross sections.

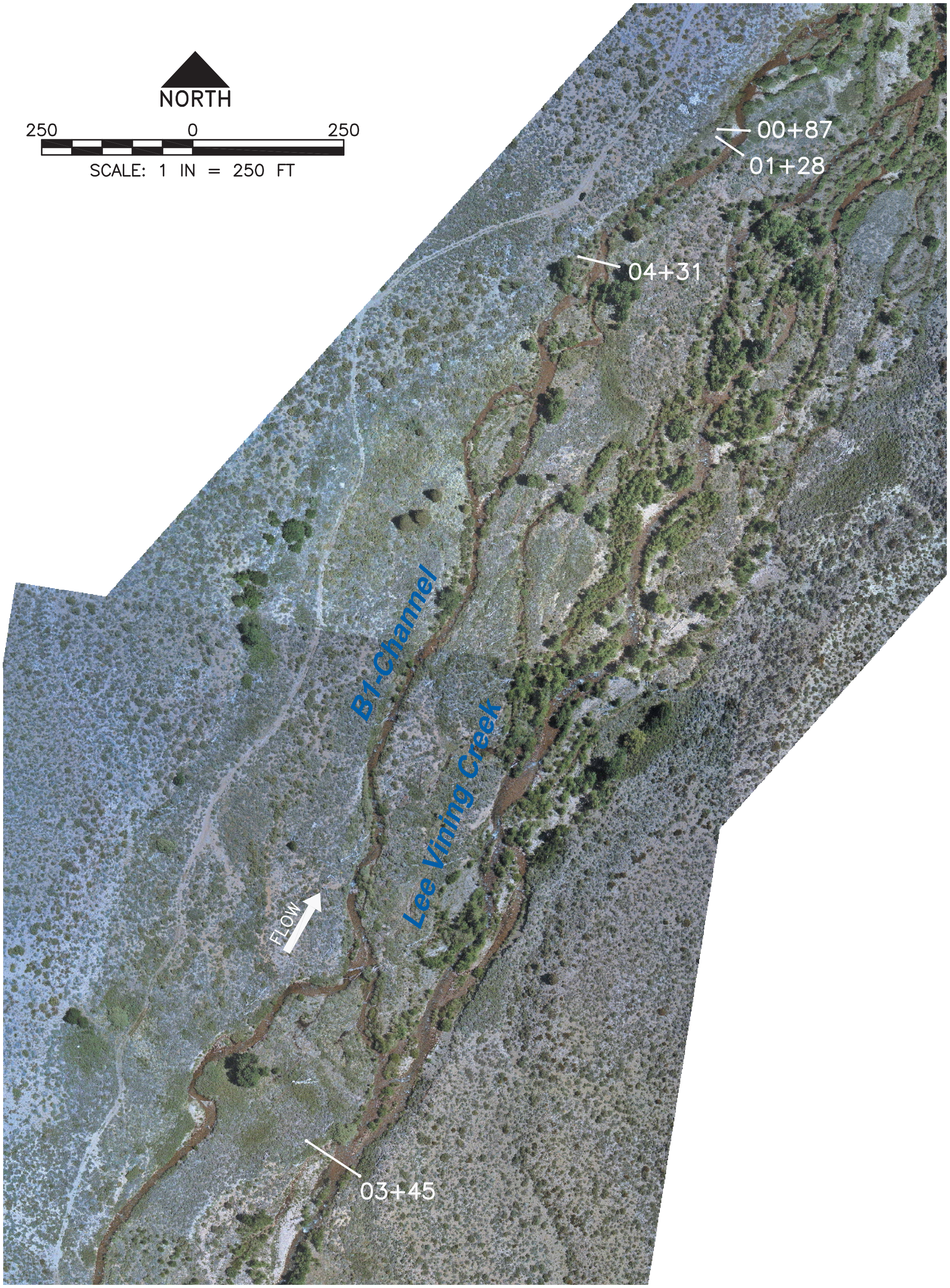


Figure 31. Location of Lee Vining Creek floodplain deposition monitoring cross sections.

Table 14. Summary of experiments at Lee Vining and Rush Creek cross sections conducted during the peak flow release for RY 2005.

Creek	Cross Section	Before/After Deposition Measured?	Colored Sand Experiment?	Bedload Sampling?	Figure # (Appendix G)
Rush Creek	239+00 (main channel)	N[1]	Y	N	G-1
	319+62 (main channel)	Y	Y	Y	G-2
	321+02 (main channel)	Y	Y	N[2]	G-3
	1+10 (10 Channel)	Y	Y	N[2]	G-4
	-25+00 (main channel)	Y	Y	Y	G-5
Lee Vining Creek	3+45 (main channel)	Y	N	N	G-6
	4+31 (B-1 Channel)	Y	N	N	G-7
	1+28 (B-1 Channel)	Y	N	N	G-8
	0+87 (B-1 Channel)	Y	N	N	G-9

[1] Gravel bar formed during high flow, no fine sediment deposition
[2] Bedload sampling initiated, but transport rates too low and not continued

3.4.2 Analysis and Results

As with RY 2004 results, sediment transport and floodplain deposition data collected during the 2005 SRF releases should be considered site-specific, and extrapolated only with caution for the following reasons: (1) there are site differences in sediment supply, transport rates, and physical conditions influencing the extent and duration of inundation, (2) low-elevation floodplain sites were selected to increase the probability of inundation during the June 2004 SRF releases and not selected to represent the range of floodplain surfaces found along Rush and Lee Vining creeks, and (3) the data are from only one peak flood event and may differ from other high flow releases of similar magnitude and duration, which have access to different sources and supplies of stored sediment.

Despite the site-specificity of our results, the 2005 SRF releases and corresponding floodplain deposition monitoring improved our understanding of floodplain recovery processes, particularly with regard to the magnitude and duration of SRF releases. Floodplain deposition depths and final elevations are illustrated in cross section plots in Appendix G-1 to G-12. Bedload transport rates measured at floodplain deposition sites are provided in Appendix G-13 to G-17, and floodplain depositional rates are illustrated in Figure 32. The D_{84} and D_{50} grain size of floodplain deposits are summarized in Table 15. In contrast to the floodplain deposition samples, the grain size of the bedload samples was too small to compute the D_{84} based on the sieve set used, so results are presented as:

(1) the range of sieves where the largest particle was trapped, and (2) the percent of total sample captured on that largest sieve opening (Table 16).

3.4.3 Discussion

The 2005 peak SRF release magnitude of 400 cfs (resulting in a 467 cfs peak in Lower Rush Creek) was larger than the RY 2004 releases (384 cfs), but more significantly, had a longer duration (1 day in 2004 versus 8 days in 2005). Consequently, floodplain deposition was more pronounced than in RY 2004. Deposition depths were still modest, however, with most deposition at our study sites less than 40 mm (1.5 inches) (Appendix G-4, G-5, G-7, G-9, G-10). Deposition depths were slightly larger along channel margins, with depths up to 100 mm (4 inches) (Appendix G-3, G-6, G-7, G-8).

Fine sediment deposition was greatest on the floodplain edge immediately adjacent to the channel margin. In addition, bedload transport rates and floodplain depositional rates were also greatest along the channel margins (Figure 32). Visual observations and particle size sampling on cross section -25+00 indicated the grain size and depth of the depositional material was greatest along the channel margins on the inside of point bars where coarser bedload was deposited (Table 15, Appendix G-14 and G-17). On the large floodplain traversed by cross section 319+62 (Figure 33), significant deposition occurred behind clumps of vegetation adjacent to lanes of substantial bedload transport across the floodplain (Appendix G-3 and G-12), but this deposition was still smaller than along the channel margins where bedload from the main channel was deposited among the first vegetation. This pattern of deposition explains the asymmetrical floodplain morphology frequently observed in Rush Creek, in which the floodplain elevation is highest along the channel margins and slopes downward away from the channel.

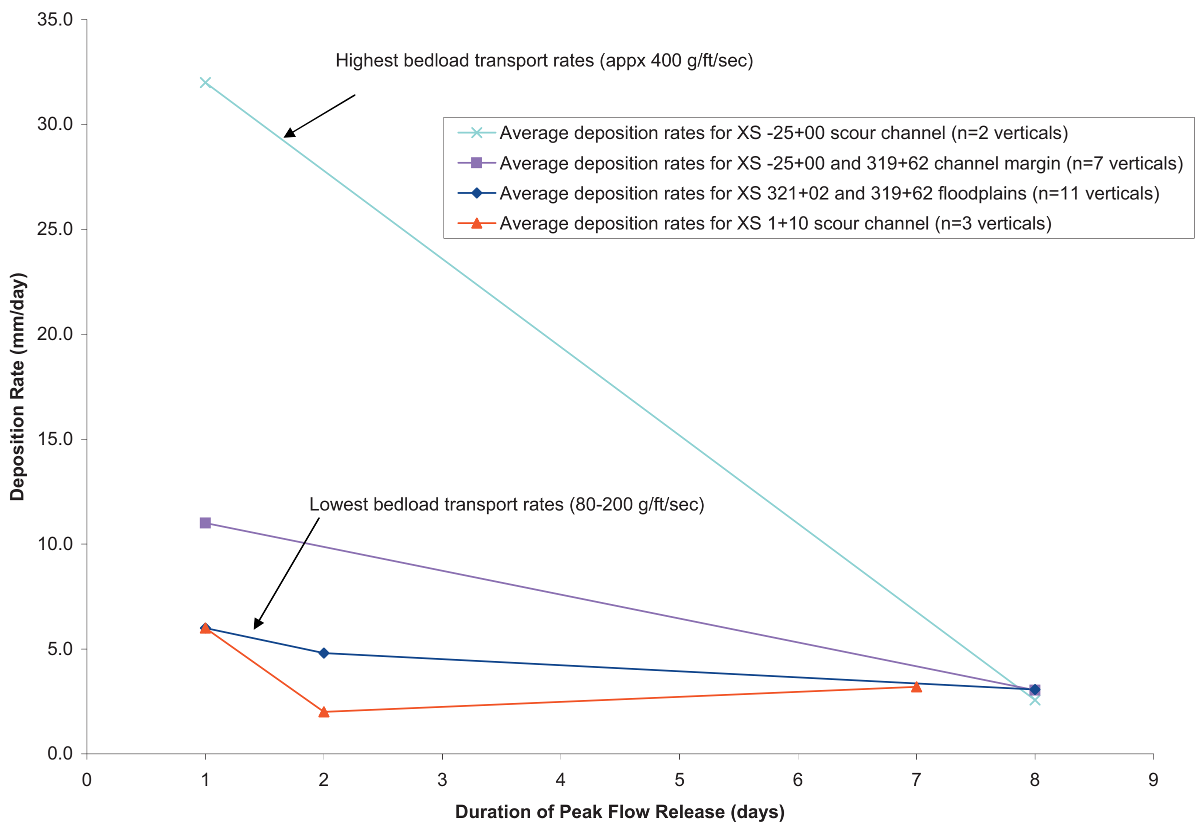


Figure 32. Average deposition rates as a function of peak flow release duration for geomorphic features on selected verticals on Rush Creek cross sections 321+02, 319+62, 1+10, and -25+00.

Floodplain bedload transport rates, while more variable than the mainstem bedload transport results presented in Section 3-3, followed the same trend of decreasing transport rates with duration (Appendix G-15 through G-17, Figure 32). With the exception of cross section -25+00 Station 126.0, the bedload transport rates decreased dramatically (by 50% or more) after a 3-day duration. A similar decrease in bedload transport rates was observed on the mainstem, but occurred after a 2-day duration, suggesting that there may have been a 1-day lag time between mainstem and floodplain transport rates. There was no detectable change in maximum grain size in bedload samples with increasing duration (Table 16), although the range of sieves did not allow a precise analysis of changing grain sizes with duration.

The colored sand experiments were not as useful as hoped due to several factors. The experiment would work well for sites where the primary depositional process was settling of suspended sediment (e.g., cross section 319+62 near station 172, Figure 34); however, most depositional features were formed by bedload deposition and many had a high exchange with bedload transport, preventing the desired "lenses" of colored sand from being retained. For those stations where the bedload exchange was minimal and the experiment performed well, the rates of deposition as a function of duration were computed and averaged for scour channel locations, channel margins, and floodplains (Figure

Table 15. Summary of D_{84} and D_{50} grain sizes of floodplain depositional features on Rush Creek and Lee Vining Creek cross sections.

Stream	Cross Section	Station (ft)	D_{84} (mm)	D_{50} (mm)
Rush Creek	319+62	101.2	0.31	0.17
		103.4	0.34	0.18
		107.3	0.34	0.17
		113.3	0.44	0.23
		119.6	0.65	0.37
		133.0	0.39	0.18
		150.3	0.40	0.18
		154.6	0.29	0.15
		155.6	0.48	0.34
		174.5	0.31	0.17
Rush Creek	321+02	143.6	0.83	0.44
		152.0	0.46	0.22
		157.7	0.46	0.25
		159.1	0.46	0.20
Rush Creek	1+10	45.0	0.38	0.20
		46.5	0.59	0.32
		50.4	0.38	0.20
Rush Creek	-25+00	123.6	0.42	0.20
		124.8	0.45	0.21
		159.5	1.25	0.44
		161.0	0.80	0.40
		162.5	0.88	0.42
		164.0	0.80	0.36
		165.5	1.63	0.64
		167.0	0.94	0.41
		168.7	0.61	0.34
Lee Vining Creek	3+45	38.0	0.43	0.27
Lee Vining Creek	4+31	20.2 - 21.2	1.03	0.56
Lee Vining Creek	1+28	26.3 - 27.3	0.41	0.20

Table 16. Summary of maximum grain sizes of floodplain bedload samples on Rush Creek as a function of duration.

Cross Section	Station	Date	Flow Release Duration (days)	Largest particle size class in bedload sample (mm)	Percent of total sample weight contained in the largest particle size class sieve
319+62	183.2	23-Jun-05	1	2 mm - 4 mm	2.2%
		24-Jun-05	2	4 mm - 8 mm	0.2%
		25-Jun-05	3	4 mm - 8 mm	0.4%
		26-Jun-05	4	4 mm - 8 mm	0.2%
		28-Jun-05	6	4 mm - 8 mm	0.2%
		30-Jun-05	8	4 mm - 8 mm	2.1%
319+62	152.6	23-Jun-05	1	8 mm - 16 mm	0.5%
		24-Jun-05	2	4 mm - 8 mm	0.9%
		25-Jun-05	3	8 mm - 16 mm	0.3%
		26-Jun-05	4	4 mm - 8 mm	1.0%
		28-Jun-05	6	4 mm - 8 mm	0.2%
		30-Jun-05	8	4 mm - 8 mm	0.5%
319+62	106.7	23-Jun-05	1	2 mm - 4 mm	0.8%
		24-Jun-05	2	4 mm - 8 mm	0.4%
		25-Jun-05	3	4 mm - 8 mm	0.1%
		26-Jun-05	4	4 mm - 8 mm	1.1%
		28-Jun-05	6	4 mm - 8 mm	0.2%
		30-Jun-05	8	2 mm - 4 mm	8.7%
-25+00	153.3	23-Jun-05	1	8 mm - 16 mm	0.4%
		24-Jun-05	2	8 mm - 16 mm	0.6%
		25-Jun-05	3	8 mm - 16 mm	0.5%
		26-Jun-05	4	4 mm - 8 mm	2.1%
		28-Jun-05	6	4 mm - 8 mm	4.0%
		30-Jun-05	8	4 mm - 8 mm	6.5%
-25+00	126.0	23-Jun-05	1	8 mm - 16 mm	3.4%
		24-Jun-05	2	8 mm - 16 mm	1.0%
		25-Jun-05	3	8 mm - 16 mm	2.3%
		26-Jun-05	4	8 mm - 16 mm	1.0%
		28-Jun-05	6	8 mm - 16 mm	0.7%
		30-Jun-05	8	8 mm - 16 mm	0.6%

32). While there was some variability at individual verticals, the average values indicated a decreasing rate of deposition with duration, and were most pronounced in zones where bedload transport was highest. This helped corroborate our qualitative field observations that most net deposition for a given high flow occurred rapidly, reaching equilibrium conditions in a day or two. The higher the sediment supply (inferred from bedload transport rates), the faster the initial deposition to near equilibrium conditions occurred. On floodplains with lower bedload transport rates and/or dominated by suspended sediment deposition, the rate of deposition did not appear to change significantly, although the small sample size tempered our confidence in this observation as a verified "conclusion". If the experiment were conducted again, a better approach would be to insert a thin metal ruler into the fresh deposit each day at consistent stations to track deposition depth. Hydraulic disturbance to the deposit would be minimal with this method, and disturbance to the micro-topography of the deposit would be reversed within a minute or two from fresh bedload exchange.

As observed in RY 2004, the primary depositional process during incipient floodplain development in 2005 was bedload deposition rather than suspended sediment deposition. Suspended sediment

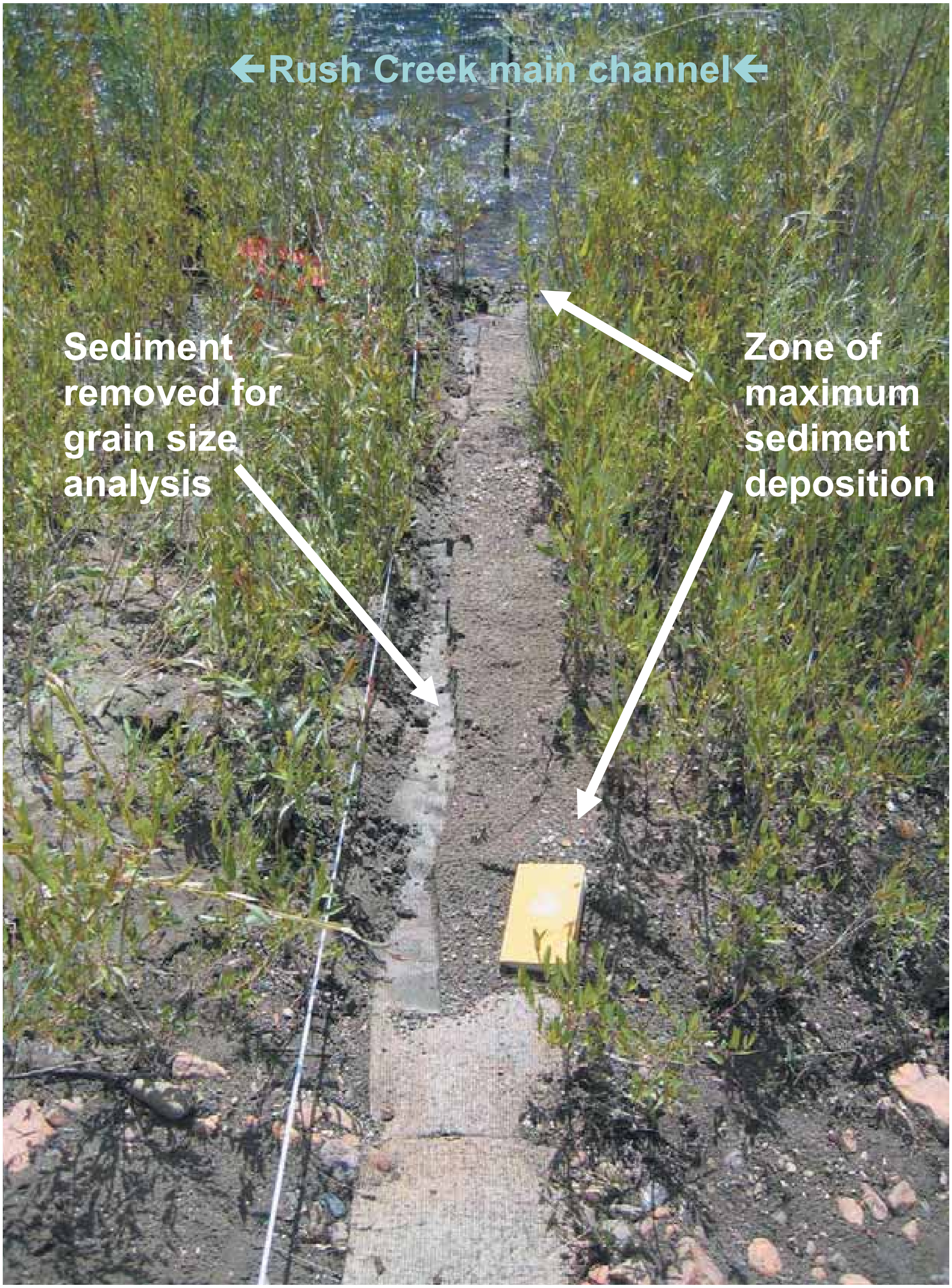


Figure 33. Floodplain deposition carpets installed across XS 319+62 on Lower Rush Creek, showing sediment deposited along the mainstem channel margin after the RY 2005 SRF recession.

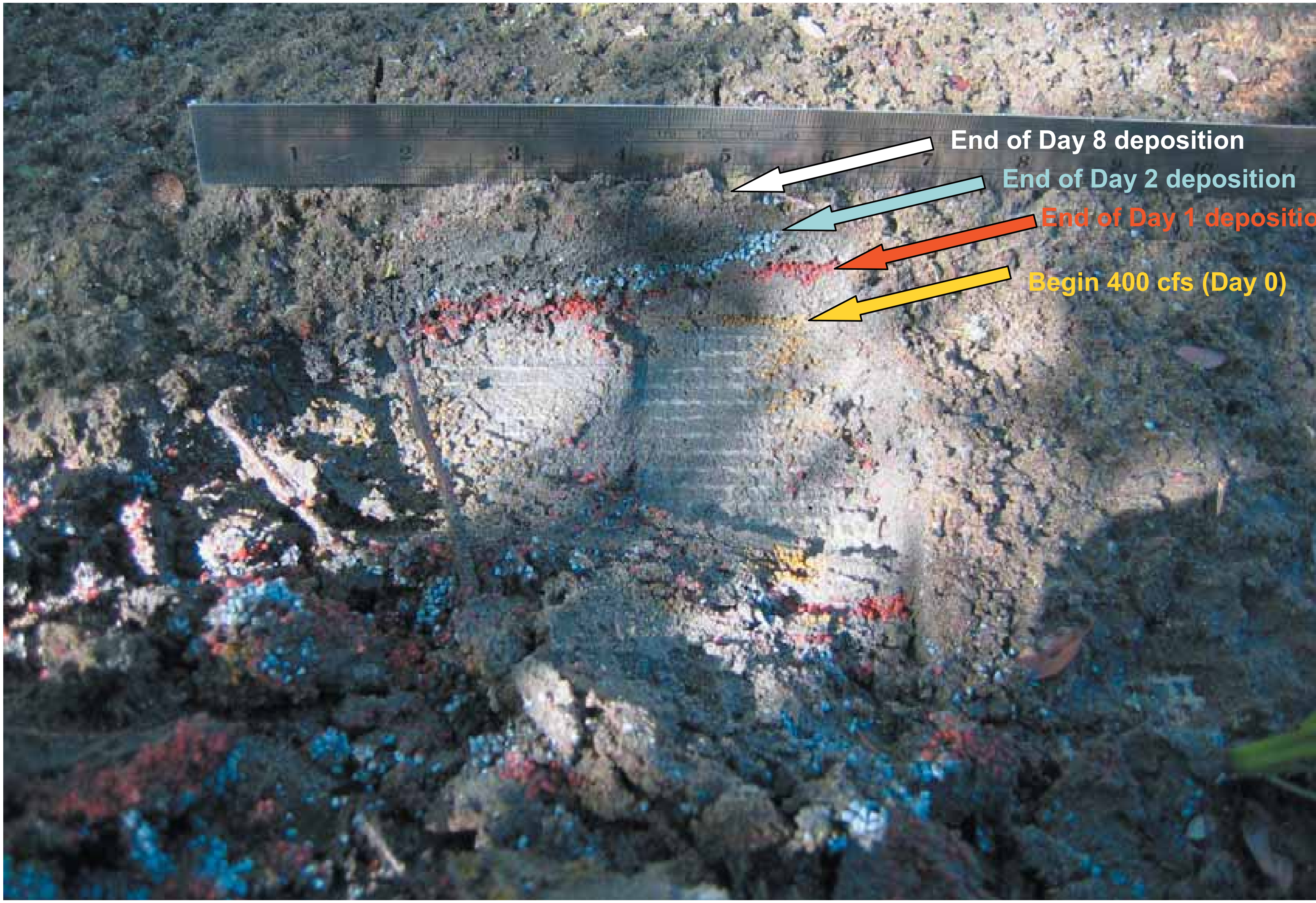


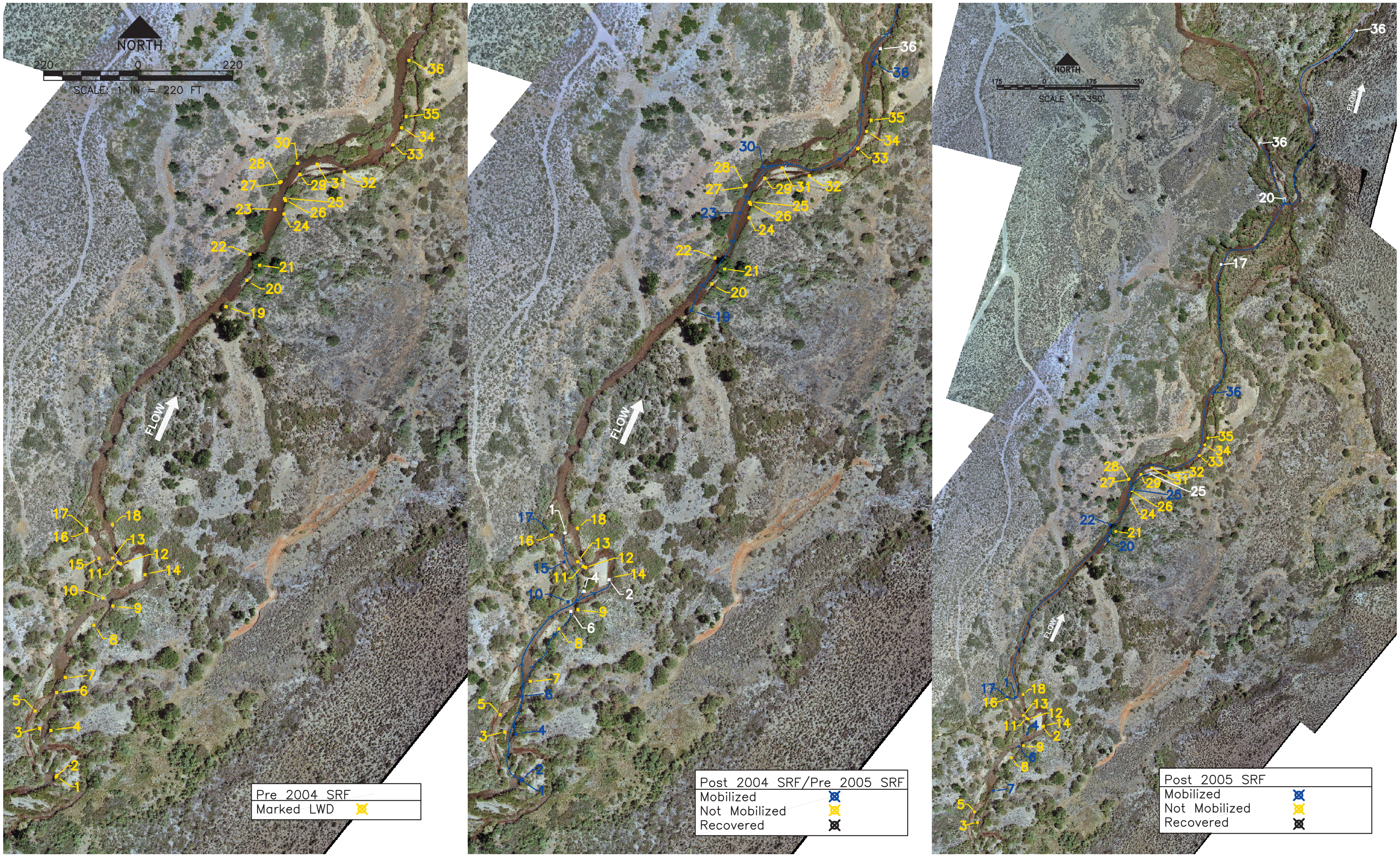
Figure 34. Close-up of floodplain deposition on Lower Rush Creek, showing successive depositional layers indicated by colored sand sprinkled across the surface during the SRF release.

concentrations were again low during this release (see Section 3-3), minimizing the contribution of suspended sediment deposition in floodplain development. Suspended sediment deposition was observed independent of bedload deposition on certain portions of cross sections (e.g., XS 319+62 at station 172), but the deposition depths were less than 20 mm (3/4 inch) (Appendix G-7). Accretion from fine sediment deposition likely plays only a minor role in floodplain building at the sites monitored.

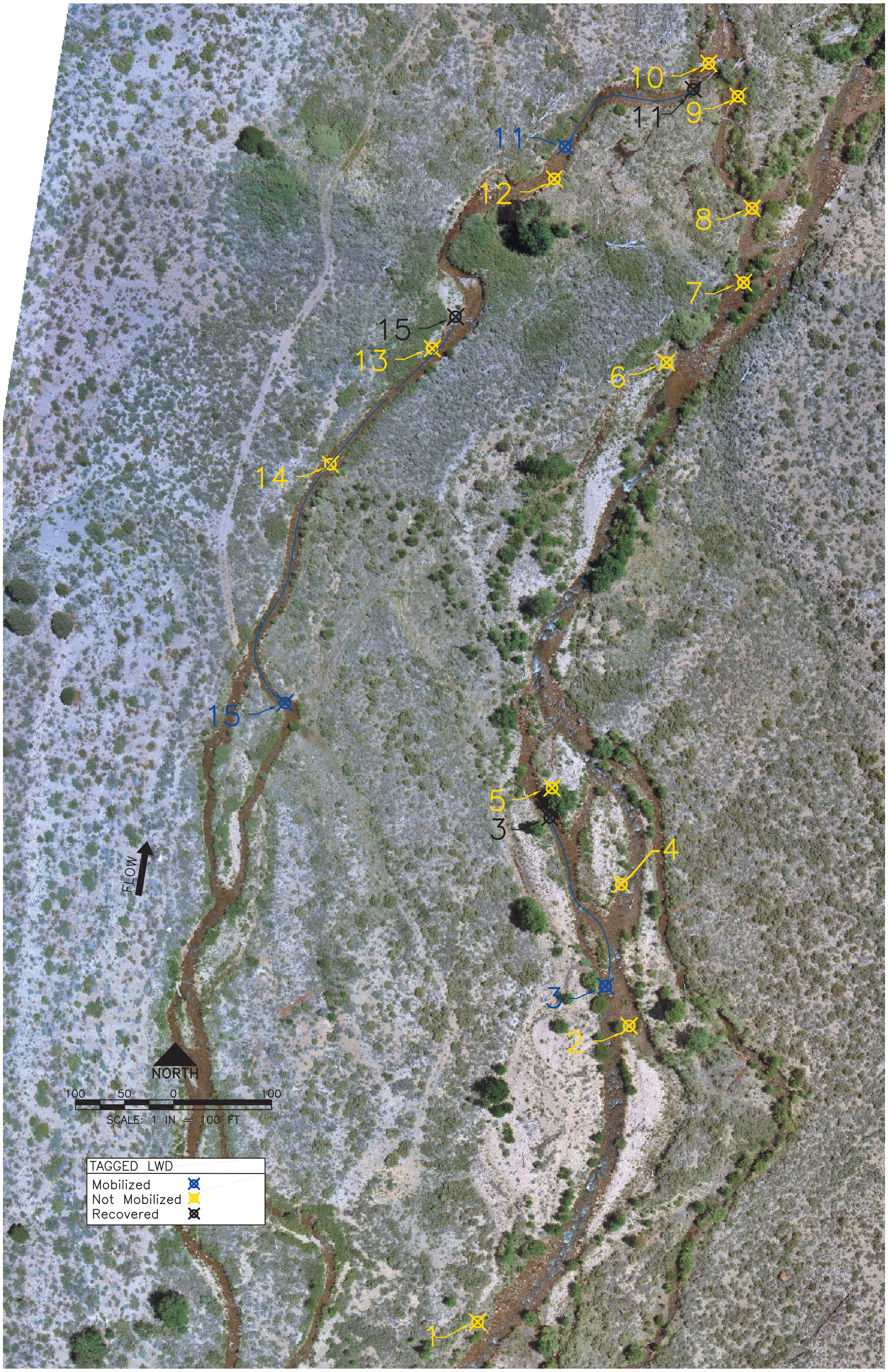
Fine sediment deposition on what were considered floodplains on the Lee Vining Creek B-1 channel was minimal during the 2005 peak flow (372 cfs, approximately a 5.6-yr flood) because flow did not substantially inundate those surfaces. Channel incision within the multiple channels in Lee Vining Creek may have largely abandoned these former floodplains, preventing their inundation by frequent flood events (i.e., 1.5 to 2-year floods). The maximum deposition depth at the Lower Lee Vining B-1 cross sections was less than 20 mm at cross section 1+28 (Appendix G-8). More substantial fine sediment deposition occurred on the main channel cross section 3+45 (up to 100 mm) in the backwater channel (Appendix G-6). This backwater may eventually fill with fine sediment over the long term, unless the entrance opens up and the channel avulses.

As observed in RY 2004 and RY 2005, SRF release magnitudes of approximately 400 cfs met several important ecological objectives expected for a Normal and Wet-Normal runoff year type (see Figure 18 of RY 2003 Annual Report [McBain and Trush 2004]). As expected, this release magnitude appeared to be a minimum threshold for measurable fine sediment deposition on incipient floodplains. Flow magnitudes larger than 400 cfs scheduled for Wet and Extremely-Wet runoff year types will be required to re-build (aggrade) floodplains and re-confine channels close to pre-1941 levels. As a rough approximation of the discharge needed to initiate deposition, the stage height of a given high flow can be assumed commensurate with fine sediment deposition elevation. The RY 1999 Report (McBain and Trush 2000) recommended a minimum inundation depth of 0.5 ft for initiating floodplain deposition. In lieu of attempting complex fine sediment deposition models as a way to determine how to maximize floodplain deposition rates, we recommend targeting a minimum inundation depth. This approach would address the variability of floodplain elevations, and would require increasingly larger floods to achieve the same inundation depth as floodplains build over time. However, this need for larger floods is counterbalanced by increases in stage height for a given flow magnitude that results from increased channel and floodplain roughness. The RY 1999 Report (McBain and Trush 2000) provides additional description of this process.

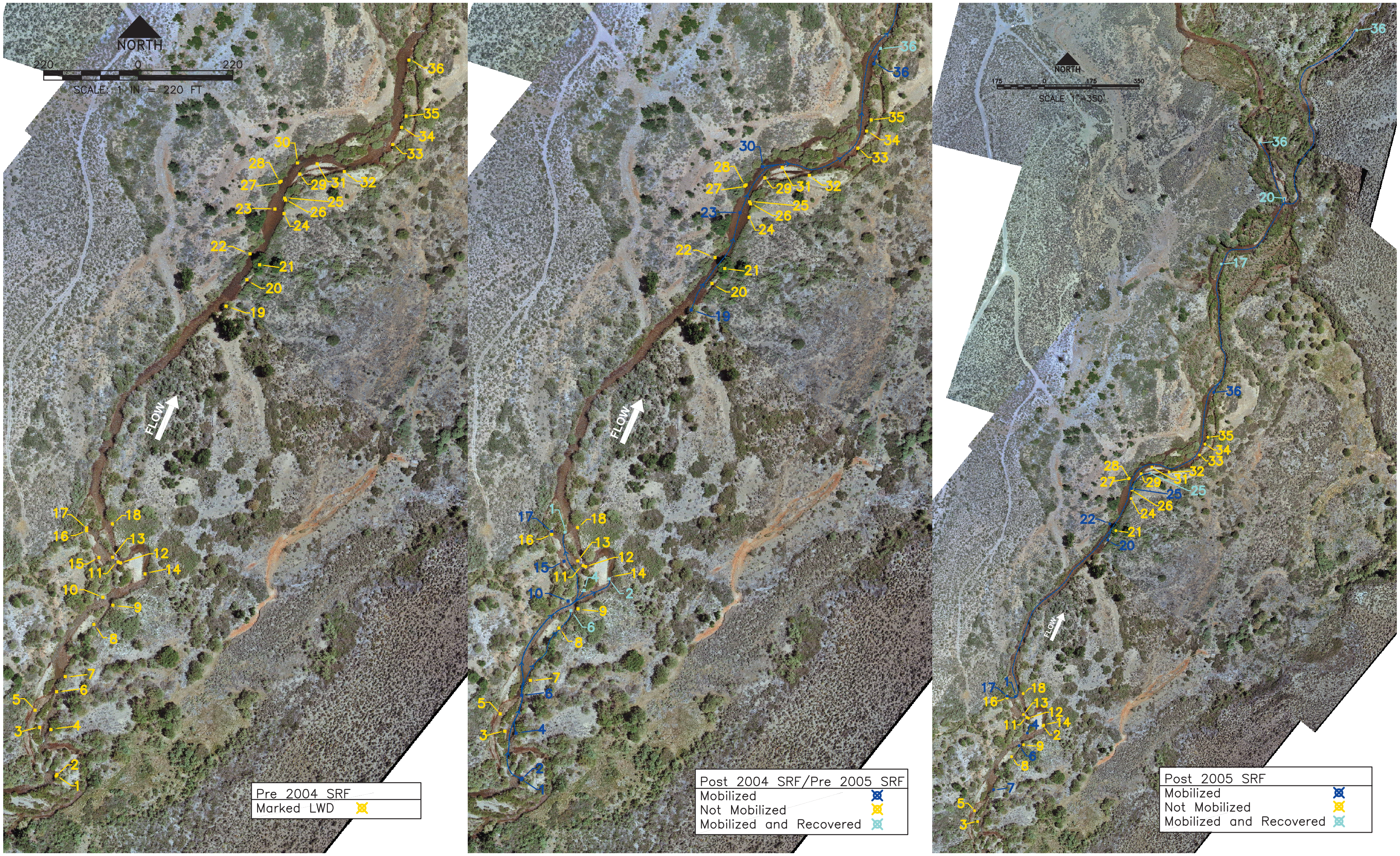
APPENDIX B-6. LARGE WOOD TRANSPORT



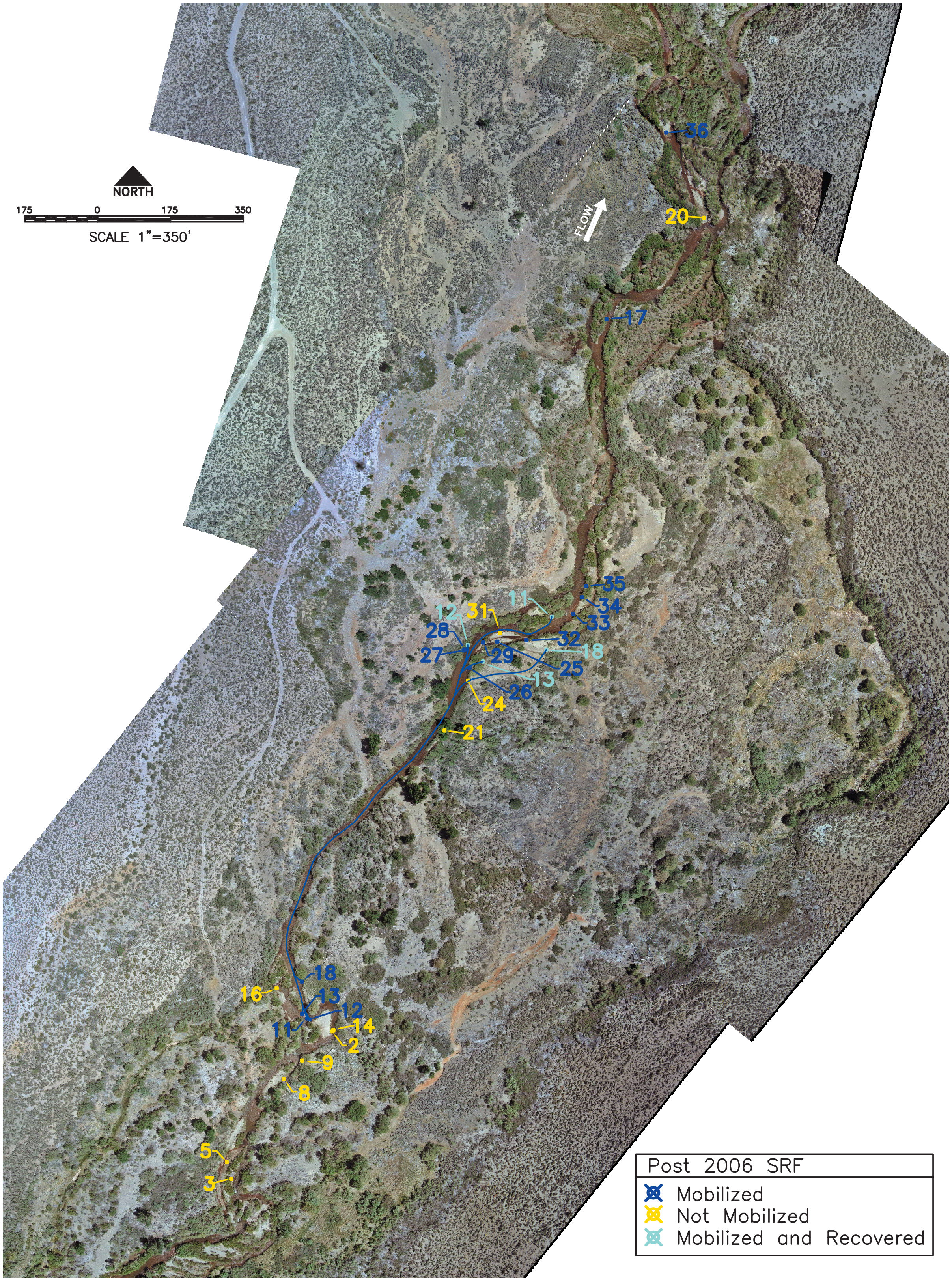
Appendix B-6. Figure 1. Large woody debris marked and relocated on Lower Rush Creek before and after the RY 2004 and 2005 SRF releases.



Appendix B-6. Figure 2. Large woody debris marked and relocated on Lee Vining Creek before and after the RY 2005 snowmelt peak.



Appendix B-6. Figure 3. Runoff Year 2005 large wood transport tracking in Lower Rush Creek.



Appendix B-6. Figure 4. Runoff Year 2006 large wood transport recovery in Lower Rush Creek.

APPENDIX C. RIPARIAN VEGETATION AND SHALLOW GROUNDWATER ANALYSES

Riparian vegetation and groundwater monitoring, primary topics of several Annual Reports (M&T 2000, 2004, 2005, 2006, and 2007), was designed to evaluate SRFs and baseflows that sustain groundwater conditions that in turn promote the desired ecological outcomes identified for riparian vegetation recovery. Recovery (i.e., the 'desired ecological outcomes' for riparian vegetation) entails: (1) expanding riparian vegetation acreage to occupy geomorphic surfaces capable of sustaining riparian vegetation, (2) maintaining a naturally fluctuating riparian corridor through sequences of dry runoff years (i.e., preventing major, but not all, die-back of vegetation during drought), (3) periodically regenerating dominant woody riparian tree species (primarily willows and cottonwoods) in wetter years through seed germination and eventual recruitment, and (4) developing structural complexity within riparian corridors defined by species diversity, a mature canopy and understory, and a varied age-class structure.

Riparian vegetation recovery along Rush and Lee Vining creeks depends on two primary functions the annual hydrograph provides: overbank/side-channel streamflows during spring snowmelt and shallow groundwater maintenance in the floodplains throughout the growing season (May 1 to September 30), Seasonal re-watering of side-channels plays an important role in both functions. To predict the extent and timing of moist floodplain surfaces during snowmelt streamflows, interactions among shallow groundwater, mainstem streamflows, and side-channel streamflows had to be understood rudimentarily. Seed dispersal periods for dominant woody riparian tree species were measured. Regeneration will not occur unless moist floodplain surfaces coincide with seed availability. Another important objective was estimating the elevation of the shallow groundwater (relative to the floodplain surface elevation) needed by established woody riparian plants to uptake shallow groundwater through the growing season.

With a basic understanding of these processes, woody riparian vegetation recovery was evaluated to determine if each distinct floodplain surface within the Rush and Lee Vining creek corridors could/would recover under the recommended SEF streamflows. Several streamflow thresholds critical for eventual recovery were established to formulate and evaluate how well the SEF annual hydrograph recommendations would perform relative to unregulated, SCE-regulated, and SRF annual hydrographs. This was accomplished by computing NGDs and NGYs for the key recovery processes described.

C-1: Riparian Vegetation Life History Characteristics in Relation to the Annual Snowmelt Hydrograph

Riparian corridors are, by definition, located adjacent to a stream channel where groundwater is higher than if sustained only by precipitation (Warner and Hendrix 1984; McBain and Trush 2004). Riparian corridors for Rush and Lee

Vining creeks generally are the areas between the valley toe-slopes or, in the delta reaches, at a topographic break between 1929 low and high terraces (McBain and Trush 2004). Riparian vegetation has been distinguished throughout the monitoring as either woody riparian vegetation, grasslands, or wet meadows, with mapped "plant stands" defined by the dominant or co-dominant species. Most riparian monitoring and analyses focused on the dominant woody riparian species – willows and cottonwood.

Three riparian plant life history stages were identified (Figure C-1). Initiation is the earliest life stage, beginning when a seed finds a suitable nursery site (defined by substrate, moisture availability, sunlight, etc.) and germinates. Initiation continues as germinated seedlings find perennial water and set roots and extends through a plant's first growing season until leaf abscission. Establishment begins at the end of the first growing season with a plant's first leaf abscission. The establishment stage can extend over several growing seasons. Recruitment (maturity) begins when vegetation matures and begins to expend energy to reproduce through flowering and seed propagation.

Successful willow and cottonwood initiation relies on the coincidence of late-spring snowmelt floods, the timing and rate of the snowmelt recession, available nursery sites, and the timing of seed dispersal (Bradley and Smith 1986, Scott et al. 1993, Segelquist 1993, Mahoney and Rood 1998, Stuart and Rood 2000). Typically riparian woody plant seed dispersal overlaps with the annual snowmelt flood and snowmelt recession and ends during summer baseflows (Figure C-2). Historically, the receding limb of the unimpaired snowmelt hydrograph often extended into late-August and occasionally to the end of the growing season in late-September (Figure C-3). The variability in the annual streamflow recession rate allowed woody riparian plants to successfully colonize a broad range of floodplain surface elevations.

Within the Mono Basin, seed dispersal periods vary between species: yellow willow starts early in the growing season, black cottonwood occurs shortly after the annual snowmelt flood, and narrowleaf willow disperses seeds until August (Table C-1). Seeds from one species or another are thus available throughout most of the growing season regardless of the runoff year type, which means that every year some woody riparian plant initiation can occur.

During the establishment stage (after the first growing season), seedlings are subject to numerous mortality agents bracketed by two extremes: flood-induced scour, and desiccation (Figure C-1). The upper elevation limit of seedling establishment is a function of desiccation; the lower limit of establishment is primarily a function of scour. Large floods are important in creating seedbeds and facilitating seedling germination higher and farther away from the stream channel and groundwater table. However, large floods occur less frequently. Seedlings that germinate higher on the bank risk desiccation. Seedlings more often establish along channel margins where water is more readily available during seed release and germination periods, and where groundwater recession is less pronounced. But plants that germinate on lower surfaces are more vulnerable to scour induced mortality.

Individual woody riparian plants typically live less than 150 years, but under certain conditions can survive past 400 years. In the Mono Basin, most woody riparian plant species can persist for several decades without a flood event causing initiation of new cohorts from seeds. However, a plant's ability to clone or successfully grow another generation of individuals through root sprouting allows some woody plant species to persist for centuries and survive long periods of drought.

C-2: Sources of Groundwater for Sustaining Riparian Vegetation

Streamflow-groundwater recharge processes are described in M&T 2004. Riparian corridor width is a function of the extent of shallow groundwater tables supplied by streamflow, either through lateral recharge from the stream channel or floodplain inundation from overbank flows. Our conceptual model also assumes the presence of a deeper groundwater table recharged through precipitation. During snowmelt runoff, the deep groundwater rises and often merges with the stream-fed shallow groundwater. In many instances, riparian vegetation recovery is limited by the inability to affect the deeper groundwater table by surface streamflow to broaden the shallower "riparian" groundwater table. Managed streamflows to recover and sustain riparian vegetation are intended primarily to affect the shallow groundwater table.

The riparian corridors in Rush and Lee Vining creeks are a mosaic of geomorphic surfaces of varying area and shapes, proximity to surface flow, and elevation above the shallow groundwater table. The breadth, volume, and duration of surface flow distribution across the stream corridor, the volume and duration of main-channel flow, and the volume and duration of overbank flow all affect the extent of shallow groundwater available to support riparian vegetation. In general, geomorphic surfaces that are higher and more distant from the stream channel have a deeper groundwater and a shorter-duration surface saturation period in which to allow seed germination and initiation. Reaches with a single perennial channel typically have narrow riparian corridors; locations with seasonal or perennial side channels have wider riparian corridors. Only in wetter years will riparian plants successfully initiate on elevated surfaces or farther from the stream. Desiccation, resulting from seasonal groundwater decline and multi-year drought periods, defines the physical boundaries of the riparian corridor.

Riparian vegetation only initiates and successfully establishes where environmental conditions meet each plant species' life history requirements. The distance roots must grow to reach a perennial water source and the duration a plant can survive drought are common environmental conditions each plant species must cope with. Historically riparian plant vigor and riparian corridor width along Rush and Lee Vining creeks varied with different patterns of wet and dry years. In both creeks, under unimpaired conditions, riparian vegetation likely flourished in wetter years. In drier years, riparian vegetation vigor was not maintained in some locations, and resulted in vegetation die-back. Consecutive dry or wet years (Figure C-4) created periods of drought when the riparian corridor would contract and periods of abundant water and plant regeneration when the riparian corridor would expand. The contrast between vigorous growth and dieback created during wet and dry years historically resulted in structural complexity and a patchy distribution of riparian vegetation.

C-3: Groundwater and Soil Moisture Responses to Streamflow

Successful plant establishment begins with seed germination and root formation where sufficient soil moisture is available when and where seeds are present. Seedlings die unless their roots can utilize available soil moisture and grow until they reach perennial groundwater. The soil moisture needed to satisfy annual growth differs between plant species. When soil moisture diminishes beyond the point at which a root can extract enough water to survive, the plant wilts permanently. The 'permanent wilting point' is different for each plant species. Desert species have permanent wilting points at very low soil moisture content; the permanent wilting points of riparian plants are much higher.

The relationship between groundwater and soil moisture is complex. Above the distinct groundwater table elevation are two less distinct zones of varying moisture content – the capillary fringe and the zone of diminishing soil moisture (Figure C-5). The soil is saturated up to the groundwater table and within the capillary fringe, but then gradually diminishes above the capillary fringe boundary. Changes in stream stage affect groundwater elevation adjacent to the stream, which in turn affect saturation within the soil profile. The capillary fringe provides a buffer from diurnal and seasonal streamflow fluctuations. This buffer is considered in streamflow and groundwater management recommendations. Soil moisture above the capillary fringe can promote plant germination, initiation, and establishment. The ability to develop quantitative soil moisture targets (above the capillary fringe) to maintain riparian vegetation is limited by an understanding of the soil moisture needs of all riparian plant species, the variation in soil moisture created by different soil textures in the field, and the rate of soil moisture change as a function of groundwater depth, season, and climatic conditions. Thus while streamflow management to maintain shallow groundwater is an important mechanism to manage riparian plant establishment and growth, the streamflow recommendations are intended to maintain groundwater and a defined capillary fringe, but not soil moisture, and are thus conservative.

Based on field observations from several monitoring seasons, soil within the capillary fringe remains saturated up to approximately 1.6 ft above the groundwater table. The capillary fringe is variable based on soil texture; finer soils can draw groundwater up farther into the soil column than coarser soils. The capillary fringe associated with fine sand is 1.6 ft (a prevalent soil texture in Rush and Lee Vining Creek riparian corridors) and 0.5 ft for coarse sand (M&T 2005). When groundwater rises to the elevation of the ground surface, the soil is by definition saturated throughout the profile (i.e., the process that occurs during overbank flood events). Additionally, groundwater can recede to the limit of the capillary fringe associated with the soil texture and the soil will still be saturated at the ground surface. For example, groundwater sustained by streamflows could theoretically recede instantaneously 1.6 ft below the ground surface; locations with fine sand substrate would still maintain a fully saturated ground surface. A saturated soil profile to a depth of 1.6 ft would exceed the soil moisture needs of all plants and would meet the requirements for seedling germination and root growth.

Sustaining saturated (or near saturated) soil at the ground surface is vital to successful willow and cottonwood seed germination. However, once the capillary fringe begins to recede, the rate at which the soil transitions from saturated to permanent wilting point is a function of evapotranspiration, solar radiation, and distance from ground surface. The surface dries within hours in many instances. A duration of 21 continuous days of surface saturation was used as a threshold for ensuring a seedling's roots have grown sufficiently deep to reduce effects from additional recession in stream stage. Recession rates associated with unimpaired snowmelt floods, and therefore recession in groundwater table elevation, would have been much slower than the rate necessary for seeds to germinate and seedlings' roots to grow.

C-4: Vegetation Patterns Reflect Shallow Groundwater Hydrology

Given limitations of how site-specific data represent conditions found throughout Rush and Lee Vining creek corridors, several key assumptions were made to simplify our analyses: (1) groundwater responses to streamflows quantified in greater detail on Rush Creek were similar in Lee Vining Creek which was studied less intensively, (2) stream channel water surface elevation, projected laterally as a flat plane across the stream corridor defines an upper limit to groundwater elevation (though not soil moisture driven by capillarity, discussed in the next section), and (3) the vegetation patch type was defined by the distance above this projected groundwater surface. The 2009 riparian vegetation patches (individually mapped plant stands) were overlaid onto the 2003 Digital Terrain Model (DTM) derived from aerial photogrammetry of Rush and Lee Vining creeks. Next, height of the 2009 patch types above the projected 91 cfs water surface elevation on Rush Creek (below the Narrows) and above the projected 63 cfs water surface on Lee Vining Creek (below the Intake) on June 23, 2003 (the dates and discharges during the 2003 aerial photography flight) were estimated from the model.

On Rush Creek, more than 70% of cover associated with specific riparian patch types occurred within 5 ft of the 91 cfs projected water surface; on Lee Vining Creek more than 70% occurred within 3 ft of the projected water surface. As a threshold to better preserve and promote self-sustaining riparian vegetation (herbaceous or woody), groundwater sustained by mainstem baseflow should be within 5 ft of the floodplain surface on Rush Creek and within 3 ft of the floodplain surface on Lee Vining Creek. (Figures C-6 and C-7).

C-5: Groundwater and Riparian Vegetation Monitoring Study Sites

Groundwater studies focused on several key locations in the Rush Creek and Lee Vining Creek bottomlands, primarily where side-channels were re-watered. Five side-channels on Rush Creek have been re-watered: the 3A, 3B, 3D, 4bii, 8, and 10 channels. On Lee Vining Creek, the A-1, A-2, A-3, A-4, B-1, and B-2 side-channels were also mechanically re-watered.

Groundwater monitoring by the Mono Lake Committee began in RY1995 at several piezometer arrays near the Rush Creek 10-Channel and on Lee Vining Creek between the mainstem and A-4 Channels (summarized in RY2003 and RY2004 Annual Reports (McBain and Trush 2004, 2005).

McBain and Trush began monitoring groundwater on Rush Creek at the 8C and the 3D after these channels were re-watered in RY2002 (McBain and Trush 2002). The 8-Channel was initially opened to allow Rush Creek below the Narrows streamflows of approximately 275 cfs or greater to access the side-channel (Table C-2); the 3D side-channel was constructed for perennial flow. In RY2004, piezometers were installed to monitor the effect of side-channel re-watering on the groundwater and riparian vegetation.

Groundwater analyses focused initially on data from the 8-Channel. This site proved ideal for evaluating: (1) temporal responses of groundwater to streamflow with different background runoff year and SRF conditions, (2) variable effects of mainstem, seasonal side-channel, and perennial side-channel streamflows on groundwater elevation, and (3) riparian vegetation responses to different surface flow patterns (i.e., mainstem, seasonal, and perennial) on geomorphic surfaces and with variable elevation and distance relative to surface flow (Figure C-8). Results from these three categories of analysis are in the following Section (Section 1.6). The 4bii side-channel was re-watered in RY2006 then modified in RY2007 to allow perennial flow. There were no piezometers installed near the 4bii Channel; field observations and photographs were used to substantiate groundwater analyses from the 8-Channel.

The 8-Channel entrance was first modified in RY2004 to allow seasonal flow above approximately 275 cfs. In this first season, streamflows barely inundated the 8-channel (for approximately 6 days) and provide baseline data describing groundwater response to streamflow without a side-channel. The channel entrance was subsequently expanded twice: (1) in RY2005, the entrance was enlarged to facilitate higher magnitude and longer (seasonal) flow and (2) in RY2007 the entrance was enlarged again to allow perennial streamflow. Groundwater data from piezometer arrays along the 8-Channel (Figure C-9) were used to monitor varying durations of seasonal and perennial inundation (Table C-2).

Riparian vegetation response monitoring began in fall of RY2004 at the 3D and 8-channels, using nested quadrats (McBain and Trush 2005), qualitative observations, and seedling mapping (McBain and Trush 2005, 2006, and 2007). Riparian vegetation monitoring at the 8-Channel was used to link mainstem and side-channel streamflows, groundwater (and soil moisture) conditions, and riparian vegetation response.

C-6: Groundwater and Riparian Response Monitoring Results

Groundwater response to surface flow

Previous analyses (McBain and Trush 2005, 2006) demonstrated that groundwater elevation responds rapidly to changes in mainstem streamflow. Relationships between streamflow and groundwater were evaluated by converting streamflow to stage using rating curves developed at several main channel locations adjacent to piezometers. 'Stage-o-graphs' were plotted from daily average streamflow and daily average groundwater elevations to assess changes in shallow groundwater with changing streamflow, and the influence of seasonal or perennial side-channels on groundwater.

In addition to rapid response to streamflow change, the 8-Channel piezometer data also demonstrate proportionally larger changes in groundwater stage with smaller incremental changes in streamflow stage (Figure C-10), and different proportional changes at different discharge ranges. For example, during the August 2008 instream flow test releases at Piezometer 8C-5, the change in discharge below the Narrows from 101 cfs to 24 cfs (August 16 to 20) resulted in a 0.25 ft stream stage change and a 0.56 ft groundwater stage change. Later in the fall (at 8C-5), the change in discharge below the Narrows from 51 cfs to 21 cfs resulted in a 0.10 ft stream stage change, and a 2.15 ft groundwater stage change. This relationship appears especially strong in the lower streamflow ranges, in which small changes in streamflow cause groundwater stage to drop precipitously (Figure C-10). Small adjustments in streamflow magnitude thus disproportionately affect shallow groundwater and consequently influence successful establishment and annual growth of riparian vegetation. The primary mechanism for this relationship is streamflow *rate*, in contrast to streamflow *stage* (elevation). Our analysis thus focused on identifying a streamflow threshold in the baseflow range that would sustain higher groundwater elevations and prevent precipitous drops in groundwater elevation during the riparian growing season.

Groundwater responses to varying mainstem and side-channel conditions

Groundwater and riparian vegetation responses to streamflows at the 8-Channel (Rush Creek below the Narrows) were used to identify streamflow thresholds with specific riparian functions. Riparian thresholds were then used to guide SRF streamflow evaluation and SEF recommendations via NGD analyses.

Different streamflow magnitudes, soil textures, and the presence or absence of seasonal or perennial side-channels influence the rates at which groundwater tables rise and fall. The flow rate and duration that inundated the 8-Channel entrance varied among years. However, regardless of the side-channel flow duration, groundwater fluctuations in response to changes in stream discharge were similar among all 8-Channel piezometers (Figure C-11). This observation suggests that groundwater throughout the riparian corridor fluctuates (to varying degrees) with changes in streamflows regardless of the presence or absence of a side-channel. Streamflows in a side-channel *and* in the mainstem increase the proximity of the groundwater table to the ground surface. A side-channel can elevate the groundwater table farther from the mainstem. The increase in area of shallow groundwater available to riparian vegetation (i.e., within 5 ft of the surface for approximately 50% of the growing season) may in turn increase riparian corridor width. Greater distance from the source of flowing water (either the mainstem or side-channel) resulted in a deeper groundwater table. (Figures C-12 and C-13)

The duration of side-channel flow affected the depth to which shallow groundwater falls in the summer, fall, and winter. Groundwater responses observed in RY2005 and RY2006 (Figure C-12, Piezometer 8C-1 in 2006) suggest that if side-channel flow ceases entirely (seasonal channel), groundwater begins to recede, and continues until it reaches a deeper water table supplied by precipitation. In most years when streamflows start to rise at the onset of snowmelt, the deep groundwater table also begins to rise. When snowmelt runoff and streamflows are of sufficient magnitude and duration, the deeper water table rises and merges with the shallow groundwater supplied by mainstem and side channels. In drier years, however, precipitation may not be sufficient to elevate the deeper groundwater table to allow it to merge with the shallow groundwater. In contrast, groundwater supplied via a perennial side-channel, observed since RY2007 (Figure C-12, Piezometer 8C-1 in 2008), appears to maintain a slightly higher groundwater elevation (approximately 1 ft) and thus requires less water to initiate a seasonal increase in groundwater elevation.

Groundwater effects on initiation, establishment, and annual riparian growth (plant vigor)

Riparian plant species did not respond to RY2004 peak streamflows on geomorphic surfaces sampled at the 8-Channel. In RY 2005 and RY2006, yellow willow and narrowleaf willow seedlings initiated along moist mainstem and side-channel margins. However, farther up the banks of emergent floodplains and aggraded floodplains, successful willow initiation was infrequent. Black cottonwood root sprouting was observed in these locations (emergent and aggraded floodplains). Black cottonwood seedlings initiated in interfluve depressions of aggraded floodplains along the 8-Channel and 4bii-Channel in RY2005 and RY2006. No riparian vegetation response monitoring was conducted during RY2007 or RY2008. In July 2009, floodplain surfaces where seedlings had established in RY2005 and RY2006 were revisited. During the RY2007 growing season (May 1 to September 30), many RY2005 and RY2006 seedlings had died back to the ground and in many instances never resprouted (Figure C-14 former D-16). Other seedlings had died back but then resprouted new shoots in RY2008 (Figure C-15 former D-17).

In Lower Rush Creek, vigorous shoot growth was documented in mature trees on aggraded floodplains during RY2006 (McBain and Trush 2007). Mature cottonwood shoot growth was much shorter in RY2007 than in RY2006, but long shoot growth returned in RY2008. The variable growth, vigor, and seedling establishment success was related to differences in the runoff year sequence and to the duration side-channels flowed or were inundated annually (Figure C-16).

Success and failure of seedling establishment in interfluve depressions on aggraded floodplains where seedlings were documented were assessed to determine the groundwater conditions required to establish woody riparian plants. Interfluve depressions occur in aggraded floodplains on surfaces that may be elevated relative to summer streamflows or located far from a flowing channel (either mainstem or side-channel) (Figure C-8). To establish woody plant seedlings in interfluve depressions, shallow groundwater must provide a moist surface for seeds to germinate, then provide adequate soil moisture for seedling roots to grow into perennial groundwater. Seedling establishment is expected only in Wet-Normal and wetter runoff year types.

Streamflow Thresholds for Lower Rush Creek

During the May 1 through September 30 growing season in the Lower Rush Creek floodplain, vigorous woody riparian vegetation growth depends on shallow, streamflow-supported groundwater. Elevations of floodplain surfaces supporting woody riparian patch types are typically within 4 to 5 ft of the mainstem water surface elevation.

APPENDIX C

Piezometer data from the 8-Channel indicate a threshold of 80 cfs baseflow sustains shallow groundwater across the floodplain within 4 ft to 5 ft of the rolling floodplain surface (Figure C-17). This snowmelt-supported, shallow groundwater table allows established woody riparian vegetation to uptake groundwater and sustain vigorous growth.. When receding snowmelt streamflows drop under 80 cfs, the shallow groundwater table elevation drops sharply in the floodplain, to elevations well below the elevation of the adjacent riffle crest thalweg. The floodplain's shallow groundwater elevation may eventually drop 5 ft and more only 50 ft from the mainstem (Figure C-17). More dramatic groundwater recession was observed at the 3D Channel (M&T 2006). Maintaining this groundwater-floodplain relationship will be particularly important for future riparian recovery as the migrating mainstem channel creates new floodplains above the present delta

More days flowing with an 80 cfs baseflow or greater between May 1 and September 30 will culminate in longer shoot growth and better overall woody riparian vegetation maintenance. Receding snowmelt streamflows in most unregulated runoff years eventually drop under 80 cfs (e.g., see Appendix A, Figure 3a). Growth will slow, and eventually may cease before the general growing season ends. The NGD analysis (Appendix E) showed that Rush Creek estimated unimpaired below the Narrows streamflows during Dry and Dry-Normal I runoff years typically did not provide vigorous growth (i.e., achieve the 80 cfs threshold) throughout the entire growing season above the Rush Creek delta. The unimpaired reference condition (below the Narrows) provided 61 days and 76 days above 80 cfs for Dry and Dry-Normal I runoff years, respectively. The SCE regulated annual hydrographs for Rush Creek at Damsite provided only 21 and 46 NGDs for these runoff year types. The analysis used a minimum duration threshold of 77 days above 80 cfs (half of the May 1 to September 30 riparian growing season [n=153 days]) for a runoff year with favorable growth. However, these drier runoff year types (Dry and Dry-Normal I) did not meet the 77 day duration threshold in either reference condition (unimpaired or SCE-regulated), but instead sustained less than favorable conditions encountered in unregulated runoff years. SEF recommendations simulated below the Narrows provide 53 and 61 NGDs for Dry and Dry-Normal I runoff years, improving on SCE regulated streamflows (and the SRF streamflows) but did not attain NGDs under unimpaired conditions.

An early release of 80 cfs, before the snowmelt flood begins, also extends the number of vigorous growth days towards the start of the growing season (May 1). But a pre-snowmelt 80 cfs release accomplishes considerably more. A springtime 80 cfs streamflow leaving the Narrows prior to the snowmelt peak replenishes, and essentially primes, the floodplain's groundwater table to respond quickly, i.e., rise higher quicker, once snowmelt flooding begins. If there is no transitional flow (i.e., the 80 cfs) between low winter baseflows and the onset of snowmelt flooding (as observed in RY2006), the floodplain's groundwater table is slower to ascend. This results in less wetted floodplain surfaces, with shorter duration of surface wetting, available for seedling initiation. More water is required to accomplish less without the transitional (spring bench) streamflow.

Three narrow ranges of rising mainstem streamflows produce ecologically significant jumps in shallow groundwater elevation within the Lower Rush Creek floodplain (Figure C-18-21). These narrow streamflow ranges are important thresholds for seedling initiation; seeds need a moist surface to germinate. Streamflows of approximately 275 cfs and 230 cfs raise the shallow groundwater table so that the soil's capillary fringe saturates the surface of aggraded floodplains and their interfluves, respectively, without active side-channels present. Streamflows between 120 cfs and 160 cfs saturate the surfaces (via the capillary fringe intersecting the floodplains' surfaces) of emergent floodplains and of aggraded floodplains with active side-channels present. Future riparian recovery will depend not only on generating these wetted snowmelt-supported floodplain surfaces, but also on providing these wetted surfaces at the right times (coinciding with viable seed release periods) and of sufficient duration for willow and cottonwood seedlings to successfully initiate.

Streamflows promoting groundwater conditions favorable to woody riparian plant initiation along a single mainstem channel were prioritized. Side-channel contributions to shallow groundwater are preserved or increased by prioritizing streamflows that meet the needs of the riparian groundwater where there is a single mainstem channel, but not vice versa. Riparian areas with a single mainstem channel are more common along Rush Creek, and locations where there are single channels require higher streamflows to achieve desired ecological outcomes for riparian vegetation. Locations where perennial side-channels support shallow groundwater require considerably less streamflow to create floodplain surface conditions where seedlings can initiate.

Streamflow Thresholds for Lee Vining Creek

In Lee Vining Creek, groundwater is recharged through multiple channels, similar to the condition observed at the Rush Creek 8-Channel. Groundwater is shallower in locations that sustain riparian vegetation than observed in the Rush Creek bottomlands (Figure C-7), possibly a result of fire, vegetation die-off, and soil loss beginning in the mid-1950's. When riparian vegetation began to re-grow, it occupied locations closer to the shallow groundwater table. Stream restoration in the early-1990's also re-watered and constructed several side-channels that helped raise the shallow groundwater table to increase riparian corridor width. Without benefit of piezometer data from continuously recording dataloggers, our analysis used groundwater data collected by the MLC to identify a threshold of 30 cfs at Lee Vining below Intake that sustained higher groundwater elevations (Figure C-22). At streamflows below 30 cfs, groundwater was observed through many runoff years to drop precipitously.

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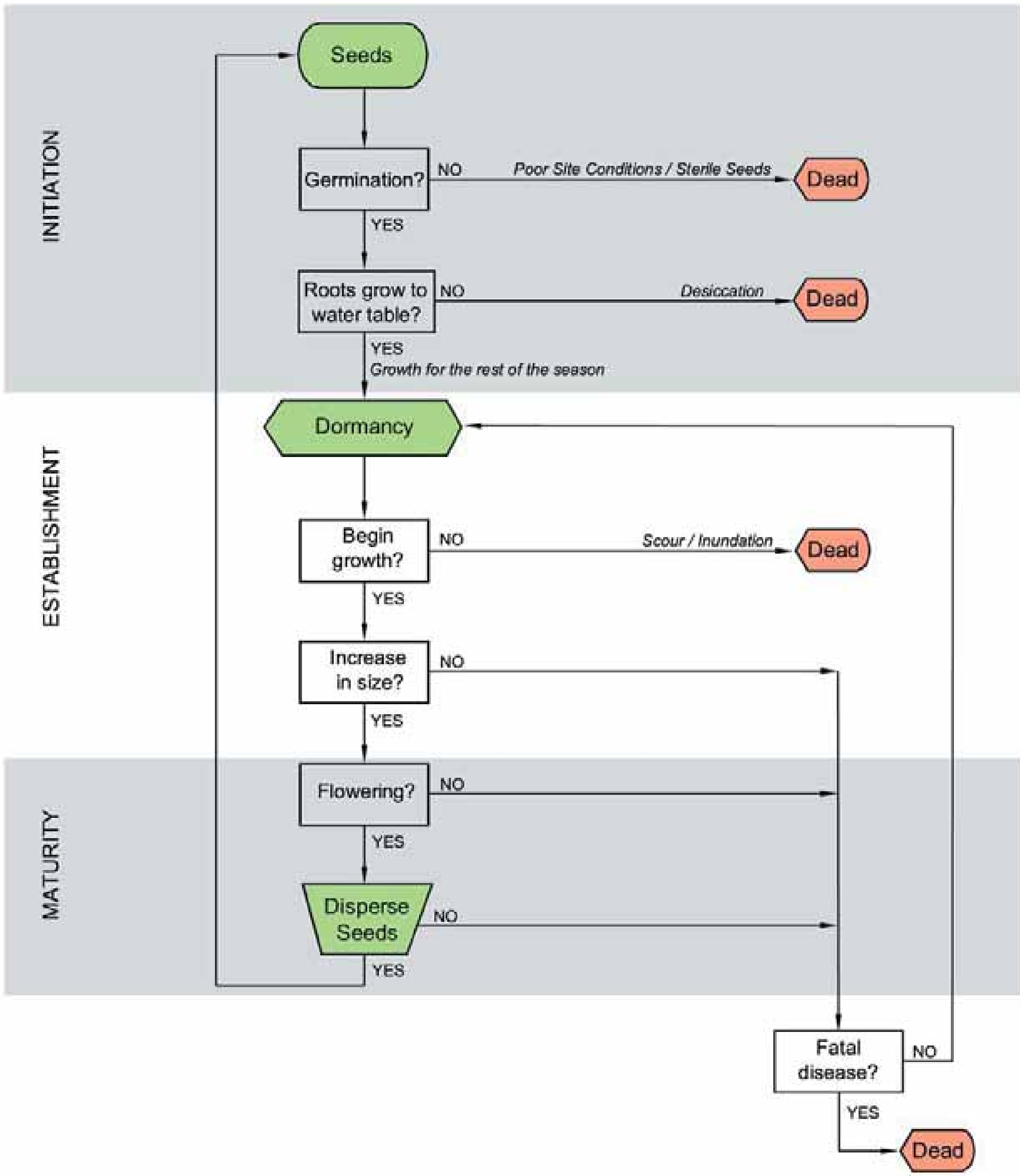


Figure C-1. Generalized riparian plant life history showing life stage, and mortality agents that affect life stages.

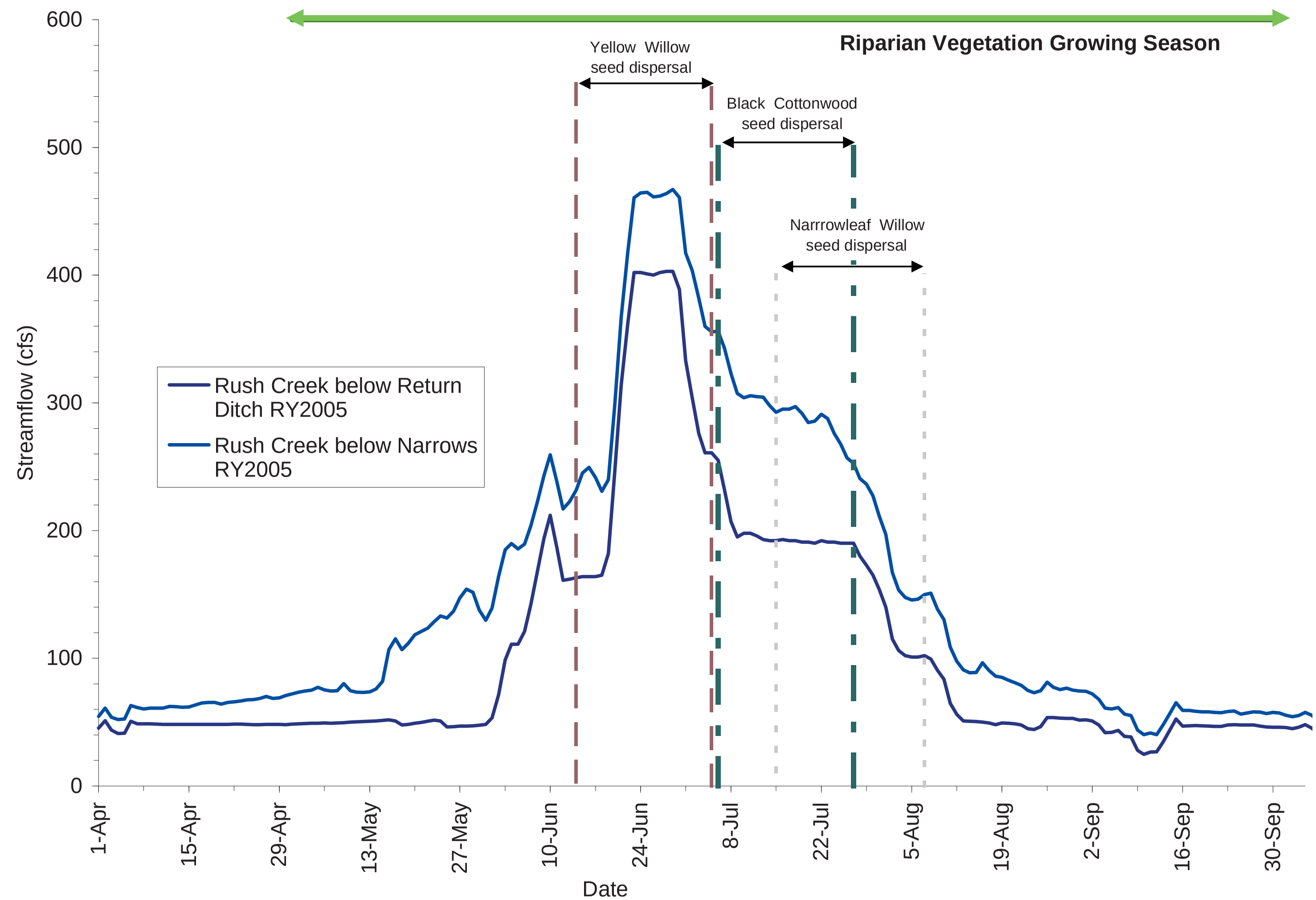


Figure C-2. Rush Creek RY2005 annual daily average hydrograph with the average timing of yellow willow, black cottonwood, and narrowleaf willow peak seed dispersal periods.

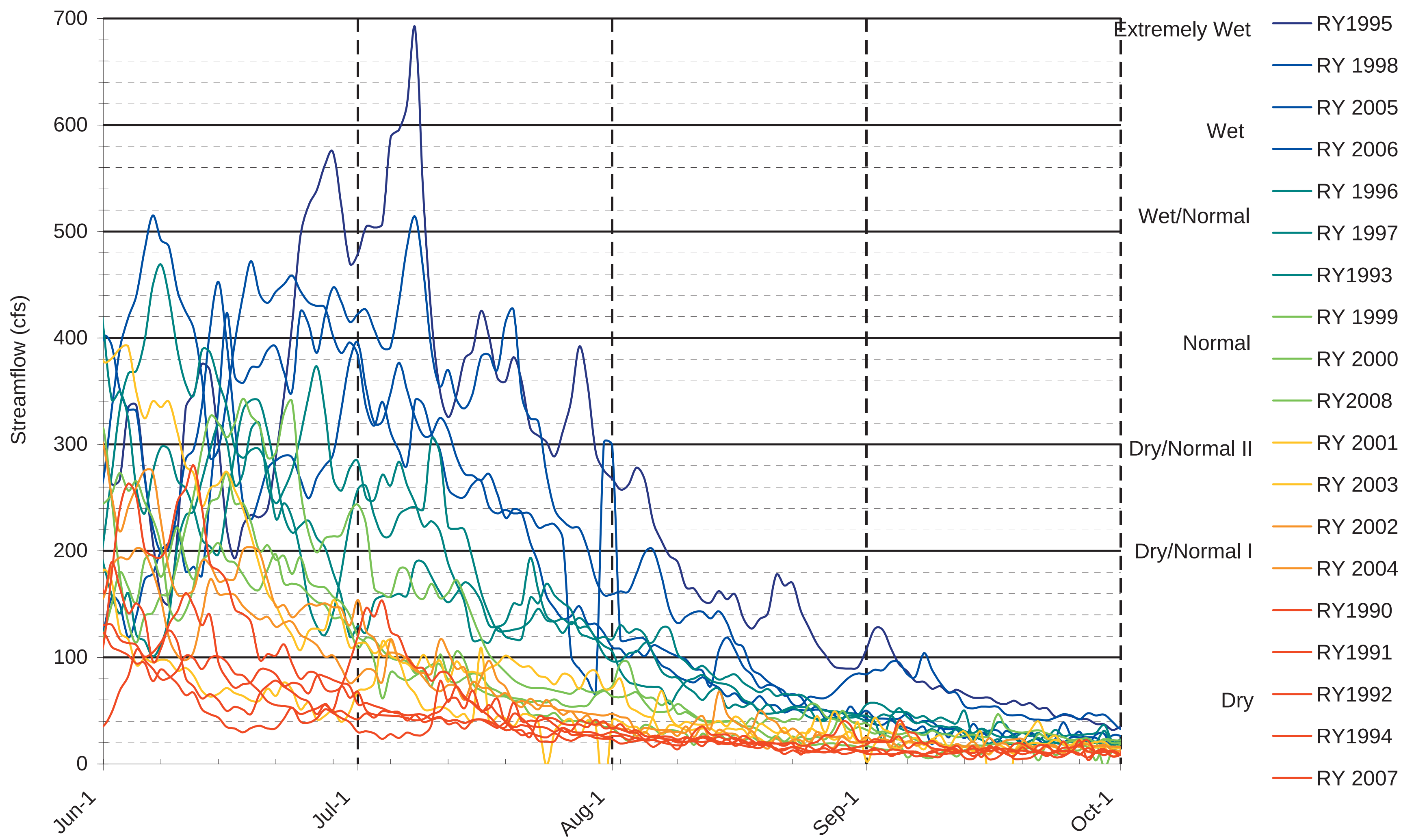


Figure C-3. Unimpaired Lee Vining Creek streamflows during the snowmelt recession between July 1 and Oct 1.

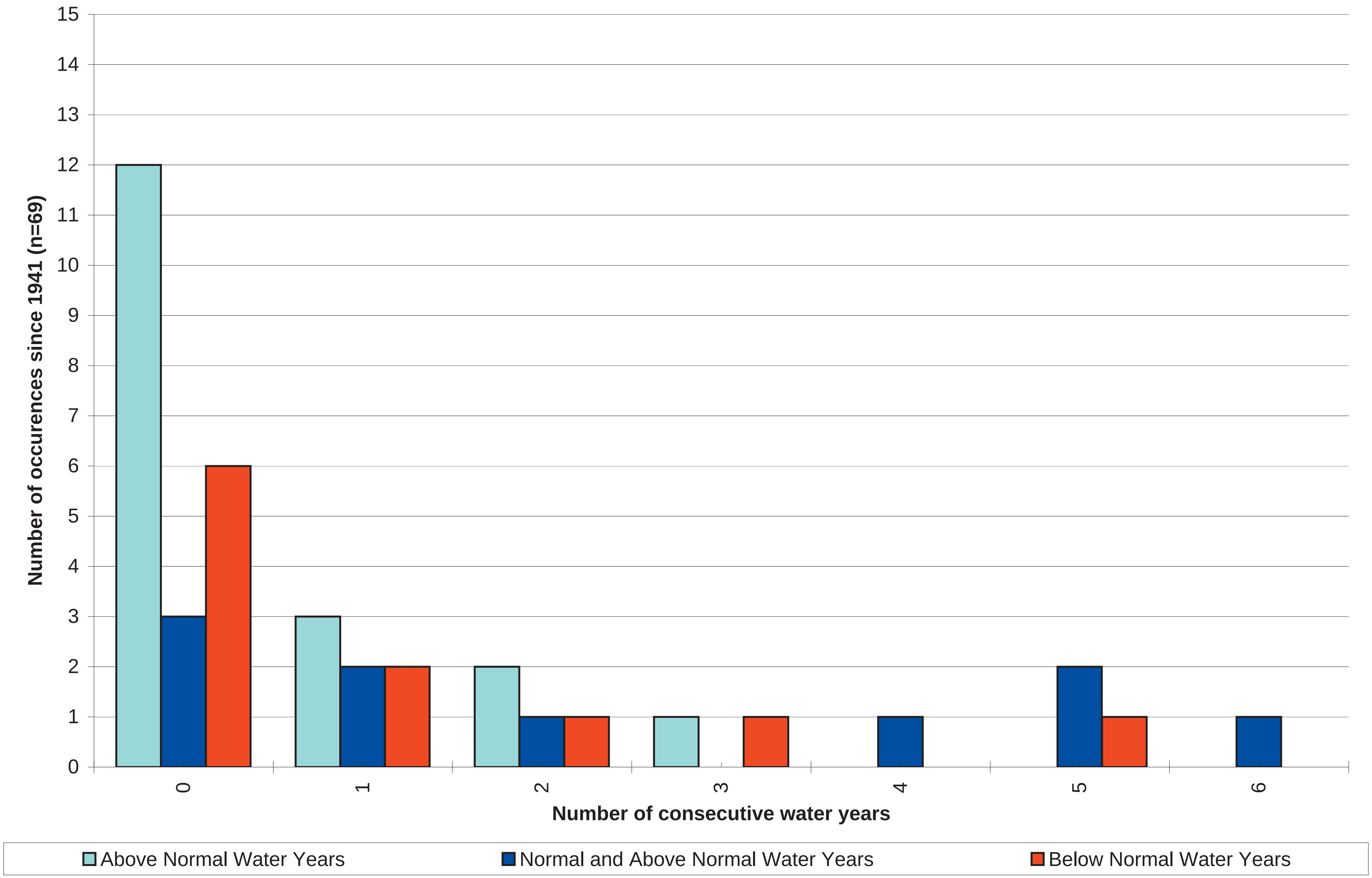


Figure C-4. Number of consecutive above normal, normal and above normal combined, and below normal water years between 1941 and 2008.

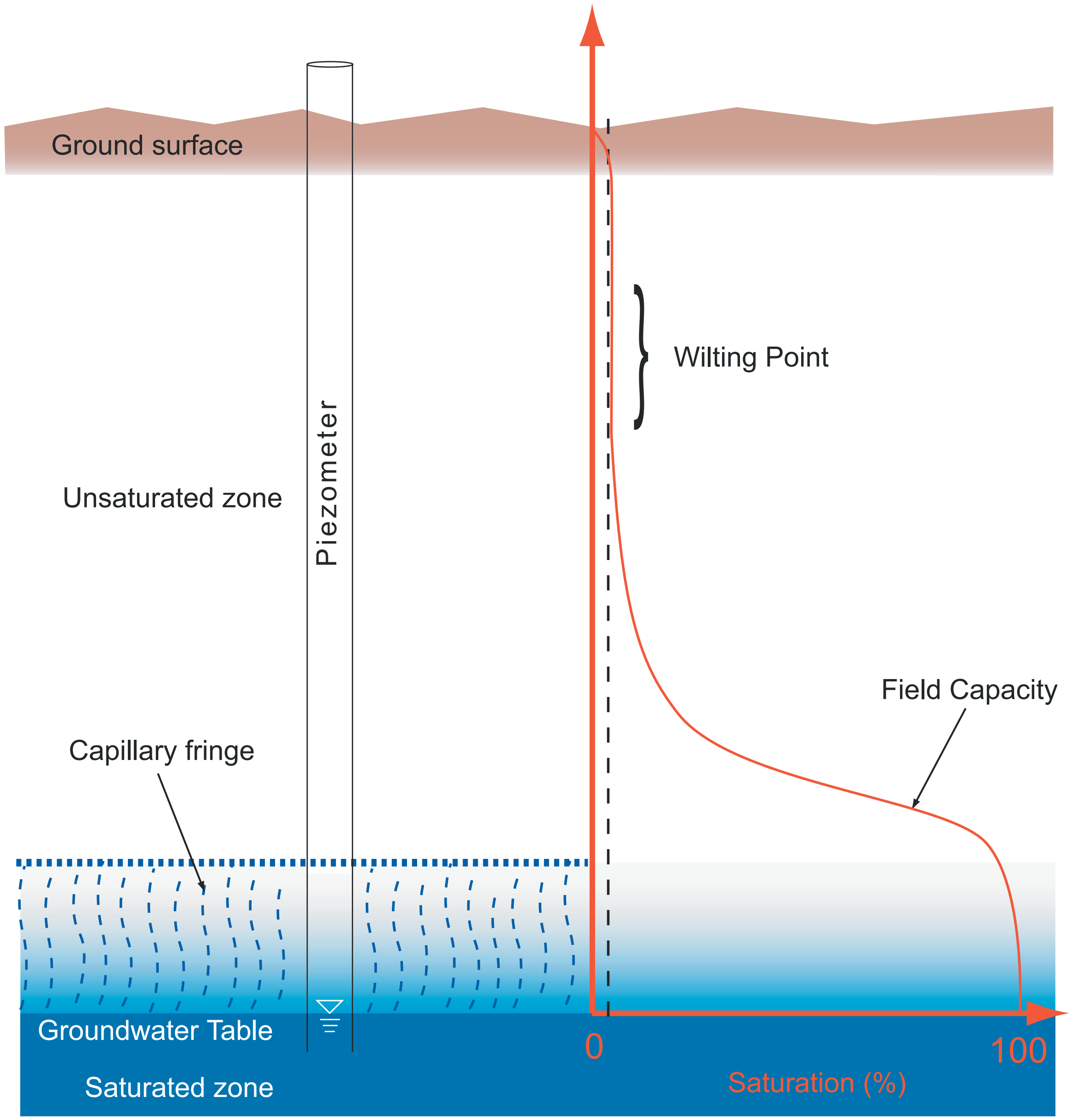


Figure C-5. Conceptual soil moisture profile for Rush and Lee Vining creek riparian corridors.

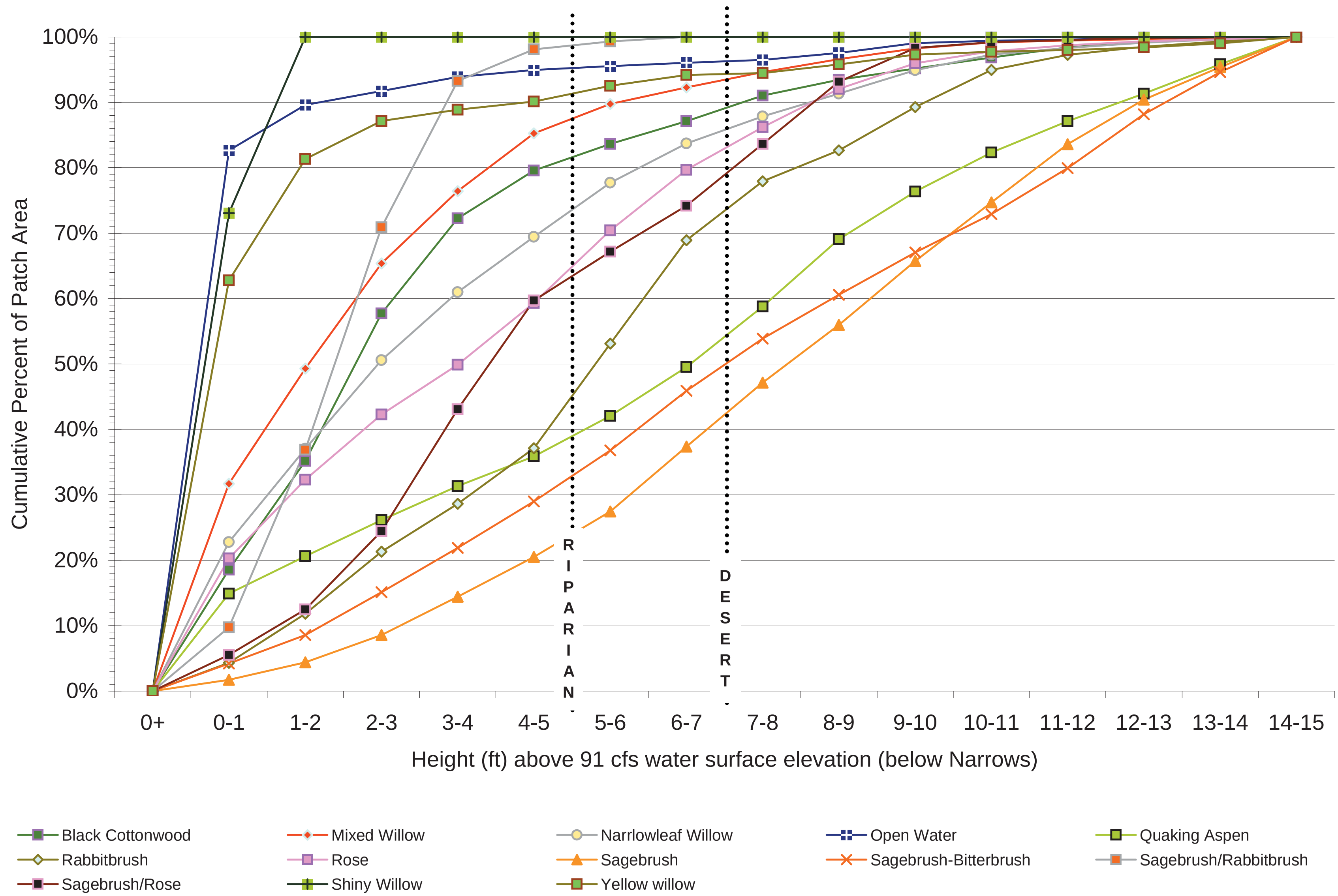


Figure C-6. Cumulative Percent of riparian and desert patch types above the June 23, 2003 streamflow on Rush Creek 91 cfs below the Narrows).

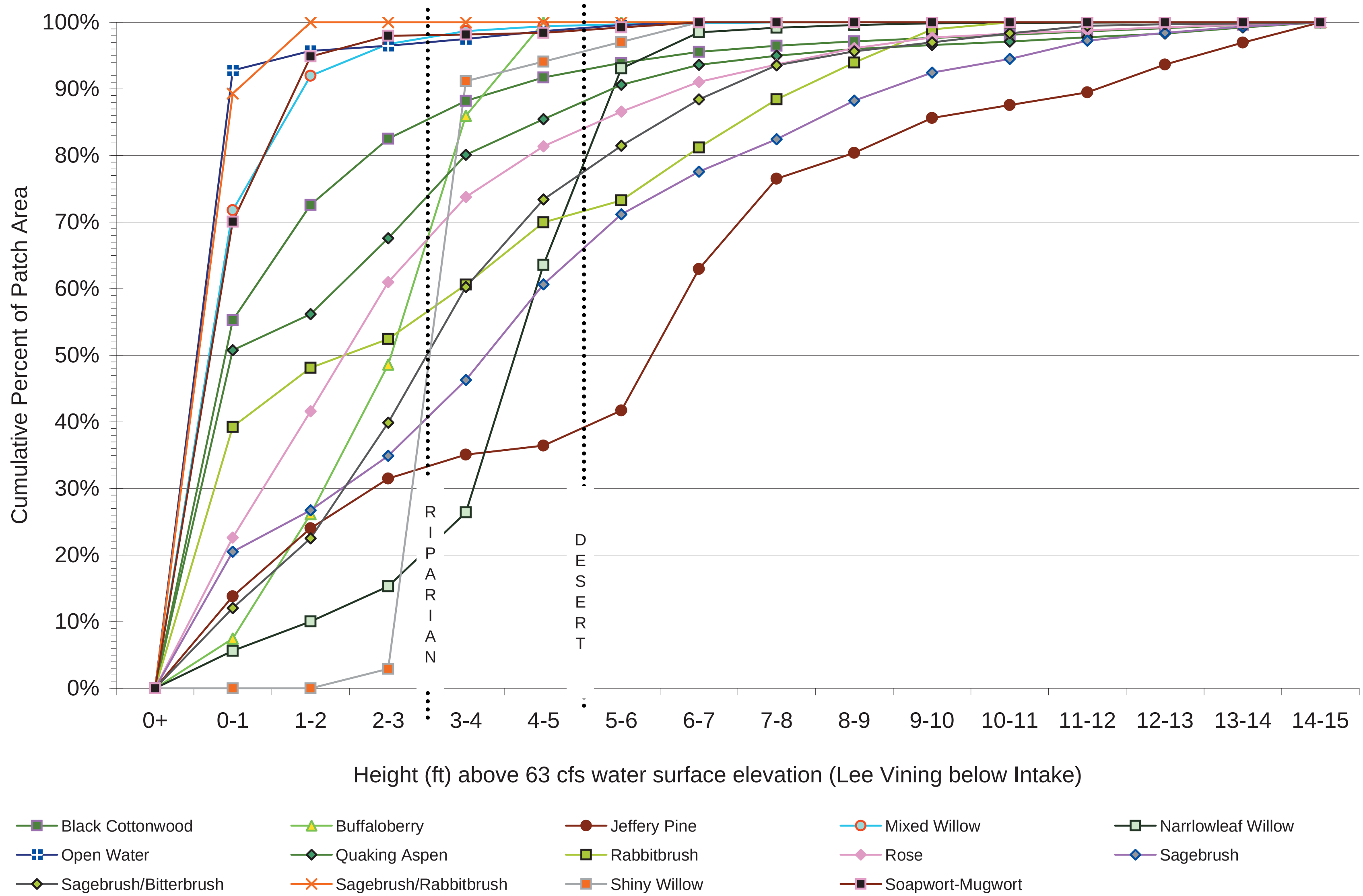


Figure C-7. Cumulative Percent of riparian and desert patch types above the June 23, 2003 streamflow on Lee Vining Creek (63 cfs below the LVC intake).

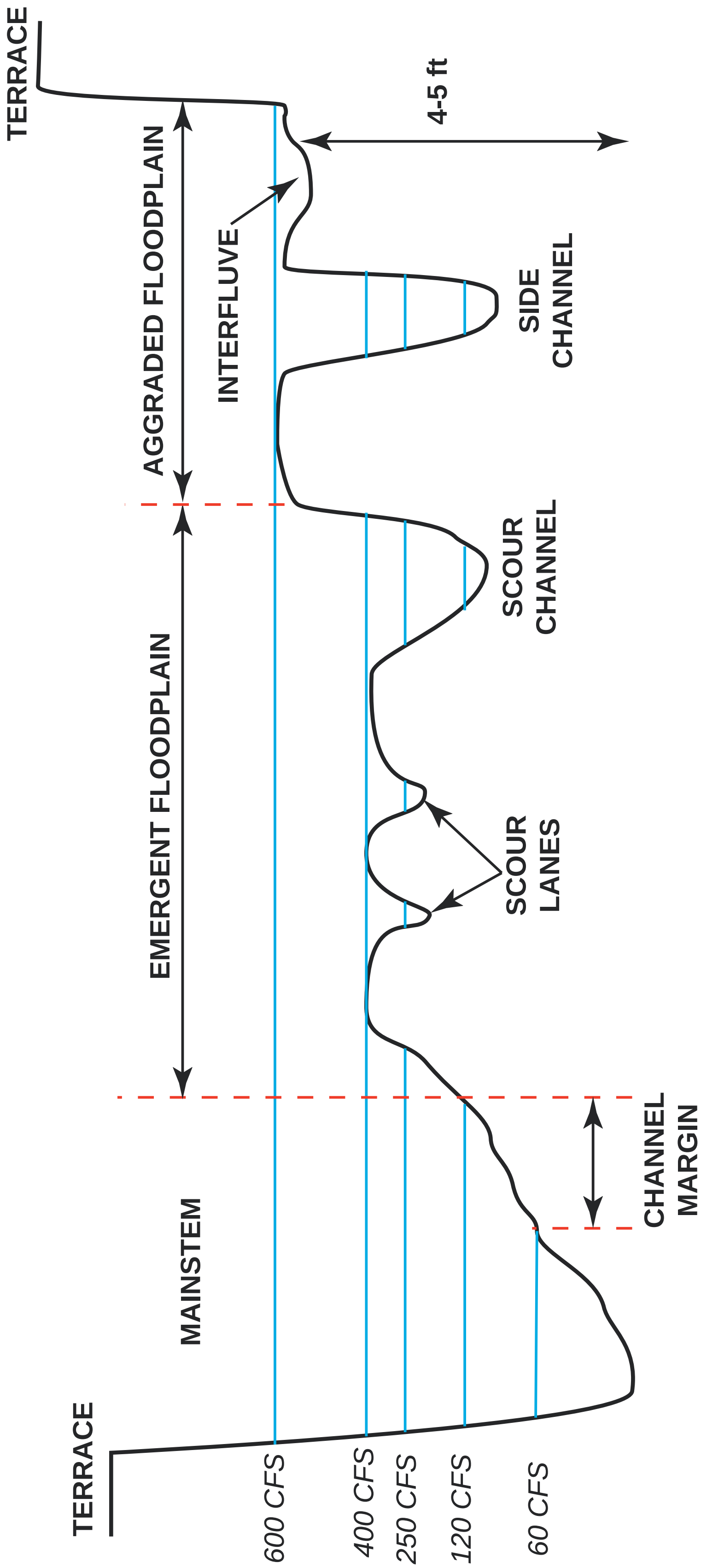


Figure C-8. Conceptual cross section showing different geomorphic surfaces relative to a range of flood stages.

APPENDIX C

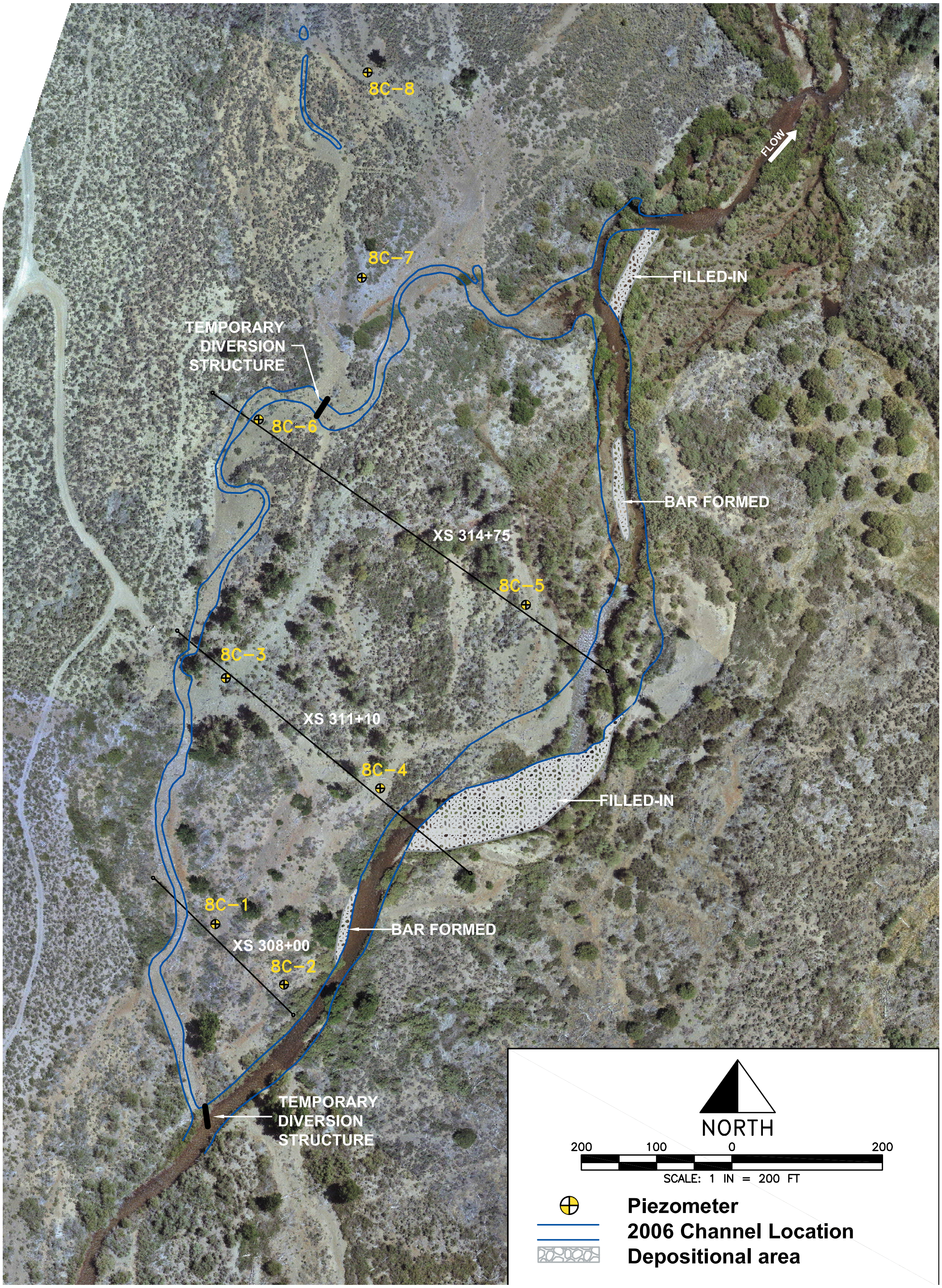


Figure C-9. The 8-Channel groundwater and riparian response study area in the Rush Creek bottomlands

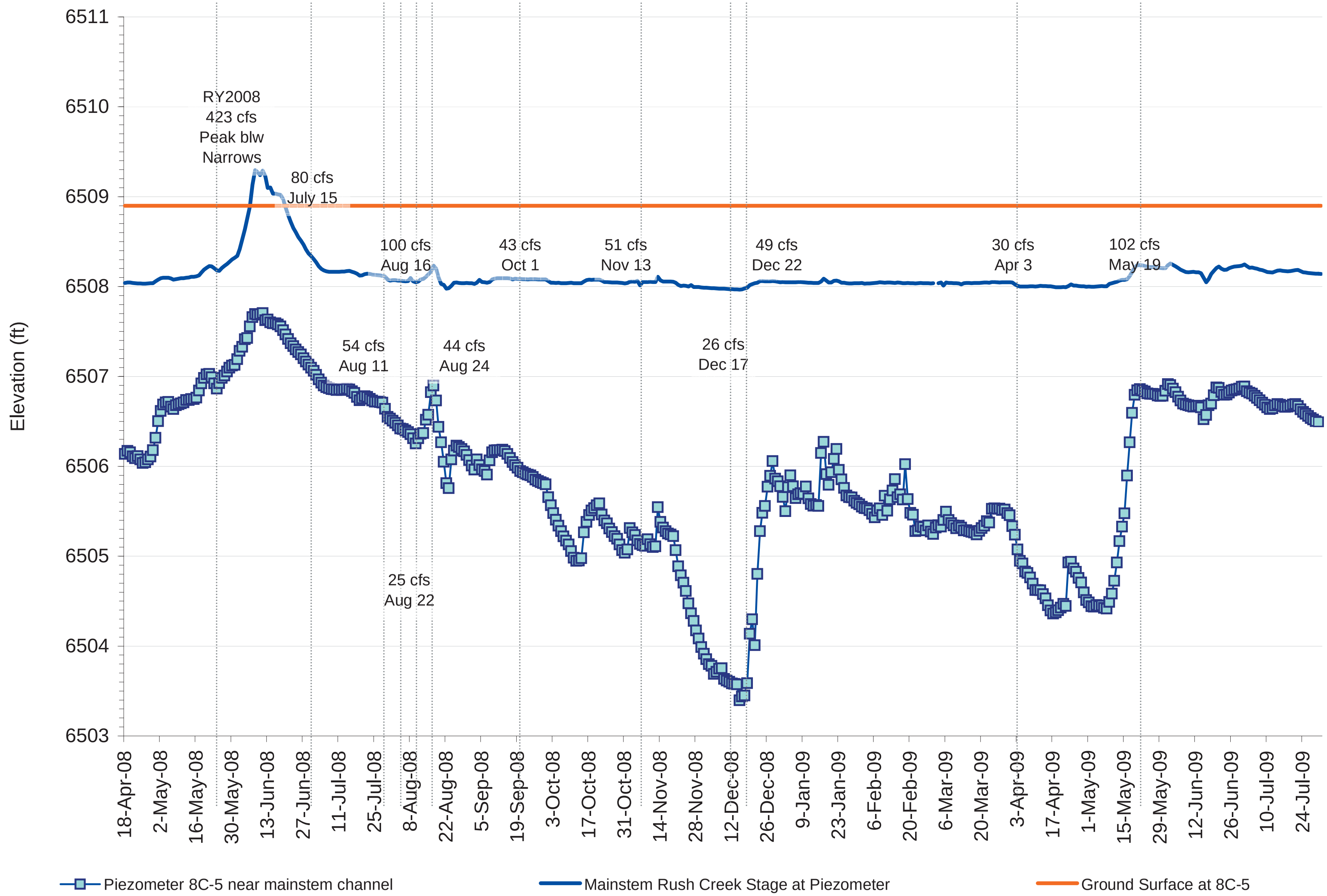


Figure C-10. RY2008-2009 mainstem Rush Creek stream stage and groundwater stage at piezometer 8C-5.

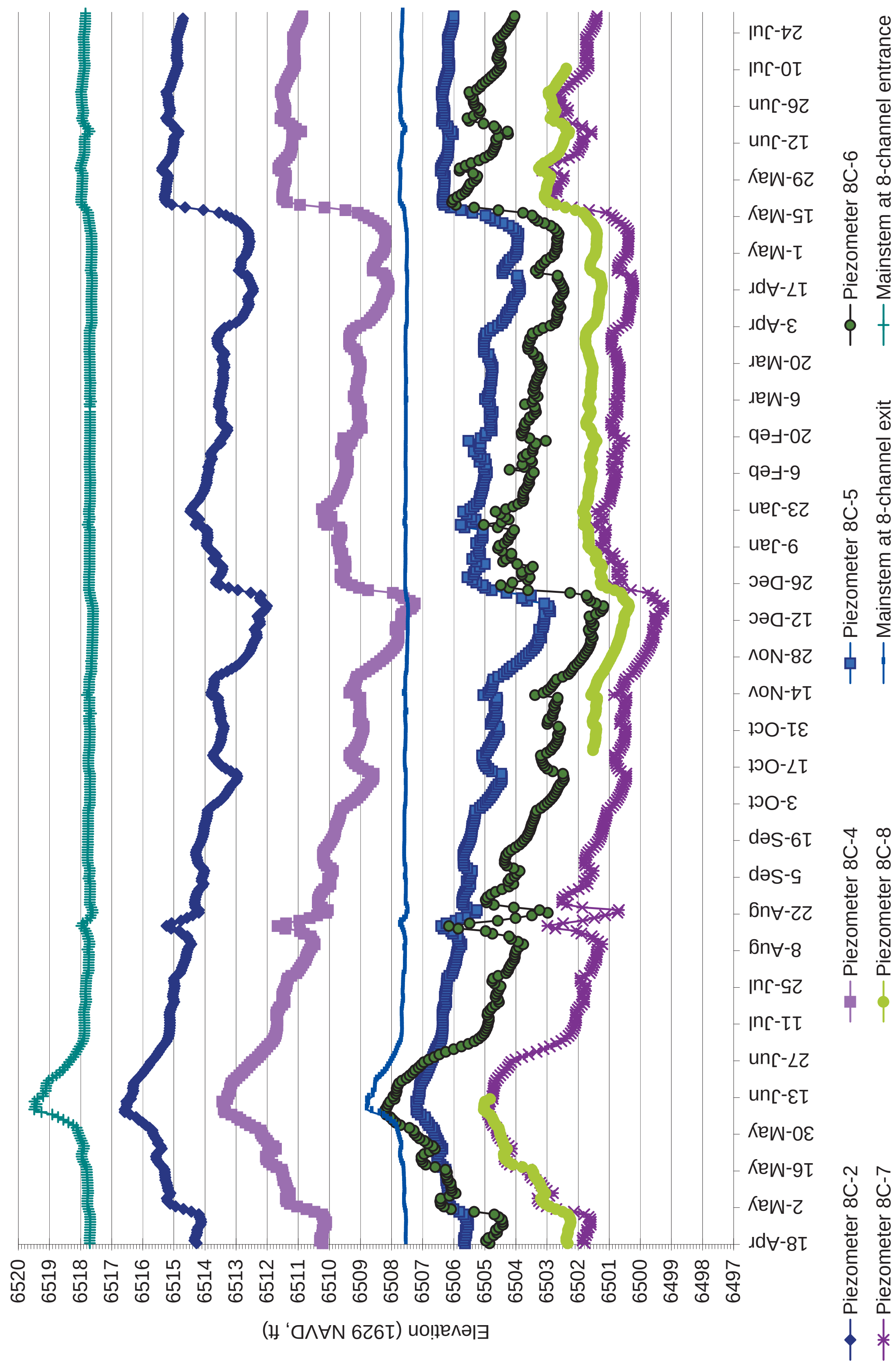


Figure C-11. RY2009-2010 mainstem Rush Creek stream stage and groundwater at six piezometers within the 8-Channel study area.

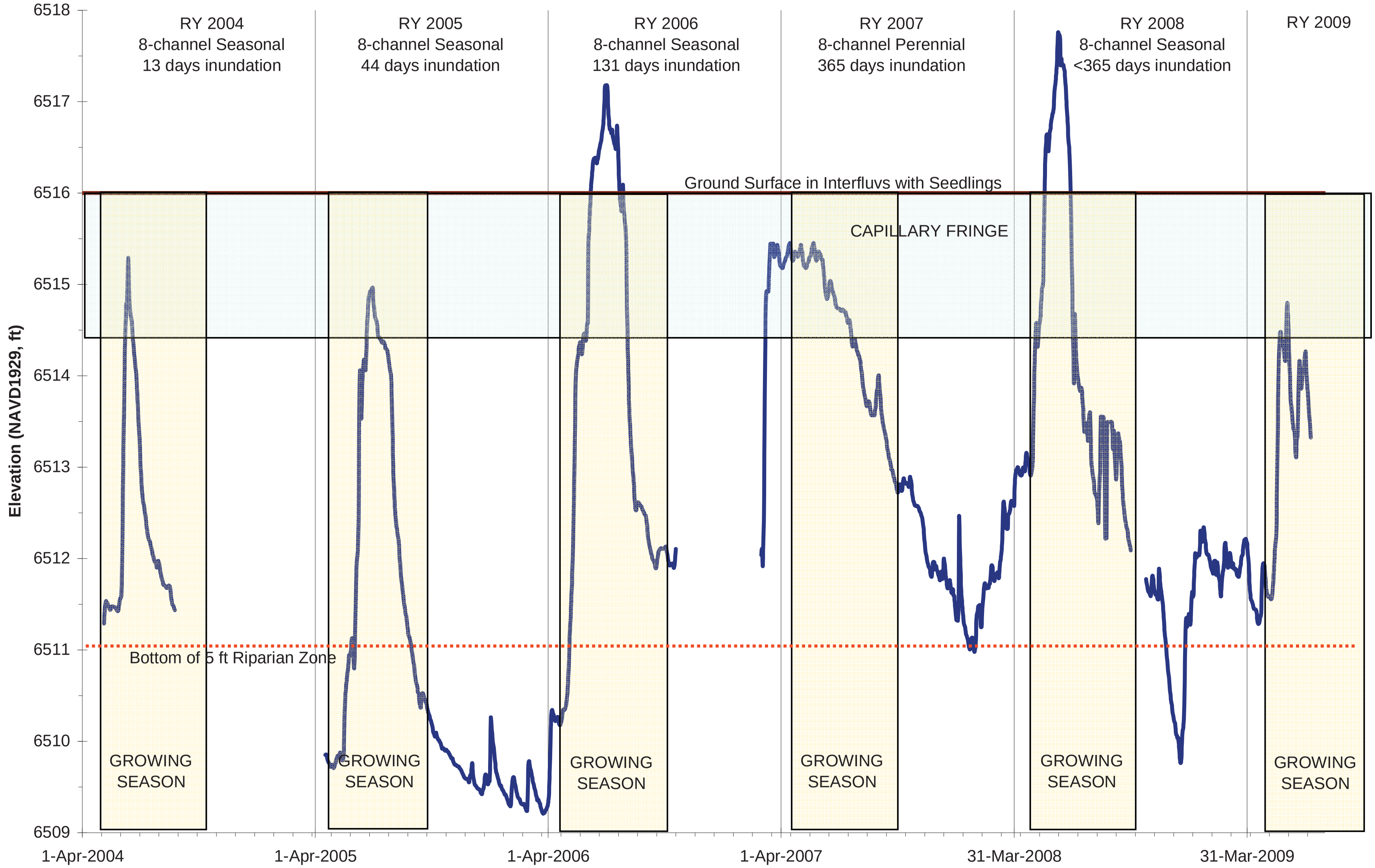


Figure C-12. Groundwater response at piezometer 8C-1 to seasonal and perennial side channel inundation between RY2004 and RY2009.

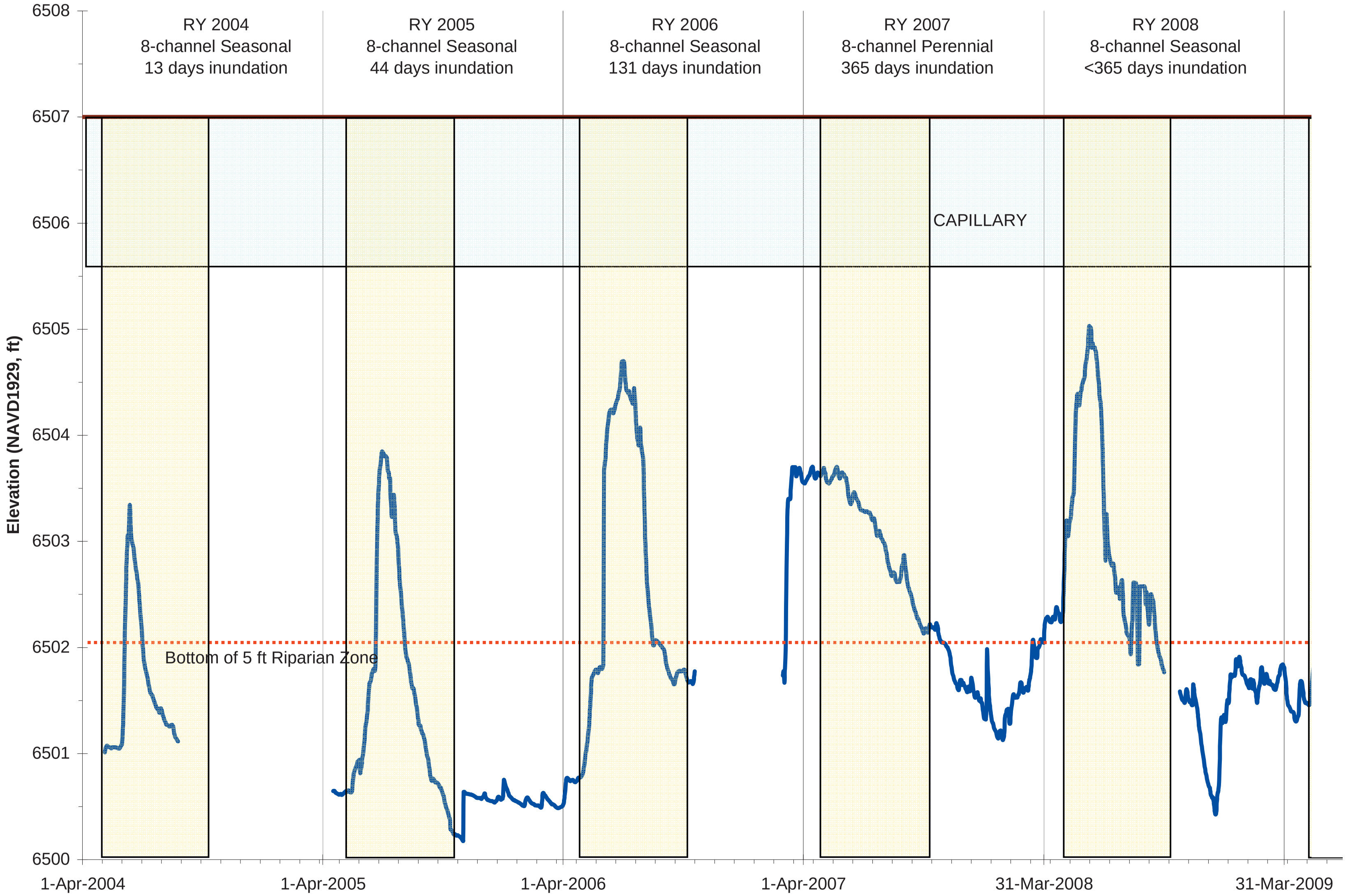


Figure C-13. Groundwater response at piezometer 8C-8 to seasonal and perennial side channel inundation between RY2004 and RY2008.

Figure C-14. Dead seedling on interfluv depressions between the mainstem and the 8-channel.

Figure C-15. Seedling on interfluv depressions between the mainstem and the 8-channel that resprouted in 2008 after dying back to the ground in 2007.

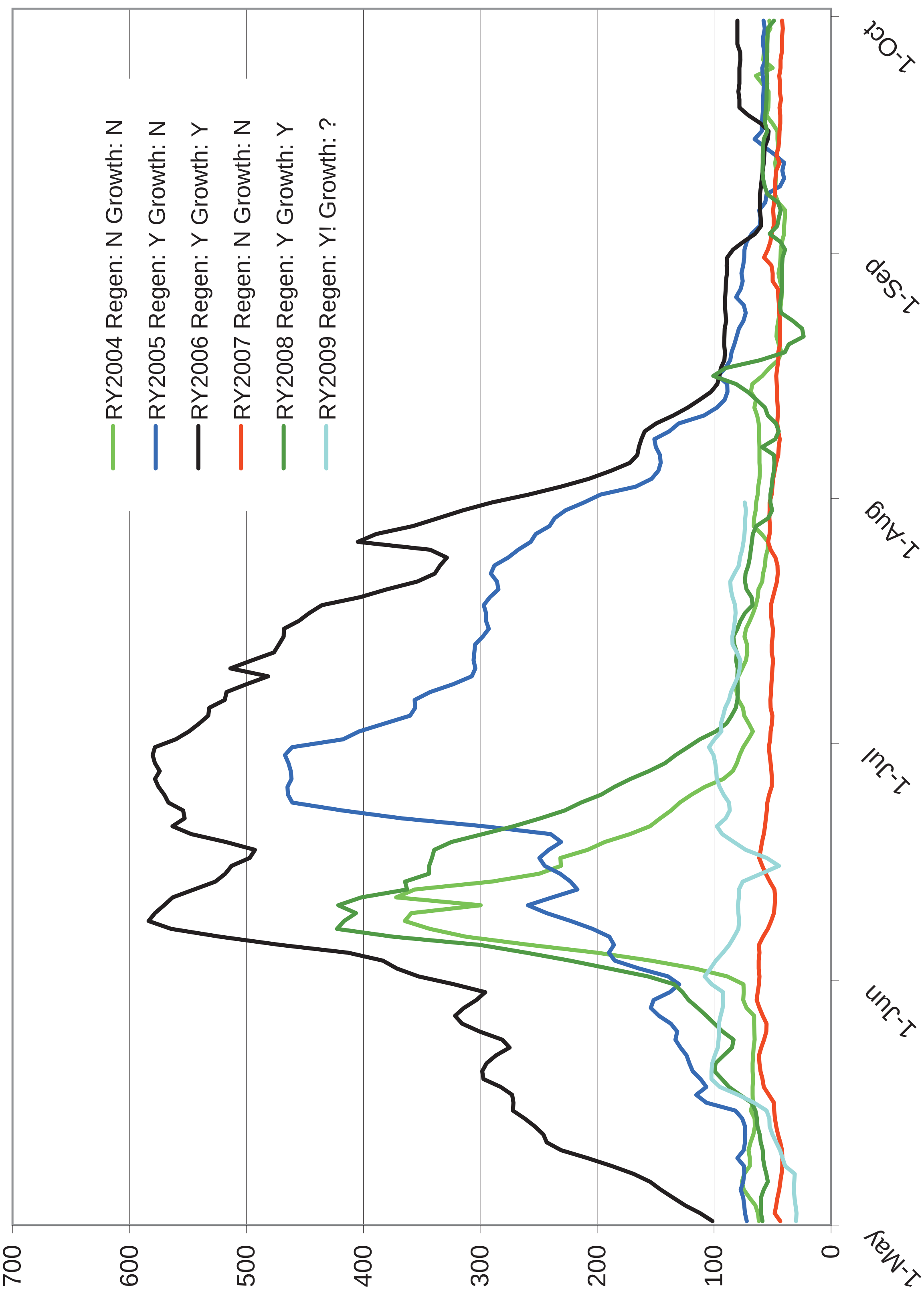


Figure C-16. Rush Creek snowmelt hydrographs for RY2004 to RY2008, indicating riparian vegetation germination and growth outcomes observes at 8-Channel interfluves.

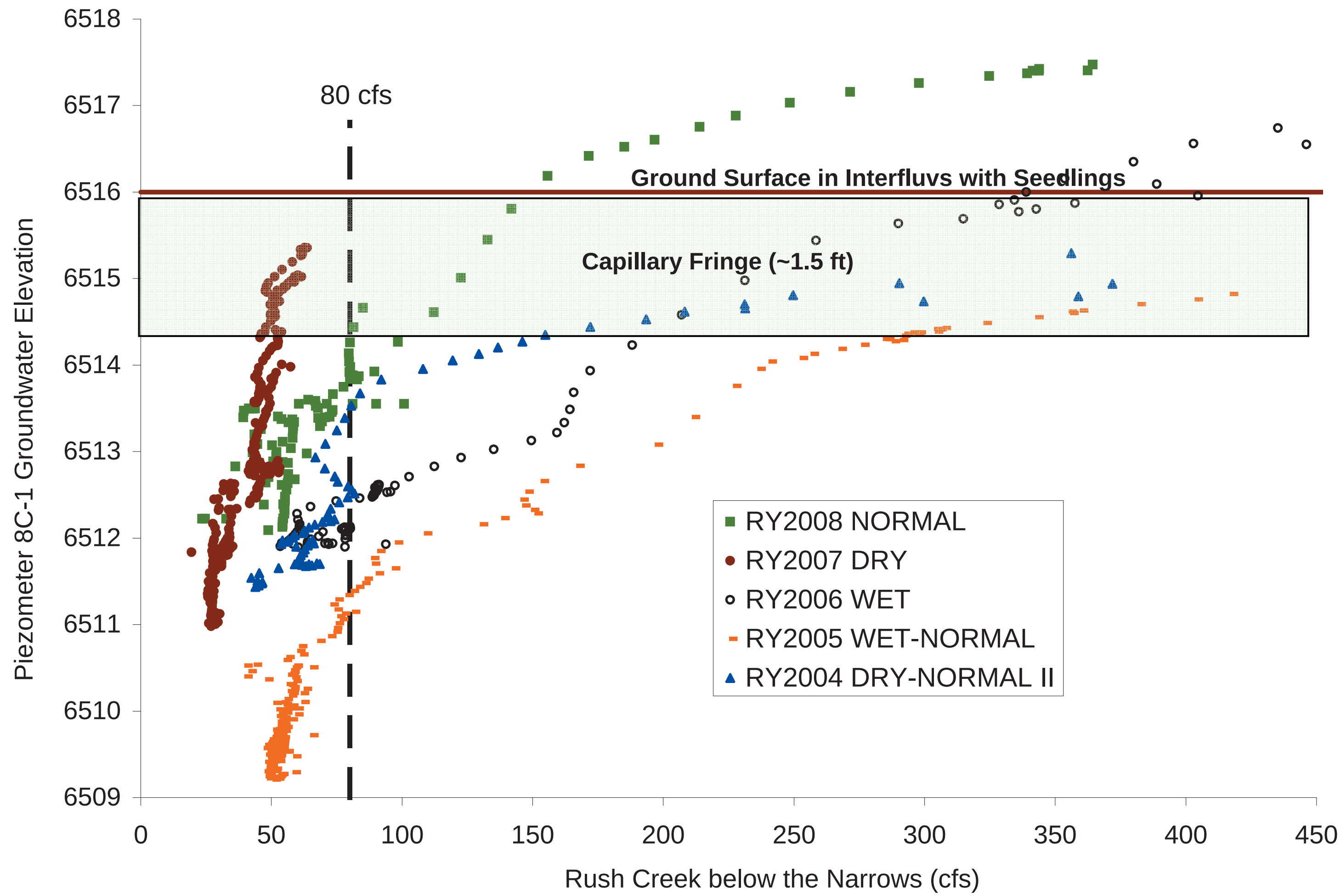


Figure C-17. Piezometer 8C-1 groundwater response to streamflow during the snowmelt recession for RY2004 to RY2008.

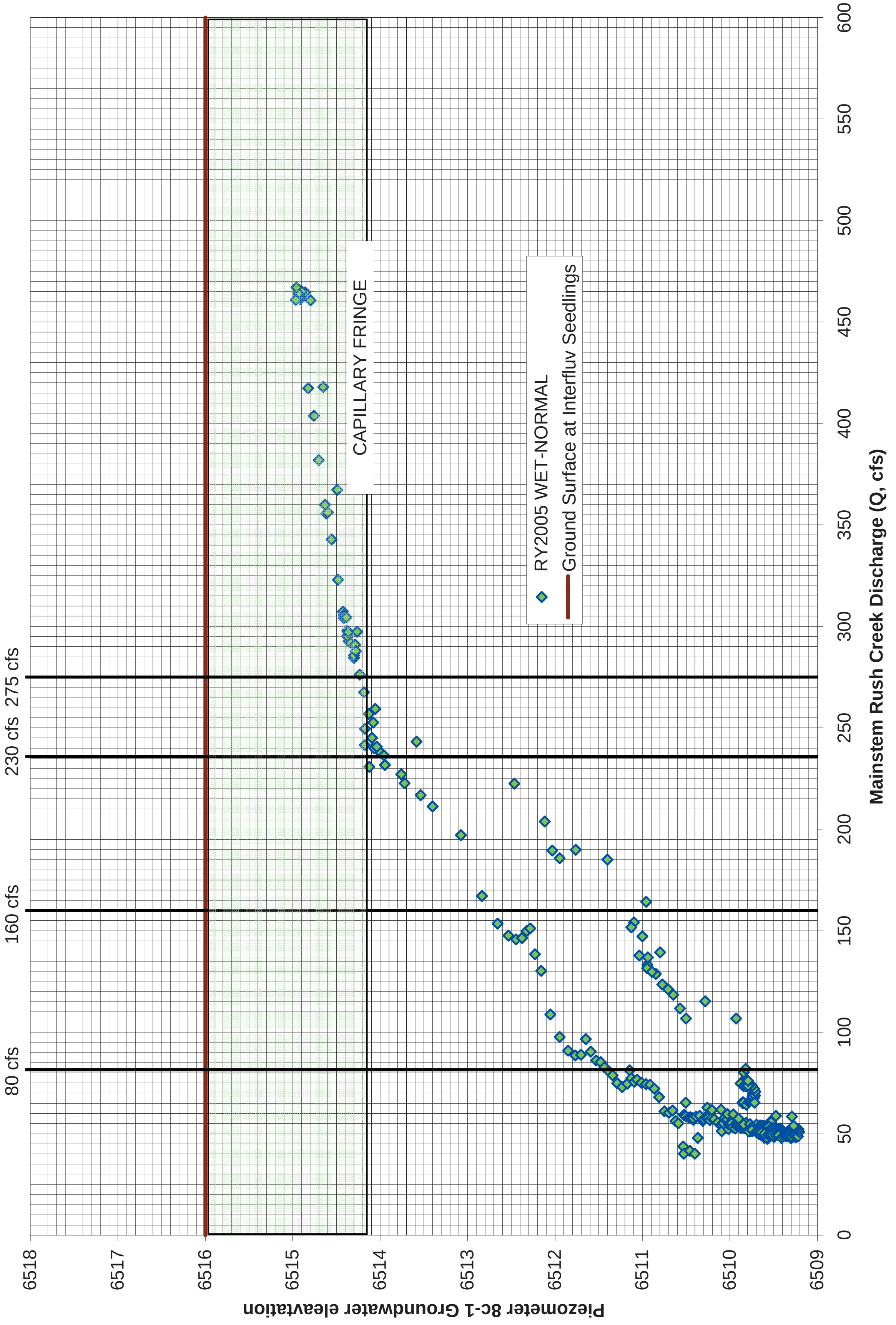


Figure C-18. Piezometer 8C-1 groundwater response to streamflow during Wet-Normal RY2005.

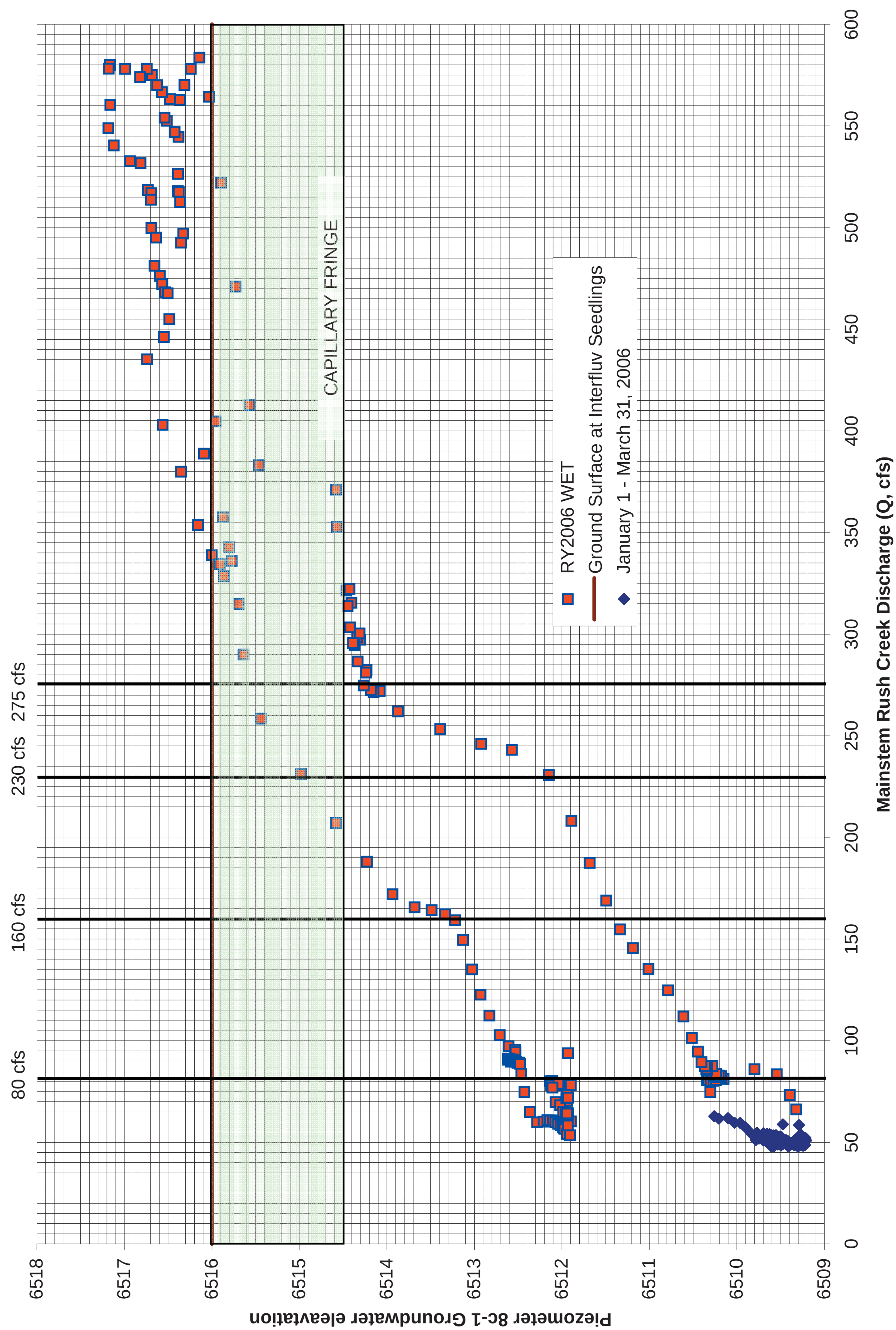


Figure C-19. Piezometer 8C-1 groundwater response to streamflow during Wet RY2006.

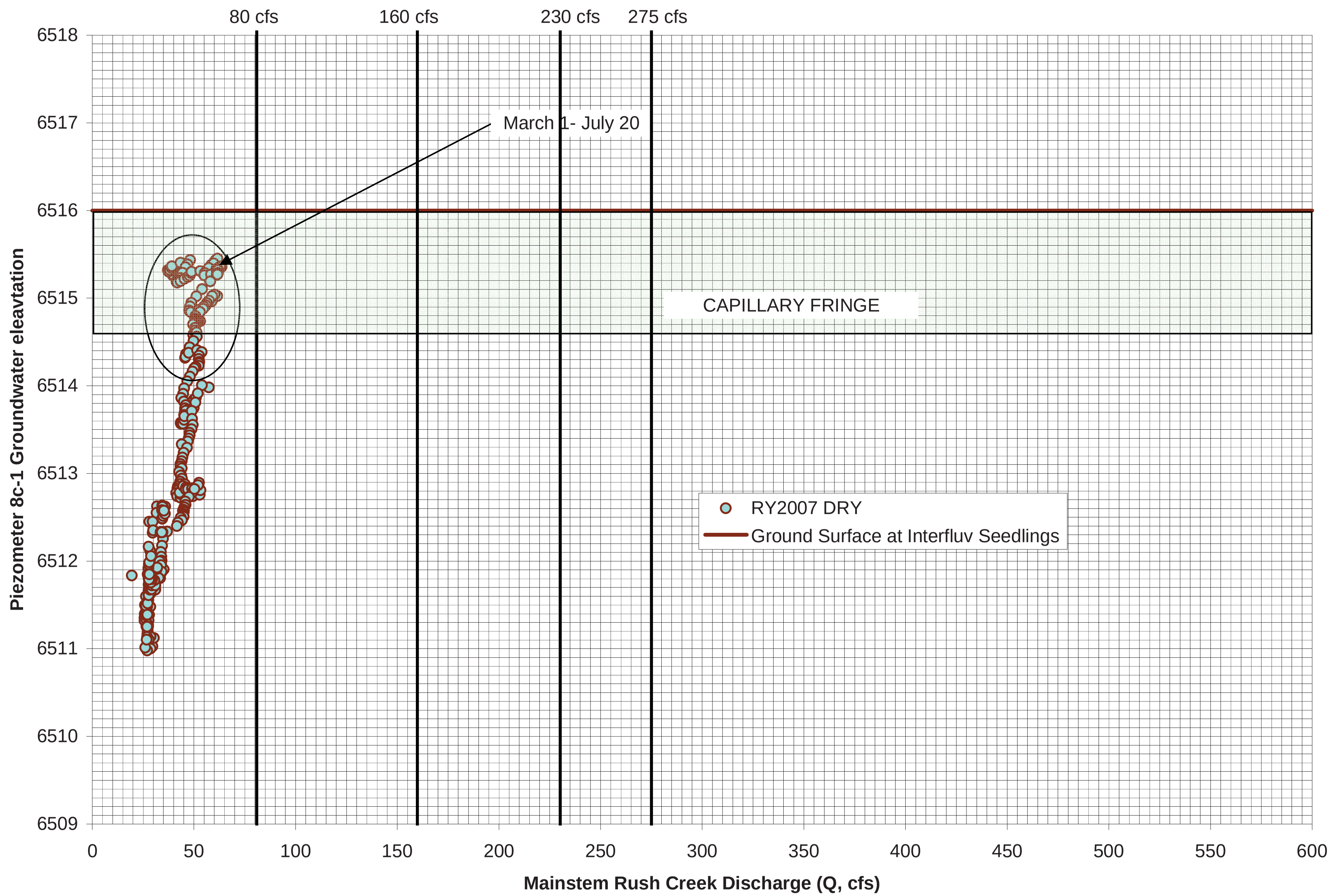


Figure C-20. Piezometer 8C-1 groundwater response to streamflow during Dry RY2007.

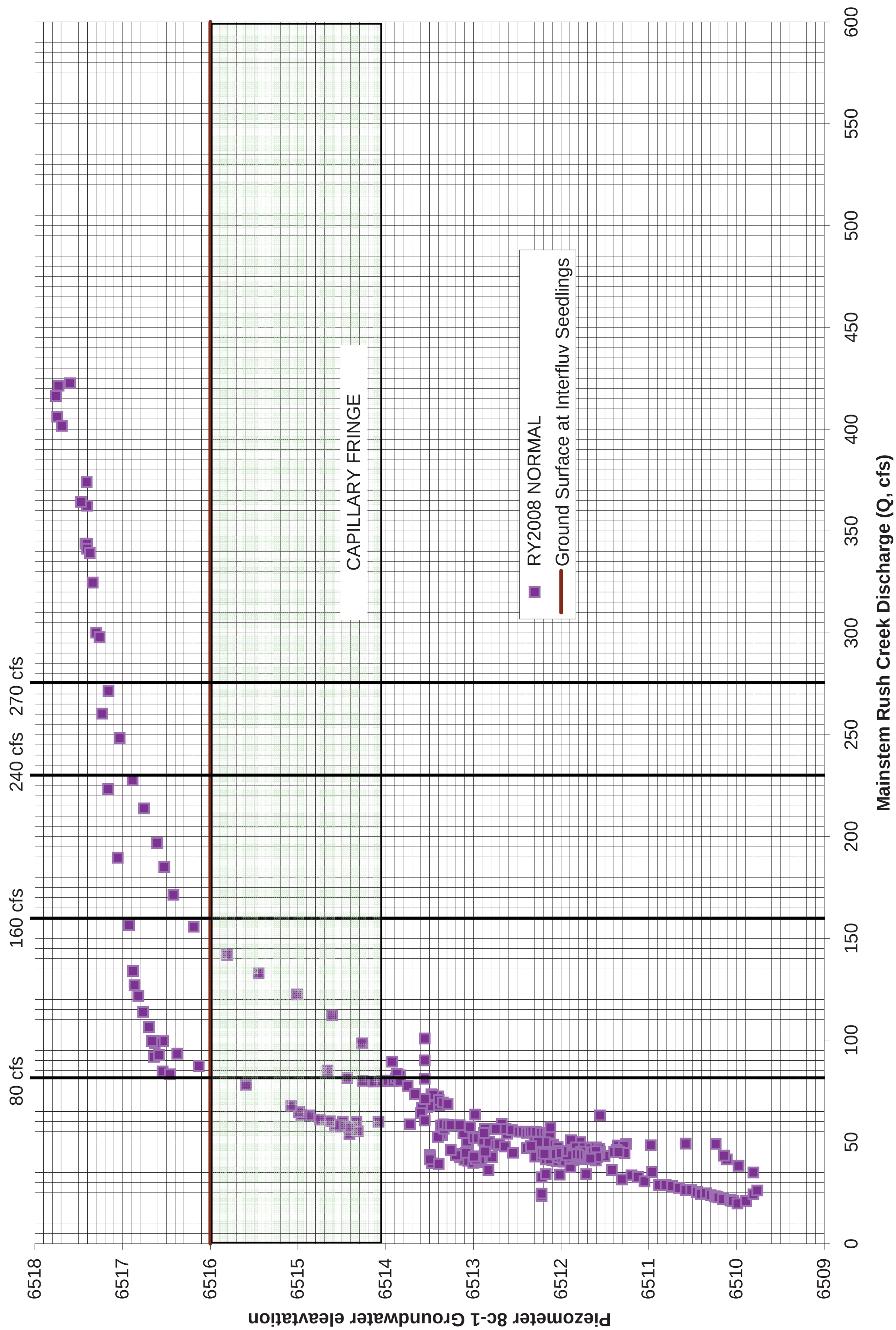
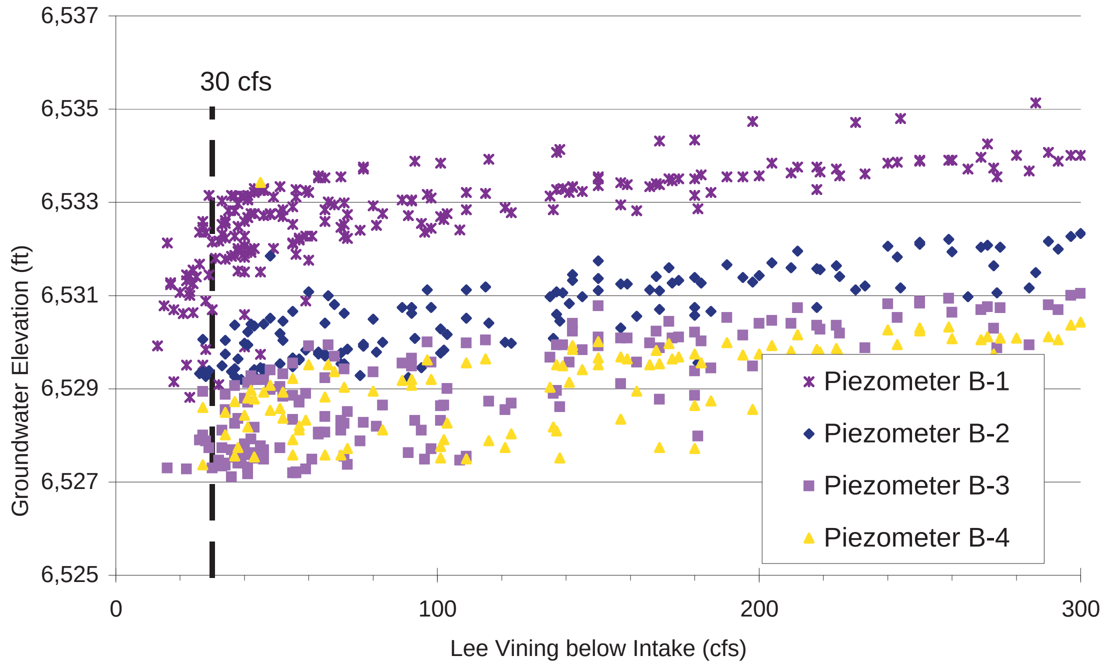


Figure C-21. Piezometer 8C-1 groundwater response to streamflow during Normal RY 2008.



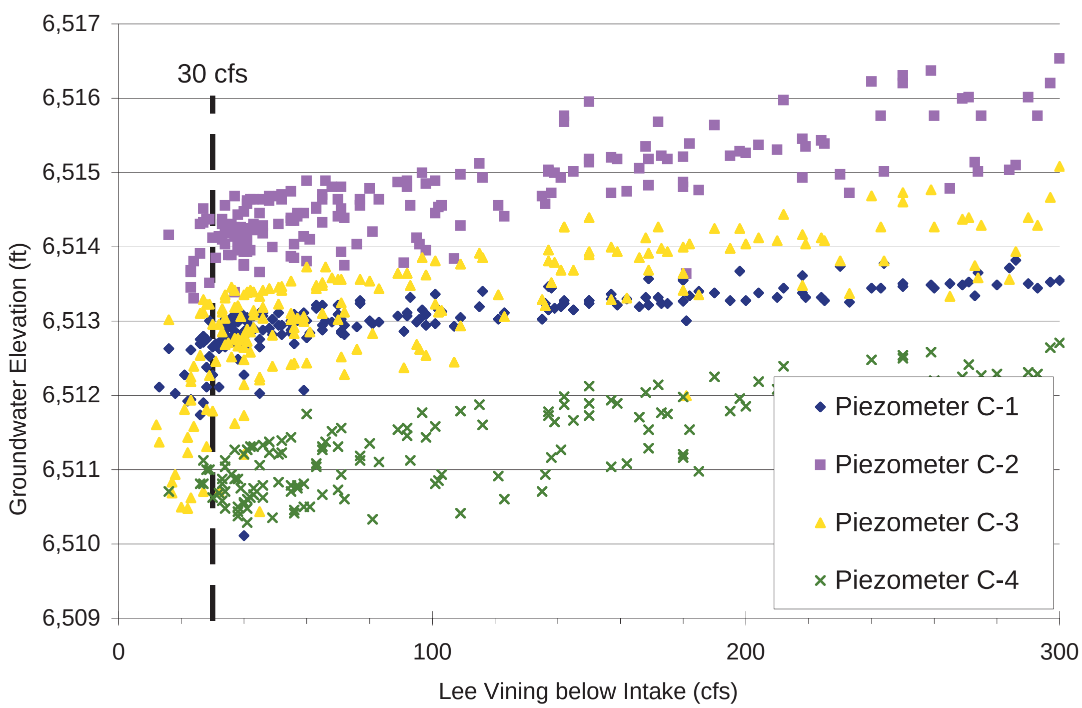


Figure C-22. Figure 4-8. Groundwater elevations at Lee Vining Creek piezometers B 1-4 and C 1-4 collected by the Mono Lake Committee for RYs 1995 to 2009.

Table C-1. Average peak seed dispersal periods for three common riparian hardwoods growing along Rush and Lee Vining creeks.

Common Name	Scientific Name	Begin Peak Seed Dispersal (average)	End Peak Seed Dispersal (average)
black cottonwood	*Populus balsamifera* ssp. *trichocarpa*	6-Jul	27-Jul
yellow willow	*Salix lutea*	14-Jun	5-Jul
narrowleaf willow	*Salix exigua*	15-Jul	7-Aug

Table C-2. Water year class and associated discharges that seasonally and perennially inundated the 8-channel entrance and the duration that the 8 channel flowed between RY2004 and RY2008.

Runoff Year	Runoff Year Class	Peak below Narrows (cfs)	Estimated discharge that inundates 8-channel (cfs)	Number of days 8 Channel entrance inundates 0.01ft	Number of days 8 Channel entrance inundates 0.10 ft	Number of days 8 Channel entrance inundates 0.25 ft	Number of days 8 Channel entrance inundates 0.50 ft	Number of days 8 Channel entrance inundates 1.0 ft	Notes about entrance
2002-2003	Dry-Normal I	225	496 +	0	0	0	0	0	Fall 02 8 channel opened to inudate at ~275 cfs
2003-2004	Dry-Normal I	283	496 +	0	0	0	0	0	
2004-2005	Dry-Normal II	372	333 +	6	5	2	0	0	Spring 2004 entrance enlarged #1
2005-2006	Wet-Normal	467	224 ++	44	36	28	16	8	Spring 2005 entrance enlarged #2; Channel went sub-surface between 8c-3 and 8c-6 July 24th 2005
2006-2007	Wet	584	100 ++	131	98	91	85	59	Spring 2006 entrance evolved; 4bii was opened to seasonal flow; G. Reis "8- channel closed itself"; Oct 18-20 channel was observed drying up
2007-2008	Dry	64	40 +	365	365	59	0	0	March 2007 DWP spent two days opening the 8 channel; the 4bii was opened to periennial flow
2008-2009	Normal	423	40 +	365	364	133	36	21	

+ = Estimates developed from survey and stage discharge relationships at the 8-channel entrance
++ = Estimates based on field observation (McBain and Trush 2005, McBain and Trush 2006, and McBain and Trush 2007)

APPENDIX D. MONO BASIN FISHERIES

The non-native trout fisheries residing within streams of the Mono Lake Basin have been the subject of a multitude of past studies and analyses. This technical Appendix provides additional information and analyses from previously conducted studies and prepared reports; as well as information from analyses conducted specifically for the Synthesis Report.

In this Appendix, we present the following additional data and analyses relevant to the revised Stream Ecosystem Flows recommended in the Synthesis Report:

Appendix D-1: Review of California Department of Fish and Game's Instream Flow Studies

Appendix D-2: Development of Brown Trout Holding Habitat Criteria

Appendix D-3: Predicting Brown Trout Emergence Times for Lee Vining and Rush Creeks

Appendix D-4: Modeling Rush Creek Summer Water Temperatures and Predictions of Brown Trout Growth

Appendix D-1: Review of California Department of Fish and Game's Instream Flow Studies

We evaluated the currently prescribed flows for Rush and Lee Vining creeks as determined by studies conducted by CDFG and other experts in the late 1980s and early 1990s ((Smith and Aceituno 1987; CDFG 1991; CDFG 1993). While these older studies were probably conducted with the best available information and methodologies at the time and have provided the streams adequate flow regimes to start the recovery process; we contend these studies and resulting flow recommendations are dated.

A couple of our concerns were also raised as far back as the 1993 Water Board hearings. First, the stream channels have evolved so much that the original flow recommendations for trout habitat are no longer relevant. At the 1993 hearing, Jim Canaday asked Dr. Thomas Hardy to elaborate on an IFIM premise that the stream channel must be stable, and if a channel had undergone measureable changes how would this affect flow recommendations. After Dr. Hardy agreed that the Rush Creek channel had changed as a result of increased flows between 1987 and 1993, Canaday specifically asked Hardy, "Would that affect the applicability of the recommendations from either one of those studies if the stream is significantly different today than it was when those studies were put on?" Dr. Hardy responded, "It definitely has that potential, sir." Dr. Hardy was also questioned about applying WUA curves derived from a wide, shallow channel to a narrower, deeper channel more indicative of pre-1941 conditions. Dr. Hardy responded that the amount of habitat would be quite different. Habitat typing and pool surveys conducted between 1991 and 2008 (Trihey and Associates 1994; Knudson et al 2009) along with time-series photographs (Figures 7a-f) support our contention that significant riparian and channel evolution has occurred over the past 17 years, and that the present channels are not representative of channel conditions used in developing the currently prescribed instream flows for trout.

The second issue discussed during the 1993 Water Board hearing was development of habitat criteria curves. Dr. Hardy was again asked to comment on the issue. Mr. Birmingham asked, "If you were to develop onsite criteria curves, would you take all your data at a flow lower than the zero percentile flow for that stream?" Dr Hardy responded, "No. I would want to collect observations from a wider range of flows as I could physically collect the data in the stream." Mr. Birmingham then asked, "So would you then have a criticism of the E.A. study based on the fact that they took all of their observations at 19 cfs?" Hardy responded, "From that viewpoint, it would be a criticism." When cross-examined by Bruce Dodge, Dr. Hardy was asked why he would want a broader range of flows. Dr. Hardy responded, "Primarily, the fundamental problem with suitability curves is that they are surrogate for what we know to be true fish behavior on selection of stream locations. They really select energetically favorable positions.” This response echoes the concluding sentence of a journal article that critiqued WUA estimates derived from PHABSIM studies (Williams 1995).

“It seems wiser to put effort into learning the basic biology of the species of concern, which alone can provide a firm foundation for valid applied methods and sound water management decisions”

We concur with Dr. Hardy’s responses and have delved further into the issue of habitat criteria curves by examining the habitat preference criteria study used in developing the CDFG flow recommendations. Smith and Aceituno (1987) readily admitted that all of their brown trout observations were made during the daytime and also during the spring, summer, and fall. They cautioned against using these data for making either night time or winter flow recommendations; yet CDFG used these data for generating instream flow recommendations for all seasons, including winter months. Smith and Aceituno (1987) also made very few direct observations of brown trout utilizing habitat deeper than 2 ft, probably because few pools were present with depths greater than 2 ft, yet CDFG still used these preference criteria to prescribe instream flows to address juvenile and adult brown trout pool habitat.

Smith and Aceituno (1987) alluded to measuring focal point velocities of observed brown trout. However; all of the habitat preference criteria utilized by CDFG to develop instream flows were based on mean water column velocities measured at 6/10th total water column depth, rather than being based on focal velocities taken near the stream bottom in locations actually occupied by the observed brown trout (CDFG 1991; 1993). During our 12 years of studying the basic biology of brown trout in Rush and Lee Vining creeks, including extensive day and night snorkeling and three years of relocating radio-tagged fish, we came to the conclusion that mean water column velocities are a very poor descriptor of brown trout habitat. This is because more than 80% of the brown trout observations made during our field surveys were either directly on, or within 0.5 ft, of the stream bottom (Appendix D-2). We therefore contend that focal velocities taken at 0.5 ft (or even closer to the stream bottom) more accurately describe the velocity preferences of brown trout in their holding positions compared to velocities taken higher in the water column in a location that brown trout are rarely, if ever, observed utilizing as holding habitat. Our findings were consistent with those reported by Raleigh et al (1986); Clapp et al (1992); Meyers et al (1992); and Heggenes (2002).

Unlike many other instream flow studies, our fall and winter baseflow recommendations were developed with data generated from relocations of our radio-tagged brown trout during winter (December-March) and non-winter (April-November) periods. We used site-specific habitat measurements, taken at each relocation site, to develop holding habitat criteria for brown trout on Rush Creek. We did not need to extrapolate non-winter observations to winter conditions, like most other IFS recommendations, including CDFG’s studies on Rush and Lee Vining creeks (CDFG 1991; 1993).

Appendix D-2: Development of Brown Trout Holding Habitat Criteria

Prior to the development of brown trout holding habitat criteria for the IFS, we focused on studying the relevant biology and habitat of brown trout in Rush and Lee Vining creeks, which we felt would provide the most valid foundation for the methods needed to support sound water management decisions for this species in the Mono Lake Basin. Annual fish population estimate surveys conducted from 1999-2009 evaluated changes that occurred to the numbers, biomass, age-class structure and condition of the populations during different water-year types (Hunter et al. 2000 – 2009). The analysis of Rush Creek water temperature data in concert with fish population data identified statistical relationships between Grant Lake Reservoir storage levels, water temperatures, and brown trout abundance and condition factor (Shepard et al. 2009a-b). The extent of potential adult brown trout holding habitat was documented by measuring the frequency and distribution of high-quality pools (Platts et al. 1983) throughout the length of Rush Creek during 2002 and 2003 (Knudson et al. 2009). The evolution of the Rush Creek channel towards more high-quality pools as a result of large SRF flow releases in 2005 and 2006 was evaluated by repeating the pool survey in 2008 (Knudson et al. 2009).

The Platts et al. (1983) methodology rated pools based on their depth, surface area and amount of hiding cover, but did not factor water velocities into the ratings. While conducting day and night snorkel surveys in 2000 and 2002, we noticed that there were often relatively low numbers of brown trout in some of the high-quality pools identified during the pool survey. It appeared that brown trout largely avoided pools with relatively high water column velocities near the stream bottom, even when good to excellent hiding cover was present. This apparent preference by brown trout for low velocity holding areas was confirmed during our three-year study of the movement and habitat preferences of radio-tagged juvenile and adult fish in Rush Creek (Taylor et al. 2009). During this study, measured habitat parameters included the amounts and types of hiding cover, total water depths, and water column velocity measurements at 6/10th and 9/10th of total stream depth for each tagged fish that was relocated during winter (December-March) and non-winter (April-November) months. Habitat measurements were made for 132 relocated radio-tagged brown trout, including 45 juveniles (197-206 mm) that were tagged in Rush Creek; 56 adults (244-304 mm) tagged in Rush Creek; and 31 adults (314-518 mm) tagged in the MGORD that were subsequently relocated in Rush Creek downstream of the MGORD.

During winter months, all (100%) of the MGORD adults that were relocated downstream in Rush Creek proper, were holding in locations where water column velocities near the stream bottom ranged from 0.1 to 0.7 ft per second (fps), as were 91% of the brown trout adults tagged in Rush Creek, and even 85% of the Rush Creek juveniles (Figure D-2.1). This demonstrated that all sizes of brown trout, not just the large MGORD adults, preferred low-velocity holding habitats and would benefit from increases in areas where stream bottom velocities are 0.0 to 0.7 fps.

During the non-winter months, a somewhat higher proportion of all sizes of brown trout were relocated at sites where focal velocities were >0.7 fps, but 82% of all the adult fish and 81% of the juveniles were still found at locations with focal velocities ranging from 0.0 to 0.7 fps (Figure D-2.2). There does, however, seem to be a slight preference for lower focal velocities during the winter months, since mean stream bottom velocity for all brown trout relocated during winter (0.36 fps) was lower than the non-winter mean (0.53 fps) (Table D-2.1). For the large MGORD fish this difference was even greater: 0.33 fps during winter vs. 0.59 fps during non-winter (Table D-2.1).

The winter graph (Figure D-2.1) justifies why we used stream bottom velocities of 0.0 to 0.7 fps, measured 0.5 ft off the stream bottom, as the velocity criteria for delineating adult brown trout winter holding habitat during the IFS. Comparing mean column water velocities measured at 6/10th total depth to velocities measured at 9/10th total depth supports our contention that mean water column velocities are a poor descriptor of brown trout habitat (Table D-2.2). For 123 instances where a relocated fish occupied a location with a focal point velocity less than 0.7 fps, 33% of the time the mean column water velocities exceeded 0.7 fps (Table D-2.2).

Our water column depth criteria of >1.0 ft was based on the fact that 87% of the adult brown trout relocated during winter months were found where water column depths exceeded 1.0 ft (Figure D-2.3). Brown trout relocated in non-winter months also showed a strong preference for locations with water column depths greater than 1.0 ft (Figure D-2.4). Direct cover was the third criterion used to delineate winter holding habitat during the IFS and was also derived directly from Movement Study results. Our cover criterion was very straight-forward; there had to be enough direct hiding cover to provide at least 12 ft^2 of protection from surface detection.

The developed focal velocity, depth and cover criteria were utilized to measure the surface areas of adult brown trout holding habitat polygons during the IFS on Rush and Lee Vining creeks (Taylor et al. 2009). During the IFS mapping, water depths were measured to the nearest 0.1 ft. and focal velocities to the nearest 0.1 fps. The study reaches for this mapping effort were based, in part, on habitat typing surveys conducted on these streams just prior to the IFS, where we measured the lengths and locations of all the pool, riffle and glide/run habitats (Knudson et al. 2009). In Rush Creek, a bulk of the IFS direct habitat mapping effort was directed to the reach downstream of the Narrows because of the clusters of high-quality pools present and also because of this reach's documented geomorphic response to high runoff flows (Knudson et al. 2009). The Fisheries Scientists suggest that this reach best represents the likely future condition of the stream channel in lower Rush Creek and chose to concentrate the IFS's direct habitat mapping in this reach to better analyze flow affects for this likely future channel condition. As previously mentioned, our habitat measurements were collected during all seasons, so we did not need to extrapolate non-winter observations to winter conditions like was done during many other IFS recommendations, such as CDFG (1991; 1993) did with the habitat preference criteria developed by Smith and Aceituno (1987).

During our IFS mapping, we applied several QA/QC procedures. Depth and velocity measurements were double-checked by measuring these parameters until a polygon boundary was located, and by re-measuring at several points along the boundary. During and after each polygon was delineated, the data recorder and the person who was measuring depths and velocities always conferred to ensure that the dimensions and location of each polygon were correctly displayed. For each polygon boundary point, the distance from the previous point was recorded and triangulation with at least one other boundary point or other known reference point was done by measuring the two distances. The locations of the polygon boundary points were therefore very quantifiable and easily measured with a stadia rod, current meter and measuring tape. The boundaries between suitable and unsuitable focal velocities were usually quite obvious (i.e., clear velocity "break-points" occurred when the flow meter was moved a matter of inches, not feet); and measurements of depths (being either deeper or shallower than one-foot) were also very straight-forward, as was the presence or absence of direct overhead hiding cover.

We believe that our stream and species-specific approach for determining holding habitat criteria for adult brown trout provided a sound foundation for our IFS recommendations. The extensive data set generated from the Movement Study clearly demonstrated that holding habitat as defined by our IFS mapping criteria was utilized by several size classes of juvenile and adult brown trout during both winter and non-winter months. Management decisions that expand the area of winter habitat defined by these criteria should enhance the survival and condition of adult brown trout in Rush and Lee Vining creeks.

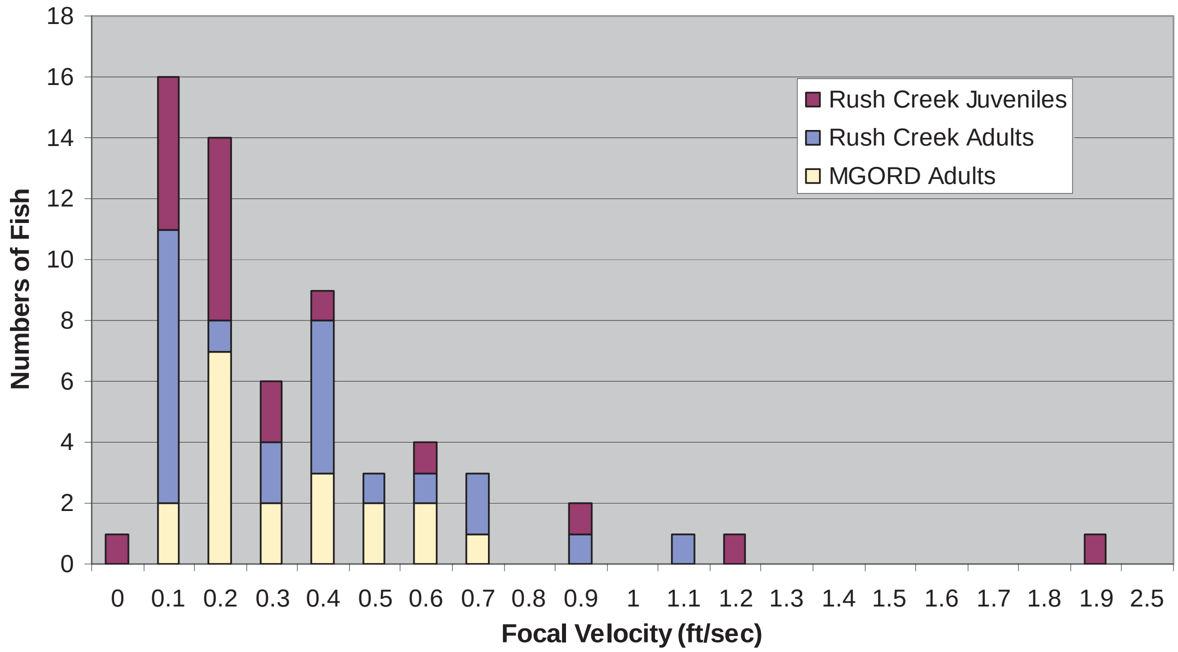


Figure D-2.1. Distribution of focal velocities for brown trout relocated during winter months (December-March) in Rush Creek.

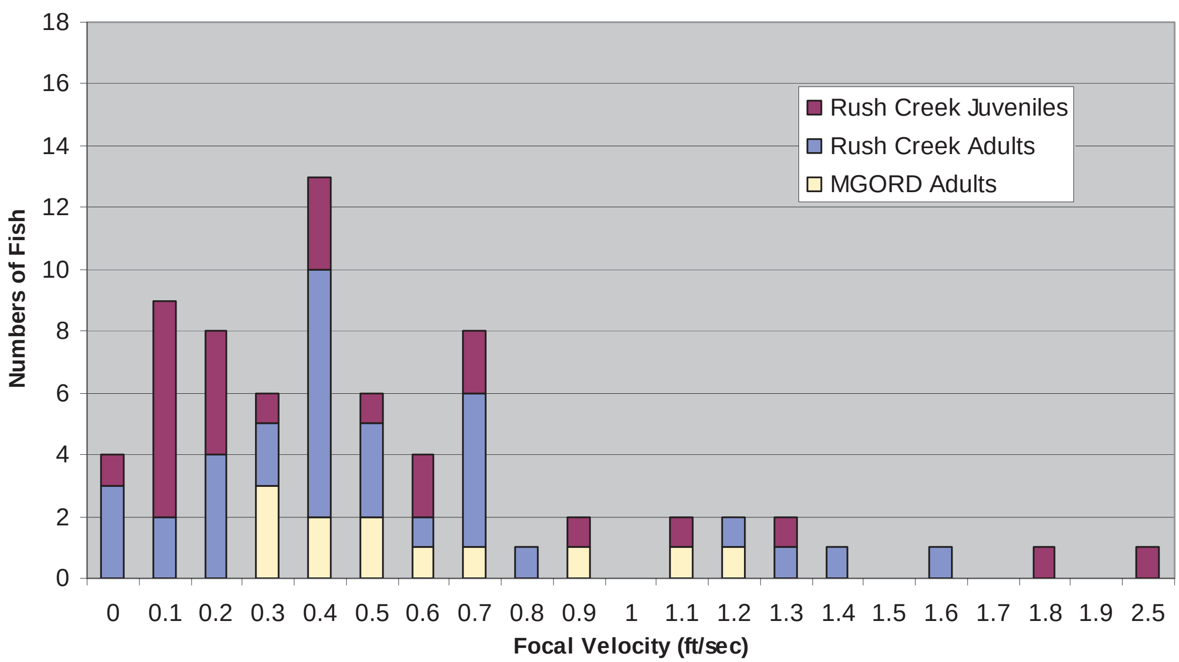


Figure D-2.2. Distribution of focal velocities for brown trout relocated during non-winter months (April-November) in Rush Creek.

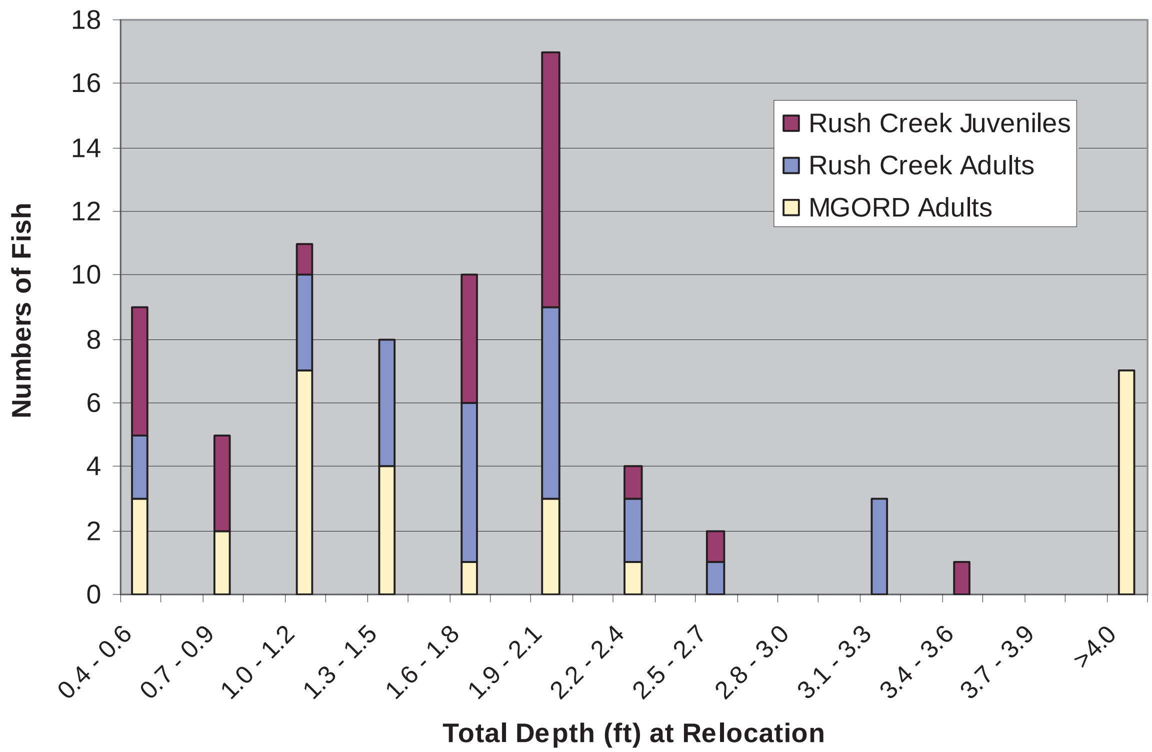


Figure D-2.3. Total depths measured at locations of brown trout relocated during winter months (December-March) in Rush Creek.

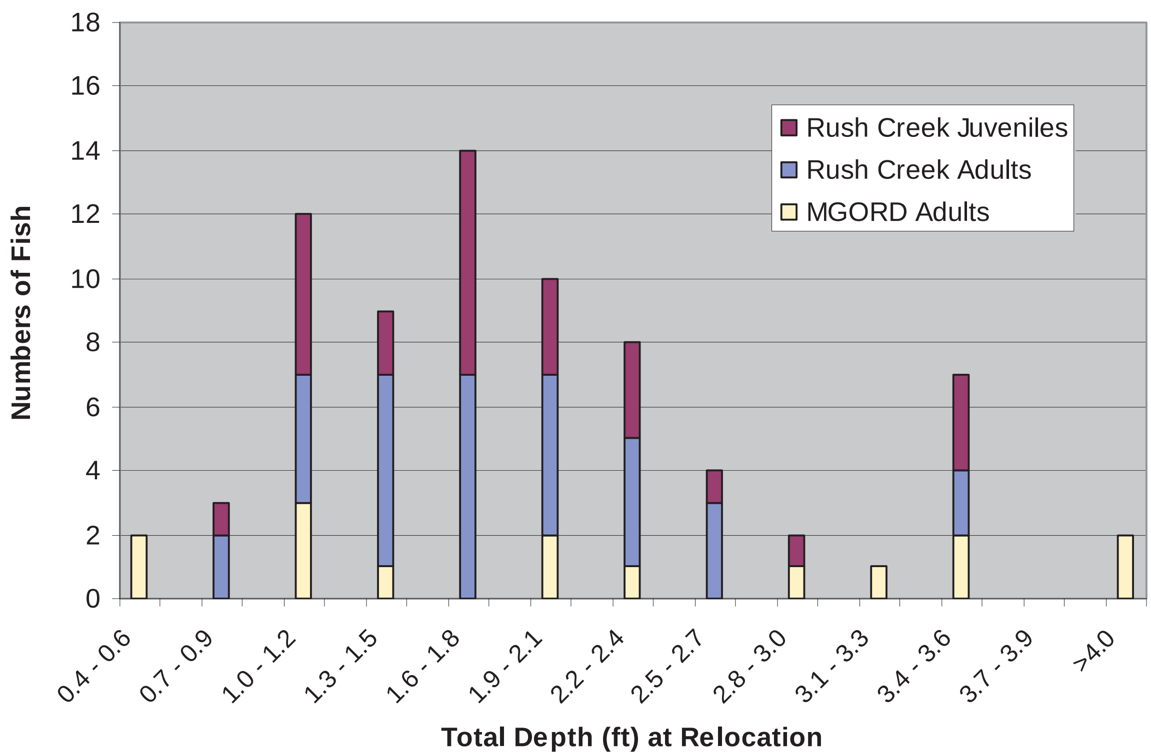


Figure D-2.4. Total depths measured at locations of brown trout relocated during non-winter months (April-November) in Rush Creek.

Table D-2.1. Total depths and water column velocities measured at 6/10th and 9/10th of total stream depth associated with relocated brown trout on Rush Creek.

Winter Period (November – March)					Non-winter Period (April – October)				
Focal Velocity (fps)	*Number of Rush Ck Juveniles*	*Number of Rush Ck Adults*	*Number of MGORD Adults*	*Total No. Relocated Fish*	*Focal Velocity (fps)*	*Number of Rush Ck Juveniles*	*Number of Rush Ck Adults*	*Number of MGORD Adults*	*Total No. Relocated Fish*
0	1	0	0	1	0	1	3	0	4
0.1	5	9	2	16	0.1	7	2	0	9
0.2	6	1	7	14	0.2	4	4	0	8
0.3	2	2	2	6	0.3	1	2	3	6
0.4	1	5	3	9	0.4	3	8	2	13
0.5	0	1	2	3	0.5	1	3	2	6
0.6	1	1	2	4	0.6	2	1	1	4
0.7	0	2	1	3	0.7	2	5	1	8
0.8	0	0	0	0	0.8	0	1	0	1
0.9	1	1	0	2	0.9	1	0	1	2
1.0	0	0	0	0	1.0	0	0	0	0
1.1	0	1	0	1	1.1	1	0	1	2
1.2	1	0	0	1	1.2	0	1	1	2
1.3	0	0	0	0	1.3	1	1	0	2
1.4	0	0	0	0	1.4	0	1	0	1
1.5	0	0	0	0	1.5	0	0	0	0
1.6	0	0	0	0	1.6	0	1	0	1
1.7	0	0	0	0	1.7	0	0	0	0
1.8	0	0	0	0	1.8	1	0	0	1
1.9	1	0	0	1	1.9	0	0	0	0
2.5	0	0	0	0	2.5	1	0	0	1
TOTALS	**19**	**23**	**19**	**61**	TOTALS	**26**	**33**	**12**	**71**
Average Velocities (fps)	**0.38**	**0.36**	**0.33**	**0.36**	Average Velocities (fps)	**0.53**	**0.51**	**0.59**	**0.53**

Table D-2.2. Measured focal velocities for three size groups of brown trout on Rush Creek during winter and non-winter periods, using the higher of the 6/10th versus 9/10th water column depths' velocity measurements for 43 observations with total depths ranging from 0.4-1.3 ft; and the 9/10th water column depths' velocity measurements for the remaining 89 observations (total depths 1.4-4.1 ft).

Rush Creek Section	Date	Fish Code Number	Fish Length (mm)	Fish Weight (g)	Velocity at 0.6 total depth (fps)	Velocity at 0.9 total depth (fps)	Total Depth at Relocation (ft)
Upper Rush Creek Sampling Section	10/18/2005	31	194	78	0.8	0.6	2.2
	10/18/2005	32	197	77	2.5	0.2	1.0
	10/18/2005	33	201	88	0.6	0.4	1.8
	10/18/2005	35	204	83	0.9	0.1	1.7
	10/18/2005	36	199	76	0.2	0.1	1.7
	10/18/2005	37	197	82	0.7	0.7	1.2
	10/18/2005	51	304	297	1.3	1.4	1.6
	10/18/2005	53	291	250	1.3	1.2	1.7
	10/18/2005	54	266	205	0.9	0.3	2.7
	10/18/2005	55	291	262	0.7	0.6	0.9
	10/18/2005	57	294	298	1.1	0.7	2.3
Lower Rush Creek Sampling Section	10/19/2005	29	475	1220	0.0	0.3	3.4
	10/19/2005	42	196	75	0.0	0.2	1.9
	10/19/2005	48	201	95	1.9	0.7	1.8
	10/19/2005	50	200	82	0.8	0.5	2.5
	10/19/2005	58	276	221	0.2	0.0	1.4
	10/19/2005	59	244	165	0.3	0.2	2.6
	10/19/2005	65	250	151	0.8	0.5	2.2
	10/19/2005	67	291	223	1.9	0.7	1.8
	10/19/2005	68	274	208	0.8	0.5	2.2
	10/19/2005	69	266	186	0.4	0.3	1.2
Rush Creek Co. Road Sampling Section	10/20/2005	40	194	75	0.1	0.9	2.0
	10/20/2005	43	202	80	1.8	1.3	0.8
	10/20/2005	45	195	72	0.8	0.1	1.6
	10/20/2005	46	206	88	0.4	0.4	1.1
	10/20/2005	61	257	170	0.1	0.2	0.9
	10/20/2005	62	265	185	0.9	0.0	2.0
	10/20/2005	66	272	209	0.2	0.0	1.1
	10/20/2005	70	257	179	1.8	0.7	1.4
Upper Rush Creek Sampling Section	11/16/2005	21	518	1311	1.1	0.5	1.1
	11/16/2005	23	338	392	1.2	0.5	3.5
	11/16/2005	33	201	88	0.4	1.1	2.2
	11/16/2005	35	204	83	0.4	0.1	1
	11/16/2005	37	197	82	0.5	0.2	1.5
	11/16/2005	54	266	205	1.2	0.5	3.5
	11/16/2005	55	291	262	0.9	0.8	1.7
	11/16/2005	57	294	298	1.2	0.2	1.5

Table D-2.2. Continued.

Rush Creek Section	Date	Fish Code Number	Fish Length (mm)	Fish Weight (g)	Velocity at 0.6 total depth (fps)	Velocity at 0.9 total depth (fps)	Total Depth at Relocation (ft)
Narrows down through Upper Rush Creek Sampling Section	11/17/2005	28	513	1110	0.6	0.5	1.1
	11/17/2005	29	475	1220	1.2	0.5	0.6
	11/17/2005	42	196	75	0.4	0.1	3.5
	11/17/2005	44	201	79	0.4	0.1	3.5
	11/17/2005	49	197	80	1.3	0.8	1.2
	11/17/2005	50	200	82	0.7	0.6	2.3
	11/17/2005	58	276	221	0.2	0.2	1.4
	11/17/2005	59	244	165	0.1	0.1	2.2
	11/17/2005	64	254	151	0.4	0.1	3.5
	11/17/2005	65	250	151	0.6	0.4	2.0
	11/17/2005	67	291	223	0.7	0.3	1.4
	11/17/2005	68	274	208	0.6	0.4	2.0
	11/17/2005	69	266	186	0.3	0.7	1.6
Ford down to County Road Culvert	11/15/2005	43	202	80	0.4	0.3	3.6
	11/15/2005	45	195	72	0	0.2	1.7
	11/15/2005	46	206	88	0.1	0.0	1.9
	11/15/2005	47	200	84	0.3	0.1	1.8
	11/15/2005	61	257	170	0.9	0.4	1.7
	11/15/2005	62	265	185	0.7	0.4	2.0
	11/15/2005	63	254	160	0.6	0.4	1.2
	11/15/2005	66	272	209	1.3	0.4	1.1
	11/15/2005	70	257	179	0.1	0.0	1.9
Gorge down to Highway 395	12/16/2005	25	362	510	0.3	0.1	0.7
	12/16/2005	35	204	83	1.8	0.6	1.8
	12/16/2005	37	197	82	0.2	0.1	0.7
	12/16/2005	53	291	250	0.1	0.1	1.0
	12/16/2005	54	266	205	1.1	0.5	1.1
	12/16/2005	55	291	262	0.9	0.6	1.1
	12/16/2005	57	294	298	0.2	0.1	2.2
Highway 395 down through Lower Sampling Section	12/17/2005	14	465	925	0.3	0.2	1.4
	12/17/2005	42	196	75	1.1	1.2	2.2
	12/17/2005	44	201	79	0.6	0.1	1.6
	12/17/2005	48	201	95	0.4	0	2.1
	12/17/2005	49	197	80	0.2	0.2	0.4
	12/17/2005	58	276	221	0.6	0.1	1.6
	12/17/2005	59	244	165	1.3	0.5	3.3
	12/17/2005	65	250	151	0.7	0.4	2.2
	12/17/2005	67	291	223	0.2	0.4	2.1
	12/17/2005	68	274	208	0.9	0.7	2
	12/17/2005	69	266	186	0.2	0.1	1.4

APPENDIX D

Table D-2.2. Continued.

Rush Creek Section	Date	Fish Code Number	Fish Length (mm)	Fish Weight (g)	Velocity at 0.6 total depth (fps)	Velocity at 0.9 total depth (fps)	Total Depth at Relocation (ft)
MGORD to Highway 395	1/28/2006	25	362	510	0.4	0.3	1.0
	1/28/2006	37	197	82	0.2	0.1	0.7
	1/28/2006	53	291	250	0.2	0.1	1.5
	1/28/2006	57	294	298	0.1	0.3	0.4
Lower Rush Creek Sampling Section	1/27/2006	44	201	79	0.6	0.1	1.6
	1/27/2006	48	201	95	0.1	0.1	1.8
	1/27/2006	49	197	80	0.2	0.2	0.4
	1/27/2006	58	276	221	0.6	0.1	1.6
	1/27/2006	59	244	165	0.1	0.1	2.7
	1/27/2006	67	291	223	0.1	0.1	1.8
	1/27/2006	68	274	208	0.9	0.7	2.0
Co. Road Section	1/26/2006	40	194	75	0.3	0.1	0.9
	1/26/2006	47	200	84	0.1	0.1	2.1
MGORD to Hwy 395	3/15/2006	25	362	510	0.4	0.3	1.1
	3/15/2006	37	197	82	0.2	0.1	0.6
	3/15/2006	57	294	298	0.1	0.3	0.4
Hwy 395 to Narrows	3/13/2006	14	465	925	0.9	0.2	1.9
	3/13/2006	54	266	205	0.8	0.6	1.6
	3/13/2006	65	250	151	0.4	0.1	1.3
Lower Rush Creek Sampling Section	3/12/2006	39	187	80	1.9	0.2	1.2
	3/12/2006	42	196	75	0.1	0.3	2.1
	3/12/2006	44	201	79	0.5	0.4	1.9
	3/12/2006	48	201	95	0.1	0.1	1.9
	3/12/2006	58	276	221	0.5	0.4	1.9
	3/12/2006	59	244	165	0.8	0.2	3.2
	3/12/2006	67	291	223	0.2	0.1	3.2
	3/12/2006	68	274	208	0.7	0.4	2.0
Co. Road Section	3/13/2006	43	202	80	0.9	0.9	2.6
	3/13/2006	45	195	72	0.2	0.1	0.5
MGORD to Hwy 395	5/13/2006	35	204	83	1.6	0.4	3
	5/13/2006	53	291	250	1.1	0.4	1.8
	5/14/2006	54	266	205	1.6	0.7	1.3
Hwy 395 Narrows	5/16/2006	14	465	925	0.1	0.6	1.2
Lower Rush	5/14/2006	58	276	221	3.1	0.4	2.7
Co. Road Section	5/15/2006	45	192	72	0.1	0.1	1.3

Table D-2.2. Continued.

Rush Creek Section	Date	Fish Code Number	Fish Length (mm)	Fish Weight (g)	Velocity at 0.6 total depth (fps)	Velocity at 0.9 total depth (fps)	Total Depth at Relocation (ft)
MGORD to Hwy 395	12/5/2006	12	508	1118	1.2	0.3	1.4
	12/5/2006	26	357	461	0.2	0.6	1.5
	12/5/2006	73	382	607	0.5	0.2	1.2
	12/5/2006	74	378	593	0.6	0.4	0.6
	12/5/2006	75	387	662	0.1	0.2	1.4
	12/5/2006	100	314	317	0.2	0.2	0.6
	12/5/2006	107	331	395	0.3	0.2	1.7
Hwy 395 to Ford	12/6/2006	28	513	1110	1.5	0.2	4.1
	12/6/2006	80	457	1056	0.5	0.1	2.0
MGORD to Hwy 395	2/17/2007	72	410	695	0.2	0.1	1.2
	2/17/2007	74	378	593	0.7	0.1	1
	2/17/2007	101	342	414	0.3	0.4	2.1
	2/17/2007	103	338	427	0.5	0.2	0.9
MGORD Hwy 395	5/1/2007	26	357	461	1.2	0.4	3.3
	5/1/2007	105	341	462	0.7	0.3	2.1
Hwy395 to Ford	5/2/2007	104	340	450	0.4	0.1	0.5
	5/2/2007	80	457	1056	0.9	0.5	2.9
MGORD to Hwy 395	9/14/2007	12	508	1118	0.7	0.3	2.3
	9/15/2007	103	338	427	0.9	0.4	1.3
	3/19/2008	89	518	1728	0.1	0.1	2.4

Appendix D-3: Predicting Brown Trout Emergence Times for Lee Vining and Rush Creeks

The peak emergence timing of brown trout was estimated for both Lee Vining and Rush creeks. The purpose of this analysis was to better evaluate how emergence timing coincided with the timing of higher streamflows during the snowmelt period in late-spring and early summer. The development of salmonid eggs and alevins is dictated by water temperature, with slower (thus longer) development occurring in cooler water temperatures. Because brown trout are fall-spawners, their progeny typically emerge in the spring close to the onset of snowmelt-driven peak flows. Recent research in northern Utah examined the effects of environmental factors on early survival and invasion success of brown trout. Wood and Budy (2009) found embryo survival was lower in high-elevation stream reaches and that model predictions based on winter water temperature data indicated that brown trout fry in higher elevation watersheds probably failed to emerge prior to the onset of high spring flows.

Daily average water temperatures were calculated from the hourly data sets collected and compiled by McBain and Trush for several locations within Lee Vining and Rush creeks. The daily average temperatures were then used with two models for brown trout development to estimate the proportion of total development that would have occurred at that average temperature on a specific day. Timing to peak emergence was estimated by using brown trout model 1b from Crisp (1981) to calculate the number of days required to reach 50% hatch at each daily average temperature. This equation is:

$$\log D = b \log(T - \acute{\alpha}) + \log a \qquad (1)$$

where T is water temperature (^{o}C), $\acute{\alpha}$ is a temperature correction (^{o}C), and *a* and *b* are constants given in Table 2 of Crisp (1981).

Then a model from Crisp (1988) was used to convert time to 50% hatch into time 50% emergence. This model was based on the comparison between time needed to reach 50% hatch and time needed to reach 50% emergence, and was developed by laboratory experiments in which brown trout embryos and fry were incubated over a range of constant water temperatures. The following equation was used:

$$D_3 = 1.66\, D_2 + 5.4 \qquad (2)$$

where D_2 is the number of days from fertilization to 50% hatch, calculated using equation (1).

Using the results from the above equations, the percent of total development (from fertilization to emergence) likely achieved during each day (1/x where x = the number of days required for emergence, based on the average temperature for each daily time-step) was estimated. The percent development for each day was then added to the accumulated total percent development from each of the previous days. An Excel spreadsheet designed to calculate emergence times was graciously provided by Dr. Phaedra Budy from Utah State University.

Ideally, information from frequent, annual spawning surveys is utilized to accurately determine the timing of peak spawning (Wood and Budy 2009). We made some limited observations of brown trout spawning in Rush Creek during the radio-telemetry movement in the autumns of 2005 and 2006, in which most activity occurred between mid-November and mid-December. We have no brown trout spawning observations from Lee Vining Creek and the only reference to spawning surveys was in November 1991 when consultants field-checked areas between the LADWP diversion and the USFS storage yard where “spawning beds” had been created by introduction of gravels (Dalton and Mesick 1991). None of these 1991 surveys were conducted downstream of Highway 395 within our long-term monitoring reaches (Dalton and Mesick 1991). Because we lacked detailed information to select a single date of when peak spawning occurred during specific years where water temperature data were available, we conducted the spreadsheet analyses to predict peak emergence timing for three dates on each creek to cover when the bulk of spawning probably occurred. We assumed that brown trout spawn a bit earlier on Lee Vining Creek than Rush Creek due to the cooler water temperatures. For Lee Vining Creek, the three dates selected for “peak spawning” were November 1st, November 15th and November 21st (Table D-3.1). For Rush Creek, the three dates selected for “peak spawning” were November 15th, November 30th and December 7th (Tables D-3.2-

The daily average water temperature data were available for nine spawning-to-emergence periods between 1999 and 2008; however complete data sets were not available for any specific reach for the entire period of record. Thus in Lee Vining Creek, peak emergence timing was predicted for five periods (Table D-3.1). The three earliest predictions (1999-2000, 2000-2001, 2003-2004) were made with temperature data collected at the Upper LV monitoring site, and the later two predictions (2006-2007 and 2007-2008) were made with temperature data collected at the LV Ford crossing (Table D-3.1). Unfortunately, for Lee Vining Creek incomplete temperature data sets prevented us from predicting timing of peak emergence in wet year-types with large discharges, primarily 2004-2005 and 2005-2006. In Rush Creek, peak timing to emergence was estimated for seven periods within the MGORD, five periods at the Narrows and for six periods at the County Road (Tables D-3.2-4).

Compared to Rush Creek, colder winter water temperatures in Lee Vining Creek resulted in longer periods of time between the presumed date of peak spawning and the predicted peak emergence (Tables D-3.1-4). For the 1999-2000 period; the length of time from peak spawning to peak emergence (start date of November 15th in both creeks) was 196 days in Lee Vining Creek, 162 days at the MGORD and 166 days at both the Narrows and County Road (Tables D-3.1-4). The longest time between the presumed date of peak spawning (November 15th) and the predicted peak emergence in Lee Vining Creek occurred during the 2007-2008 period and was 202 days (Table D-3.1). For this same period, the time between the presumed date of peak spawning (November 15th) and the predicted peak emergence in Rush Creek was 178 to 183 days (Tables D-3.2-4).

The timing and magnitude of peak discharges were also included in Tables 1-4 to determine if predicted peak emergence occurred before, during, or after peak run-off flows. In Tables D-3.1-4, the peak flow data for Lee Vining Creek downstream of the DWP diversion were from “LVC at Intake” (#5009). In Lee Vining Creek, the predicted peak emergence typically occurred during, or soon after, the peak snowmelt period (Table D-3.1). In Rush Creek, the predicted peak emergence generally occurred prior to peak flows in most years, except wetter years such as 2005 and 2006 (Tables D-3.2-4). In most years, the predicted peak emergence on Rush Creek occurred two to five weeks prior to the peak discharge, depending on the presumed date of peak spawning. In annual fisheries monitoring reports, we have previously cited several papers that investigated the effects of peak flows on recruitment of age-0 brown trout. Cattaneo (2002) concluded that hydrology only constrained trout dynamics during the critical emergence period, after which intra-cohort interactions regulated age-0+ densities in 30 French stream reaches. Nuhfer et al. (1994) monitored brown trout populations in the South Branch of the Au Sable River in Michigan for 16 years and used linear regression to test empirical relationships between age-0 recruitment and stream flow and winter severity. Results indicated that variations in stream flow (higher discharges) during the 30-day period corresponding to brown trout emergence and initial foraging behavior was when flow significantly influenced recruitment. No other time period (including spawning and incubation period) showed statistical relationships between flow and age-0 recruitment. No relationship was found between age-0 recruitment and measures of winter severity.

Nuhfer et al. (1994) may best explain the severe drops in age-0 brown trout densities often recorded in Lee Vining Creek and occasionally documented in Rush Creek (Hunter et al. 2006). According to our peak emergence predictions, peak snowmelt run-offs in Lee Vining Creek typically occur during, or soon after, brown trout fry have emerged and are attempting to forage and establish territories along channel margin areas. During these peak flows the channel bed is most likely mobile, velocities are high, and visibility may be reduced by turbid conditions making it difficult to successfully forage and/or maintain positions along channel margins. The SRF hydrographs as defined by WR 98-05 require that LADWP passes the primary peak on Lee Vining Creek and then may resume diversions. We have suspected that in some years the resumption of diversions on top the already rapidly dropping falling limb may have exacerbated stranding of newly emerged brown trout fry in side channels.

Because water temperature has been considered a possible indicator of conditions affecting the survival brown trout of embryos (Wood and Budy 2009), winter water temperature data from Lee Vining Creek for the two coldest months were also summarized (Table D-3.5). The three seasons with the coldest two-month periods occurred in 2000-2001, 2006-2007, and 2007-08; however each of these three years produced estimates of age-0 brown trout, including two of the three highest density estimates in the Lee Vining Creek main channel (Figure D-3.1). Interestingly, there was no peak discharge in the spring of 2007 and a relatively small peak of 131 cfs in the spring of 2008, the two years with high density estimates of age-0 brown trout (Table D-3.1 and Figure D-3.1).

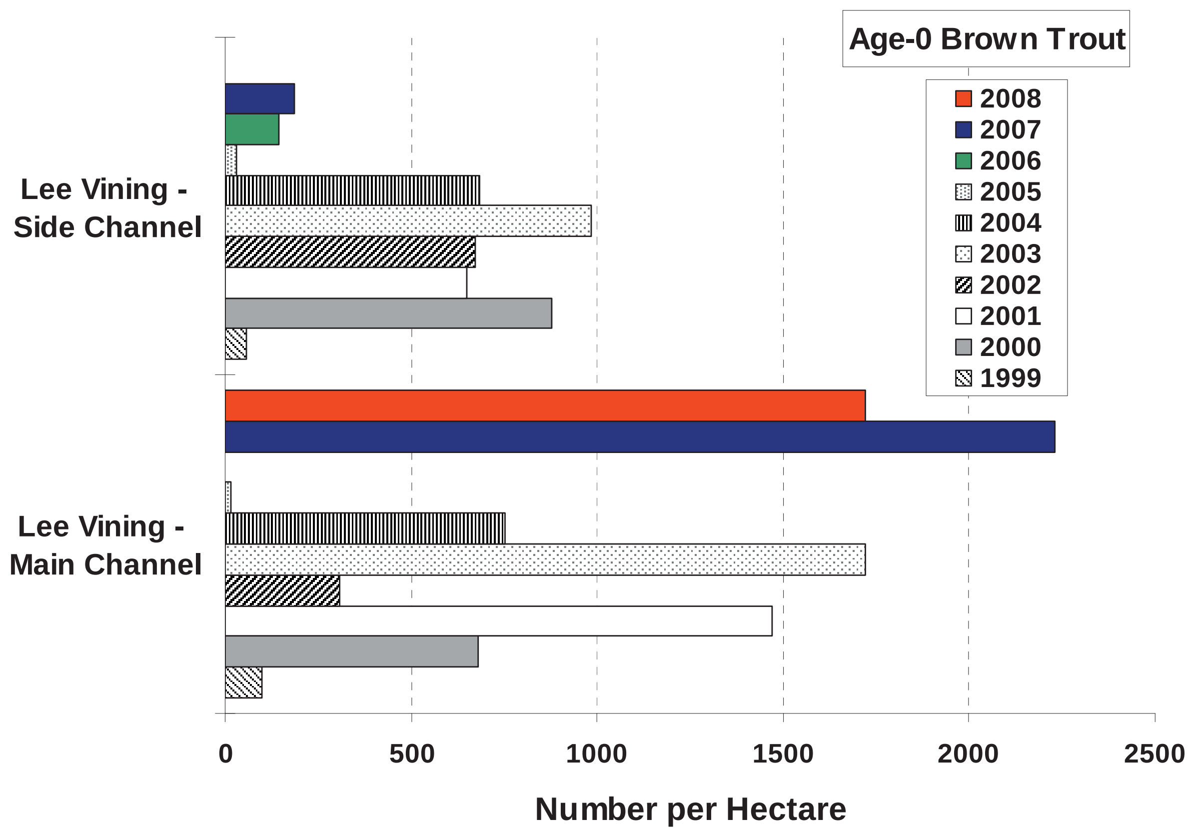


Figure D-3.1. Estimated number of age-0 brown trout per hectare in sections of Lee Vining Creek from 1999 to 2008.

Table D-3.1. Predicted peak emergence timing of brown trout in Lee Vining Creek.

Spawning Season	*Presumed Date Peak Spawning*	*Predicted Peak Emergence (PPE)*	*Q at PPE (cfs)*	*Timing and Magnitude of Peak Discharge*
1999-2000	Nov 1st	May 18th	53	May 18th – 28th 55 to 258 cfs <100cfs on July 4th
	Nov 15th	May 28th	258	
	Nov 21st	May 31st	181	
2000-2001	Nov 1st	May 25th	192	May 5th – 17th 56 to 201 cfs <100 cfs on June 11th
	Nov 15th	May 29th	146	
	Nov 21st	May 31st	113	
2003-2004	Nov 1st	April 22nd	45	April 27th – May 19th 84 to 94 cfs* <100 cfs on June 18th
	Nov 15th	May 12th	69	
	Nov 21st	May 18th	83	
2006-2007	Nov 1st	May 15th	39	No peak discharge in Lee Vining Creek below the DWP diversion
	Nov 15th	May 23rd	39	
	Nov 21st	May 26th	41	
2007-2008	Nov 1st	May 26th	85	May 19th – 23rd 56 to 131 cfs** <100 cfs on July 2nd
	Nov 15th	June 3rd	117	
	Nov 21st	June 6th	70	

*other peaks: 114 cfs/June 2nd and 141 cfs/June 15th **other peaks: 167 cfs/June 4th; 149 cfs/June 17th, 22nd and 23rd

APPENDIX D

Table D-3.2. Predicted peak emergence timing of brown trout in Rush Creek at the MGORD.

Spawning Season	Presumed Date Peak Spawning	Predicted Peak Emergence (PPE)	Q at PPE (cfs)	Timing and Magnitude of Peak Discharge
1999-2000	Nov 15th	April 24th	49	June 25th – 30th 59 to 204 cfs <100 cfs on July 17th
	Nov 30th	May 5th	47	
	Dec 7th	May 9th	46	
2000-2001	Nov 15th	May 10th	49	May 31st – June 14th 56 to 161 cfs <100 cfs on June 23rd
	Nov 30th	May 19th	53	
	Dec 7th	May 22nd	50	
2001-2002	Nov 15th	April 24th	51	June 4th – 8th 57 to 168 cfs <100 cfs on June 14th
	Nov 30th	May 3rd	51	
	Dec 7th	May 5th	52	
2003-2004	Nov 15th	May 1st	48	June 1st – 11th 59 to 343 cfs <100 cfs on June 22nd
	Nov 30th	May 6th	48	
	Dec 7th	May 8th	49	
2005-2006	Nov 15th	May 12th	189	May 2nd – June 10th 75 to 477 cfs <100 cfs on August 12th
	Nov 30th	May 25th	241	
	Dec 7th	May 28th	255	
2006-2007	Nov 15th	April 23rd	32	No peak discharge
	Nov 30th	May 4th	31	
	Dec 7th	May 7th	31	
2007-2008	Nov 15th	May 13th	48	May 25th – June 7th 64 to 388 cfs <100 cfs on June 28th
	Nov 30th	May 19th	49	
	Dec 7th	May 20th	50	

Table D-3.3. Predicted peak emergence timing of brown trout in Rush Creek at the Narrows. Discharge data includes accretions from Parker and Walker creeks.

Spawning Season	Presumed Date of Peak Spawning	Predicted Peak Emergence (PPE)	Q at PPE (cfs)	Timing and Magnitude of Peak Discharge
1999-2000	Nov 15th	April 28th	57	May 21st – June 30th 70 to 256 cfs <100 cfs on July 20th
	Nov 30th	May 6th	60	
	Dec 7th	May 8th	61	
2000-2001	Nov 15th	May 10th	97	May 21st – June 11th 73 to 202 cfs <100 cfs on 6/26
	Nov 30th	May 15th	101	
	Dec 7th	May 17th	141	
2002-2003	Nov 15th	May 7th	41	May 23rd – June 3rd 67 to 283 cfs <100 cfs on June 21st
	Nov 30th	May 14th	45	
	Dec 7th	May 17th	54	
2005-2006*	Nov 21st	May 16th	272	April 21st – June 8th 73 to 584 cfs <100 cfs on August 15th
	Nov 30th	May 21st	295	
	Dec 7th	May 24th	281	
2007-2008**	Nov 15th	May 16th	68	May 11th – June 7th 60 to 423 cfs <100 cfs on July 2nd
	Nov 30th	May 20th	100	
	Dec 7th	May 22nd	92	

*Note later start date due to no data available earlier than the 15th
**Temp data was collected at Old Highway 395 bridge

Table D-3.4. Predicted peak emergence timing of brown trout in Rush Creek at County Road. Discharge data includes accretions from Parker and Walker creeks.

Spawning Season	Presumed Date of Peak Spawning	Predicted Peak Emergence (PPE)	Q at PPE (cfs)	Timing and Magnitude of Peak Discharge
1999-2000	Nov 15th	April 28th	57	May 21st – June 30th
	Nov 30th	May 4th	61	70 to 256 cfs
	Dec 7th	May 7th	62	<100 cfs on July 20th
2000-2001	Nov 15th	May 9th	93	May 21st – June 11th
	Nov 30th	May 14th	99	73 to 202 cfs
	Dec 7th	May 16th	130	<100 cfs on 6/26
2003-2004	Nov 15th	May 1st	62	May 28th – June 11th
	Nov 30th	May 6th	76	72 to 372 cfs
	Dec 7th	May 8th	69	<100 cfs on June 26th
2004-2005	Nov 15th	May 10th	75	May 4th – June 29th
	Nov 30th	May 15th	82	75 to 467 cfs
	Dec 7th	May 16th	107	<100 cfs on August 12th
2006-2007	Nov 15th	April 28th	38	No peak discharge
	Nov 30th	May 4th	46	
	Dec 7th	May 7th	42	
2007-2008	Nov 15th	May 11th	60	May 11th – June 7th
	Nov 30th	May 16th	68	60 to 423 cfs
	Dec 7th	May 17th	78	<100 cfs on July 2nd

Table D-3.5. Mean water temperatures for the two coldest winter months in Lee Vining Creek.

Spawning/Incubation Season	Mean Water Temperature for Two Coldest Months	Two Coldest months of Incubation Period
1999 – 2000	34.32°F (1.29°C)	December-January
2000 – 2001	33.11°F (0.62°C)	January-February
2003 – 2004	36.69°F (2.61°C)	January-February
2005 – 2006	33.94°F (1.08°C)	January-February
2006 - 2007	33.49°F (0.83°C)	December-January
2007 - 2008	32.93°F (0.52°C)	December-January

Appendix D-4: Modeling Rush Creek Summer Water Temperatures and Predicting Brown Trout Growth

D-4.1: Introduction

Beak Consultants Inc (1991) conducted an instream flow requirement study for brown trout in Rush Creek as part of a cooperative study with California Department of Fish and Game and Los Angeles Department of Water and Power. As part of that study water temperatures in Rush Creek were modeled and predictions of water temperatures were made for various flow scenarios based on calibration of a model (the QUAL2E model developed by the U.S. Environmental Protection Agency) using water temperature measurements recorded from July 1, 1987 through August 4, 1988. This study found that modeled water temperatures were generally within + 2˚F, weather conditions strongly influenced water temperatures, maximum predicted water temperatures and ranges of daily fluctuations decreased with higher flows, and that at the lowest flow tested (19 cfs) predicted water travel times were sufficiently slow that temperatures lower in the stream were more influenced by weather than at higher flows with shorter travel times when water temperatures lower in the stream were more effected by Grant Lake Reservoir (GLR) outflow temperatures. This study had limited use in predicting thermal effects on trout populations because it only evaluated effects of maximum temperatures. While the study found that maximum water temperatures approached and could exceed 80˚F for relatively short time periods at the lowest flow tested (19 cfs), the authors concluded that it was unclear whether moderately short-term durations of these exposures would influence trout populations.

Shepard et al. (2009a; 2009b) found that body condition and densities of brown trout in Rush Creek were associated with flow levels and water temperatures. In general, they found that lower peak flows, moderate summer flows, and the number of days that water temperatures were ideal for growth (52 to 67˚F based on work by Raleigh et al. 1986; Elliott 1975a; Elliott 1975b; Elliott et al. 1995; Elliott and Hurley 1999; Elliott and Hurley 2000; Ojanguren et al. 2001; Figure D-4.1) resulted in higher abundances and better body conditions of brown trout in Rush Creek. Ideal growth temperatures were determined primarily using work by Elliott and Hurley (1999), who found that growth (positive weight gain) only occurred in brown trout when water temperatures ranged from 3 to 19˚C (37 to 67˚F), with the highest growth rate occurring at 14˚C (57˚F). At water temperatures above 67˚F and below 37˚F no growth occurred, even when the test fish were provided with full rations. Raleigh et al. (1986) recommended an "optimum temperature range" for growth and survival of brown trout of 54 to 66˚F.

A stream network temperature model SNTEMP (Theurer et al. 1984; Bartholow 1989; Bartholow 1991; Bartholow 2000) was suggested by both the Stream Scientists and California Department of Fish and Game and agreed upon by all Mono Basin collaborators during the scoping process to be the most useful model for predicting stream temperatures in Rush Creek. The SNTEMP model was originally developed by U.S. Fish and Wildlife Service (now USGS) scientists in Fort Collins, Colorado. This model uses a stream network approach to track thermal fluxes throughout a stream network. One major advantage to this model is its ability to evaluate different flow and temperature scenarios and predict changes in temperatures throughout a networked system. We used a Windows® operating system version of the DOS® operating system SNTEMP model called "StreamTemp" (version 1.0.4, Thomas R. Payne and Associates 2005) that is easier to use in a PC Windows environment. This model was calibrated for Rush Creek using data from 2000 through 2008 (Shepard et al. 2009c).

Shepard et al. (2009c) hypothesized that:

(1) Higher summer stream flows would result in more optimal water temperatures for trout growth, but higher flows would also increase water velocities and provide fewer slow-water habitats preferred by brown trout (Taylor et al. 2009b).
(2) Providing optimal temperatures for trout growth will result in increased annual growth rates for juvenile and adult brown trout, potentially increasing their survival and overall size of trout in the Mono Basin streams.
(3) Intermediate flow levels may provide optimal conditions for brown trout by balancing water temperature mediation with availability of slow-water habitats.

The purpose of this report is to summarize predictions of average summer water temperatures in several reaches of Rush Creek for numerous different flow, GLR elevation, and augmentation of flows into upper Rush Creek from Lee Vining Creek via the 5-Siphon Bypass, water availability, and climate scenarios to evaluate probable effects of these different scenarios on potential growth of brown trout. We are making the assumption that increasing growth potential for brown trout by providing them with water temperatures that are better for growth will increase the potential for producing more larger brown trout by increasing their annual survival and growth. Increasing survival of brown trout should also maximize the standing crop of brown trout supported in Rush Creek.

D-4.2: Model Runs

Since the StreamTemp water temperature prediction model does a much better job of predicting average daily water temperatures than either minimum or maximum water temperatures (Bartholow 1989), we elected to use average daily water temperature criterion for evaluating model outputs for different flow scenarios. We evaluated four different types of scenarios to evaluate likely response in water temperatures of Rush Creek to varying flow and temperature regimes:

(1) Varying flows (from 30 to 120 cfs) released into the MGORD from GLR using the climate and water temperature data available for 2008.
(2) Varying both flows (from 30 to 120 cfs) and initial water temperatures (from 50 to 70˚F in 5˚F increments) released into the MGORD from GLR using the climate and water temperature data available for 2008.

(3) Varying flows (from 30 to 120 cfs) released into the MGORD from GLR and adding flows to Rush Creek immediately below the MGORD (5-Siphon Bypass from Lee Vining Creek – additions of 5 and 10 cfs) using the climate and water temperature data available for 2008.

(4) Recommended timing and volume of flow releases from GLR based on seven classes of water availability (based on snowpack water availability projections), applying measured GLR outflow temperatures (measured at the MGORD footbridge) and modifying these outflow temperatures by 3.7˚F depending upon whether GLR was "full" or "empty" (Cullen and Railsback 1993), and adding or not adding water to upper Rush Creek from Lee Vining Creek via the 5-Siphon Bypass. Timing and volume of water moved from Lee Vining Creek to Rush Creek were also based on the seven classes of water availability.

Scenario types one through three above represented exploratory analyses to evaluate how changes in flows and starting water temperatures influenced the predicted average daily water temperatures throughout Rush Creek. We evaluated these scenarios by examining daily predictions of average water temperatures at various sites along Rush Creek under the different GLR outflow volumes and water temperatures. Scenario-type four represented potential flow management scenarios that would likely be implemented in Rush Creek.
To evaluate these scenarios we predicted summer growth of brown trout using a growth-prediction model developed for brown trout (Elliott et al. 1995) that uses water temperature to predict growth. We also investigated the longitudinal predictions of daily average water temperatures for several of these scenarios.

D-4.3: Criteria Used to Evaluate Predictions of Water Temperatures

We used a model that predicts growth of brown trout based on water temperature developed by Elliott et al. (1995) and field-tested by Elliott (2009) to predict growth (grams) of juvenile brown trout over the summer (June 1 to September 30) period.

$$W_t = [W_0^b + bc(T - T_{\mathrm{LIM}})t/\{100(T_{\mathrm{M}} - T_{\mathrm{LIM}})\}]^{1/b}$$

Where, W_t = weight at the end of the period,

W_0 = weight at the beginning of the period,

b = regression constant of 0.308 (Elliott et al. 1995),

c = regression constant of 2.803 (Elliott et al. 1995),

t = time-step (one day for our application),

T = temperature (˚C),

$$T_{LIM} = T_L \text{ if } T \leq T_M \text{ or } T_{LIM} = T_U \text{ if } T > T_M$$

where, T_L and T_U are the lower and upper temperature limits when growth equals zero and T_M is the temperature at which optimum growth occurs.

T_L = 3.56˚C (Elliott et al. 1995),

T_U = 19.48˚C (Elliott et al. 1995),

T_M = 13.11˚C (Elliott et al. 1995).

This equation results in a triangular relationship whereby predicted growth increases as temperature rises from T_L to T_M and then decreases as temperature increases further from T_M to T_U. We applied this model and computed daily weights for the period June 1 through September 30 using starting weights on June 1 of 10 g (indicative of age-1 fish starting their second summer of life) and at 50 grams (indicative of age-2 fish starting their third summer) and grew the fish each day based on the predicted average daily water temperature. Total weight (W_t) at the end of the summer (September 30) was converted to weight gain (grams) by subtracting the initial weight (June 1).

We evaluated the growth-prediction model of Elliott et al. (1995) using data we collected on weight gains of marked age-0 fish in Rush Creek. Our preliminary field-evaluation of this model indicated this model provided reasonable results for age-0 brown trout in Rush Creek for the 365-day period from September 1 to August 31. Our preliminary analyses indicated that this growth model provided the best way to evaluate the different flow scenarios, so we relied primarily on this growth model for displaying predicted differences for the various flow scenarios. We caution that this growth model was initially developed for brown trout fed unlimited rations of food, so actually growth in the field could be lower if brown trout do not receive a full ration of food. We also found that predicted growth during the June 1 to September 30 summer period may represent only about 60 to 70% of total annual growth predictions based on model tests we ran for the Rush Creek temperature data. In spite of these limitations, we believe this model provides the best index of temperature-mediated effects on brown trout.

We also evaluated past water temperature data collected in Rush Creek to determine a reasonable average daily water temperature criterion. There were 2,794 daily water temperature measurements recorded for sites in Rush Creek during the June 1 through September 30 time period. We first observed average daily water temperatures that were recorded on days when minimum and maximum water temperatures fell within the range of 52 to 67˚F. Of the 2,794 total records, there were a total of 1,338 daily records when temperatures fell within the 52 to 67˚F range. The overall mean for the average daily temperatures for these days (52 to 67˚F range) was 58.46˚F (S.D. = 2.2). The 95% confidence interval fell between 54.1 and 62.8˚F. Using this range as a starting point, we evaluated three different average daily temperature ranges as potential criteria: 54.0 to 62.5˚F, 55.5 to 60.5˚F, and 56.0 to 60.0˚F.

There were 1,256 days (94%) when an average range of 54.0 to 62.5˚F fell within the 1,338 days with minimums >52˚F and maximums <67˚F, dropping to 983 days (73%) for an average range of 55.5 to 60.5˚F, and 846 days (63%) for an average range of 56 to 60˚F. We also assessed how many days each of these average ranges would fall outside the 52 to 67˚F range. There were 667 days (23% of total days) that an average range of 54.0 to 62.5˚F fell outside the preferred range, dropping to 314 days (11%) for an average range of 55.5 to 60.5˚F, and 211 days (8%) for an average range of 56.0 to 60.0˚F. We explored the distributions of minimum and maximum water temperatures actually recorded for those days when these three ranges of daily average water temperatures fell outside the 52 to 67˚F daily ranges (Figure D-4.2). It appeared that for most days when these daily average ranges fell outside the 52 to 67˚F daily temperatures the differences in either daily minimums or daily maximums were usually within one to three degrees of either 52 or 67˚F and the broader average temperature range of 54.0 t 62.5˚F had many more days when maximum water temperatures fell more than 1.0 F outside this upper range of 67˚F. Based on these analyses we decided to set the range of predicted daily mean temperatures at 55.5 to 60.5˚F as the criterion for assessing how many days different flow scenarios provide good growth temperatures for brown trout.

We were also interested in determining the potential number of days that were potentially harmful to brown trout due to water temperatures exceeding their preferred thermal range. Since we had to rely on average water temperatures, we selected an upper limit on the average water temperature of 65˚F as an index that daily water temperatures were exceeding 70˚F. We used the number of days that the daily average water temperature exceeded 65˚F as the index for the number of bad thermal days experienced by brown trout.

D-4.4: Modeling Fixed-Effects

Climate - 2008 – Hot Climate Year

The summer of 2008 was one of the hotter summers on record with an average air temperature of 66.1˚F and an average monthly maximum air temperature of 81.9˚F (Figure D-4.3). For the 57-year period of record only five years had higher summer average air temperatures and only four years had higher average monthly maximum air temperatures. We used 2008 as the initial flow scenario year because GLR was very low and this resulted in outflow temperatures from GLR to the MGORD being warmer than all other years during the critical time of year (July 15 to September 1; Figures D-4.4 and D-4.5). These hot release temperatures resulted in very few days when measured daily average water temperatures at the MGORD or County Road sites were best for brown trout growth (Figure D-4.6).

Incremental Flow Scenario with No 5-Siphon Bypass

We first ran a scenario where we tested temperature effects due to different flows (in 30 cfs increments from 30 to 120 cfs) released from GLR into the MGORD with no releases from the 5-Siphon Bypass using the water temperatures measured at the MGORD footbridge during 2008 as the base condition. Interestingly, it appeared that at lower flows (especially 30 and 60 cfs) the water was actually cooled as it traveled down the Rush Creek Channel (Figure D-4.7). We speculate that this cooling is due to 1) air temperatures being similar to or cooler than released water temperatures during many days (Figure D-4.6), and 2) relatively small inputs of cool water (1 cfs groundwater into Rush at the head of the Gorge and flows input from Parker and Walker creeks).

Incremental Flow and Incremental Temperature Scenario - No 5-Siphon Bypass

Next, we ran scenarios where we altered both the upper temperatures at the MGORD footbridge from 50 to 70˚F in 5˚F increments and flows at the MGORD footbridge from 30 to 120 cfs in 30 cfs increments for the climate data for 2008. These model runs indicated that when relatively warm water temperatures were exiting the MGORD, cooling of the water occurred as it moved down the Rush Creek system and more cooling occurred at lower flows, probably due to the two speculative reasons given above (Figure D-4.8). However, warming occurred down the length of Rush Creek when cooler water temperatures were exiting the MGORD, especially during the hot time period between July 15 and September 1 (Figure D-4.9). Again, more warming occurred at the lower flows.

Incremental Flow Scenario with 5-Siphon Bypass Releases

Next, we ran scenarios for various flows from 30 to 120 cfs released from GLR into the MGORD using measured water temperatures at the MGORD footbridge for 2008 along with 5 and 10 cfs inputs from the 5-Siphon Bypass. We assumed that 5-Siphon Bypass water temperatures were equal to the water temperatures measured in upper Lee Vining Creek plus one degree F to account for potential warming as the water flowed through the LADWP conduit. When flows in upper Rush Creek were augmented by 10 cfs through the 5-Siphon Bypass water temperatures down Rush Creek were lower and temperatures in Rush Creek were coolest when the lowest flow of 30 cfs was released from GLR (Figure D-4.10). For releases of 5 cfs from the 5-Siphon Bypass an effect was also seen, but water was not cooled as much as when 10 cfs was released.

Conclusions Based on Fixed-Effects Modeling

It appears that water temperatures in Rush Creek are regulated by a moderately complex interaction of water temperatures and flow volumes released from GLR and climatic conditions (particularly air temperatures). When water temperatures released from GLR into the MGORD are cooler than average daily air temperatures a warming of this water occurs as it moves down Rush Creek and this warming becomes more pronounced at lower Rush Creek flow volumes. Conversely, when water temperatures released from GLR into the MGORD are warmer than average daily air temperatures a cooling of this water occurs as it moves down Rush Creek and this cooling also becomes more pronounced at lower flow volumes. The same types of relationships exist when water is added to the Rush Creek channel from either the 5-Siphon Bypass or by flows from Parker and Walker creeks. If water temperatures in Rush Creek are warmer than water temperatures of input waters than cooling of Rush Creek occurs and more cooling occurs as flow volumes of Rush Creek decline.

D-4.5: Water Availability Scenarios

We next evaluated different scenarios based on water availability predictions for seven classes of snowpack runoff forecasts (Dry, Dry Normal I, Dry Normal II, Normal, Wet Normal, Wet, and Extreme Wet). This strategy was used because LADWP flow releases down Rush Creek are modified based on the predicted water availability during any given year. The Stream Scientists and their associates collaborated in recommending flows that would be released from GLR and diverted from Lee Vining Creek for these seven different water availability scenarios (Tables D-4.1 and D-4.2; Appendix B).

Flows

Final recommended Rush Creek summer flows were developed by taking initial fish flow recommendations and re-shaping the flow curves to better mimic the estimated unimpaired hydrographs (Appendix B). Differences between initial fish flow recommendations and final flow recommendations primarily resulted in final recommended flows being lower than fish flows during the receding limb of the hydrograph under conditions of normal to wet water availability and being higher than fish flows under extreme wet water availability. Differences in Lee Vining Creek diversion rates also existed between the final recommended flows and fish flows with less flow at final flow recommendations for lower water conditions and final flows being higher for the Lee Vining diversion at the highest water conditions. Flows recommended to be delivered from Lee Vining Creek via the 5-Siphon Bypass to upper Rush Creek or GLR were based on two-week averages of actual flows observed from 1999 through 2008 by water availability (Table D-4.2).

GLR Outflow and Lee Vining Creek Diversion Temperatures

Outflow temperatures from GLR as recorded at the MGORD footbridge were set for three different temperature regimes based on the above seven water availability scenarios as follows: (1) temperatures recorded during 2008 were used for Dry and Dry Normal I, (2) temperatures recorded during 2000 were used for Dry Normal II, Normal, and Wet Normal, and (3) temperatures recorded during 2006 were used for Wet and Extreme Wet (Table D-4.3). GLR release temperatures were modified based on whether we tested for effects of GLR being full or empty. For the Wet and Extreme Wet tests, GLR was assumed to be full and we did not test a scenario where GLR was empty. Since GLR was near empty during the summer of 2008 (Figure D-4.5), the Dry and Dry Normal I baseline MGORD water temperature represented GLR being empty and we subtracted 3.6 F from the MGORD water temperatures recorded during 2008 to simulate the effect of GLR being full (Cullen and Railsback 1993). Since GLR was near full during the summer of 2000 (Figure D-4.5), the Dry Normal II, Normal, and Wet Normal water availability types, baseline MGORD water temperature represented GLR being full and we added 3.6 F to the MGORD water temperatures recorded during 2000 to simulate GLR being empty.

We used water temperatures recorded in upper Lee Vining Creek during 2008 for all modeled scenarios. We added one degree Fahrenheit to these measured temperatures to account for some warming of this water as it flowed through the LADWP water conduit. Initial starting water temperatures for the various scenarios illustrated that when GLR was full, water temperatures were generally lower and temperatures provided by the 5-Siphon Bypass from Lee Vining Creek were lower than all starting MGORD temperatures except for wet years when GLR was full (Figure D-4.11).

D-4.6: Climate Scenarios

We used three different climate scenarios including a current hot air temperature summer (2008), an average summer (2004), and a future hotter summer based on the assumption that global warming will increase daily average air temperatures by 2˚F. For the global warming climate scenario we opted to use a moderate increase in daily air temperatures that would possibly occur within the next 10-25 years. Predicted increases in North America and California air temperatures range from 2.2 to over 10˚F (Houghton et al. 2001; Moser et al. 2009). These increases are predicted to occur over the next 50 to 100 years.

We applied three different climate scenarios because water availability and summer climate are not necessarily correlated with each other. For example, it is possible to have a wet water year based on high snowpack and then have a hot summer when that snowpack melts and runs off as stream flow. In contrast, it is also possible to have a low snowpack year with summer temperatures that are cool.

As mentioned earlier, the summer of 2008 was one of the hotter summers on record (Figure D-4.3). We used air temperatures during the summer of 2008 to represent the current hot climate conditions. We added 2˚F to the average daily air temperatures recorded during 2008 to model the global warming scenario. Air temperatures during 2004 were considered average because the overall summer average air temperatures for the period of record was 63.6˚F and the summer maximum air temperature averaged 79.8˚F, while the summer average air temperature during 2004 was 64.1˚F and the summer maximum air temperature was 80.1˚F (Figure D-4.3).

For the average climate summer of 2004 there were no water temperature data for the MGORD footbridge site, so we used water temperature data for this site during the year 2000 as the starting temperatures for all average air temperature scenarios. Of the years for which MGORD water temperature data were available, air temperatures during 2000 were most similar to air temperatures during 2004. For the global warming climate scenario, we used the same MGORD footbridge water temperatures as were used for the "hot" summer (2008) scenarios.

Water Availability Model Runs

Predicted growth of 10 g and 50 g brown trout was always greater when GLR was full under all water availability and climate scenarios for the final recommended flows (Figures D-4.12 through D-4.15). Differences in growth between flows released during different water availability scenarios were not as pronounced under the average climate scenario as for hot and global warming climate scenarios. For these hotter summer scenarios growth was poorer under drier water availability scenarios than for wetter scenarios. For wetter water availability scenarios (Wet and Extreme Wet) growth of trout was predicted to be better under hotter climate scenarios than for the average climate scenario. This better growth for wetter water availability scenarios under the hotter climate scenarios reflected the fact that the cooler water delivered under these high water and hotter temperature scenarios was warmed to a temperature that actually increased predicted growth, whereas the average climate air temperatures did not warm this water. The average climate scenario illustrated that the cool water was not warmed and consequently was below temperatures that are ideal for growth and thus limited growth.

Predicted water temperatures based on the Stream Scientists' recommendations (flows, GLR full, and addition of 5-Siphon Bypass water to Rush Creek) were compared to the flows and temperatures actually experienced during a hot year (2008). Based on snowpack water availability forecasts, 2008 was a "Normal" water year, so we used the "Normal" water year Stream Scientists' recommended flows. This comparison illustrates how Stream Scientists' recommendations might improve fish growth. Recommended flows under the "Normal" condition of water availability resulted in a later, but similar magnitude, peak flow than was actually released during 2008 with baseflows being very similar to what was actually released during 2008 (Figure D-4.16). When the Stream Scientists' recommendations of filling GLR, providing 5-Siphon Bypass flows to upper Rush Creek, and Rush Creek flows were included, the predicted summer growth of a brown trout that was 50 g on June 1 increased about 28 g at Old 395 and 16 g at County Road based on the differences between water temperatures actually measured during 2008 and predicted water temperatures for these recommendations (Figure D-4.17).

For the hot climate year of 2008 predicted average daily water temperatures for the various flow scenarios indicated that the number of days that were good for brown trout growth were highest for the scenario when GLR was full and flows in upper Rush Creek were augmented with flows from the 5-Siphon Bypass (Figure D-4.18). Wetter flow years had more days of good water temperatures. In contrast, more bad temperature days were observed for scenarios when GLR was empty and no 5-Siphon Bypass flows were added to Rush Creek, and these bad days increased during lower water availability (Figure 18).

For the average climate year of 2004 predicted average daily water temperatures followed a similar pattern as for the hot climate year of 2008 with the scenario that had GLR full and flows added to Rush Creek from the 5-Siphon Bypass having the most days that were good for brown trout growth and the least number of days were average daily temperatures were higher than 65˚F (Figure D-4.19). There were fewer bad temperature days under an average summer's air temperatures than for a hot summer (Figure D-4.19 versus Figure D-4.18). There were also a few days under wet water availability that were below good temperatures.

Longitudinal Temperatures

Average daily water temperature predictions were compared longitudinally down the length of Rush Creek across several different dates during the summer and among several different scenarios. Longitudinal distances were originally recorded in miles with the terminus of Rush Creek at Mono Lake set at mile zero; however, the StreamTemp model only outputs distances in kilometers for graphs it produces (Figures D-4.20 and D-4.21). Predicted daily average water temperatures are usually cooled by the additions of Parker and Walker creeks (at kilometers 8.24 and 7.33, respectively); however, from the MGORD to Parker Creek and from Walker Creek to Mono Lake water temperatures may be cooled or warmed depending upon starting water temperatures and date (Figures D-4.20 and D-4.21).

D-4.7: MGORD Modeling

As detailed in Shepard et al. (2009c) we could not model the effects of the MGORD on water temperatures under different flow regimes because water temperature data were not collected at the top of the MGORD during temperature model development. Instead, we used the SSTEMP (stream segment temperature model) to assess the potential influences of the MGORD reach (top of the MGORD down to the footbridge) on water temperatures.

An analysis of the MGORD from its outflow (mile 0.001) to the footbridge (mile 1.44) was completed with SSTEMP model. This analysis was done for mid-August with an average air temperature of 70˚F, 70% sunshine, a relative humidity of 40%, and a wind speed of 4 mph (all conditions that were typical for 2008 during relatively hot days). The outflow water temperature was assumed to be 65˚F. Temperature modeling of the MGORD for this single warm day at different flows from 20 to 60 cfs predicted that water temperatures would warm less than 1˚F for all flows except flows of 20 cfs, for which water would warm 1.3˚F (Figure D-4.22). When air temperatures were increased to 80˚F, predicted water temperatures increased less than 2˚F for all flows tested. Flows above 60 cfs were also tested and predict water temperature increases were less at these higher flows.

We also compared different starting water temperatures (at the top of the MGORD) and different average air temperatures from 45 to 80˚F for flows of 30 cfs. These analyses indicated that water temperatures at the top of the MGORD usually were within two degrees Fahrenheit of those temperatures measured at the MGORD footbridge. The only exception was at extremely low starting water temperatures (45˚F) and high air temperatures (80˚F) when temperatures warmed up to three degrees. For the StreamTemp modeling analyses, we suggest that when conditions were such that GLR outflow temperatures were lower than average air temperatures, outflow temperatures were probably one to two degrees lower than temperatures measured at the MGORD footbridge. Conversely, when water temperatures released from GLR were much warmer than average air temperatures, outflow temperatures were probably one to two degrees higher than temperatures measured at the MGORD footbridge.

Increases in Shading

We evaluated flow-related temperature mediation measures such as varying stream flow, filling of GLR, and augmenting flows in upper Rush Creek by releasing water originating from Lee Vining Creek via the 5-Siphon Bypass in the above sections of this report. Increasing shade along the channel to reduce solar heating is another way to mediate water temperatures and could potentially reduce high temperatures during the summer. We evaluated potential influences of increased shading along the MGORD and along Rush Creek to determine the potential effects of increasing shade. Shade components could be increased either due to the natural establishment and succession of the riparian community or by anthropogenic enhancement. We suspect that natural shading will occur along the stream channel, but that anthropogenic efforts may be required along the MGORD, should shading of this artificial channel be desired.

Shading of the MGORD channel is currently estimated at about 3%. If shading were increased water temperatures could be reduced in direct proportion to the amount of shading provided (Figure D-4.23). If enough shade was created along the MGORD to provide 50% shading there would be no increase in water temperature at a starting water temperature of 65˚F and an average daily water temperature of 70˚F.

Current shading along the main Rush Creek channel below the MGORD ranged from about 10 to 40% and the weighted average was slightly over 19%. If shading were increased to a consistent 50% level from current levels along main Rush Creek, predicted water temperatures would be reduced by slightly under 0.5˚F at the Old Highway 395 site and by 1.0˚F at the County Road site (Figure D-4.24).

D-4.8: Discussion

Shepard et al. (2009c) hypothesized that higher summer stream flows would result in more optimal water temperatures for trout growth, based primarily on Beak Consultants Inc (1991) temperature modeling predictions for Rush Creek. However, current modeling results indicate that water temperatures in Rush Creek are regulated by a moderately complex interaction of water temperatures and flow volumes released from GLR and climatic conditions (particularly air temperatures). When water temperatures released from GLR into the MGORD are cooler than average daily air temperatures, this water is warmed as it moves down Rush Creek and this warming becomes more pronounced when Rush Creek flow volumes are lower. Conversely, when water temperatures released from GLR into the MGORD are warmer than average daily air temperatures a cooling of this water occurs as it moves down Rush Creek and this cooling also becomes more pronounced at lower flow volumes.

Potential reasons for differences between Beak Consultants Inc's (1991) findings and recommendations related to flow and water temperature and our findings and recommendations are: 1) changes in Rush Creek channel that have occurred during the last 15 to 20 years have resulted in different travel times for water moving down the channel; 2) the fact that the Beak Consultants Inc study relied on a single year of water temperatures to validate the model they used to predict water temperatures while we used several years for calibration and a few other years for validation of the model we used; 3) the use of slightly different water temperature prediction models; and 4) complex interactions between air temperature, flow, and water temperatures for which the earlier model did not fully account. An important finding was that average water temperatures delivered from GLR are often as high as, or higher, than average air temperatures during the summer. When this occurs, lower flows actually promote cooling of the water. Preliminary information from 2009 suggests that water temperatures entering GLR may already be elevated due to warming in lakes and reservoirs in the upper basin, as well as the low-gradient meandering meadow reaches of Rush Creek above GLR.

Cullen and Railsback (1993) estimated that water temperatures delivered from a full GLR would decrease by about 2˚C (3.6˚F) compared to temperatures delivered from a near-empty GRL. These Cullen and Railsback (1993) estimates of the mediating effect of GLR elevation on water temperatures delivered from GLR were used to modify MGORD footbridge water temperatures for modeling purposes. Also, the Stream Scientists are recommending that much cooler Lee Vining Creek water be delivered to GLR and Rush Creek at volumes proportional to water availability. While delivery of relatively high volumes of cool water to GLR from Lee Vining Creek via the 5-Siphon Bypass will undoubtedly result in cooler water temperatures in GLR, the exact outflow temperature decline cannot be predicted with any degree of confidence at this time (see Cullen and Railsback 1993 for a discussion of the problems in predicting water temperatures released from GLR).

We relied primarily on predicted weight gains of brown trout to evaluate the effects of different flow management scenarios on trout in Rush Creek. We caution that while we believe that these predicted weight gain estimates provide useful indices for evaluating different flow regimes, actual weight gained by brown trout is dependent upon many other factors besides water temperature and flow. We used predicted weight gains because weight gain is related to both annual survival (particularly overwinter survival) and condition factor for trout (Sloman et al. 2000; Goodwin et al. 2008).

High daily fluctuations in water temperatures can negatively impact brown trout (e.g. Wehrly et al. 2007). Measured water temperatures in Rush Creek during 2008 at the Old Highway 395 and County Road sites fluctuated up to 19˚F and had a mode of about 10˚F (Figure D-4.25). Unfortunately, the StreamTemp model does a relatively poor job of predicting maximum and minimum water temperatures, compared to its ability to predict average water temperatures, due to its reliance on daily averages for input parameters. Consequently, predicted daily temperature fluctuations during 2008 only ranged from one to five degrees Fahrenheit (Figure D-4.25).

D-4.9: Literature Cited in Appendix D

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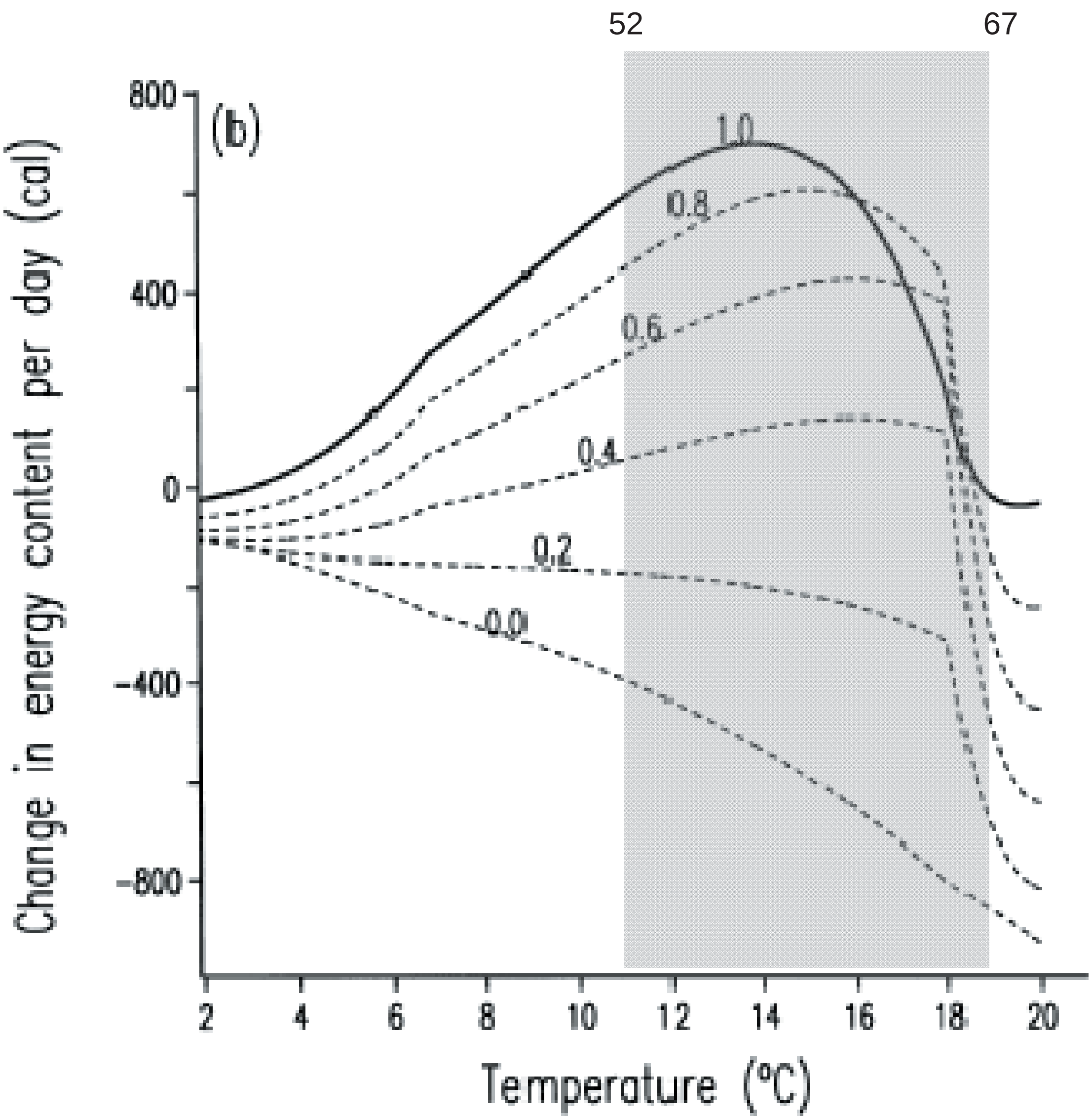
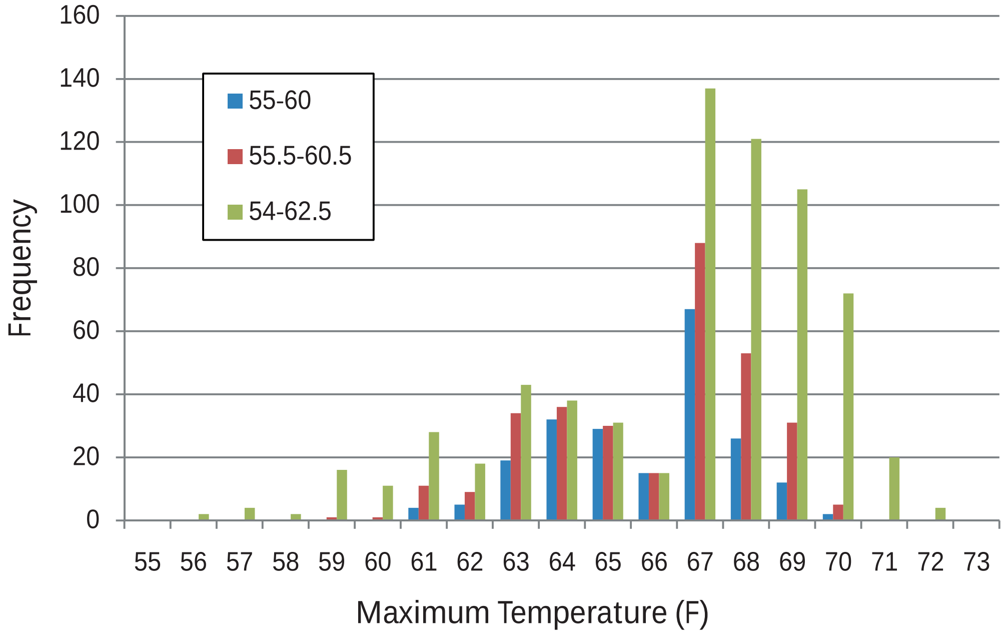


Figure D-4.1.Relationship between water temperature (C) and growth (expressed in change in energy content per day in calories) with numbers showing proportion of full ration provided to fish (graph from Elliott and Hurley 1999). The shaded portion of the graph is the temperature range used as "ideal temperature" for growth based on several studies (Raleigh et al. 1986; Elliott 1975a; Elliott 1975b; Elliott et al. 1995; Elliott and Hurley 1999; Elliott and Hurley 2000; Ojanguren et al. 2001).



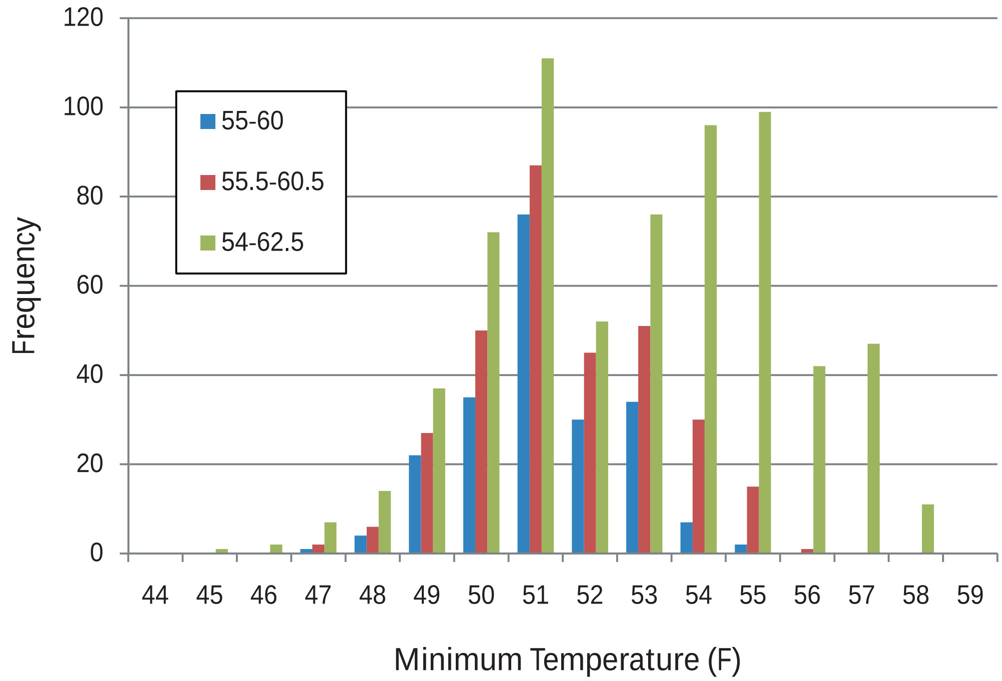


Figure D-4.2. Distributions of maximum daily (top) and minimum daily (bottom water temperatures for three average daily temperature ranges that occurred on days when daily water temperature ranges were outside the 52 to 67 F range.

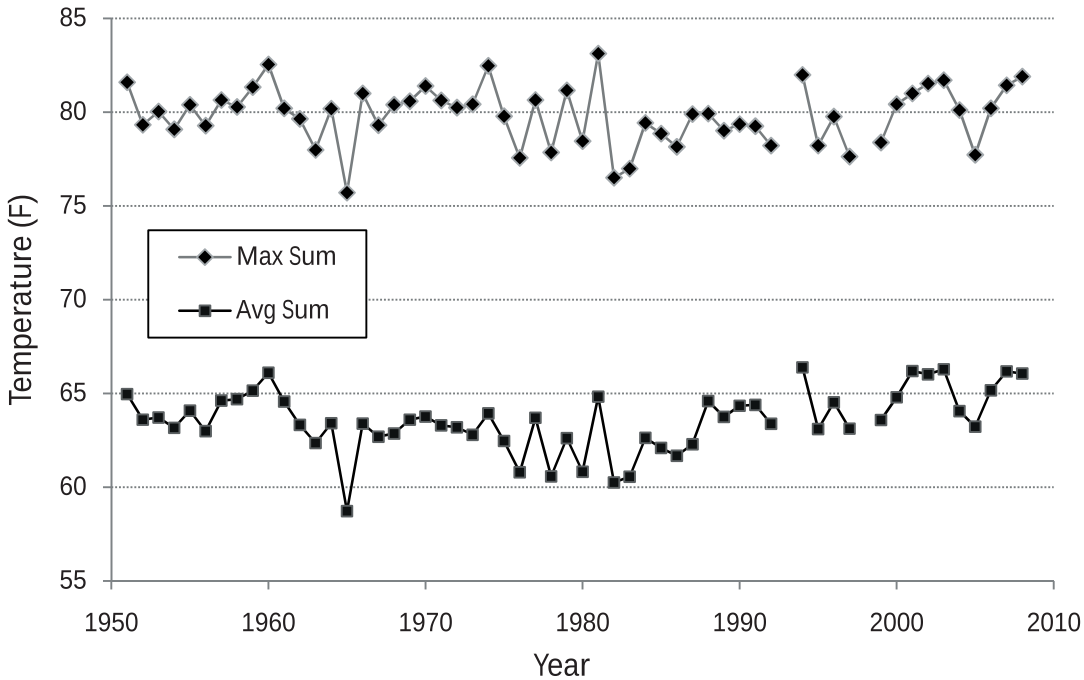


Figure D-4.3. Average monthly maximum (Max Sum) and montly average (Avg Sum) air temperatures for the summer months (June through September) measured at the Mono Lake and Lee Vining climate stations from 1951 through 2008.

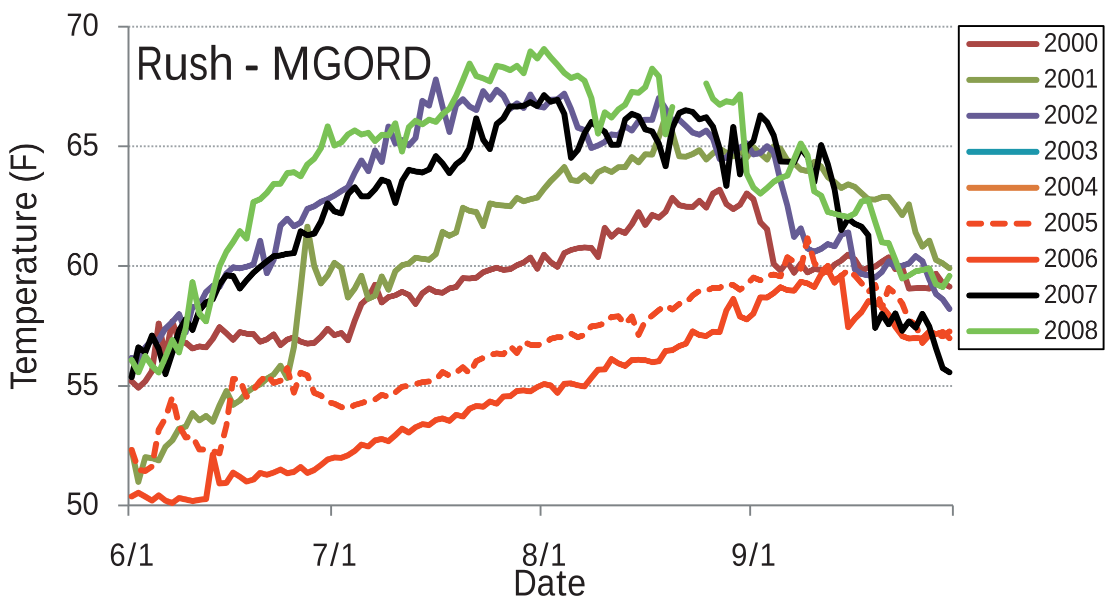


Figure D-4.4. Average daily water temperatures at the MGORD footbridge for June through September from 2000 through 2008. Note that 2008 was a warm water year.

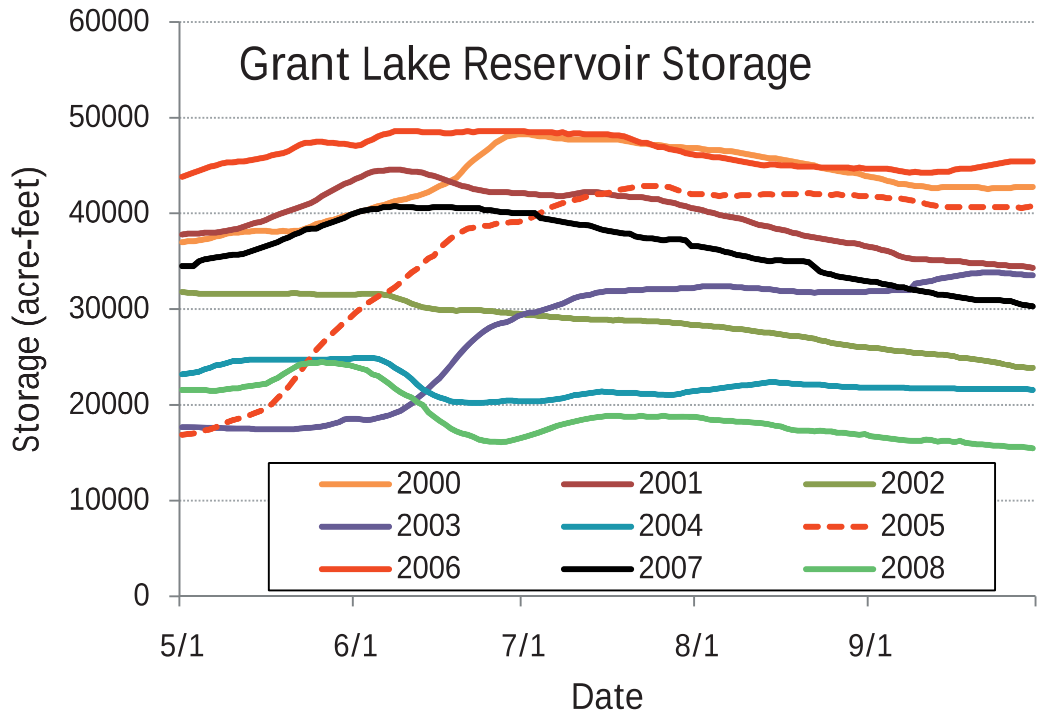


Figure D-4.5. Water elevations in Grant Lake Reservoir from 2000 through 2008 showing that during the year 2008 was a low level (near base conditions).

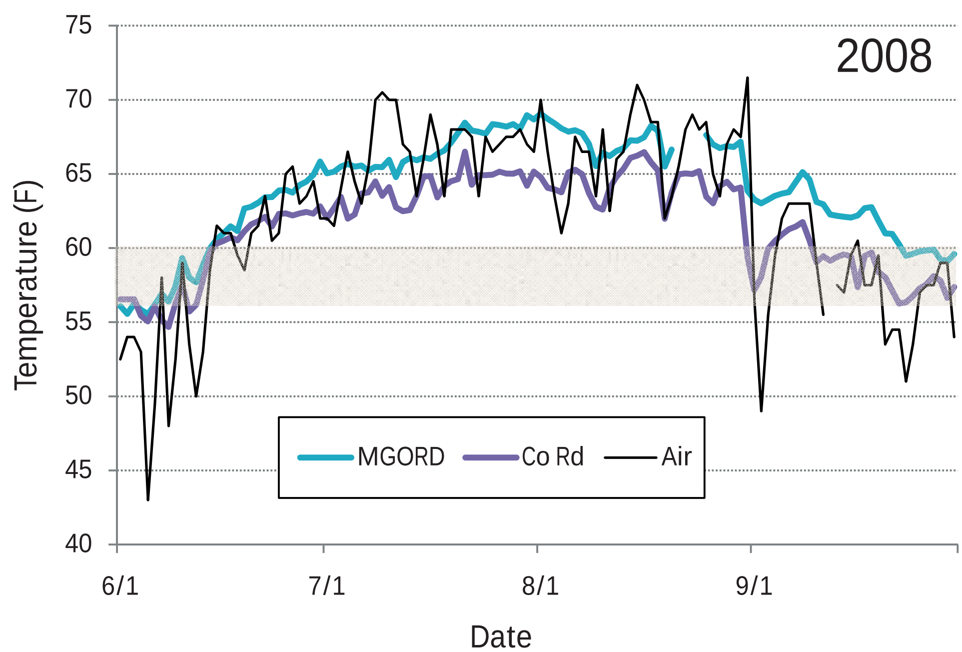


Figure D-4.6. Average daily water temperatures recorded at the MGORD footbridge and County Road culvert water temperature monitoring sites and average daily air temperatures recorded at Cain Ranch during 2008 (base condition). The shaded area represents water temperatures from 56 to 60˚F.

APPENDIX D

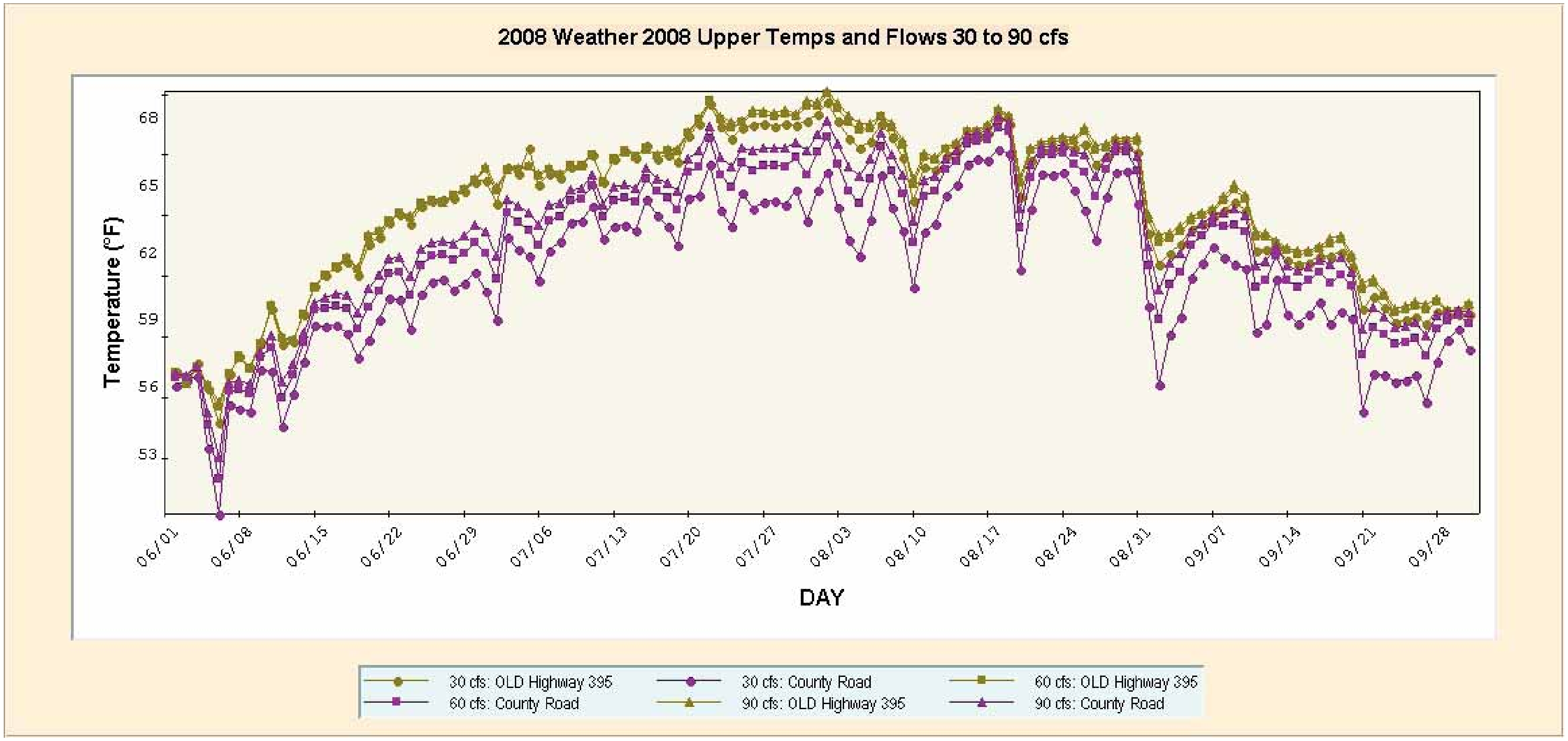


Figure D-4.7. Predicted daily average water temperatures in Rush Creek at Old Highway 395 (gold) and at the County Road culvert (purple) at different flows from 30 to 90 cfs. Note that water cooled from 395 to the County Road culvert and that this cooling was more pronounced for flows of 30 cfs (solid dots) than flows of 90 cfs (solid triangles).

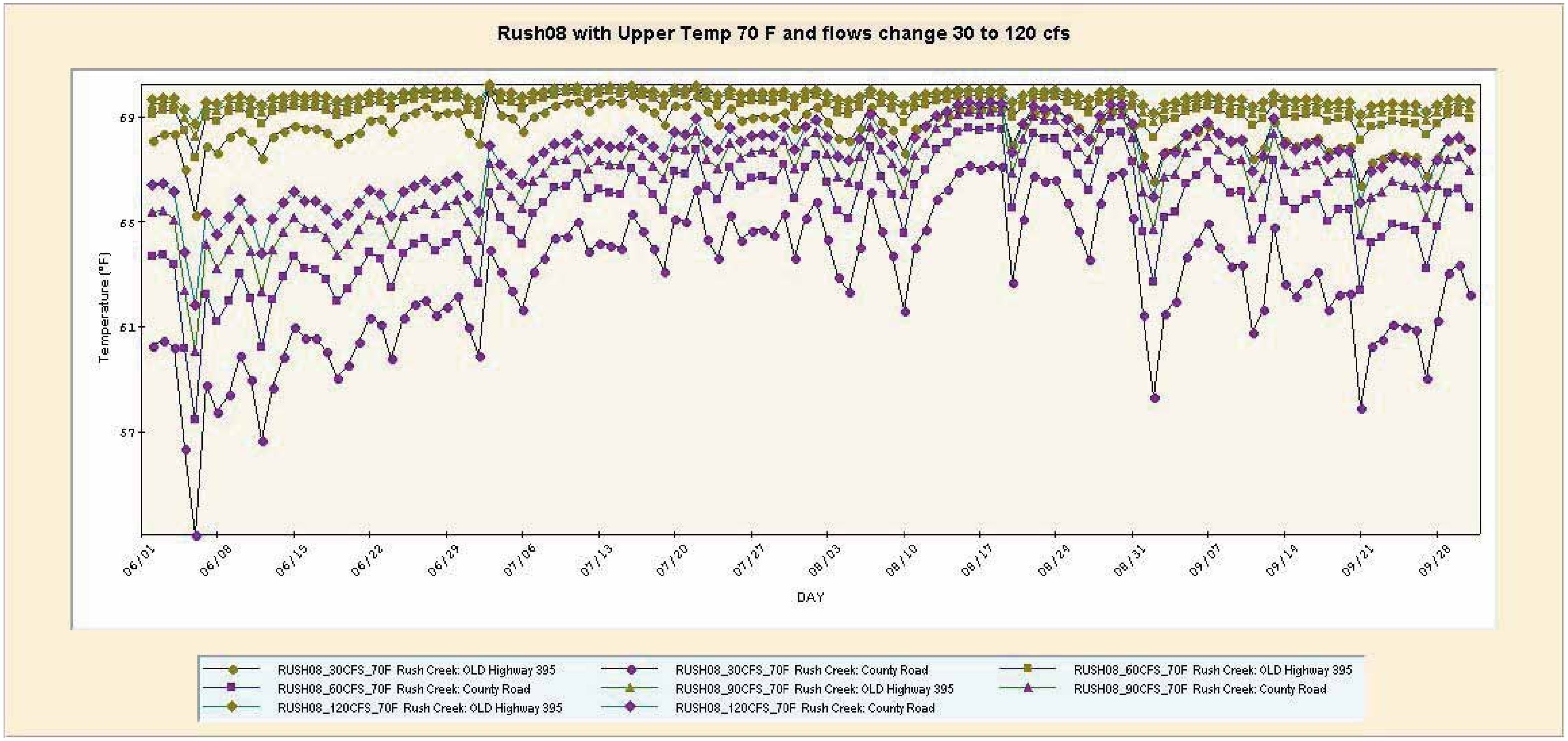


Figure D-4.8. Predicted daily average water temperatures in Rush Creek at Old Highway 395 (gold) and at the County Road culvert (purple) at different flows from 30 to 120 cfs and at a fixed outflow temperature of 70°F. Note that water cooled from 395 to the County Road culvert and that this cooling was more pronounced for flows of 30 cfs (solid dots) than flows of 120 cfs (solid triangles).

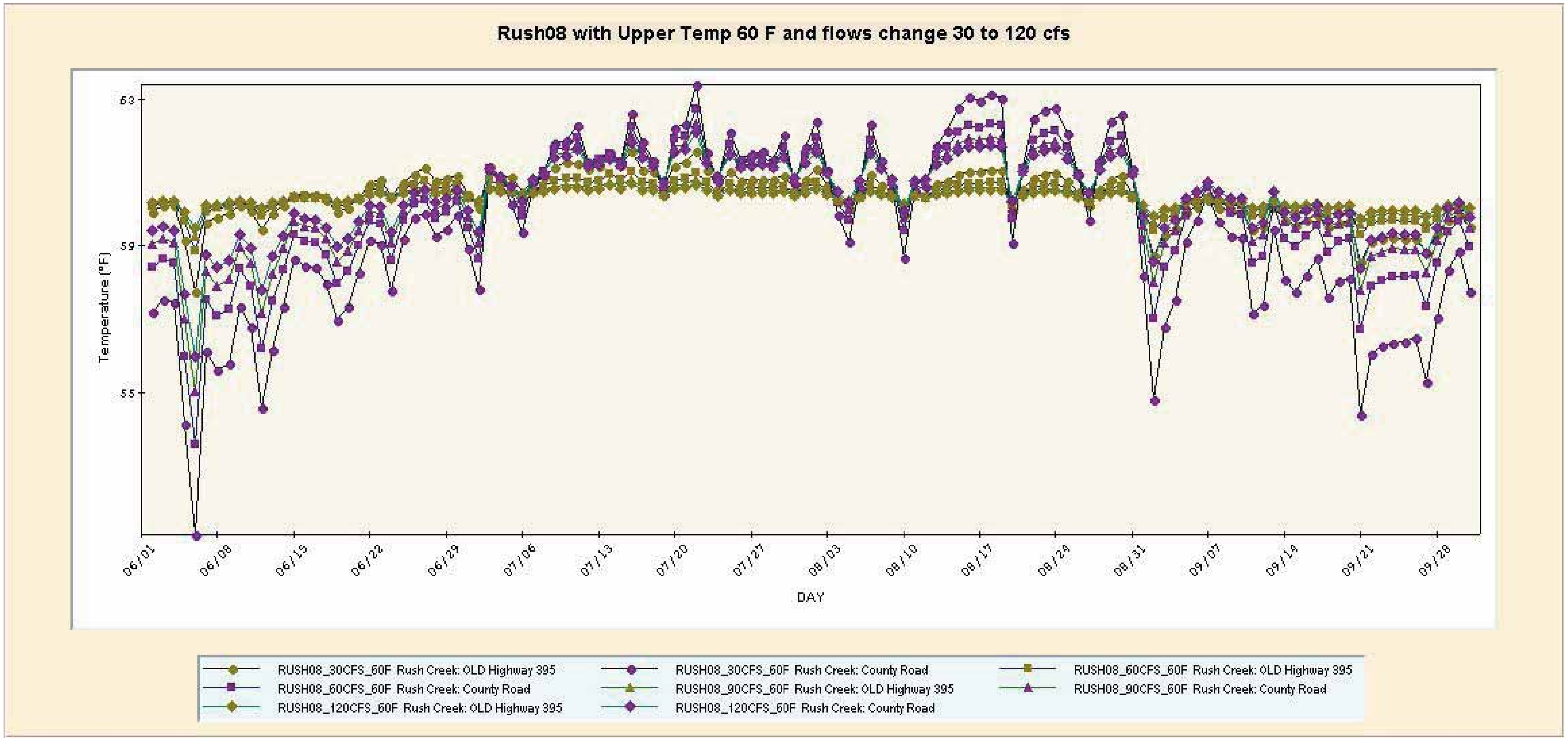


Figure D-4.9. Predicted daily average water temperatures in Rush Creek at Old Highway 395 (gold) and at the County Road culvert (purple) at different flows from 30 to 120 cfs and at a fixed outflow temperature of 60°F. Note that water primarily warmed from 395 to the County Road culvert from July 10 through August 31 and that this warming was more pronounced for flows of 30 cfs (solid dots) than flows of 120 cfs (solid triangles).

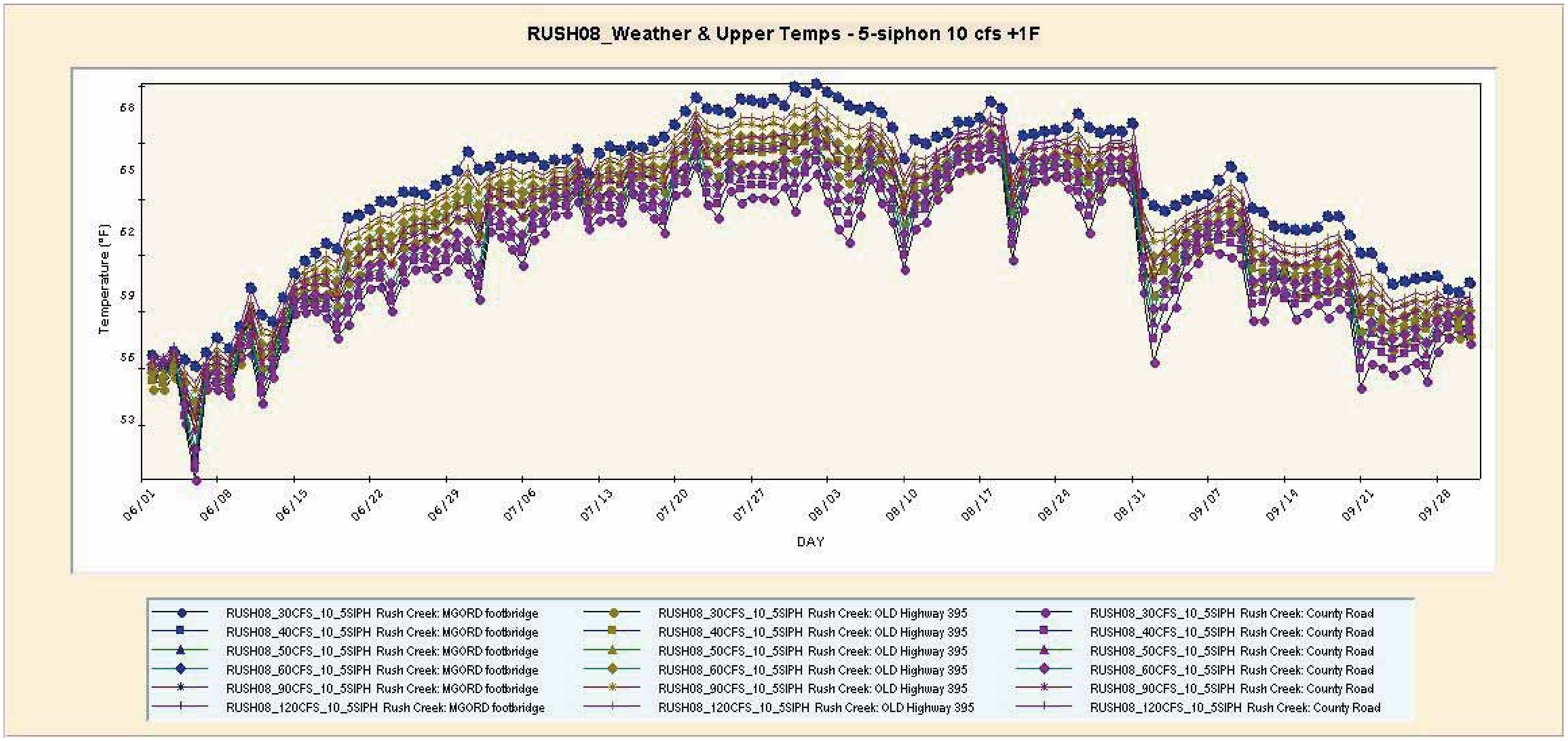


Figure D-4.10. Predicted daily average water temperatures in Rush Creek at Old Highway 395 (gold) and at the County Road culvert (purple) at different flows from 30 to 120 cfs and at outflow temperatures measured during 2008 (MGORD footbridge). Note that water cooled from the MGORD down to the County Road culvert from July 10 through August 31 and that cooling was related to flow volumes with more cooling at lower flows.

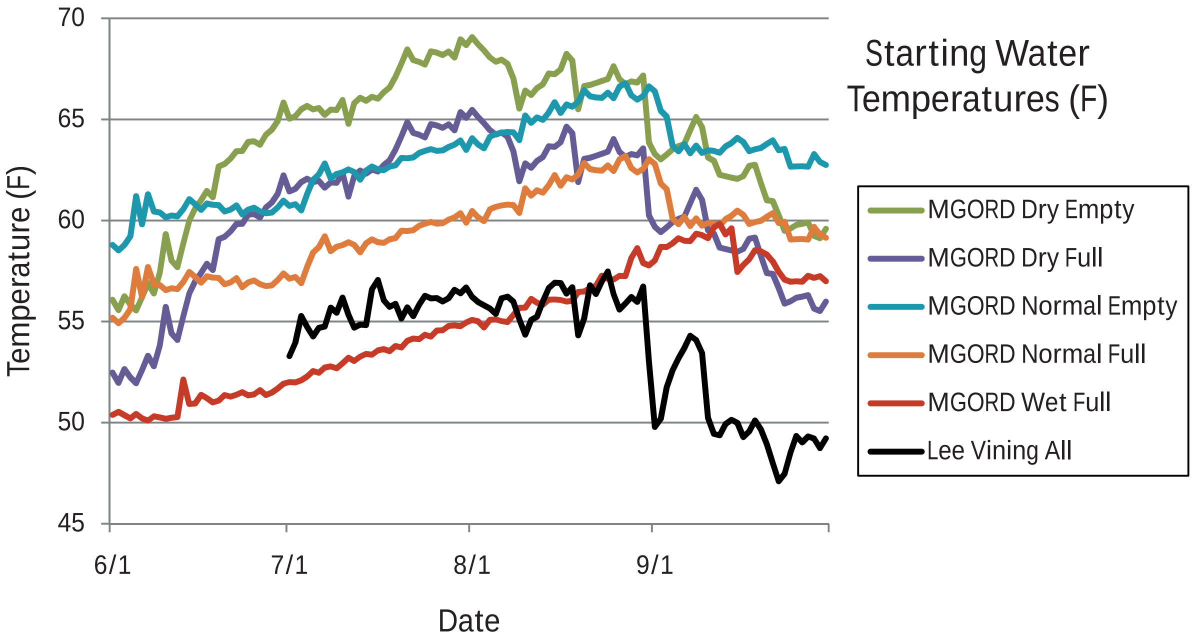
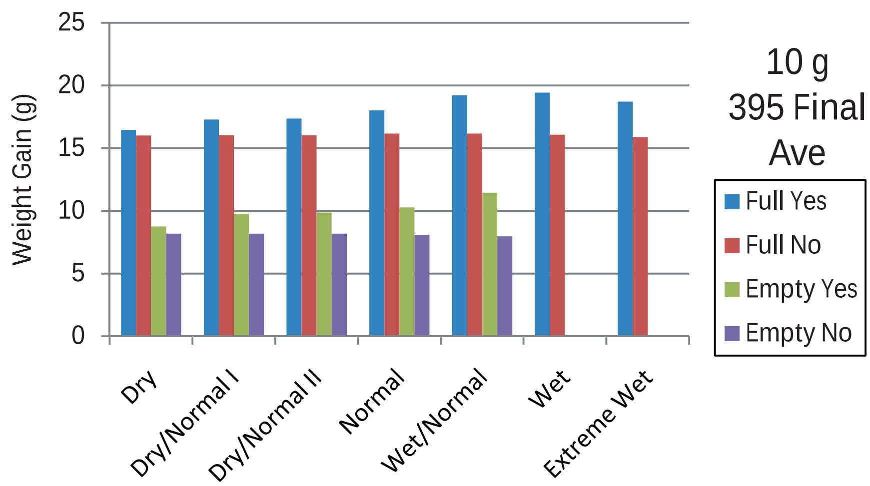
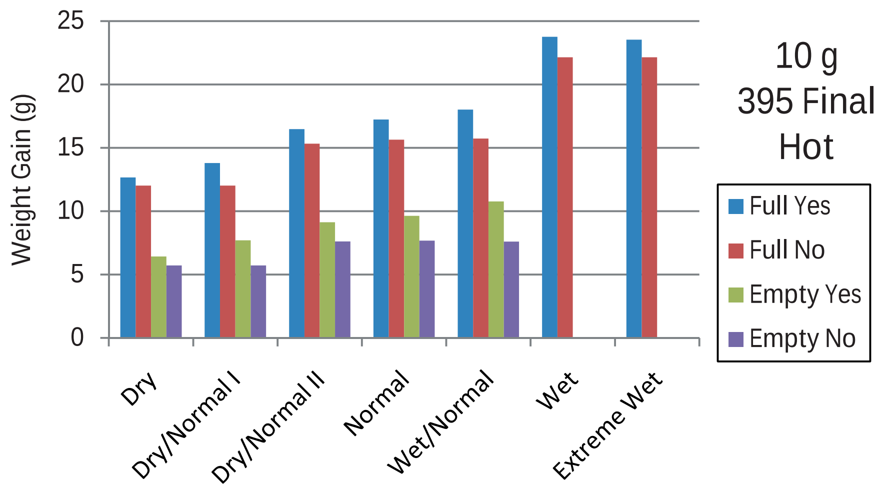


Figure D-4.11. Initial water temperatures at the MGORD footbridge site and delivered to upper Rush Creek through the 5-Siphon Bypass (Lee Vining All) for the various flow scenarios during the "hot" summer of 2008.





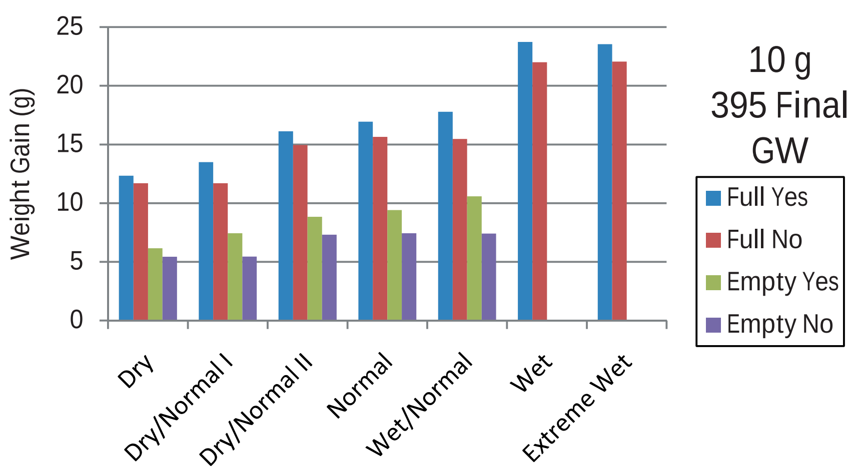


Figure D-4.12. Predicted summer growth (g) of 10 g brown trout at Old 395 bridge site in Rush Creek by water year availability (x-axis), climate (Ave, Hot, or global warming: GW), GLR full or empty (Full or Empty), and 5-Siphon Bypass flows added or not added to Rush Creek (Yes or No).

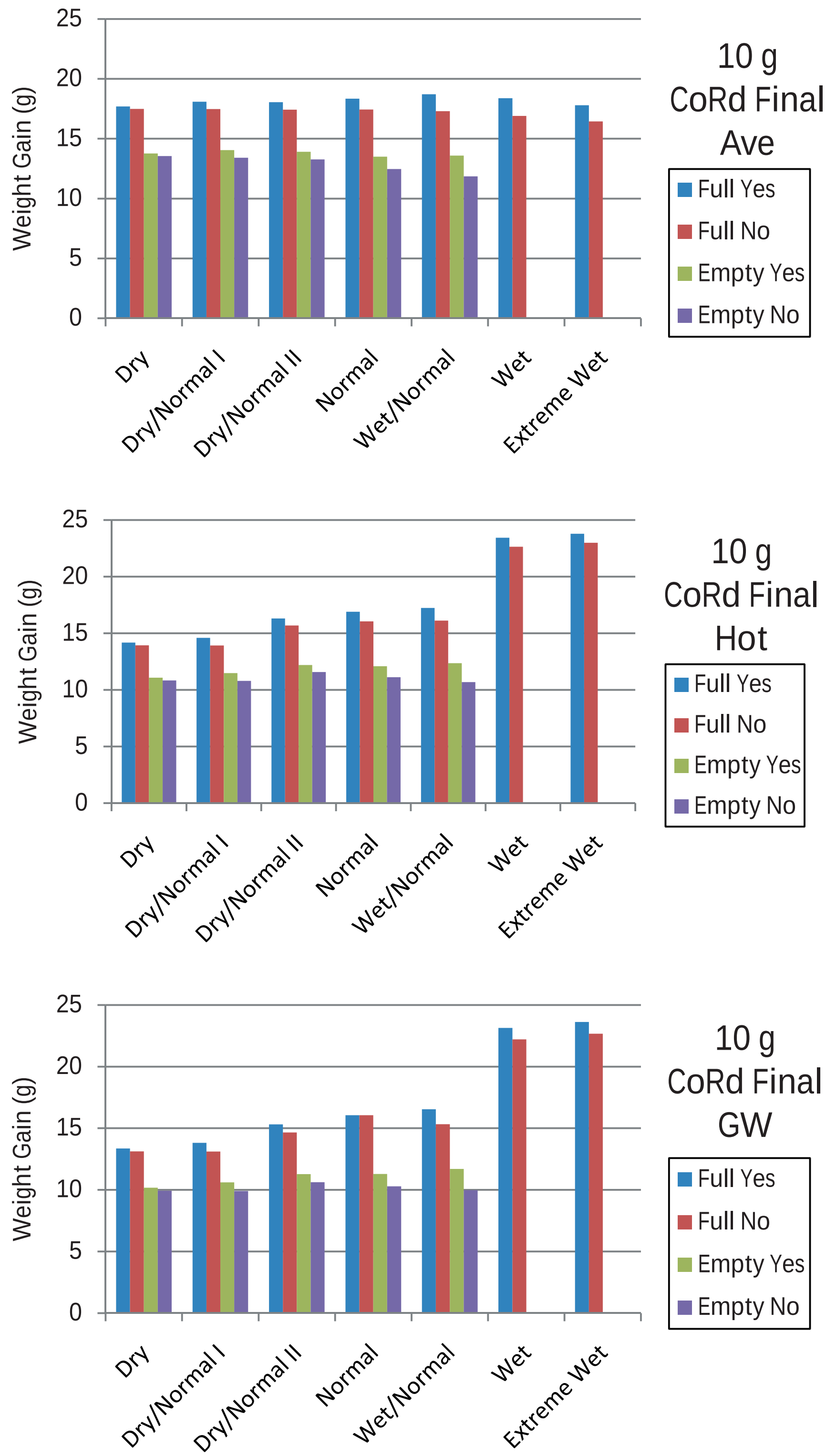


Figure D-4.13. Predicted summer growth (g) of 10 g brown trout at the County Road site in Rush Creek by water year availability (x-axis), climate (Ave, Hot, or global warming: GW), GLR full or empty (Full or Empty), and 5-Siphon Bypass flows added or not added to Rush Creek (Yes or No).

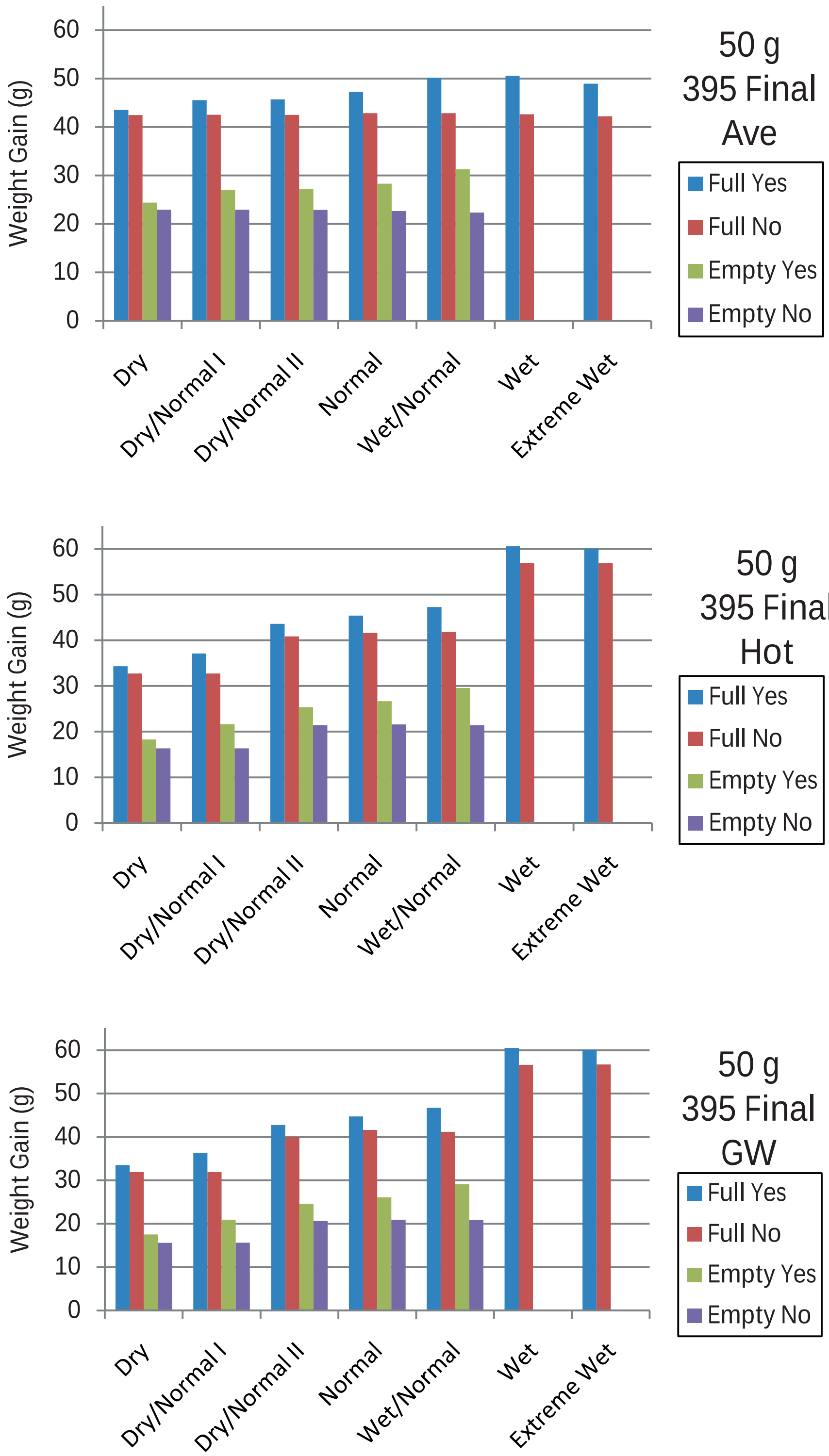


Figure D-4.14. Predicted summer growth (g) of 50 g brown trout at Old 395 bridge site in Rush Creek by water year availability (x-axis), climate (Ave, Hot, or global warming: GW), GLR full or empty (Full or Empty), and 5-Siphon Bypass flows added or not added to Rush Creek (Yes or No).

APPENDIX D

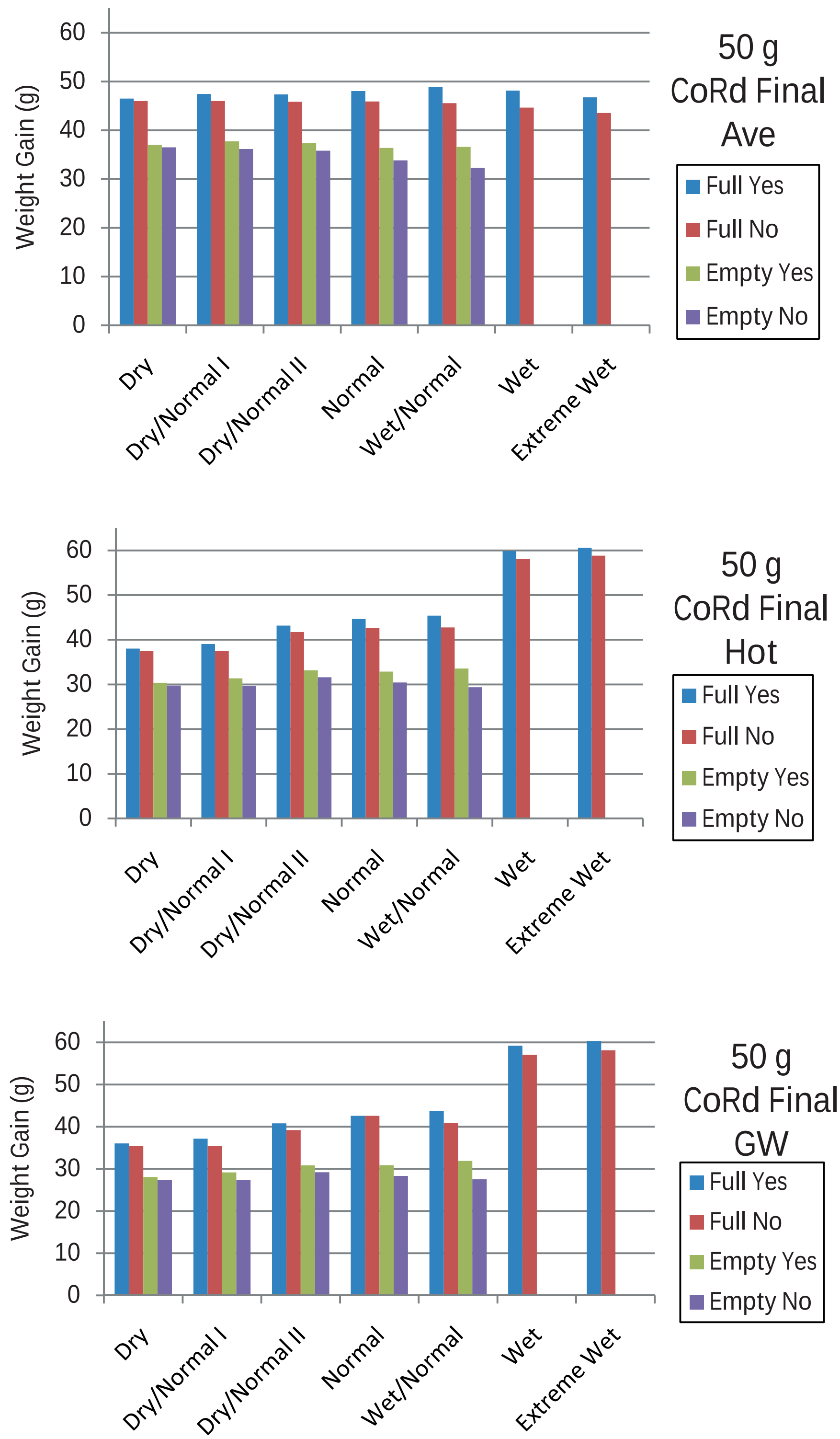


Figure D-4.15. Predicted summer growth (g) of 50 g brown trout at County Road site in Rush Creek by water year availability (x-axis), climate (Ave, Hot, or global warming: GW), GLR full or empty (Full or Empty), and 5-Siphon Bypass flows added or not added to Rush Creek (Yes or No).

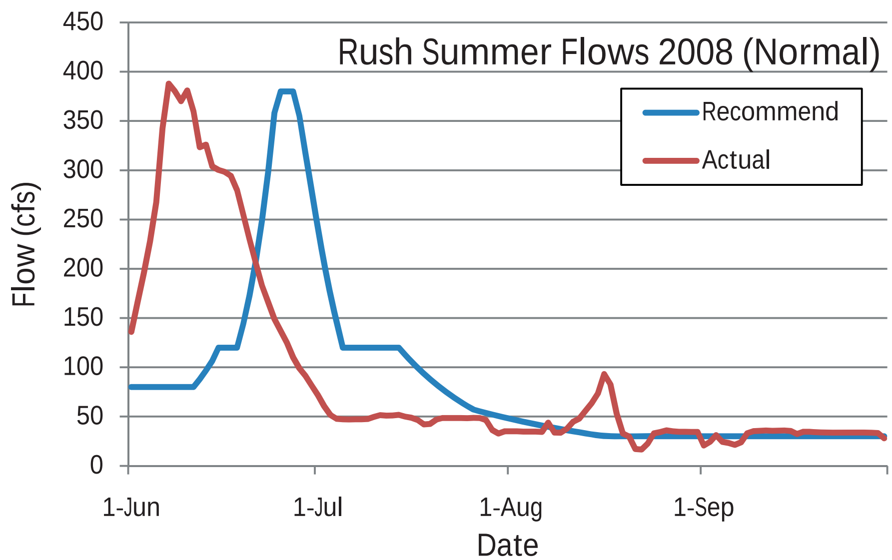


Figure D-4.16. Comparison of recommended flows (Recommended) and actual flows released down upper Rush Creek (Actual) during 2008. The short-duration increase and decline in "Actual" flows during mid-August represents test-flow releases for the instream flow study and usually D-1631 baseflows are held near 44 cfs throughout this period.

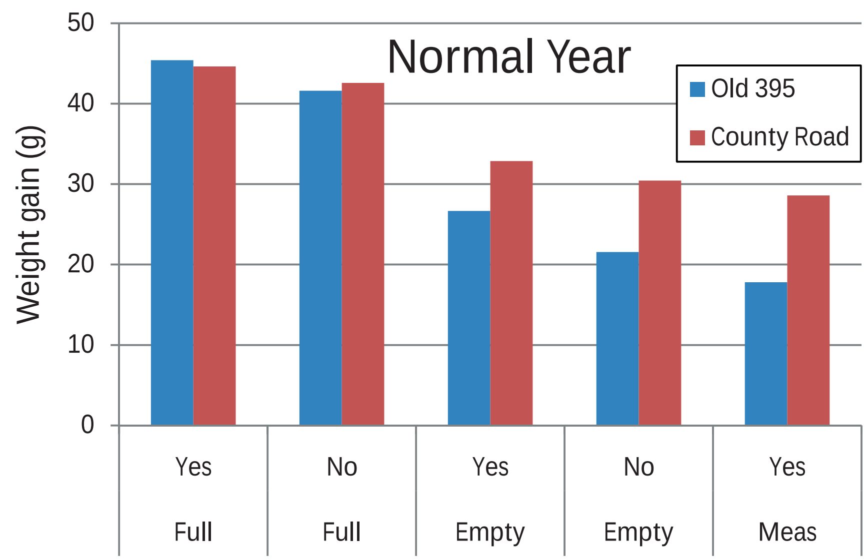
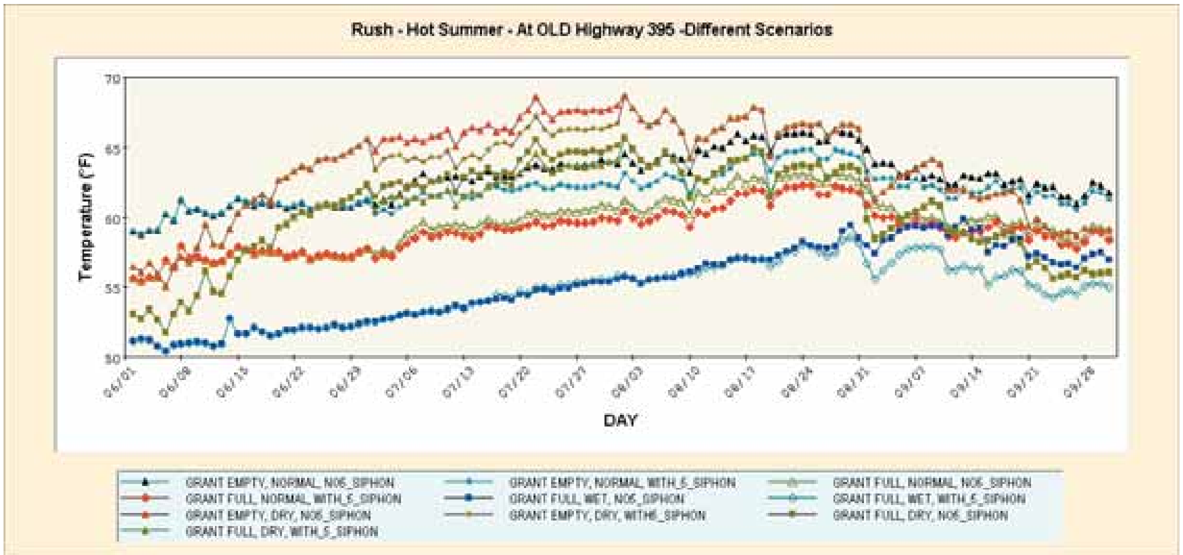


Figure D-4.17. Comparison of predicted growth of a 50 g brown trout during the summer of 2008 (a year of Normal water availability and hot summer temperatures) at the Old Highway 395 and County Road sites in Rush Creek to predicted growth for recommended flows and GLR (Full or Empty) and 5-Siphon Bypass (Yes or No) scenarios and predicted growth from predicted water temperatures for the BASE model that included (Yes) and excluded (No) 5-Siphon Bypass flow additions to upper Rush Creek and for the actual measured water temperatures (Meas) that included the 5-Siphon Bypass flows that were actually released into upper Rush Creek .



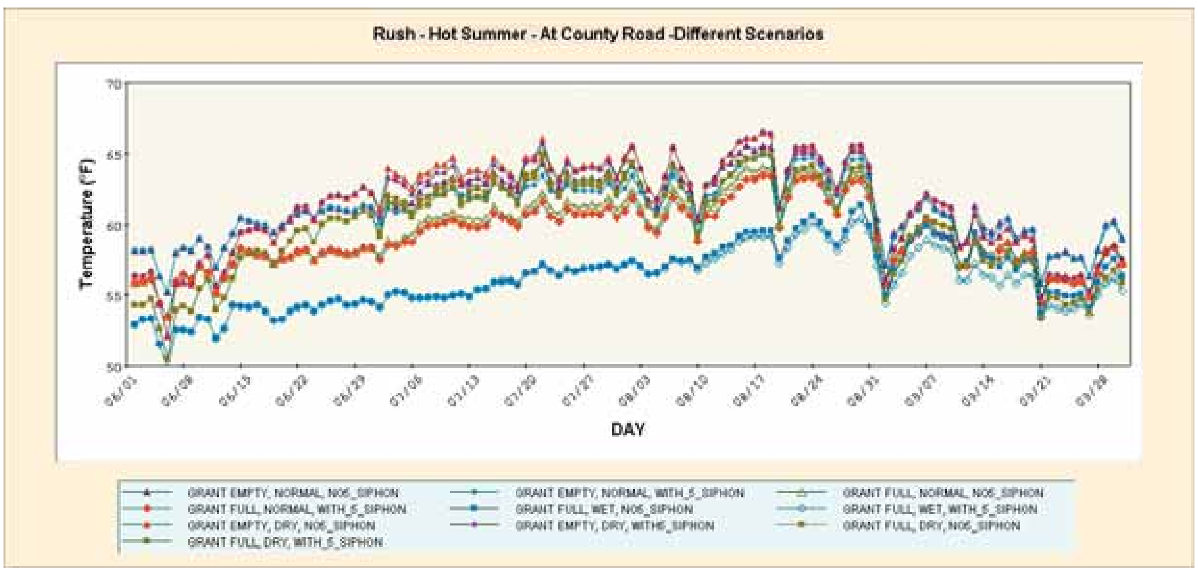
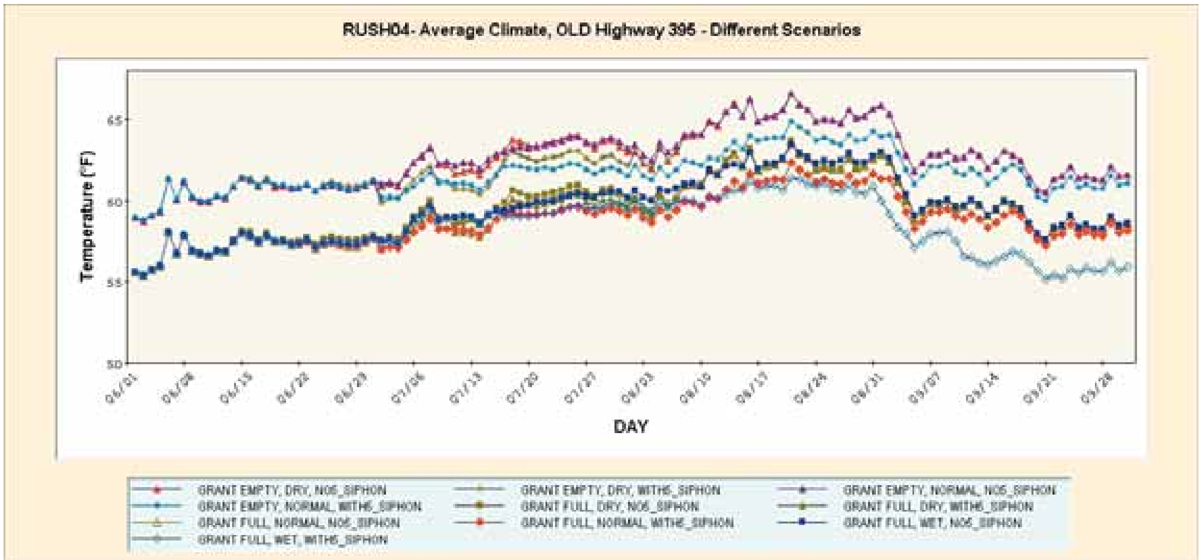


Figure D-4.18. Predicted daily average water temperatures at Old Highway 395 (top) and County Road (bottom) sites in Rush Creek during a hot summer (2008) and various scenarios (different lines). The horizontal dotted line is the 65˚F threshold above which temperatures were rated as bad for brown trout and the shaded box represents average temperatures that were rated as good for brown trout.



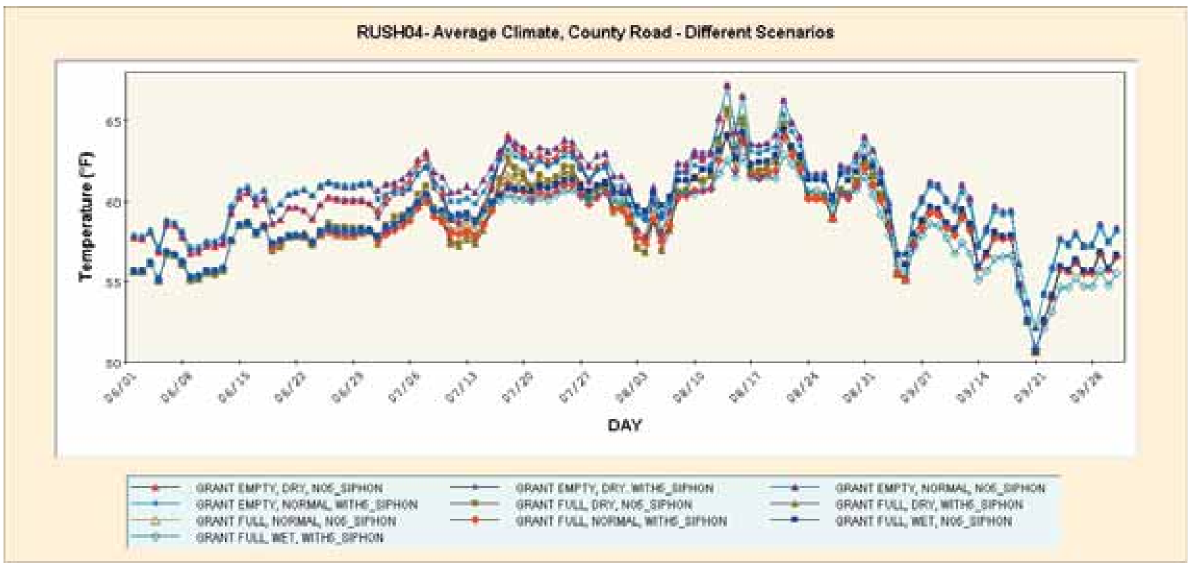
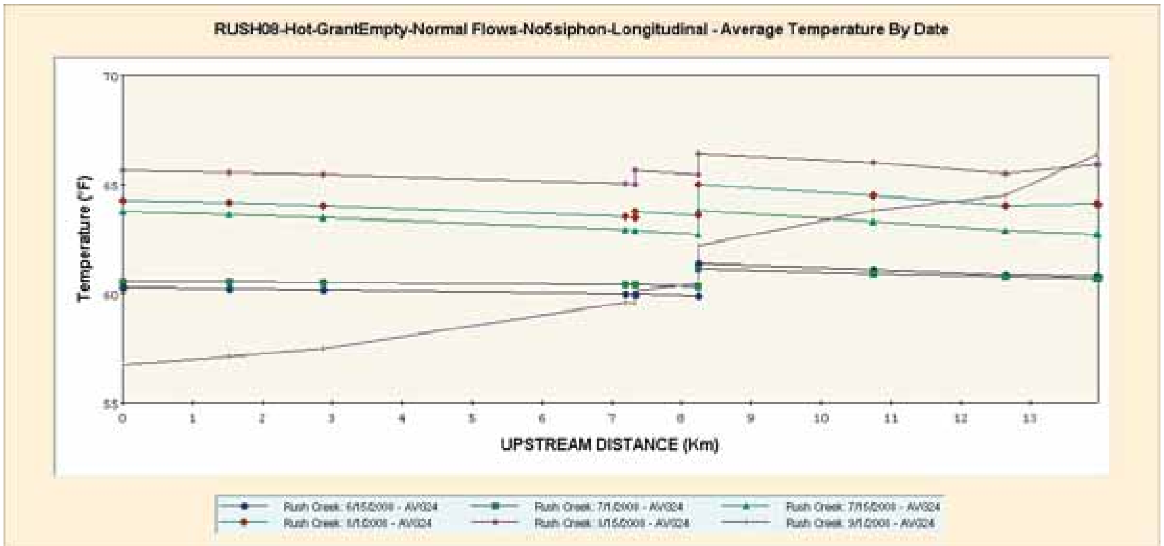


Figure D-4.19. Predicted daily average water temperatures at Old Highway 395 (top) and County Road (bottom) sites in Rush Creek during an average summer (2004) and various scenarios (different lines). The horizontal dotted line is the 65F threshold above which temperatures were rated as bad for brown trout and the shaded box represents average temperatures that were rated as good for brown trout.



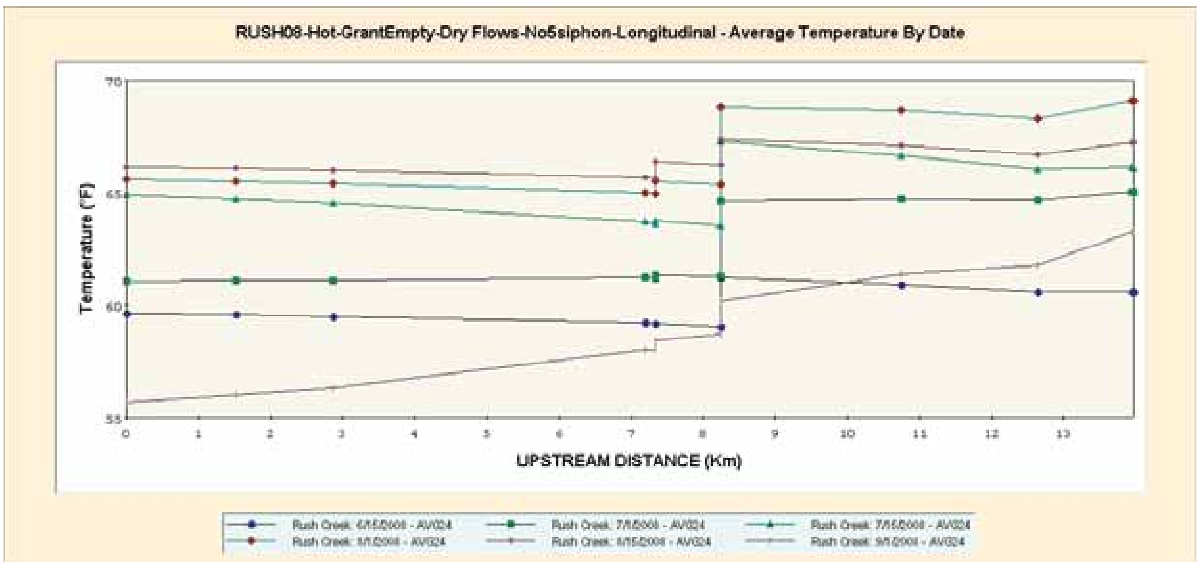
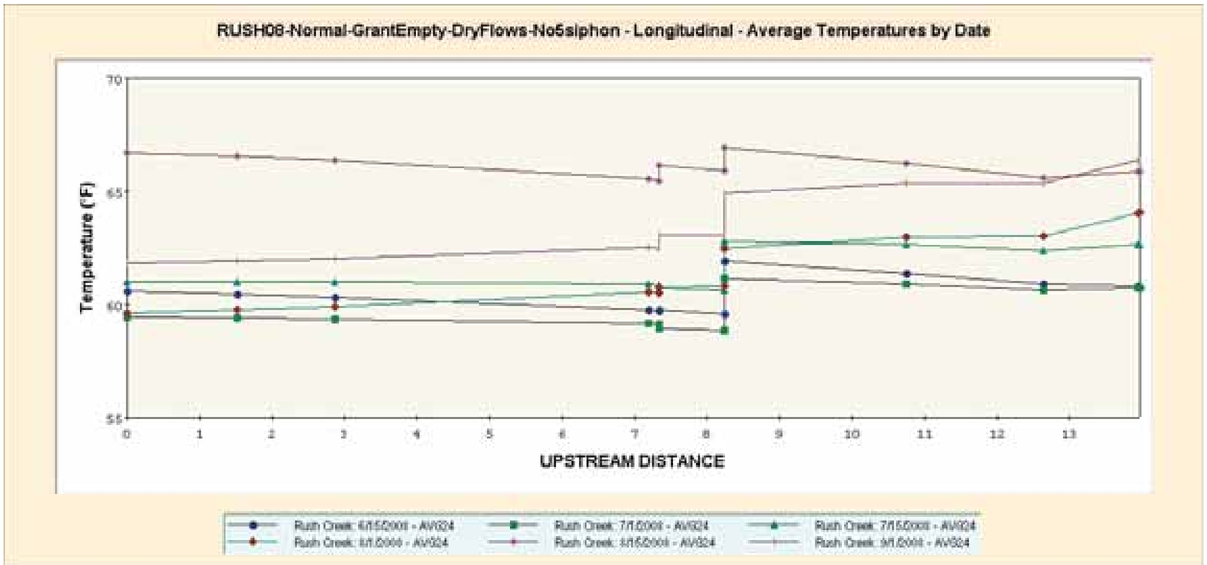


Figure D-4.20. Longitudinal temperature predictions for scenarios of a hot climate (2008), GLR empty, no input from the 5-Siphon Bypass, and normal (top) and dry (bottom) water availability.



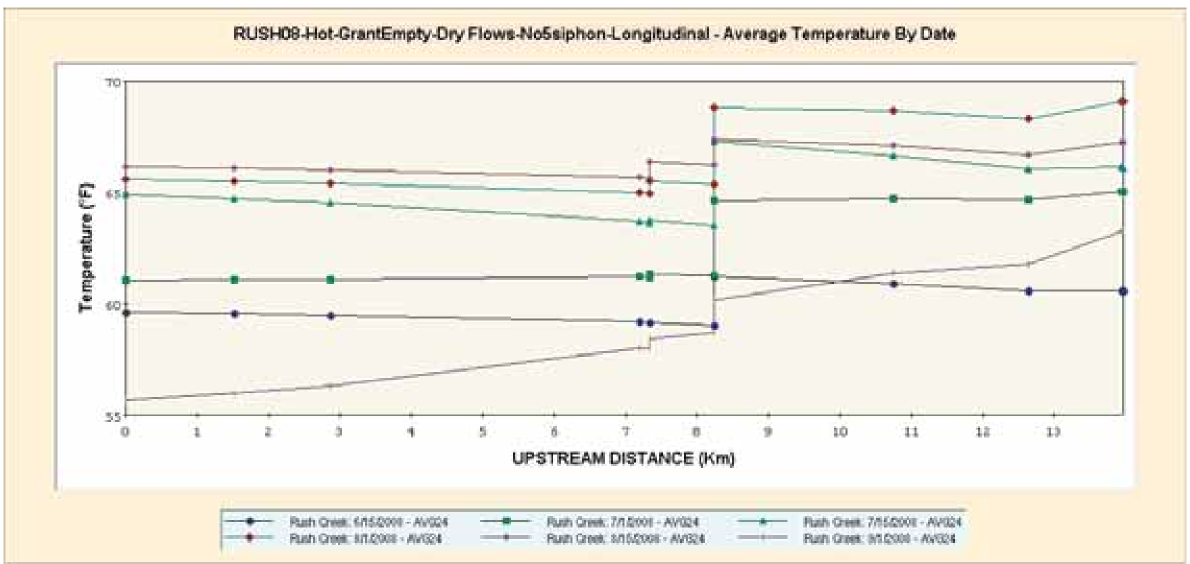


Figure D-4.21. Longitudinal temperature predictions for scenarios of an average climate (2004; top) and hot climate year (2008; bottom) and a scenario where GLR is empty, no input from the 5-Siphon Bypass, and dry water availability.

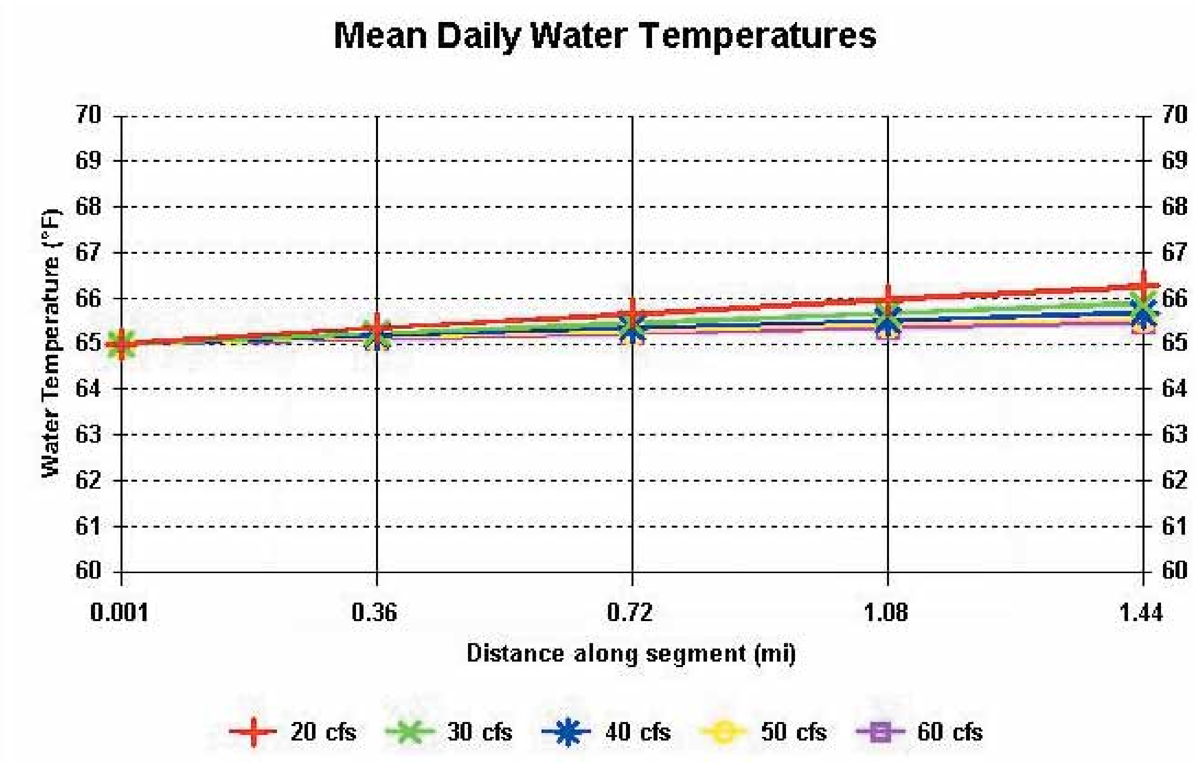


Figure D-4.22. Water temperatures predicted from the top of the MGORD (mile 0.001) to the footbridge (mile 1.44) based on a starting water temperature of 65˚F and climate conditions shown on the lower left corner of the figure illustrating the amount of warming that occurs down the length of the MGORD at different flows from 20 to 60 cfs.

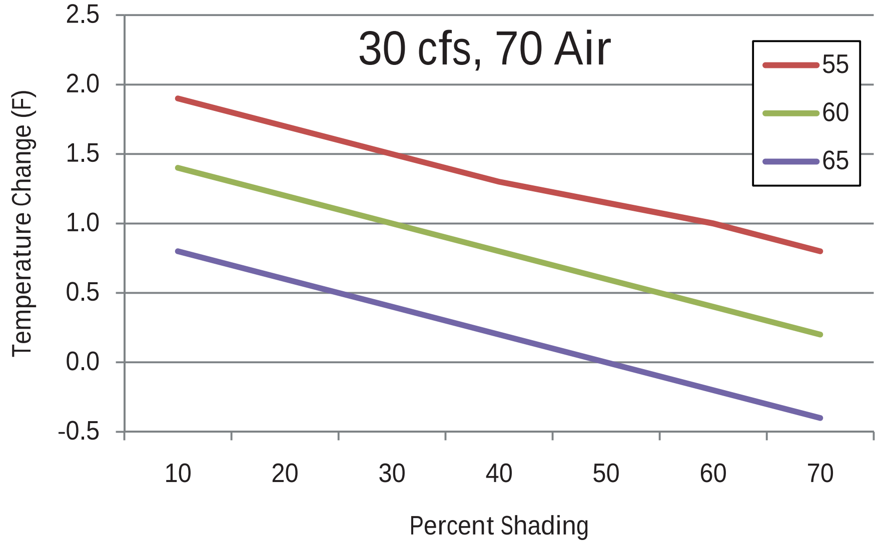


Figure D-4.23. Temperature changes at the bottom of the MGORD due to theoretical increases in shade along the MGORD for flows of 30 cfs and a daily air temperature of 70˚F at three different starting water temperatures (different lines).

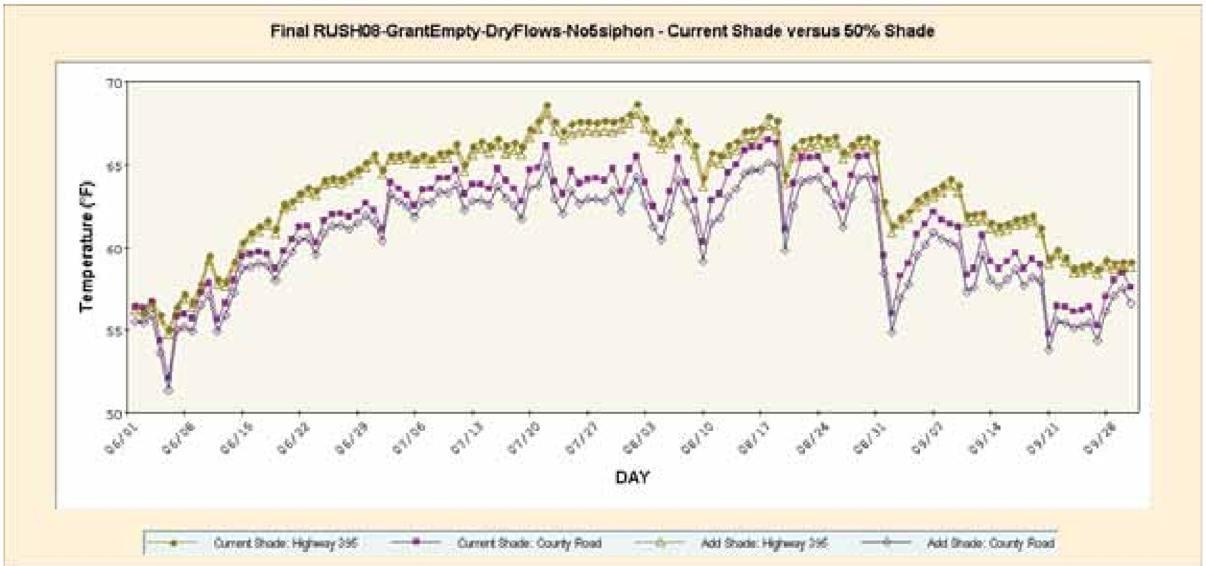


Figure D-4.24. Predicted water temperatures at the Old Highway 395 and County Road sites of Rush Creek at current levels and a consistent 50% level of channel shading for the scenario of a hot climate, dry water availability, GLR empty, and no 5-Siphon Bypass addition to upper Rush Creek.

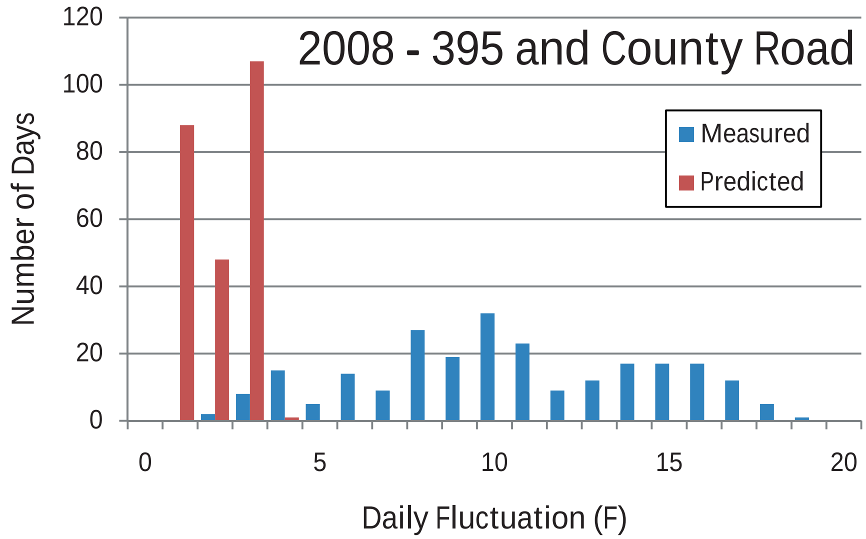


Figure D-4.25. Measured and predicted daily fluctuations in water temperatures at the Old Highway 395 and County Road sites in Rush Creek during 2008.

Table D-4.1. Daily flows (cfs) released from GLR from June 1 through September 30 based on predicted water availability by type for FINAL flows.

DATE	Dry	Dry/Normal I	Dry/Normal II	Normal	Wet/Normal	Wet	Extreme Wet
1-Jun	70	80	80	80	80	80	80
2-Jun	70	80	80	80	80	80	80
3-Jun	70	80	80	80	80	80	80
4-Jun	70	80	80	80	80	80	80
5-Jun	70	80	80	80	80	80	80
6-Jun	70	80	80	80	80	80	80
7-Jun	70	80	80	80	80	80	80
8-Jun	70	80	96	80	80	80	80
9-Jun	70	80	115	80	80	80	80
10-Jun	70	80	138	80	80	80	80
11-Jun	70	80	166	80	80	80	80
12-Jun	70	80	200	88	88	88	88
13-Jun	70	80	200	97	97	97	97
14-Jun	70	80	200	106	106	106	106
15-Jun	70	80	180	120	117	117	117
16-Jun	70	80	162	120	129	129	129
17-Jun	70	80	146	120	142	142	142
18-Jun	70	80	131	120	145	156	156
19-Jun	70	80	118	144	145	170	171
20-Jun	70	80	106	173	145	170	189
21-Jun	70	80	96	207	145	170	207
22-Jun	70	80	86	249	145	170	220
23-Jun	70	80	80	299	145	170	220
24-Jun	70	80	80	358	145	170	220
25-Jun	70	80	80	380	145	170	220
26-Jun	70	80	80	380	174	170	220
27-Jun	70	80	80	380	209	170	220
28-Jun	70	80	80	355	251	170	220
29-Jun	70	80	80	317	301	170	220
30-Jun	70	80	80	279	361	170	220
1-Jul	70	75	75	241	380	170	220
2-Jul	70	71	71	206	380	170	220
3-Jul	70	66	66	174	380	170	220
4-Jul	70	62	62	146	380	170	220
5-Jul	70	59	59	120	342	204	220
6-Jul	66	55	55	120	308	245	220
7-Jul	62	52	52	120	277	294	220
8-Jul	58	49	49	120	249	380	220
9-Jul	55	47	47	120	224	380	264
10-Jul	51	46	46	120	202	380	317
11-Jul	48	45	45	120	182	380	380
12-Jul	45	43	43	120	164	380	380
13-Jul	44	42	42	120	147	342	380
14-Jul	43	41	41	120	145	308	380
15-Jul	41	39	39	113	145	277	380
16-Jul	40	38	38	106	145	249	380

Table D-4.1. Continued. Daily flows (cfs) released from GLR from June 1 through September 30 based on predicted water availability by type for FINAL flows.

DATE	Dry	Dry/Normal I	Dry/Normal II	Normal	Wet/Normal	Wet	Extreme Wet
17-Jul	39	37	37	100	145	224	380
18-Jul	38	36	36	94	145	202	380
19-Jul	37	35	35	88	145	182	342
20-Jul	36	34	34	83	145	170	308
21-Jul	35	33	33	78	145	170	277
22-Jul	33	32	32	73	145	170	249
23-Jul	32	31	31	69	145	170	220
24-Jul	31	30	30	65	136	170	220
25-Jul	30	30	30	61	128	170	220
26-Jul	30	30	30	57	120	170	220
27-Jul	30	30	30	55	113	170	220
28-Jul	30	30	30	54	106	170	220
29-Jul	30	30	30	52	100	170	220
30-Jul	30	30	30	51	94	170	220
31-Jul	30	30	30	49	88	170	220
1-Aug	30	30	30	48	83	170	220
2-Aug	30	30	30	46	78	160	220
3-Aug	30	30	30	45	73	150	220
4-Aug	30	30	30	43	69	141	220
5-Aug	30	30	30	42	67	133	220
6-Aug	30	30	30	41	65	125	220
7-Aug	30	30	30	40	63	117	220
8-Aug	30	30	30	38	61	110	220
9-Aug	30	30	30	37	59	104	220
10-Aug	30	30	30	36	57	97	220
11-Aug	30	30	30	35	56	92	207
12-Aug	30	30	30	34	54	86	194
13-Aug	30	30	30	33	52	81	183
14-Aug	30	30	30	32	51	76	172
15-Aug	30	30	30	31	49	71	161
16-Aug	30	30	30	30	48	69	152
17-Aug	30	30	30	30	46	67	143
18-Aug	30	30	30	30	45	65	134
19-Aug	30	30	30	30	44	63	126
20-Aug	30	30	30	30	42	61	118
21-Aug	30	30	30	30	41	60	111
22-Aug	30	30	30	30	40	58	105
23-Aug	30	30	30	30	39	56	98
24-Aug	30	30	30	30	38	54	93
25-Aug	30	30	30	30	36	53	90
26-Aug	30	30	30	30	35	51	87
27-Aug	30	30	30	30	34	50	84
28-Aug	30	30	30	30	33	48	82
29-Aug	30	30	30	30	32	47	79

Table D-4.1. Continued . Daily flows (cfs) released from GLR from June 1 through September 30 based on predicted water availability by type for FINAL flows.

DATE	Dry	Dry/Normal I	Dry/Normal II	Normal	Wet/Normal	Wet	Extreme Wet
30-Aug	30	30	30	30	31	45	77
31-Aug	30	30	30	30	30	44	75
1-Sep	30	30	30	30	30	43	73
2-Sep	30	30	30	30	30	41	70
3-Sep	30	30	30	30	30	40	68
4-Sep	30	30	30	30	30	39	66
5-Sep	30	30	30	30	30	38	64
6-Sep	30	30	30	30	30	37	62
7-Sep	30	30	30	30	30	35	60
8-Sep	30	30	30	30	30	34	59
9-Sep	30	30	30	30	30	33	57
10-Sep	30	30	30	30	30	32	55
11-Sep	30	30	30	30	30	31	53
12-Sep	30	30	30	30	30	30	52
13-Sep	30	30	30	30	30	30	50
14-Sep	30	30	30	30	30	30	49
15-Sep	30	30	30	30	30	30	47
16-Sep	30	30	30	30	30	30	46
17-Sep	30	30	30	30	30	30	45
18-Sep	30	30	30	30	30	30	43
19-Sep	30	30	30	30	30	30	42
20-Sep	30	30	30	30	30	30	41
21-Sep	30	30	30	30	30	30	39
22-Sep	30	30	30	30	30	30	38
23-Sep	30	30	30	30	30	30	37
24-Sep	30	30	30	30	30	30	36
25-Sep	30	30	30	30	30	30	35
26-Sep	30	30	30	30	30	30	34
27-Sep	30	30	30	30	30	30	33
28-Sep	30	30	30	30	30	30	32
29-Sep	30	30	30	30	30	30	31
30-Sep	30	30	30	30	30	30	30

APPENDIX D

Table D-4.2. Daily flows (cfs) diverted from Lee Vining Creek into the LADWP conduit for release into upper Rush Creek via the 5-Siphon Bypass from July 1 through September 30 based on predicted water availability by type for FINAL flows.

Date	Dry	Dry Normal I and II	Normal	Wet Norm	Wet	Ext Wet
1-Jul	10.8	19.8	25.2	33.6	4.7	0.0
2-Jul	10.8	19.8	25.2	33.6	4.7	0.0
3-Jul	10.8	19.8	25.2	33.6	4.7	0.0
4-Jul	10.8	19.8	25.2	33.6	4.7	0.0
5-Jul	10.8	19.8	25.2	33.6	4.7	0.0
6-Jul	10.8	19.8	25.2	33.6	4.7	0.0
7-Jul	10.8	19.8	25.2	33.6	4.7	0.0
8-Jul	10.8	19.8	25.2	33.6	4.7	0.0
9-Jul	10.8	19.8	25.2	33.6	4.7	0.0
10-Jul	10.8	19.8	25.2	33.6	4.7	0.0
11-Jul	10.8	19.8	25.2	33.6	4.7	0.0
12-Jul	10.8	19.8	25.2	33.6	4.7	0.0
13-Jul	10.8	19.8	25.2	33.6	4.7	0.0
14-Jul	10.8	19.8	25.2	33.6	4.7	0.0
15-Jul	10.8	19.8	25.2	33.6	4.7	0.0
16-Jul	5.0	13.9	17.3	26.9	30.7	2.7
17-Jul	5.0	13.9	17.3	26.9	30.7	2.7
18-Jul	5.0	13.9	17.3	26.9	30.7	2.7
19-Jul	5.0	13.9	17.3	26.9	30.7	2.7
20-Jul	5.0	13.9	17.3	26.9	30.7	2.7
21-Jul	5.0	13.9	17.3	26.9	30.7	2.7
22-Jul	5.0	13.9	17.3	26.9	30.7	2.7
23-Jul	5.0	13.9	17.3	26.9	30.7	2.7
24-Jul	5.0	13.9	17.3	26.9	30.7	2.7
25-Jul	5.0	13.9	17.3	26.9	30.7	2.7
26-Jul	5.0	13.9	17.3	26.9	30.7	2.7
27-Jul	5.0	13.9	17.3	26.9	30.7	2.7
28-Jul	5.0	13.9	17.3	26.9	30.7	2.7
29-Jul	5.0	13.9	17.3	26.9	30.7	2.7
30-Jul	5.0	13.9	17.3	26.9	30.7	2.7
31-Jul	5.0	13.9	17.3	26.9	30.7	2.7
1-Aug	0.0	6.5	10.9	21.2	25.8	36.9
2-Aug	0.0	6.5	10.9	21.2	25.8	36.9
3-Aug	0.0	6.5	10.9	21.2	25.8	36.9
4-Aug	0.0	6.5	10.9	21.2	25.8	36.9
5-Aug	0.0	6.5	10.9	21.2	25.8	36.9
6-Aug	0.0	6.5	10.9	21.2	25.8	36.9
7-Aug	0.0	6.5	10.9	21.2	25.8	36.9
8-Aug	0.0	6.5	10.9	21.2	25.8	36.9
9-Aug	0.0	6.5	10.9	21.2	25.8	36.9
10-Aug	0.0	6.5	10.9	21.2	25.8	36.9
11-Aug	0.0	6.5	10.9	21.2	25.8	36.9
12-Aug	0.0	6.5	10.9	21.2	25.8	36.9
13-Aug	0.0	6.5	10.9	21.2	25.8	36.9

Table D-4.2. Continued. Daily flows (cfs) diverted from Lee Vining Creek into the LADWP conduit for release into upper Rush Creek via the 5-Siphon Bypass from July 1 through September 30 based on predicted water availability by type for FINAL flows.

Date	Dry	Dry Normal I and II	Normal	Wet Norm	Wet	Ext Wet
14-Aug	0.0	6.5	10.9	21.2	25.8	36.9
15-Aug	0.0	6.5	10.9	21.2	25.8	36.9
16-Aug	0.1	1.4	6.1	14.2	19.5	28.4
17-Aug	0.1	1.4	6.1	14.2	19.5	28.4
18-Aug	0.1	1.4	6.1	14.2	19.5	28.4
19-Aug	0.1	1.4	6.1	14.2	19.5	28.4
20-Aug	0.1	1.4	6.1	14.2	19.5	28.4
21-Aug	0.1	1.4	6.1	14.2	19.5	28.4
22-Aug	0.1	1.4	6.1	14.2	19.5	28.4
23-Aug	0.1	1.4	6.1	14.2	19.5	28.4
24-Aug	0.1	1.4	6.1	14.2	19.5	28.4
25-Aug	0.1	1.4	6.1	14.2	19.5	28.4
26-Aug	0.1	1.4	6.1	14.2	19.5	28.4
27-Aug	0.1	1.4	6.1	14.2	19.5	28.4
28-Aug	0.1	1.4	6.1	14.2	19.5	28.4
29-Aug	0.1	1.4	6.1	14.2	19.5	28.4
30-Aug	0.1	1.4	6.1	14.2	19.5	28.4
31-Aug	0.1	1.4	6.1	14.2	19.5	28.4
1-Sep	0.0	0.0	3.2	9.8	16.8	21.0
2-Sep	0.0	0.0	3.2	9.8	16.8	21.0
3-Sep	0.0	0.0	3.2	9.8	16.8	21.0
4-Sep	0.0	0.0	3.2	9.8	16.8	21.0
5-Sep	0.0	0.0	3.2	9.8	16.8	21.0
6-Sep	0.0	0.0	3.2	9.8	16.8	21.0
7-Sep	0.0	0.0	3.2	9.8	16.8	21.0
8-Sep	0.0	0.0	3.2	9.8	16.8	21.0
9-Sep	0.0	0.0	3.2	9.8	16.8	21.0
10-Sep	0.0	0.0	3.2	9.8	16.8	21.0
11-Sep	0.0	0.0	3.2	9.8	16.8	21.0
12-Sep	0.0	0.0	3.2	9.8	16.8	21.0
13-Sep	0.0	0.0	3.2	9.8	16.8	21.0
14-Sep	0.0	0.0	3.2	9.8	16.8	21.0
15-Sep	0.0	0.0	3.2	9.8	16.8	21.0
16-Sep	0.0	0.0	1.6	7.0	12.8	16.9
17-Sep	0.0	0.0	1.6	7.0	12.8	16.9
18-Sep	0.0	0.0	1.6	7.0	12.8	16.9
19-Sep	0.0	0.0	1.6	7.0	12.8	16.9
20-Sep	0.0	0.0	1.6	7.0	12.8	16.9
21-Sep	0.0	0.0	1.6	7.0	12.8	16.9
22-Sep	0.0	0.0	1.6	7.0	12.8	16.9
23-Sep	0.0	0.0	1.6	7.0	12.8	16.9
24-Sep	0.0	0.0	1.6	7.0	12.8	16.9

APPENDIX D

Table D-4.2. Continued. Daily flows (cfs) diverted from Lee Vining Creek into the LADWP conduit for release into upper Rush Creek via the 5-Siphon Bypass from July 1 through September 30 based on predicted water availability by type for FINAL flows.

Date	Dry	Dry Normal I and II	Normal	Wet Norm	Wet	Ext Wet
25-Sep	0.0	0.0	1.6	7.0	12.8	16.9
26-Sep	0.0	0.0	1.6	7.0	12.8	16.9
27-Sep	0.0	0.0	1.6	7.0	12.8	16.9
28-Sep	0.0	0.0	1.6	7.0	12.8	16.9
29-Sep	0.0	0.0	1.6	7.0	12.8	16.9
30-Sep	0.0	0.0	1.6	7.0	12.8	16.9

Table D-4.3. Various flow scenarios for which average daily water temperatures in Rush Creek were predicted, including the year and temperature adjustments for which average water temperature data were used for the MGORD site and Lee Vining Creek water delivered via the 5-Siphon Bypass, based on water availability.

Air Temperature	Water Availability	Grant	5-Siphon Bypass flow	MGORD water temperature	5-Siphon (LV) water temperature
Hot - 2008	Dry	Full	No	2008 - 3.6F	2008 + 1F
	Dry/Normal I	Full	No	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	No	2000	2008 + 1F
	Normal	Full	No	2000	2008 + 1F
	Wet/Normal	Full	No	2000	2008 + 1F
	Wet	Full	No	2006	2008 + 1F
	Extreme Wet	Full	No	2006	2008 + 1F
Hot - 2008	Dry	Full	Yes	2008 - 3.6F	2008 + 1F
	Dry/Normal I	Full	Yes	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	Yes	2000	2008 + 1F
	Normal	Full	Yes	2000	2008 + 1F
	Wet/Normal	Full	Yes	2000	2008 + 1F
	Wet	Full	Yes	2006	2008 + 1F
	Extreme Wet	Full	Yes	2006	2008 + 1F
Hot - 2008	Dry	Empty	No	2008	2008 + 1F
	Dry/Normal I	Empty	No	2008	2008 + 1F
	Dry/Normal II	Empty	No	2000 + 3.6F	2008 + 1F
	Normal	Empty	No	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	No	2000 + 3.6F	2008 + 1F
Hot - 2008	Dry	Empty	Yes	2008	2008 + 1F
	Dry/Normal I	Empty	Yes	2008	2008 + 1F
	Dry/Normal II	Empty	Yes	2000 + 3.6F	2008 + 1F
	Normal	Empty	Yes	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	Yes	2000 + 3.6F	2008 + 1F
Average - 2004	Dry	Full	No	2008 - 3.6F	2008 + 1F
	Dry/Normal I	Full	No	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	No	2000	2008 + 1F
	Normal	Full	No	2000	2008 + 1F
	Wet/Normal	Full	No	2000	2008 + 1F
	Wet	Full	No	2006	2008 + 1F
	Extreme Wet	Full	No	2006	
Average - 2004	Dry	Full	Yes	2008 - 3.6F	2008 + 1F
	Dry/Normal I	Full	Yes	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	Yes	2000	2008 + 1F
	Normal	Full	Yes	2000	2008 + 1F
	Wet/Normal	Full	Yes	2000	2008 + 1F
	Wet	Full	Yes	2006	2008 + 1F
	Extreme Wet	Full	Yes	2006	2008 + 1F

APPENDIX D

Table D-4.3. Continued. Various flow scenarios for which average daily water temperatures in Rush Creek were predicted, including the year and temperature adjustments for which average water temperature data were used for the MGORD site and Lee Vining Creek water delivered via the 5-Siphon Bypass, based on water availability.

Air Temperature	Water Availability	Grant	5-Siphon Bypass flow	MGORD water temperature	5-Siphon (LV) water temperature
Average - 2004	Dry	Empty	No	2008	2008 + 1F
	Dry/Normal I	Empty	No	2008	2008 + 1F
	Dry/Normal II	Empty	No	2000 + 3.6F	2008 + 1F
	Normal	Empty	No	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	No	2000 + 3.6F	2008 + 1F
Average - 2004	Dry	Empty	Yes	2008	2008 + 1F
	Dry/Normal I	Empty	Yes	2008	2008 + 1F
	Dry/Normal II	Empty	Yes	2000 + 3.6F	2008 + 1F
	Normal	Empty	Yes	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	Yes	2000 + 3.6F	2008 + 1F
Global Warming	Dry	Full	No	2008 - 3.6F	2008 + 1F
2008 + 2F	Dry/Normal I	Full	No	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	No	2000	2008 + 1F
	Normal	Full	No	2000	2008 + 1F
	Wet/Normal	Full	No	2000	2008 + 1F
	Wet	Full	No	2006	2008 + 1F
	Extreme Wet	Full	No	2006	2008 + 1F
Global Warming	Dry	Full	Yes	2008 - 3.6F	2008 + 1F
2008 + 2F	Dry/Normal I	Full	Yes	2008 - 3.6F	2008 + 1F
	Dry/Normal II	Full	Yes	2000	2008 + 1F
	Normal	Full	Yes	2000	2008 + 1F
	Wet/Normal	Full	Yes	2000	2008 + 1F
	Wet	Full	Yes	2006	2008 + 1F
	Extreme Wet	Full	Yes	2006	2008 + 1F
Global Warming	Dry	Empty	No	2008	2008 + 1F
2008 + 2F	Dry/Normal I	Empty	No	2008	2008 + 1F
	Dry/Normal II	Empty	No	2000 + 3.6F	2008 + 1F
	Normal	Empty	No	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	No	2000 + 3.6F	2008 + 1F
Global Warming	Dry	Empty	Yes	2008	2008 + 1F
2008 + 2F	Dry/Normal I	Empty	Yes	2008	2008 + 1F
	Dry/Normal II	Empty	Yes	2000 + 3.6F	2008 + 1F
	Normal	Empty	Yes	2000 + 3.6F	2008 + 1F
	Wet/Normal	Empty	Yes	2000 + 3.6F	2008 + 1F

APPENDIX E. NUMBER OF GOOD DAYS AND REFERENCE CONDITION CURVES

The Number of Good Days analysis used **threshold** magnitudes and durations identified for each 'desired ecological outcome' (Synthesis Report Table 3-1) to compute the number of days each ecological outcome was met for each runoff year. As with other analyses in this Report, RYs 1990 to 2008 were examined. The NGD analysis was slightly different for Lee Vining Creek and Rush Creek. For Lee Vining Creek, the analysis was applied to a range of diversion rates (computed for allowable stage change of 0.0 to 0.5 ft with representative XS 6+61 rating curve) to identify a balance between increasing diversion rate with minimizing impacts to ecological outcomes. The analysis used the Lee Vining Creek Runoff unimpaired and Lee Vining Creek above Intake (SCE regulated) annual hydrographs as reference conditions. Reference condition curves were plotted for all runoff years combined (Figure E-1) and for each of five runoff year types (Dry, Dry-Normal, Normal, Wet-Normal, Wet). By contrasting NGDs among different reference (baseline) conditions, the ecological performance (measured in NGD) was evaluated These reference curves were used (in concert with other information) to develop Lee Vining Creek diversion rate recommendations. The NGD (and NGY) results were considered guidelines, not absolute decision-makers for recommending the SEFs.

For Lee Vining Creek, Tables 1-4 (in this Appendix) present the results of NGD analyses for each of four sets of annual hydrographs for RYs 1990 to 2008: (1) Lee Vining Creek Unimpaired, (2) Lee Vining Creek above Intake (SCE Regulated), (3) Lee Vining Creek below Intake (SRF streamflows), and (4) Lee Vining Creek simulated SEF streamflows. The simulated SEF streamflows use the recommended diversion rates and bypass flows presented in the Synthesis Report Chapter 2. Tables 1-4 present NGDs for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Table 3-1 of the Synthesis Report, showing the threshold criteria for each 'desired ecological outcome' therefore, is the centerpiece of the NGD analysis. All computations are derived from the magnitude, duration, timing, and frequency thresholds provided, and these were distilled from 12 years of monitoring, analyses, and field experience. The NGD results tables allow readers to do performance analyses without doing the computations. To compare how well the SEFs perform ecologically relative to the SRFs, NGDs for SEFs and SRFs can be contrasted. SCE's effects on Lower Rush Creek, without LADWP downstream, can be evaluated by comparing NGDs computed from the unimpaired annual hydrographs.

In Rush Creek, the NGD analytical procedure to assess alternative diversion rates was not required. The NGD analysis used threshold criteria for each 'desired ecological outcome' presented in the Synthesis Report Table 3-1, and computed NGDs for the following sets of annual hydrographs for RYs 1990 to 2008:

- Rush Creek unimpaired (at Damsite)
- Rush Creek unimpaired (below the Narrows)
- Rush Creek at Damsite (5013) (SRF streamflows)
- Rush Creek at Damsite plus Parker and Walker creeks below the Conduit (5013+5003+5002) (simulating Rush Creek below the Narrows with a constant full GLR and no SRF flow releases)
- Rush Creek below Narrows actual (SRF below Narrows streamflows)
- Rush Creek recommended SEF streamflows (at Damsite)
- Rush Creek recommended SEF streamflows (below the Narrows)

Tables 5-11 present NGDs for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

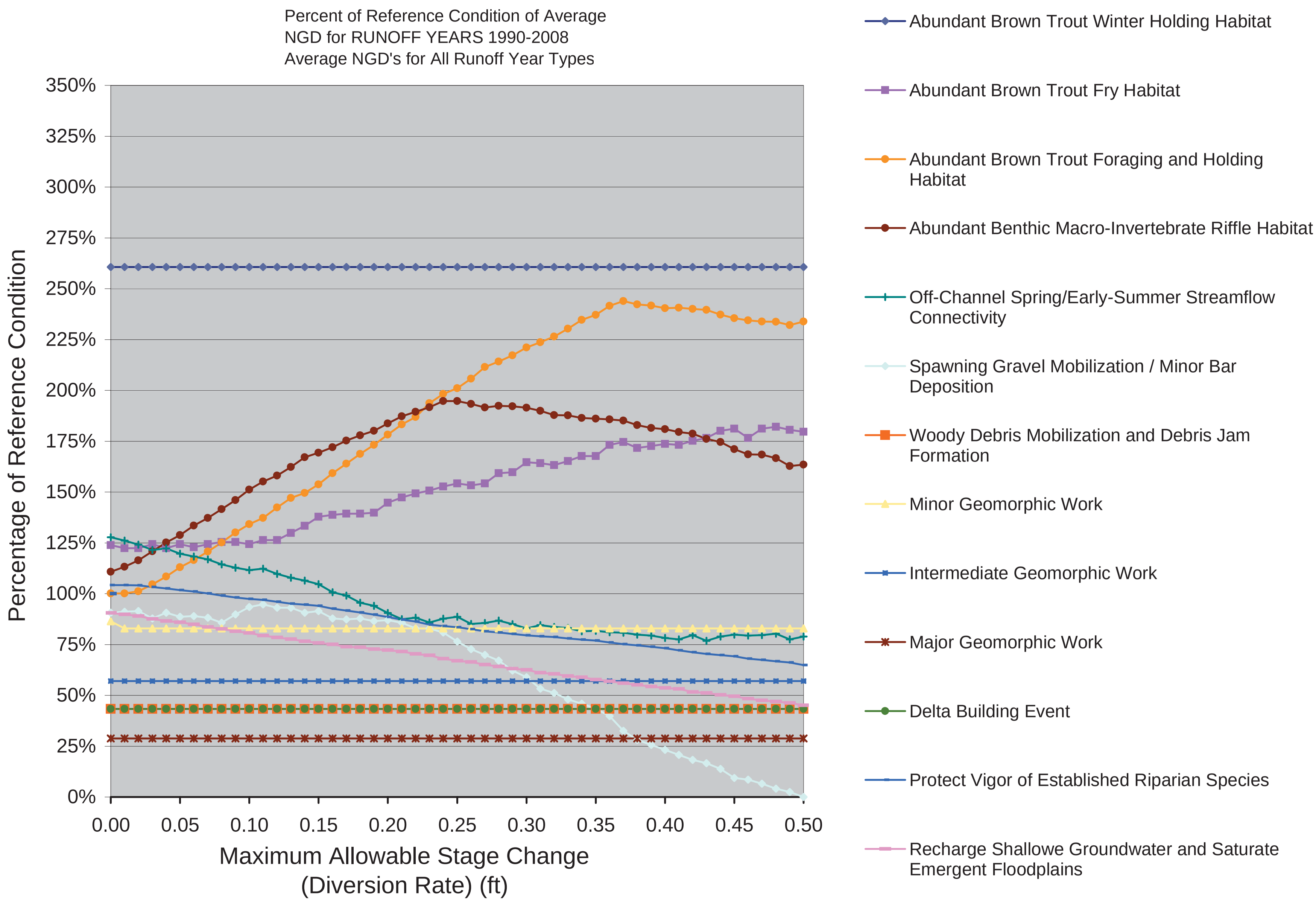


Figure E-1. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for ALL runoff years (1990-2008) combined.

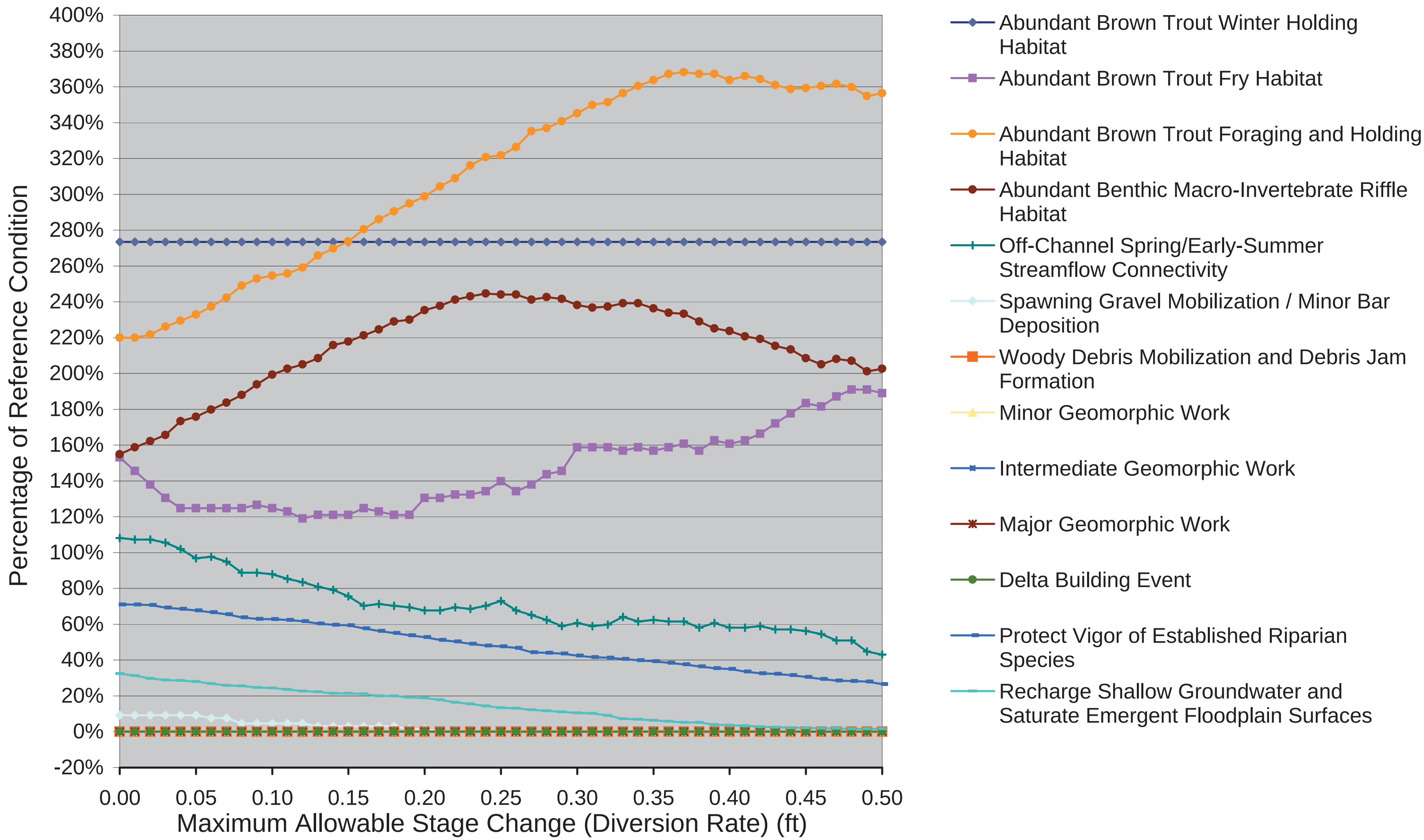


Figure E-2. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for DRY runoff years (1990-2008) combined.

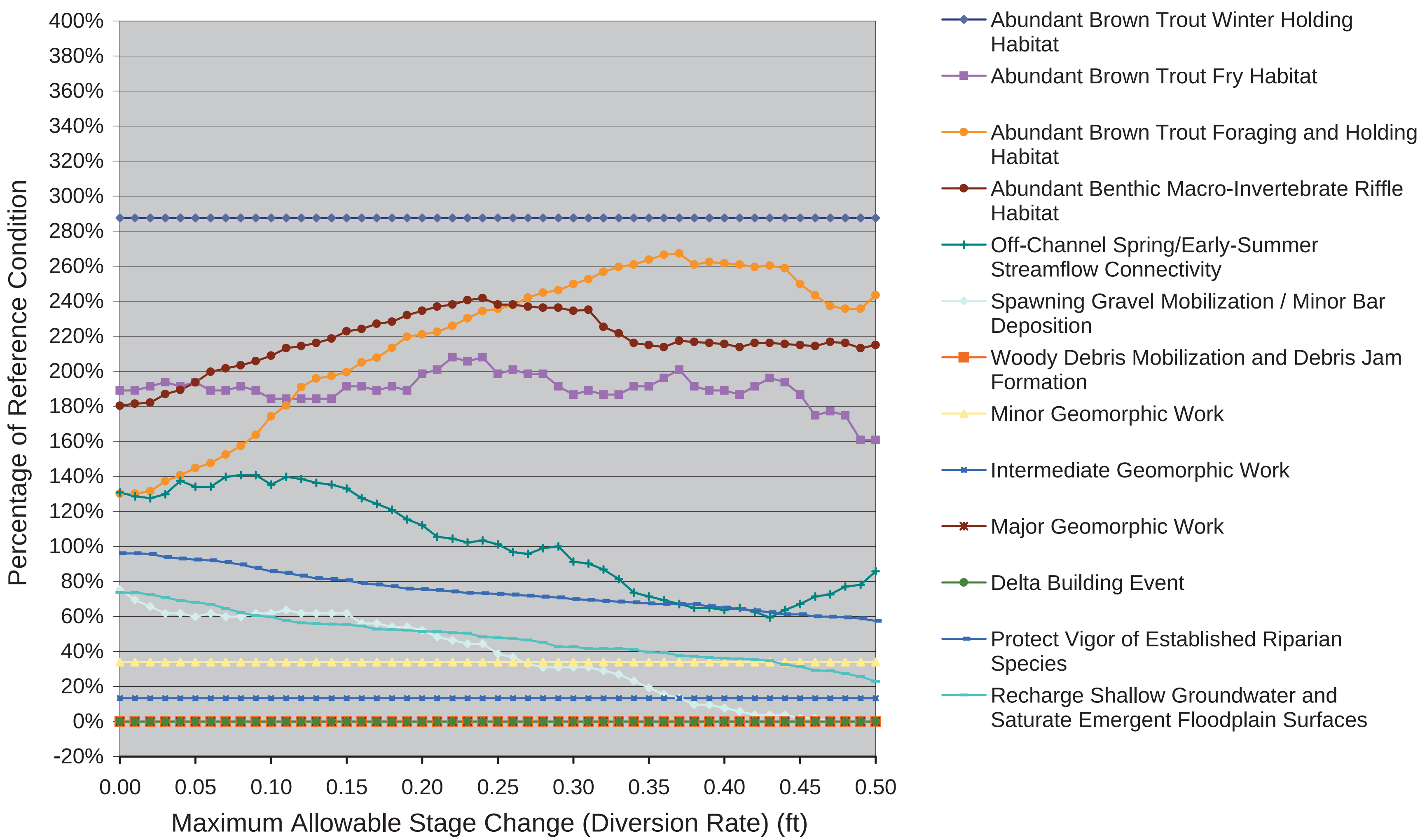


Figure E-3. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for DRY-NORMAL runoff years (1990-2008) combined.

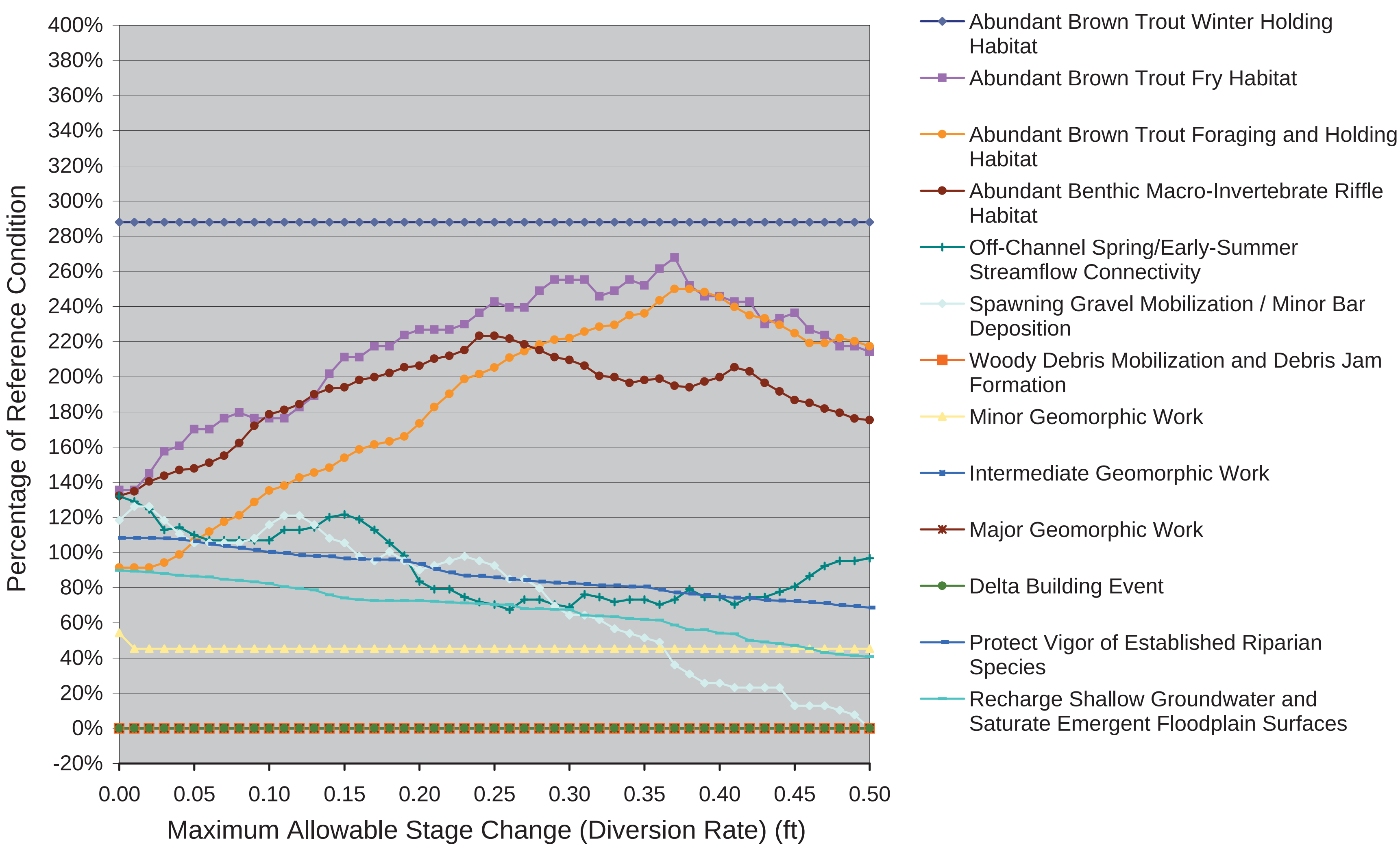


Figure E-4. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for NORMAL runoff years (1990-2008) combined.

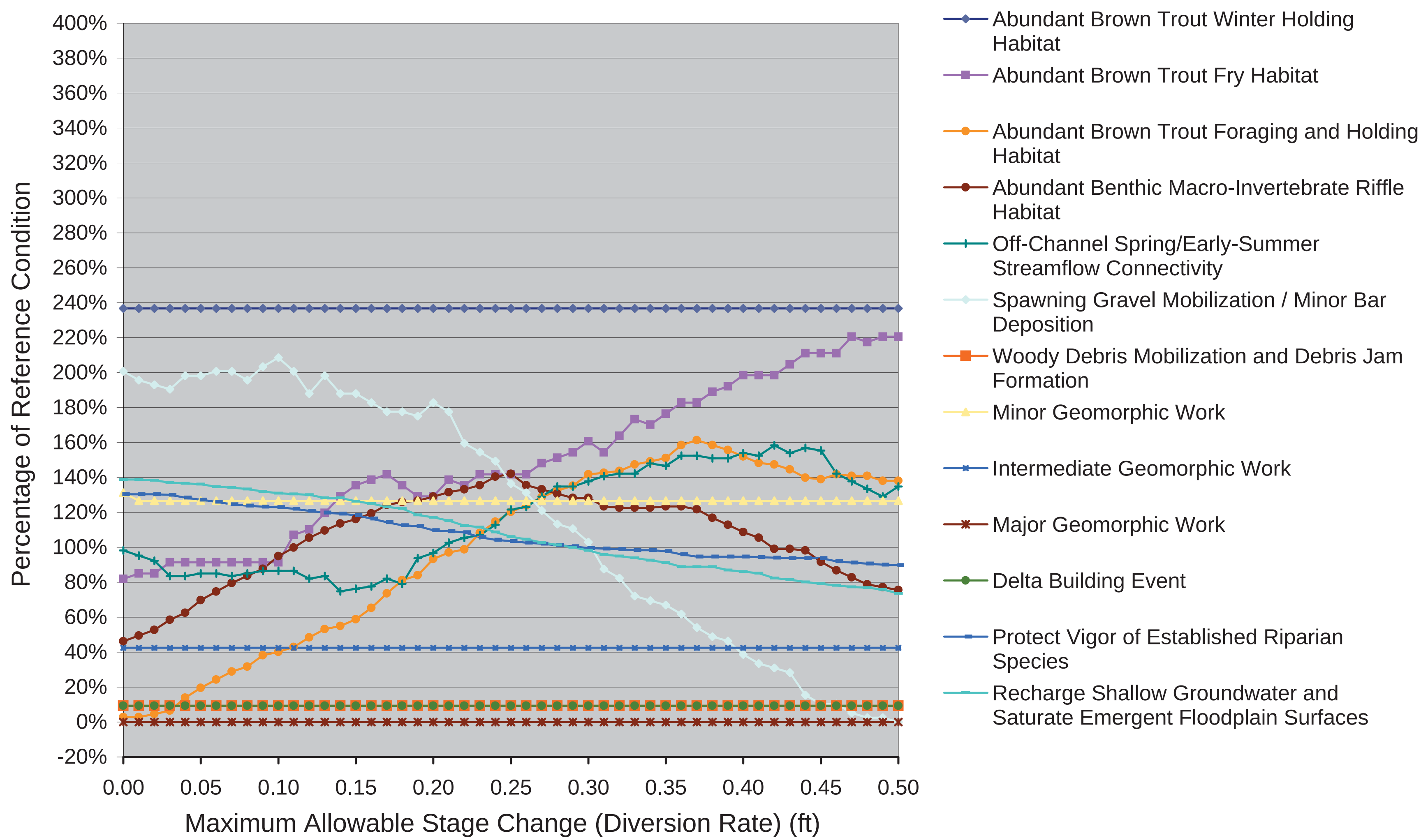


Figure E-5. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for WET-NORMAL runoff years (1990-2008) combined.

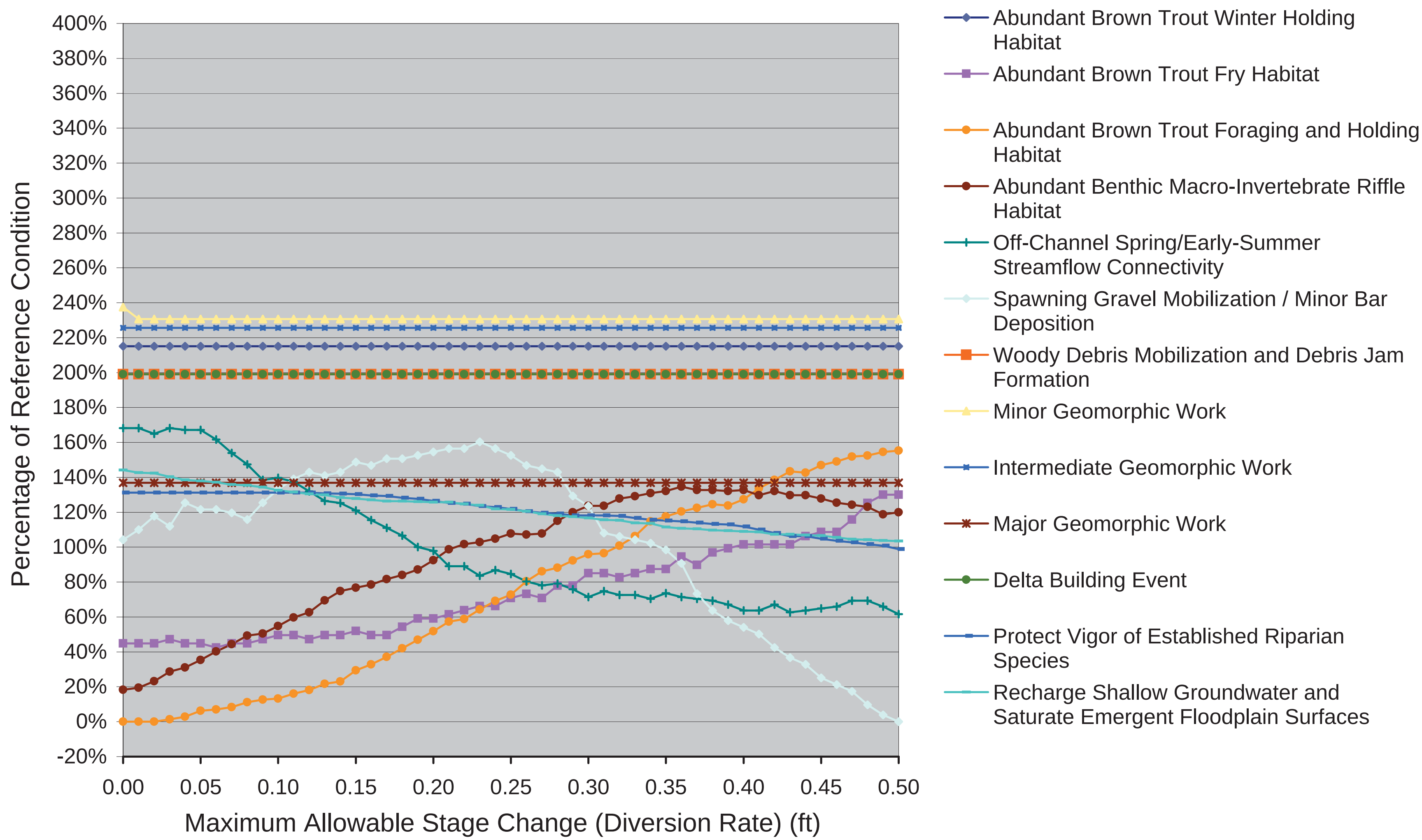


Figure E-6. NGD analysis with Lee Vining Creek unimpaired as reference condition, allowable diversion rates ranging from 0.0 (no diversion) to 0.5 ft stage change (at Lee Vining Creek reference XS 6+61). Average NGDs for WET runoff years (1990-2008) combined.

TABLES 5-11 PRESENT NGDS FOR EACH RUNOFF YEAR, AVERAGES FOR EACH RUNOFF YEAR TYPE, AND AVERAGES FOR ALL RUNOFF YEARS COMBINED.

Table E-1. NGDs for Lee Vining Creek unimpaired RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Average NDGs					
			Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Stream Productivity and Brown Trout Habitat								
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	16-22	44	73	80	75	57	63
Abundant Brown Trout Fry Habitat in Mainstem and along Channel Margin	May 20 to June 30	12-28; 80-150	18	15	6	7	4	11
Abundant Brown Trout Foraging and Holding Habitat	April 1 to September 30	15-30	49	43	43	21	18	36
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	20-38	49	48	47	29	29	41
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	55-80	25	22	25	17	24	23
Geomorphic Thresholds								
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	150-200	6	13	20	22	10	13
General LWD Transport and Debris Jam Formation	April 1 to September 30	>350	0	2	1	5	28	7
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	250-300	1	4	6	15	14	7
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	300-400	0	4	8	13	25	9
Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	400-500	0	1	0	2	12	3
Delta Building Event	April 1 to September 30	>350 for 5+ consec days	0	2	1	5	28	7
Mainstem Channel Avulsion	April 1 to September 30	500+	0	0	0	0	4	1
Riparian Growth and Maintenance								
Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>30	88	109	116	137	146	117
Groundwater and Saturating Emergent Floodplain Surfaces	June 15 to August 26	>80	36	66	70	102	103	72

APPENDIX E

Table E-1. Continued.

Lee Vining Creek Unimpaired

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
15	55	47	99	69	44	41	84	79	90	67	75	64	71	82	51	52	34	82
8	16	17	6	19	9	14	0	7	4	3	10	12	9	28	0	0	28	11
41	67	52	27	35	4	23	12	17	38	39	33	39	58	41	25	26	50	52
43	43	58	39	40	15	30	17	20	51	43	47	33	76	36	40	39	62	48
47	15	17	11	26	27	20	19	34	21	33	20	26	8	34	19	16	19	20
0	12	2	16	12	16	19	30	16	20	13	10	21	5	15	3	4	5	27
0	0	0	1	0	31	11	4	32	1	1	0	0	8	0	18	29	0	0
0	4	0	22	0	14	11	13	2	7	9	3	6	8	0	21	17	0	3
0	0	0	8	0	24	14	16	24	17	6	1	2	13	0	29	24	0	1
0	0	0	0	0	7	3	3	15	0	0	0	0	4	0	7	20	0	0
0	0	0	1	0	31	11	4	32	1	1	0	0	8	0	18	29	0	0
0	0	0	0	0	13	0	0	1	0	0	0	0	0	0	0	1	0	0
86	94	74	138	90	153	131	141	153	131	118	114	106	107	109	137	139	96	98
15	48	35	100	42	112	97	108	100	75	69	47	73	74	69	99	100	39	66

Table E-2. NGDs for Lee Vining Creek above Intake (SCE Regulated) RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Average NDGs: Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Stream Productivity and Brown Trout Habitat								
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	16-22	71	21	28	0	4	28
Abundant Brown Trout Fry Habitat in Mainstem and along Channel Margin	May 20 to June 30	12-28; 80-150	16	20	14	9	5	13
Abundant Brown Trout Foraging and Holding Habitat	April 1 to September 30	15-30	79	47	33	1	0	36
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	20-38	64	74	54	19	8	45
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	55-80	25	30	30	22	38	29
Geomorphic Thresholds								
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	150-200	1	10	15	26	14	12
General LWD Transport and Debris Jam Formation	April 1 to September 30	>350	0	0	0	1	14	3
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	250-300	0	3	4	10	18	6
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	300-400	0	1	0	4	21	5
Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	400-500	0	0	0	0	4	1
Delta Building Event	April 1 to September 30	>350 for 5+ consec days	0	0	0	1	14	3
Mainstem Channel Avulsion	April 1 to September 30	500+	0	0	0	0	0.4	0
Riparian Growth and Maintenance								
Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>30	83	112	126	152	153	122
Groundwater and Saturating Emergent Floodplain Surfaces	June 15 to August 26	>80	23	53	65	100	104	65

Table E-2. Continued.

Lee Vining Creek above Intake

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
128	60	40	0	20	0	0	0	1	0	3	19	32	3	28	4	11	106	82
4	23	15	9	22	10	17	0	9	6	11	12	23	12	33	0	0	17	26
73	98	87	0	64	0	3	0	0	7	26	52	42	54	38	0	0	71	65
54	46	102	32	60	15	25	0	0	44	40	92	50	99	55	10	5	56	79
20	18	23	16	39	29	17	34	56	21	51	21	35	23	40	36	32	23	18
0	6	0	26	0	16	26	26	18	17	19	16	16	6	1	6	14	0	10
0	0	0	0	0	17	0	2	13	0	0	0	0	0	0	5	22	0	0
0	0	0	3	0	15	9	17	10	11	1	0	0	10	0	30	15	0	0
0	0	0	0	0	14	8	4	29	0	0	0	0	5	0	13	29	0	0
0	0	0	0	0	12	0	0	1	0	0	0	0	0	0	0	4	0	0
0	0	0	0	0	17	0	2	13	0	0	0	0	0	0	5	22	0	0
0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
85	85	73	153	81	153	150	153	153	153	127	112	111	110	115	153	153	90	99
7	34	23	95	27	111	99	106	98	75	59	40	59	57	56	96	110	26	60

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Table E-3. NGDs for Lee Vining Creek below Intake (SRF streamflows) RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

			Average NDGs					
Desired Ecological Condition	Date	Flow Range (cfs)	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Stream Productivity and Brown Trout Habitat								
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	16-22	70	27	40	0	9	32
Abundant Brown Trout Fry Habitat in Mainstem and along Channel Margin	May 20 to June 30	12-28; 80-150	9	16	13	13	6	11
Abundant Brown Trout Foraging and Holding Habitat	April 1 to September 30	15-30	70	49	36	4	0	35
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	20-38	62	74	57	21	10	46
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	55-80	17	45	35	21	39	31
Geomorphic Thresholds								
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	150-200	1	8	16	25	16	12
General LWD Transport and Debris Jam Formation	April 1 to September 30	>350	0	0	0	1	14	3
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	250-300	0	1	3	7	17	5
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	300-400	0	0	0	2	19	4
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	400-500	0	0	0	0	4	1
Delta Building Event	April 1 to September 30	>350 for 5+ consec days	0	0	0	1	14	3
Mainstem Channel Avulsion	April 1 to September 30	500+	0	0	0	0	0	0
Riparian Growth and Maintenance								
Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>30	75	109	126	151	153	119
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces	June 15 to August 26	>80	11	36	52	97	99	55

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Table E-3. Continued.

Lee Vining Creek SRF

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
119	65	37	0	18	0	0	0	1	1	14	26	39	4	37	4	29	111	104
1	16	7	17	20	10	21	1	9	7	11	10	24	9	22	6	0	0	20
81	59	84	7	58	0	6	0	0	20	22	52	42	61	42	0	0	68	66
62	49	94	33	47	15	31	0	0	50	41	87	50	99	58	14	9	58	81
5	17	24	21	37	30	13	29	56	21	38	23	34	55	66	41	30	0	47
0	3	0	31	0	16	23	21	18	18	22	15	16	2	0	14	17	0	7
0	0	0	0	0	15	0	2	13	0	0	0	0	0	0	4	22	0	0
0	0	0	0	0	17	8	14	11	8	1	0	0	3	0	23	16	0	0
0	0	0	0	0	17	5	2	26	0	0	0	0	1	0	9	24	0	0
0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	11	0	0
0	0	0	0	0	15	0	2	13	0	0	0	0	0	0	4	22	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	84	55	153	81	153	147	153	153	149	131	112	111	103	111	153	153	92	99
0	24	5	90	26	108	97	104	92	73	55	37	58	21	28	84	110	0	27

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Table E-4. NGDs for Lee Vining Creek recommended SEF streamflows for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Average NDGs					
			Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Stream Productivity and Brown Trout Habitat								
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	16-22	173	182	182	150	136	165
Abundant Brown Trout Fry Habitat in Mainstem and along Channel Margin	May 20 to June 30	12-28; 80-150	10	21	24	14	6	14
Abundant Brown Trout Foraging and Holding Habitat	April 1 to September 30	15-30	81	51	35	7	1	39
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	20-38	97	96	85	53	38	75
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	55-80	15	26	19	22	22	21
Geomorphic Thresholds								
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	150-200	0	7	12	24	20	11
General LWD Transport and Debris Jam Formation	April 1 to September 30	>350	0	0	0	1	14	3
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	250-300	0	3	3	9	17	6
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	300-400	0	1	0	4	21	5
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	400-500	0	0	0	0	4	1
Delta Building Event	April 1 to September 30	>350 for 5+ consec days	0	0	0	1	14	3
Mainstem Channel Avulsion	April 1 to September 30	500+	0	0	0	0	0	0
Riparian Growth and Maintenance								
Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>30	81	108	125	150	153	120
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces	June 15 to August 26	>80	14	37	52	84	91	52

Table E-4. Continued.

Lee Vining Creek SEF

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
158	182	182	151	175	136	149	151	136	182	182	181	182	182	182	136	136	167	182
0	23	5	15	14	11	15	11	13	16	25	14	30	14	25	0	1	7	31
76	99	91	15	68	1	5	0	0	9	28	60	47	55	42	2	0	73	68
119	63	122	71	82	40	60	28	27	87	67	118	84	102	81	47	38	97	100
10	10	22	26	13	16	15	25	33	12	20	17	26	24	35	24	16	22	25
0	1	0	32	0	21	20	19	6	14	16	6	9	12	0	25	28	0	5
0	0	0	0	0	17	0	2	13	0	0	0	0	0	0	5	22	0	0
0	0	0	3	0	15	9	16	9	9	1	0	0	10	0	29	15	0	0
0	0	0	0	0	14	8	4	29	0	0	0	0	5	0	13	29	0	0
0	0	0	0	0	12	0	0	1	0	0	0	0	0	0	0	4	0	0
0	0	0	0	0	17	0	2	13	0	0	0	0	0	0	5	22	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
82	84	71	148	80	153	148	153	153	151	126	106	106	110	111	151	153	90	98
0	29	8	73	18	101	88	92	78	64	54	31	45	39	33	82	101	13	39

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Table E-5. NGDs for Rush Creek unimpaired at Damsite for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Unimpaired at Damsite 1990	1991	1992	1993	1994
Stream Productivity and Trout Habitat							
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	10	15	35	11	64
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	21	59	36	13	34
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	71	40	43	50	45
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	52	27	24	19	23
Geomorphic Thresholds							
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	8	3	15	11	10
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	4	0	21	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	4	0	17	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	4	0	20	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	1	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	2	0	7	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0	0
Riparian Growth and Maintenance							
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	65	67	48	102	48
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	9	21	4	24	1
Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	3	0	22	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	9	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	5	0	22	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	10	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	1	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	5	19	0	22	1
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	4	5	4	22	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	3	0	1	24	0

Table E-5. Continued.

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
58	68	30	50	26	26	24	25	17	39	94	37	24	62
4	19	14	20	35	21	35	43	32	20	15	12	50	37
59	35	49	59	42	44	52	36	58	59	57	58	60	41
31	23	40	39	17	28	16	43	18	35	28	14	28	32
20	27	13	7	12	12	6	10	3	20	5	2	0	12
45	12	8	39	12	10	11	0	17	0	40	39	0	0
13	6	7	1	5	6	6	2	2	0	12	9	0	1
24	10	8	28	12	10	11	0	12	0	32	38	0	0
6	2	0	10	1	0	0	0	3	0	6	1	0	0
35	9	5	32	4	7	4	0	11	0	26	24	0	0
4	0	0	1	0	0	0	0	3	0	2	0	0	0
129	95	95	116	72	80	57	69	60	75	104	100	38	74
19	33	29	17	17	10	5	12	13	10	15	16	2	13
21	9	5	22	12	14	0	0	5	0	21	22	0	3
22	0	0	22	0	0	0	0	0	0	16	11	0	0
24	0	0	15	0	0	0	0	0	0	7	4	0	0
22	18	8	22	14	15	0	0	6	0	22	22	0	5
22	6	0	22	0	0	0	0	0	0	18	19	0	0
24	0	0	16	0	0	0	0	0	0	9	10	0	0
22	22	19	22	22	22	3	13	17	10	22	22	2	16
22	17	16	22	7	1	2	0	1	1	22	22	0	0
24	11	7	24	0	1	0	0	0	0	19	18	0	0

APPENDIX E

Table E-6. NGDs for Rush Creek unimpaired below the Narrows for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Unimpaired Below Narrows 1990	1991	1992	1993	1994	1995
Stream Productivity and Trout Habitat								
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	16	56	55	45	93	102
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	29	62	27	15	37	0
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	61	40	60	57	61	49
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	56	24	18	9	34	37
Geomorphic Thresholds								
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	13	6	14	12	13	7
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	8	0	35	0	61
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	4	0	8	2	3
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	8	0	32	0	27
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	2	0	13
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	6	0	20	0	52
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	1	0	6
Riparian Growth and Maintenance								
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	74	74	58	107	61	141
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	17	26	5	24	2	11
Aggraded Floodplains w/o a Side-Channel								
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	5	0	22	0	22
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	10	0	22
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	1	0	24
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel								
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	9	0	22	0	22
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	1	0	15	0	22
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	6	0	24
Emergent Floodplains and Aggraded Floodplains with Side-Channels								
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	9	22	0	22	3	22
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	7	9	5	22	0	22
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	5	0	2	24	0	24

Table E-6. Continued.

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
53	82	54	59	45	63	40	44	40	80	67	36	70
17	14	3	32	18	32	35	6	15	13	3	40	38
50	44	64	64	52	58	44	87	57	51	62	77	39
28	34	47	5	33	23	40	29	42	38	22	38	30
15	16	12	8	8	9	14	6	18	5	4	3	8
18	14	41	18	15	19	3	20	0	53	52	0	1
6	9	3	5	11	4	1	2	0	8	10	0	3
13	14	10	16	13	15	3	11	0	29	30	0	1
5	1	24	1	2	4	0	4	0	16	21	0	0
13	9	39	12	10	12	0	17	0	45	41	0	0
0	0	7	1	0	0	0	4	0	8	1	0	0
109	105	133	77	90	73	70	81	81	116	117	49	78
23	41	19	17	19	10	26	21	18	20	13	4	25
18	9	22	16	18	0	0	6	0	22	22	0	5
9	0	22	0	0	0	0	0	0	20	21	0	0
0	0	17	0	0	0	0	0	0	11	12	0	0
19	14	22	21	18	0	4	9	3	22	22	0	9
10	1	22	0	0	0	0	0	0	21	22	0	0
1	0	24	0	0	0	0	0	0	14	13	0	0
22	22	22	22	22	7	22	21	16	22	22	4	21
22	22	22	11	14	4	5	6	3	22	22	0	8
19	17	24	2	8	0	0	2	0	24	24	0	0

Table E-7. NGDs for Rush Creek at Damsite (5013) for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek at Damsite 1990	1991	1992	1993
Stream Productivity and Trout Habitat						
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	160	113	91	30
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	3	35	35	0
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	156	134	131	69
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	15	27	24	50
Geomorphic Thresholds						
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0	28
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0
Riparian Growth and Maintenance						
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	2	33	22	149
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	0	0	56
Aggraded Floodplains w/o a Side-Channel						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0	4
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	7
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0	11
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	7
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	1	0	22
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	0	22
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	0	24

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Table E-7. Continued.

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
60	6	15	87	26	64	105	0	4	11	3	8	83	10	62
71	5	0	0	0	36	25	21	45	45	29	6	5	81	72
112	18	103	69	53	61	95	91	129	89	134	79	70	52	98
6	57	103	121	85	68	54	33	6	58	21	47	39	33	28
0	21	13	5	18	6	7	4	0	4	0	5	19	0	0
0	26	0	0	6	0	0	0	0	0	0	0	5	0	0
0	18	0	0	9	0	0	0	0	0	0	9	29	0	0
0	25	0	0	6	0	0	0	0	0	0	0	5	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	153	151	153	148	86	75	51	18	79	34	122	118	35	38
0	18	15	49	45	31	24	2	0	22	0	17	16	0	7
0	22	5	0	0	0	9	0	0	3	0	22	22	0	0
0	22	0	0	20	0	0	0	0	0	0	17	13	0	0
0	24	0	0	16	0	0	0	0	0	0	9	4	0	0
0	22	6	0	20	0	12	0	0	6	0	22	22	0	0
0	22	0	0	22	0	0	0	0	0	0	19	13	0	0
0	24	0	0	16	0	0	0	0	0	0	10	4	0	0
0	22	15	17	22	21	22	0	0	22	0	22	22	0	7
0	22	6	19	22	11	11	2	0	4	0	22	22	0	0
0	24	4	18	24	2	2	0	0	0	0	24	20	0	0

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Table E-8. NGDs for Rush Creek at Damsite plus Parker and Walker creek below the Conduit for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek at Damsite 1990	1991	1992
Stream Productivity and Trout Habitat					
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	181	176	166
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	155	0	0
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	9	140	138
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	0	0	0
Geomorphic Thresholds					
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0
Riparian Growth and Maintenance					
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	0	0	0
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	0	0
Aggraded Floodplains w/o a Side-Channel					
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel					
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels					
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	0	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	0

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Table E-8. Continued.

+ Parker&Walker below Conduit

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	128	0	0	0	0	0	0	0	0	0	0	0	0	178	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	134	92	127	132	108	144	136	138	153	148	157	94	95	153	142
13	0	142	26	33	66	21	29	39	21	16	16	78	68	0	17
6	0	0	7	6	6	7	7	7	8	7	11	4	5	0	6
0	0	0	3	0	18	1	1	0	0	0	0	17	17	0	0
5	0	0	12	5	3	4	4	0	0	0	0	3	4	0	5
0	0	0	3	0	18	1	1	0	0	0	0	18	18	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	9	0	0	0	0	0	0	16	6	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	153	71	80	153	61	66	63	42	50	38	140	142	0	54
19	0	62	22	21	24	14	15	10	18	10	15	20	17	0	15
10	0	0	10	10	13	16	16	5	0	6	0	12	13	0	15
12	0	0	12	12	18	4	3	0	0	0	0	18	18	0	4
3	0	0	3	3	9	0	0	0	0	0	0	9	9	0	0
12	0	0	13	14	15	18	19	9	7	9	7	14	17	0	17
13	0	0	14	14	20	6	5	0	0	0	0	20	20	0	5
4	0	0	5	5	11	0	0	0	0	0	0	11	11	0	0
21	0	18	22	22	22	22	22	16	18	17	16	22	22	0	22
20	0	22	22	22	22	13	13	0	0	0	0	22	22	0	12
11	0	24	13	13	23	4	4	0	0	0	0	19	18	0	3

Table E-9. NGDs for Rush Creek below the Narrows (SRF streamflows) for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek below Narrows Actual 1990	1991	1992	1993	1994
Stream Productivity and Trout Habitat							
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	165	3	2	0	97
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	0	29	1	0	0
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	102	123	164	51	178
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	153	38	77	80	28
Geomorphic Thresholds							
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0	18	0
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0	0	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0	0
Riparian Growth and Maintenance							
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	123	44	92	153	50
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	16	5	73	2
Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0	0	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	0	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0	0	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	0	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	16	4	22	2
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	1	22	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	1	24	0

Table E-9. Continued.

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0	0	1	0	27	157	118
0	0	0	0	0	0	0	0	0	0	0	0	2	3
16	31	80	83	148	146	143	172	161	160	98	79	174	144
71	71	60	29	47	47	39	26	18	9	30	30	0	21
50	24	30	11	13	4	2	5	4	5	16	6	0	4
15	0	0	22	0	0	0	0	0	0	8	42	0	0
2	0	0	2	0	0	0	0	0	0	3	5	0	5
13	0	0	20	0	0	0	0	0	0	8	42	0	0
3	0	0	2	0	0	0	0	0	0	0	0	0	0
11	0	0	19	0	0	0	0	0	0	0	31	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	153	130	117	84	68	66	48	57	30	101	128	0	59
45	64	63	25	30	27	10	0	0	10	22	12	0	11
5	10	0	20	0	0	0	0	0	0	16	22	0	6
7	0	0	22	0	0	0	0	0	0	19	22	0	0
18	0	0	19	0	0	0	0	0	0	10	17	0	0
12	16	0	21	1	4	0	0	0	3	22	22	0	8
20	0	0	22	7	0	0	0	0	0	22	22	0	0
24	0	0	22	0	0	0	0	0	0	15	19	0	0
22	22	22	22	14	16	11	1	0	10	22	22	0	17
22	22	22	22	16	11	0	0	0	0	22	22	0	0
24	24	24	24	7	3	0	0	0	0	24	24	0	0

Table E-10. NGDs for Rush Creek recommended SEF streamflows for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Recommended SEF 1990	1991	1992	1993	1994
Stream Productivity and Trout Habitat							
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	181	181	181	181	181
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	95	95	95	0	95
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	84	84	84	127	84
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	0	0	0	46	0
Geomorphic Thresholds							
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0	5	0
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0	0	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0	0
Riparian Growth and Maintenance							
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	0	0	0	74	0
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	0	0	40	0
Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0	6	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	2	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0	8	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	5	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	0	0	16	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	0	22	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	0	22	0

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Table E-10. Continued.

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
181	181	181	181	181	181	181	181	181	181	181	181	181	181
0	0	0	0	0	0	0	0	0	0	0	0	95	0
130	127	127	138	141	141	170	183	170	183	138	138	84	141
74	46	46	70	40	40	47	42	47	42	70	70	0	40
5	5	5	4	4	4	3	0	3	0	4	4	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	74	74	104	65	65	62	51	62	51	104	104	0	65
28	40	40	33	23	23	6	0	6	0	33	33	0	23
0	6	6	0	8	8	0	0	0	0	0	0	0	8
14	2	2	10	0	0	0	0	0	0	10	10	0	0
7	0	0	1	0	0	0	0	0	0	1	1	0	0
0	8	8	2	12	12	0	0	0	0	2	2	0	12
17	5	5	13	0	0	0	0	0	0	13	13	0	0
8	0	0	4	0	0	0	0	0	0	4	4	0	0
6	16	16	9	22	22	7	0	7	0	9	9	0	22
22	22	22	22	9	9	0	0	0	0	22	22	0	9
24	22	22	24	0	0	0	0	0	0	24	24	0	0

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Table E-11. NGDs for Rush Creek recommended SEF streamflows plus Parker and Walker creeks above the Conduit for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Recommended SEF +P&W 1990	1991	1992	1993	1994
Stream Productivity and Trout Habitat							
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	181	181	181	180	167
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	77	2	0	0	0
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	84	141	132	113	126
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	0	32	24	46	39
Geomorphic Thresholds							
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0	5	0
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0	4	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0	0
Riparian Growth and Maintenance							
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	0	47	55	88	55
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	0	0	33	0
Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0	8	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	3	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0	9	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	5	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels							
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	0	0	22	0
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	0	22	0
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	0	14	0

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Table E-11. Continued.

below Conduit													
1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
153	81	178	163	178	174	181	179	181	181	174	181	181	181
0	0	0	0	0	0	0	0	0	0	0	0	1	3
83	109	105	112	130	121	121	121	133	131	89	86	139	87
50	44	52	49	40	53	50	56	24	59	38	33	35	52
9	16	10	14	4	3	5	0	5	0	24	11	0	4
6	1	0	5	1	1	0	0	0	0	6	5	0	0
5	5	5	1	4	4	0	0	0	0	2	1	0	4
6	1	0	5	1	1	0	0	0	0	6	5	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	98	97	113	76	82	62	64	46	66	111	113	54	76
24	36	35	45	24	24	9	19	11	12	44	41	0	23
13	8	8	1	11	10	0	0	0	0	2	4	0	10
22	4	3	16	0	0	0	0	0	0	14	13	0	0
24	0	0	7	0	0	0	0	0	0	5	4	0	0
16	9	9	18	14	13	1	0	2	0	11	18	0	12
22	7	5	22	0	0	0	0	0	0	22	22	0	0
24	0	0	17	0	0	0	0	0	0	16	17	0	0
22	22	22	22	22	22	10	20	10	12	22	22	0	22
22	22	22	22	14	13	0	0	0	0	22	22	0	12
24	18	16	24	5	4	0	0	0	0	24	24	0	3

Table E-12. NGDs for Rush Creek recommended SEF streamflows, with simulated spills, plus Parker and Walker creeks above the Conduit for RYs 1990-2008, computed for each runoff year, averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Recommended 1990	1991	1992	1993
Stream Productivity and Trout Habitat						
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	181	181	181	181
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	103	103	103	35
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	75	75	75	101
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	0	0	0	31
Geomorphic Thresholds						
Spawning Gravel Mobilization in Pool Tails / Minor Bar Deposition	April 1 to September 30	200-250	0	0	0	4
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	0	0	0	0
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	0	0	0	0
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	0	0	0	0
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	0	0	0
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	0	0	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	0	0	0
Riparian Growth and Maintenance						
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	0	0	0	51
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	0	0	0	32
Aggraded Floodplains w/o a Side-Channel						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	0	0	0	7
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	2
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	0
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	0	0	0	8
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	3
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	0
Emergent Floodplains and Aggraded Floodplains with Side-Channels						
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	0	0	0	20
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	0	0	0	21
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	0	0	0	12

APPENDIX E

Table E-12. Continued.

SEF with Simulated Spills (Pre-Transition)

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
181	0	9	126	45	97	104	110	160	113	99	25	96	181	0
103	0	35	14	0	50	50	74	69	29	69	11	11	86	0
75	55	52	75	76	91	80	75	111	118	111	75	68	74	0
0	39	39	46	83	37	36	13	9	22	1	23	20	31	0
0	17	15	4	24	4	5	9	0	10	0	14	21	0	0
0	17	0	0	0	0	0	0	0	0	0	0	1	0	0
0	23	0	0	9	0	1	0	0	0	0	9	31	0	0
0	17	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	140	93	97	153	55	63	35	31	40	0	101	112	34	0
0	16	29	33	43	22	19	4	0	20	0	17	19	0	0
0	22	11	7	0	8	11	0	0	0	0	22	22	0	0
0	22	2	2	21	0	0	0	0	0	0	15	13	0	0
0	24	0	0	17	0	0	0	0	0	0	6	4	0	0
0	22	13	8	5	10	13	0	0	3	0	22	22	0	0
0	22	3	3	22	0	0	0	0	0	0	21	15	0	0
0	24	0	0	18	0	0	0	0	0	0	12	6	0	0
0	22	22	22	22	21	22	5	0	21	0	22	22	0	0
0	22	21	21	22	0	9	0	0	0	0	22	22	0	0
0	24	12	12	24	0	0	0	0	0	0	23	23	0	0

Table E-13. Summary of NGDs for Rush Creek for each of the hydrology data sets, with averages for each runoff year type, and averages for all runoff years combined.

Desired Ecological Condition	Date	Flow Range (cfs)	Rush Creek Unimpaired at Damsite: Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Rush Creek Unimpaired Below Narrows: Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Stream Productivity and Trout Habitat														
Abundant Brown Trout Winter Holding Habitat	October 1 to March 31	25-45	71	68	70	82	73	73	99	87	96	105	83	0
Abundant Brown Trout Foraging and Holding Habitat Spring through Early-Fall	April 1 to September 30	15-35	24	25	23	12	15	20	29	20	20	10	5	18
Abundant Productive Benthic Macro-Invertebrate Riffle Habitat	April 1 to September 30	40-110	52	51	42	48	58	50	60	62	52	50	57	57
Off-Channel Spring/Early-Summer Streamflow Connectivity	April 1 to July 30	90-160	31	28	26	28	27	28	34	34	23	24	36	31
Geomorphic Thresholds														
Spawning Gravel Mobilization in Pool Tails / Minor Bar Depositior	April 1 to September 30	200-250	7	10	12	18	5	10	10	12	8	14	7	10
General LWD Transport and Debris Jam Formation	April 1 to September 30	>450	1	7	7	22	39	14	2	11	11	22	52	19
Emergent Floodplain Deposition / Channel Maintenance / Significant Fine Bed Material Transport / Point Bar Extension / Minor Riffle Mobilization	April 1 to September 30	400-450	1	3	4	11	7	5	1	2	6	8	6	4
Intermediate Floodplain Deposition / Bar Formation / Significant Coarse Bed Material Transport / Deep Pool Scour / Coarse Riffle Mobilization	April 1 to September 30	450-600	1	6	7	16	33	11	2	7	10	20	24	12
Advanced Floodplain Deposition / Prominent Bar Formation / Significant Side Channel Entrance Alteration	April 1 to September 30	600-700	0	1	0	2	6	2	0	2	1	3	19	5
Delta Building Event	April 1 to September 30	>500 for 5+ consec days	0	4	4	14	27	9	1	7	7	14	44	0
Mainstem Channel Avulsion	April 1 to September 30	700-800	0	1	0	1	1	1	0	1	0	0	6	0
Riparian Growth and Maintenance														
Protect Vigor of Established Riparian Species along the Mainstem and Side-Channel Margins as well as on the Floodplain	May 1 to September 30	>80	53	65	75	105	107	79	61	76	82	107	127	89
Minimum Streamflows Recharging Shallow Groundwater and Saturating Emergent Floodplain Surfaces for Willows and Black Cottonwood : 120 cfs to 275 cfs	June 15 to August 26	120-275	7	10	13	26	16	14	11	19	20	29	16	18
Aggraded Floodplains w/o a Side-Channel														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>275	1	1	10	14	22	8	1	2	13	16	22	10
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>275	0	0	0	8	16	4	0	0	0	6	21	5
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>275	0	0	0	6	9	3	0	0	0	0	16	3
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>230	1	2	11	18	22	10	2	4	16	18	22	11
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>230	0	0	0	10	20	5	0	0	0	9	22	6
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>230	0	0	0	6	12	3	0	0	0	2	19	4
Emergent Floodplains and Aggraded Floodplains with Side-Channels														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 5	>120	5	11	20	21	22	15	8	17	22	22	22	17
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to July 27	>120	3	1	3	19	22	9	4	5	11	22	22	12
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 7	>120	1	0	0	17	20	7	1	1	3	20	24	9
Aggraded Floodplains w/o a Side-Channel (NGY)														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 26	>275	1	1	10	22	38	12	1	2	13	23	43	15
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to August 17	>275	0	0	0	11	17	5	0	0	0	6	26	7
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 26	>275	0	0	0	6	9	3	0	0	0	0	18	4
Interfluves/Depressions within Aggraded Floodplains w/o a Side-Channel (NGY)														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 26	>230	1	2	11	27	41	15	2	4	16	27	43	17
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to August 17	>230	0	0	0	13	21	6	0	0	0	9	31	8
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 26	>230	0	0	0	8	12	3	0	0	0	2	23	5
Emergent Floodplains and Aggraded Floodplains with Side-Channels (NGY)														
Number of Days that a yellow willow seed could land a moist surface and germinate	June 14 to July 26	>120	8	12	23	40	43	23	12	21	33	43	43	29
Number of Days that a black cottonwood seed could land on a moist surface and germinate	July 6 to August 17	>120	3	1	3	28	33	12	4	5	11	30	40	17
Number of Days that a narrowleaf willow seed could land on a moist surface and germinate	July 15 to August 26	>120	1	0	0	21	24	8	1	1	3	21	34	11

APPENDIX E

Table E-13. Continued.

Rush Creek at Damsite						Rush Creek at Damsite + Parker&Walker below Conduit						Rush Creek below Narrows Actual						Rush Creek Recommended SEF (w/spills)						Rush Creek Recommended SEF (w/spills) +P&W below Conduit					
Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
51	0	49	3	10	0	0	0	0	0	0	0	45	0	9	0	0	0	181	181	181	181	181	0	156	151	137	90	51	119
32	36	38	0	7	23	77	0	0	0	0	20	17	1	2	0	0	5	109	115	85	70	56	89	77	38	30	10	7	36
117	111	85	80	55	92	115	149	141	133	102	126	148	159	146	54	69	119	75	102	98	101	102	94	111	112	104	102	89	104
21	30	50	91	57	46	0	23	22	24	81	29	59	23	38	70	40	46	0	2	22	28	19	12	26	40	48	47	43	39
0	2	4	15	16	7	0	7	7	6	4	4	0	4	7	24	21	10	0	6	4	3	12	5	0	5	4	9	13	6
0	0	0	0	9	2	0	0	1	1	12	3	0	0	0	0	22	5	0	0	0	4	7	2	0	0	1	6	10	3
0	0	0	0	16	3	0	0	4	7	2	2	0	0	2	0	3	1	0	0	0	3	2	1	0	0	4	1	2	1
0	0	0	0	9	2	0	0	1	1	13	3	0	0	0	0	21	4	0	0	0	4	3	1	0	0	1	6	4	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	1	0	0	0	1	2	0
0	0	0	0	2	0	0	0	0	0	4	0	0	0	0	0	15	0	0	0	0	3	7	0	0	0	0	4	9	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	1
21	46	66	151	135	78	0	49	60	71	136	60	47	50	70	145	125	87	0	8	39	51	64	29	53	54	78	94	115	74
0	6	21	40	24	0	0	13	15	21	31	0	5	5	23	67	26	0	0	4	22	29	40	0	0	11	24	31	34	18
0	1	3	3	17	5	0	3	16	10	9	7	0	0	2	3	16	4	0	0	8	8	2	3	0	0	10	9	7	5
0	0	0	2	18	4	0	0	4	12	13	5	0	0	0	0	18	4	0	0	0	4	11	3	0	0	0	6	16	4
0	0	0	0	13	3	0	0	0	3	6	2	0	0	0	0	16	3	0	0	0	0	4	1	0	0	0	0	10	2
0	2	4	6	22	6	0	8	18	13	11	9	0	1	4	5	19	6	0	0	10	9	3	4	0	5	13	10	16	8
0	0	0	2	19	4	0	0	5	14	15	6	0	0	2	0	22	5	0	0	0	6	12	4	0	0	0	8	21	6
0	0	0	0	14	3	0	0	0	5	8	2	0	0	0	0	20	4	0	0	0	0	5	1	0	0	0	0	17	4
0	6	17	18	22	11	0	17	22	22	21	15	4	6	16	22	22	13	0	5	16	20	20	11	0	11	22	22	22	14
0	2	7	16	22	9	0	0	13	21	22	10	0	0	9	22	22	10	0	0	0	21	22	8	0	0	13	22	22	10
0	0	1	15	23	7	0	0	4	12	20	7	0	0	3	24	24	9	0	0	0	12	21	6	0	0	4	16	23	8
0	1	3	5	34	9	0	3	19	22	22	12	0	0	2	3	33	8	0	0	8	12	13	6	0	0	10	15	23	9
0	0	0	2	22	5	0	0	4	12	13	5	0	0	0	0	24	5	0	0	0	4	11	3	0	0	0	6	19	5
0	0	0	0	14	3	0	0	0	3	6	2	0	0	0	0	17	4	0	0	0	0	4	1	0	0	0	0	10	2
0	2	4	8	40	11	0	8	23	27	26	15	0	1	7	5	40	10	0	0	10	15	15	7	0	5	13	18	36	13
0	0	0	2	24	5	0	0	5	14	15	6	0	0	2	0	31	7	0	0	0	6	12	4	0	0	0	8	27	7
0	0	0	0	15	3	0	0	0	5	8	2	0	0	0	0	23	5	0	0	0	0	5	1	0	0	0	0	18	4
0	7	24	33	43	20	0	17	35	42	42	25	5	6	25	43	43	22	0	5	16	41	41	19	0	11	35	43	43	24
0	2	7	26	37	13	0	0	13	21	31	12	0	0	9	43	40	17	0	0	0	21	32	10	0	0	13	25	37	14
0	0	1	22	32	10	0	0	4	12	23	7	0	0	3	40	36	14	0	0	0	12	24	7	0	0	4	16	31	10

APPENDIX E

APPENDIX F. GRANT LAKE RESERVOIR MODELING SCENARIOS

The spreadsheet model developed for the Synthesis Report analyses is described in Report Section 3.4 and Section 6. Each scenario provided an output of daily average Grant Lake Reservoir (GLR) storage (in acre-feet [af]) for the 19 year period of analysis (RYs 1990 to 2008). These output data were used to compute the NGDs for each runoff year in which GLR storage volume was exceeded, for each modeled scenario. The NGDs are compiled in Table E-1.

The output GLR storage chart is presented in this Appendix for each of the following scenarios:

Scenario 1a: Actual Historical Conditions

Scenario 1b: Predicted Historical Conditions

Scenario 2: Historical Rush Creek and Exports; Lee Vining Creek SEF streamflows

Scenario 3: Historical Exports; Rush and Lee Vining SEF streamflows

Scenario 4: Rush and Lee Vining SEF streamflows; 16,000 af Export; No Export Curtailment

Scenario 5: Rush and Lee Vining SEF streamflows; 16,000 af Export; 3 Month curtailment

Scenario 6: Rush and Lee Vining SEF streamflows; 16,000 af Export; 3 Month curtailment; Change RY2008 to Dry-Normal I [BASELINE SCENARIO]

Scenario 10: BASELINE SCENARIO + Export Remaining Yield from Each Runoff Year (~30,000 af)

Scenario 11: BASELINE SCENARIO + Export Remaining Yield from Each Runoff Year (~30,000 af); constrain RY1995 to 10,000 af export.

Table F-1. NGD computations for different Grant Lake Reservoir storage volumes for each modeled scenario.

	Scenario 1a: Actual Historical Conditions Average NGDs						Scenario 1b: Predicted Historical Conditions Average NGDs						Scenario 2: Historical Rush Creek and Exports; Lee Vining Creek SEF Average NGDs						Scenario 3: Historical Exports; Rush and Lee Vining SEFs Average NGDs					
	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
Number of Days Grant Lake Elevation below 7,090 ft	94	0	45	0	0	32	0	0	29	0	0	5	2	0	0	0	0	1	0	0	21	0	0	3
Number of Days Grant Lake Elevation above 7,090 ft	271	365	320	365	365	333	365	365	336	365	365	360	363	365	365	365	365	364	365	365	344	365	365	362
Number of Days Grant Lake Elevation above 7,100 ft	121	310	268	341	353	268	215	348	282	356	365	307	274	365	314	365	365	333	365	365	274	365	365	351
Number of Days Grant Lake Elevation above 7,110 ft	49	172	243	270	330	200	82	236	243	297	331	226	172	365	256	352	365	295	355	365	243	365	365	343
Number of Days Grant Lake Elevation above 7,120 ft	15	37	232	243	312	152	45	48	220	238	322	162	66	365	243	317	365	260	244	365	243	365	365	314
Number of Days Grant Lake Elevation above 7,130 ft (Spillway Elevation)	0	0	21	70	65	28	0	0	11	71	92	32	5	19	49	144	211	80	103	144	106	279	333	188
Peak Discharge below MGORD (cfs)	102	219	264	225	492	254	116	218	256	241	464	253	128	233	297	231	485	268	112	192	392	421	489	301

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Table F-1. Continued. NGD computations for different Grant Lake Reservoir storage volumes for each modeled scenario.

Scenario 4: Rush and Lee Vining SEFs; 16K Export; NO Curtailment — Average NGDs						Scenario 5: Rush and Lee Vining SEFs; 16K Export; 3 Month curtailment — Average NGDs						Scenario 6: Rush and Lee Vining SEFs; 16K Export; Change RY2008 to DN-I — Average NGDs						Scenario 10: BASELINE + Export Excess from Each Runoff Year (~30,000 af) — Average NGDs						Scenario 11: Baseline + Export Excess from Each Runoff Year (~30,000 af); RY1995 10,000 af export — Average NGDs					
Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years	Dry	Dry-Normal	Normal	Wet-Normal	Wet/Extreme-Wet	All Runoff Years
0	0	30	0	0	5	0	0	28	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
365	365	335	365	365	360	365	365	337	365	365	361	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
216	365	274	354	365	310	243	365	279	354	365	318	243	365	365	354	365	331	287	365	365	316	350	334	287	365	365	362	365	344
141	365	243	342	365	283	154	365	243	344	365	287	154	365	261	344	365	290	80	65	345	126	284	169	80	365	365	285	350	274
111	365	243	313	365	271	117	365	243	324	365	274	117	365	243	324	365	274	7	0	4	0	86	20	7	99	229	203	300	154
12	201	111	157	321	156	14	187	108	155	304	148	14	187	108	155	304	148	0	0	0	0	6	1	0	0	0	35	109	28
82	170	387	409	472	283	91	191	392	405	492	294	91	191	292	405	492	278	70	140	280	380	392	235	70	140	320	380	428	248

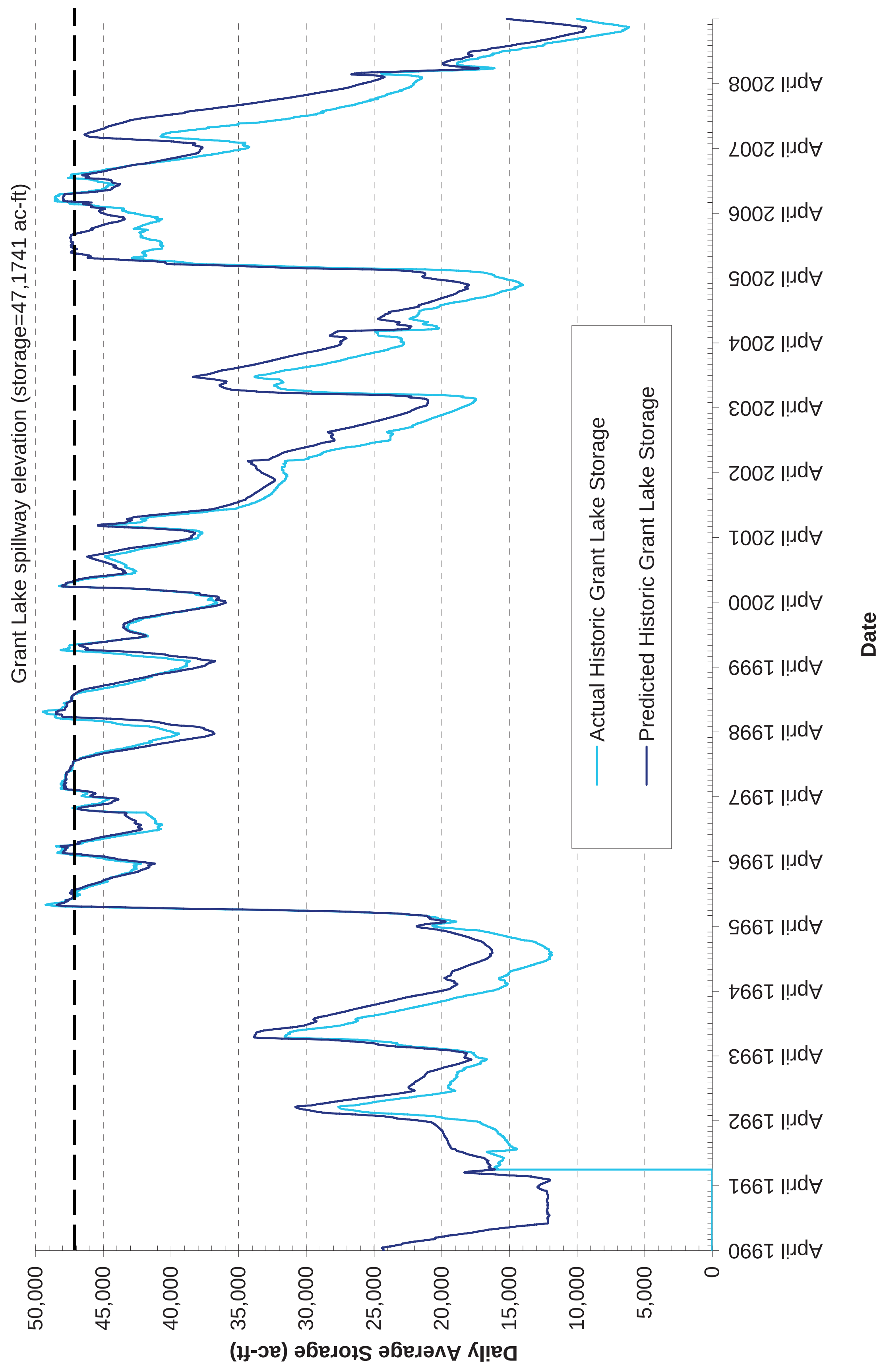

Figure F-1. Scenario 1: Actual and predicted historical conditions.

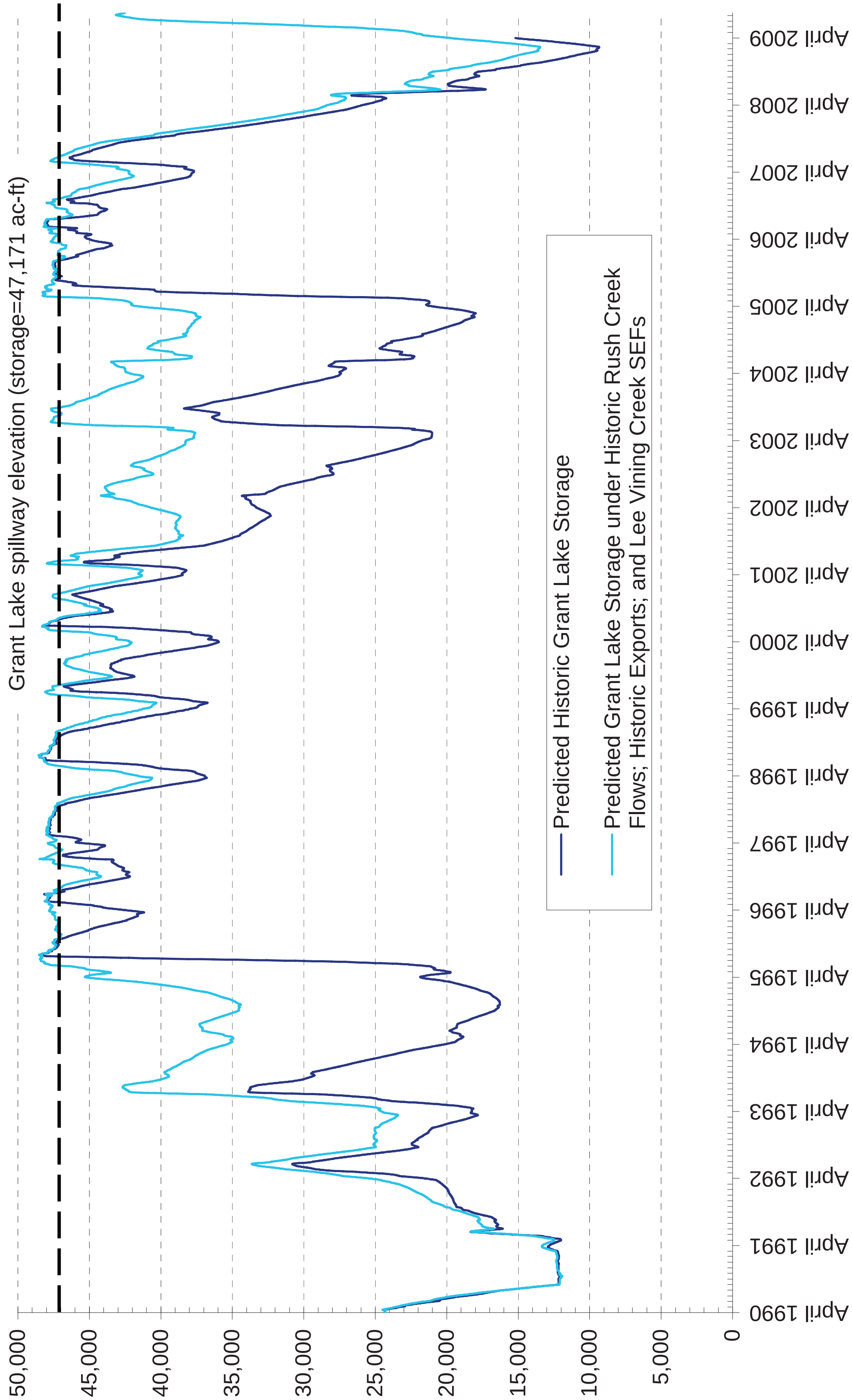

Figure F-2. Scenario 2: Historical Rush Creek and Exports; Lee Vining Creek SEF streamflows.

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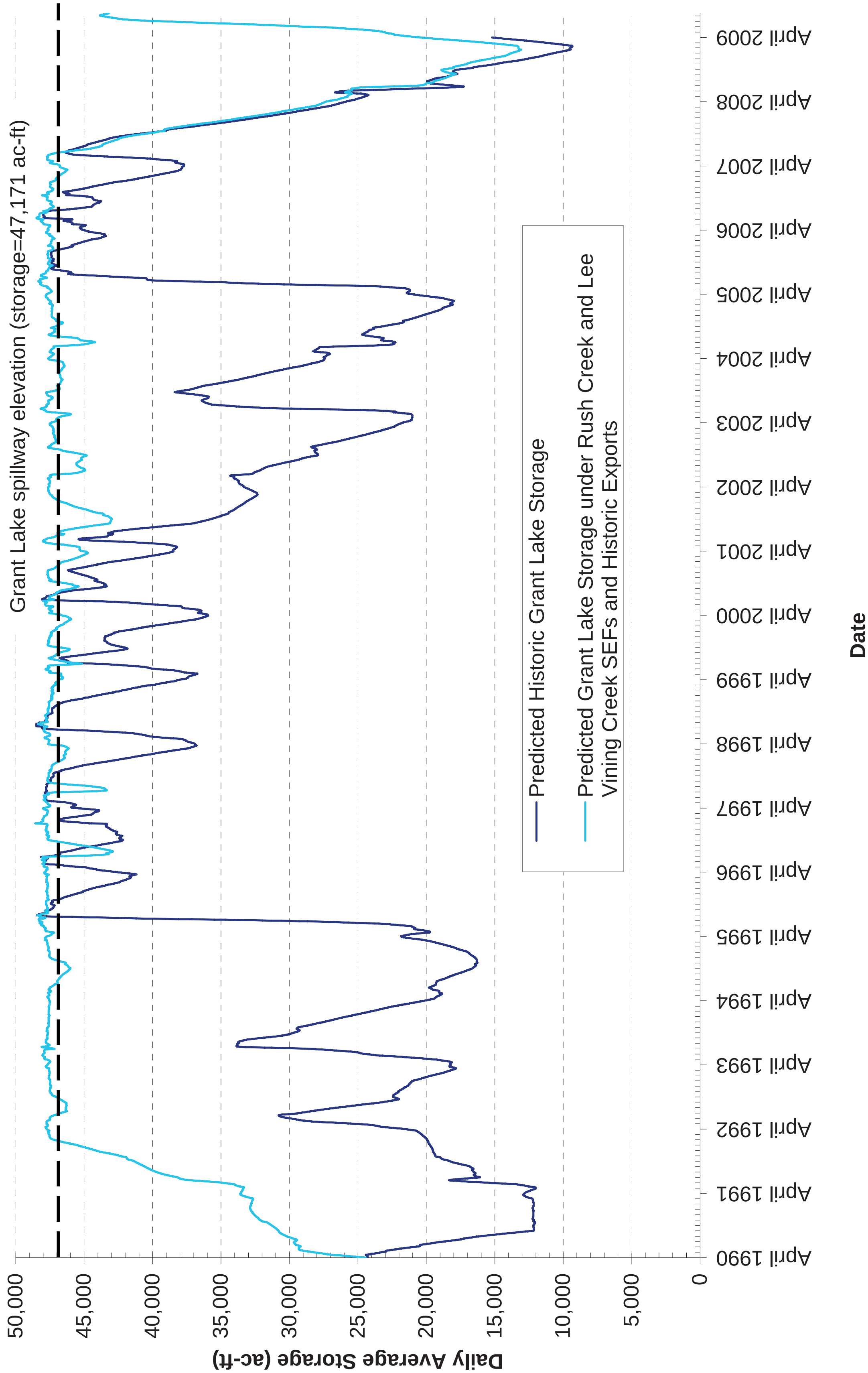

Figure F-3. Scenario 3: Historical Exports; Rush and Lee Vining SEF streamflows.

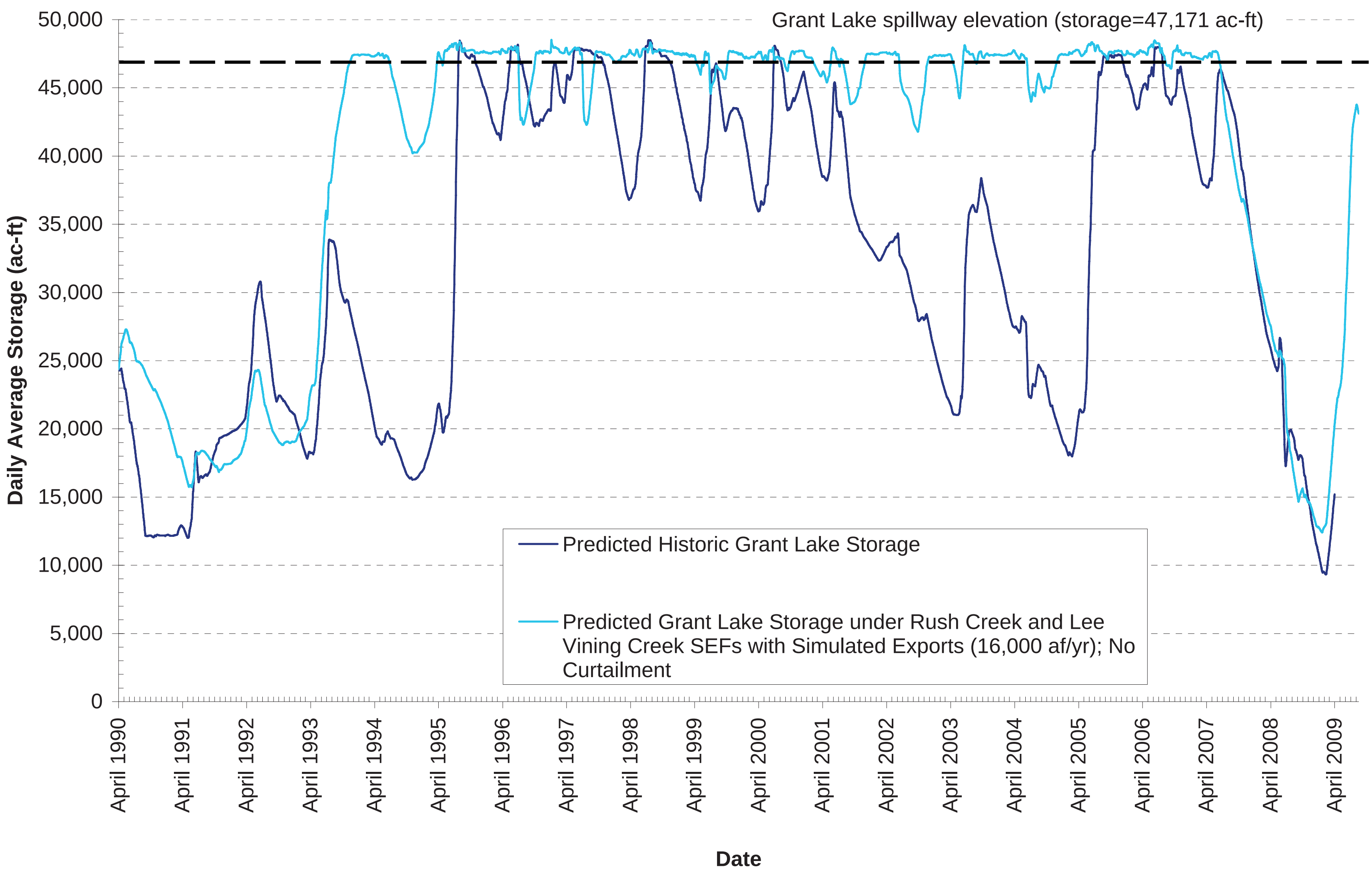

Figure F-4. Scenario 4: Rush and Lee Vining SEF streamflows; 16,000 af Export; No Export Curtailment.

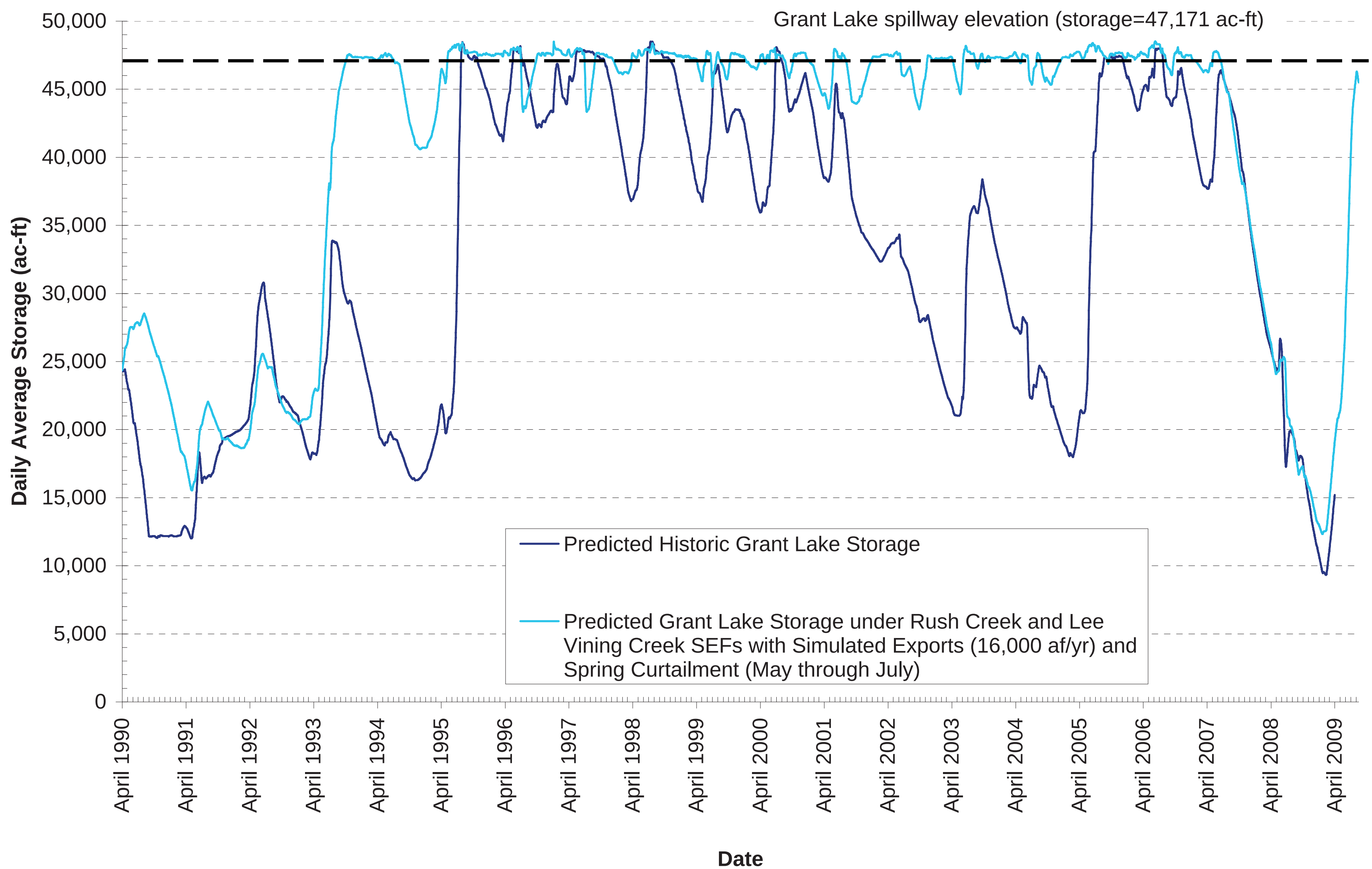

Figure F-5. Scenario 5: Rush and Lee Vining SEF streamflows; 16,000 af Export; 3 Month curtailment.

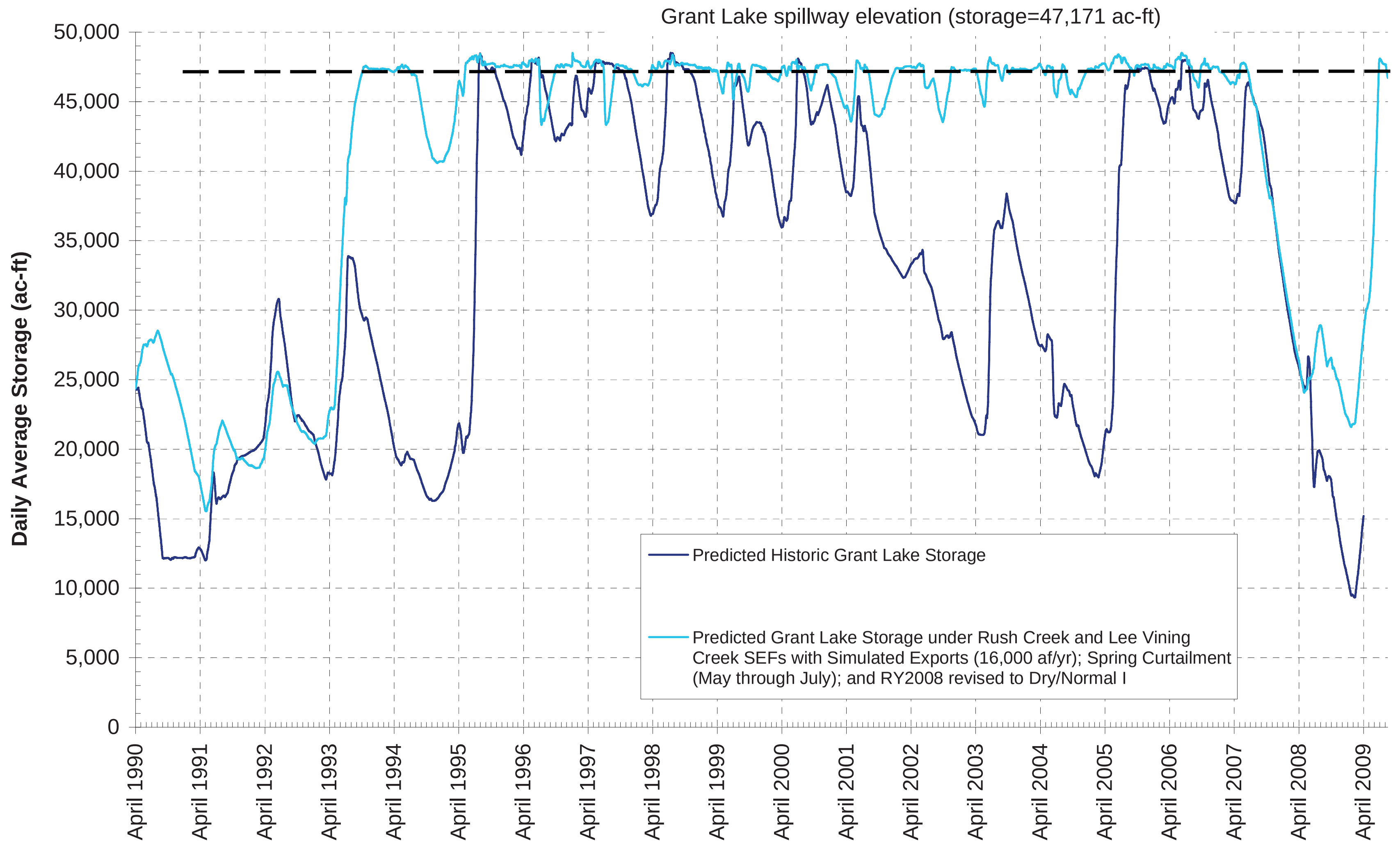

Figure F-6. Scenario 6: Rush and Lee Vining SEF streamflows; 16,000 af Export; 3 Month curtailment; RY2008 revised to Dry-Normal I [BASELINE SCENARIO].

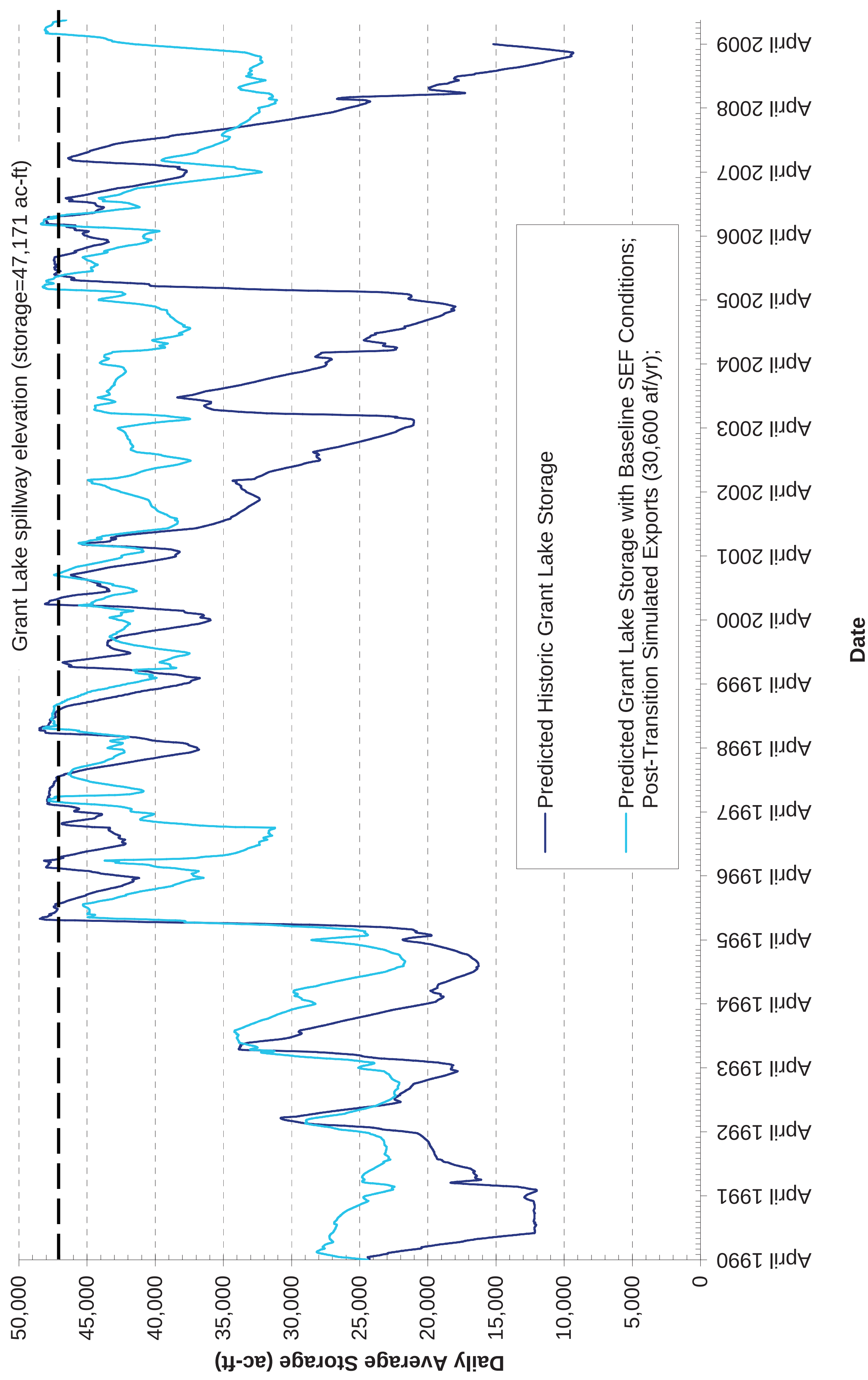

Figure F-7. Scenario 10: BASELINE SCENARIO + Export Remaining Yield from Each Runoff Year (~30,000 af).

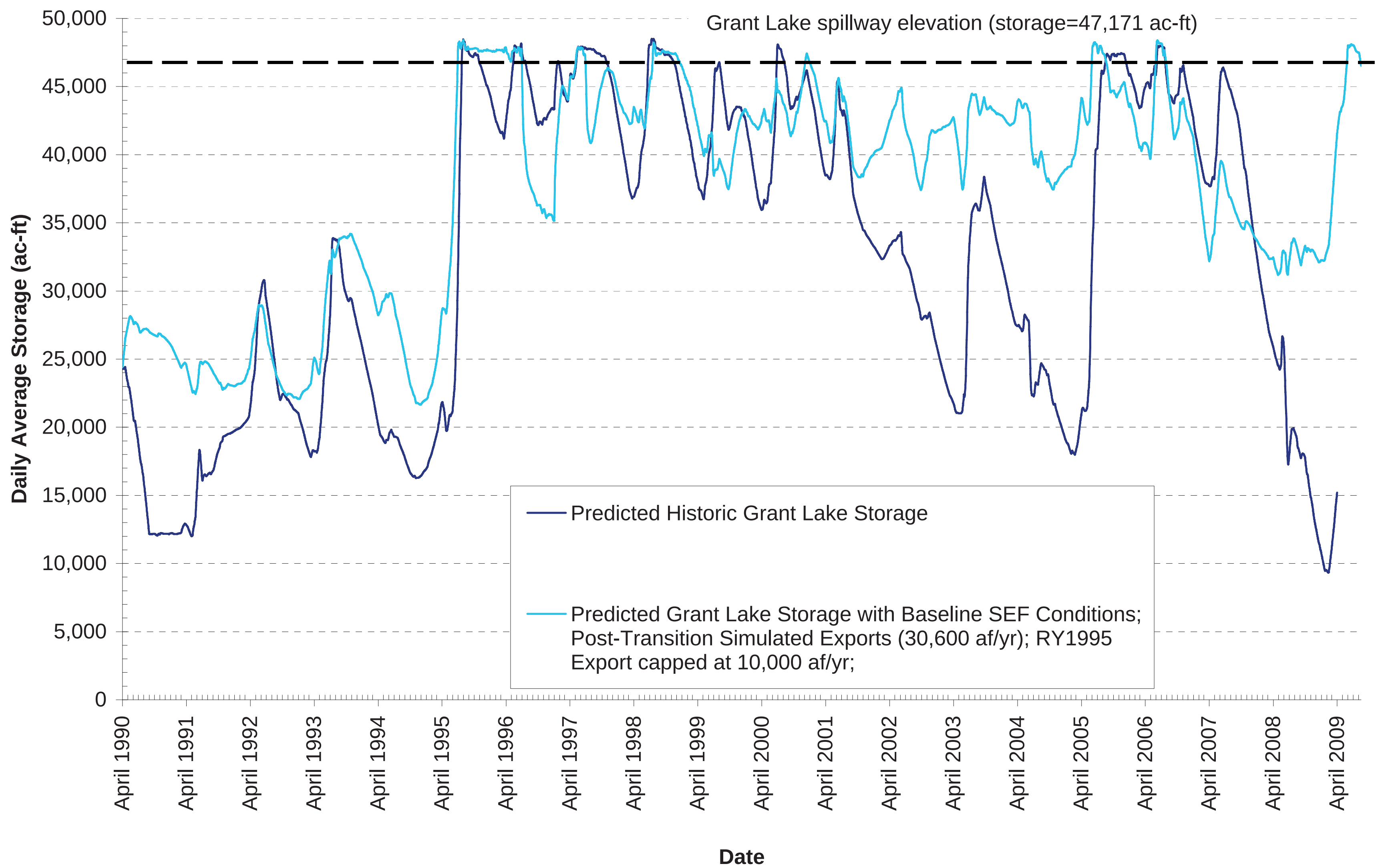

Figure F-8. Scenario 11: BASELINE SCENARIO + Export Remaining Yield from Each Runoff Year (~30,000 af); constrain RY1995 to 10,000 af export.

APPENDIX F

COMMENTS ON THE SYNTHESIS REPORT PUBLIC REVIEW DRAFT, WITH STREAM SCIENTISTS' RESPONSES

EXHIBIT A. LADWP's SPECIFIC COMMENTS
Mono Basin Stream Restoration & Monitoring Program:
"Synthesis of Instream Flow Recommendations" Public Review Draft Report

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
General Comments					
				Mono Basin Exports Export allocations and conditions are specified in order 98-05 and at this time LADWP is allowed 16,000 acre-feet (af) for export. The Stream Scientist have recommended no exports before the end of peaking operations and no exports if Grant Lake Reservoir (GLR) falls below 11,500 af annually. In addition, their recommendations severely limit exports during dry years and will require drawing from storage to meet requirements in extremely dry years. These conditions are not acceptable to LADWP. Also, although LADWP has not been diverting from Walker and Parker creeks in recent years, LADWP does not accept the recommendation of “continued curtailment of diversions”. The option to divert from Parker and Walker creeks should remain open.	Issues of water supply available for export from the Mono Basin are beyond the limited directive assiged to the Stream Scientists. Our recommendations are specifically directed to recovery and long-term protection of ecological conditions of the four Mono Lake tributaries. With regard to diversion from Parker and Walker Creeks, we emphasize that streamflow from Parker and Walker creeks were important when developing flow recommendations for Rush Creek, specifically during the snowmelt runoff and summer seasons, and especially the higher water quality (water temperature) and timing of snowmelt peaks.
				As mentioned earlier, Mono Basin exports have always been an important component of the overall water supply and operations of the Los Angeles Aqueduct. There are a number of environmental projects and conditions that must be accounted for downstream of Mono Basin that could be adversel affected by restrictions of both water supplies and timing of exports. These include Crowley Lake operations, the Owens River Gorge Rewatering, the Lower Owens River Project (LORP), Owens Lake Dust Control Project, irrigation demands, and environmental enhancement projects under the Inyo/LA agreement and 1997 Memorandum of Understanding. Mono Basin decisions of the past have also received significant criticisms regarding the failure to recognize down-system impacts. For instance the Upper Owens River thermal problems are exacerbated during dry years and with zero exports this situation will only worsen. Spawning runs out of Crowley lake will be greatly inhibited due to the fish barrier (thermal barrier) created by Hot Creek’s influence on the river and lack of moderating water from above. Irrigation on the Upper Owens River for private ranches and LADWP ranchers also becomes severely restricted. Crowley Lake experiences severe algal blooms leading to water quality issues that emanate throughout the whole Owens River system.	Operational considerations outside of the Mono Basin are beyond the limited directive assigned to the Stream Scientists.
				From a statewide perspective, water resources are becoming scarcer while an increasing human population is creating ever higher demands. Water that LADWP cannot receive from the Mono Basin would have to be replaced by deliveries from elsewhere in the State (i.e. Delta) as Los Angeles still needs the water and the State’s water systems are integrally tied together. Mono Basin exports have become even more valuable as the State’s water availability scenarios have changed dramatically since Order 98-05. In addition, environmental demands for water in the Eastern Sierra (LORP, Owens Lake Dust Control, etc...) have reduced LADWP’s average annual exports to less than half of those from the 1971-1988 period. These factors make it critical that LADWP meet the environmental goals of the Mono Basin in “an efficient and reasonable manner.”	The Mission Statement from the LADWP Strategic Plan states the following, which is mis-quoted in the comments provided: "We are a publicly-owned utility committed to providing clean, reliable water and power in a safe, environmentally responsible and cost-effective manner with excellent customer service to the communities we serve.
				Forecast A May 1st forecast would be impractical for several reasons. To begin with, our forecasting models with their polynomial equations and their associated constants and coefficients, were developed using April 1st snow survey information. To input May 1st snow survey information into them would be inherently inaccurate. In addition, in the past 60 years, there have been no May 1st snow surveys performed, with the exception of a couple of extremely wet years; so there exists no database with which to develop May 1st forecasting equations. Additionally, even if May 1st runoff equations for Mono Basin could be somehow developed, like their April 1st forecast counterparts, they would depend on the snow courses in the Mono Basin, which are measured by Southern California Edison (SCE), and SCE does not perform May 1st snow surveys. Further, a May 1st forecast is unnecessary as illustrated by Table 2 in Appendix A-5. During the 38 year period from 1970 to 2008, the April 1st runoff forecast only overestimated the runoff year twice and underestimated the runoff year three times.	As you are aware, the Decision 1631 states: "Preliminary determinations of the runoff classification shall be made by Licensee in February, March, and April with the final determination made on or about May 1." The Synthesis Report and analyses concluded that a May 1 forecast "would improve the accuracy of the runoff year forecast and the year-type designation" (pg. 38), and this has been demonstrated in our analyses, and in LADWP's analyses presented in the GLOMP and in Hasencamp's report. However, our suggestion was not specifically that new forecasting models, snow-course survey, or reliance on SCE would be required.

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
				As a surrogate for the May 1 forecast, LADWP proposes the following: if the April 1 forecast is within +/- 2.5 percent of a year-type border, LADWP will monitor April's precipitation data, using the Cain Ranch precipitation station, to decide if a May 1 update to the April 1 forecast would be useful. If the April precipitation is less than half of the median April precipitation, the lower year type will be used; if the April precipitation is more than twice the median April precipitation, the higher year type will be used; if the April precipitation falls between 50 percent and 200 percent of the median April precipitation, then the actual April 1 forecast will be used. We suggest using the Cain Ranch precipitation station, as that station is operated by LADW and is consistently maintained and read, as opposed to the Gem Lake precipitation station which is operated by Southern California Edison, and which has not been read in several years.	We provisionally support your "surrogate" suggestion, and request that this May 1 update process be demonstrated in the LADWP MBOP with examples of past runoff years' forecasts and precipitation data, and potential runoff year revisions.
				Southern California Edison (SCE) Since SCE operates reservoirs upstream of LADWP's facilities for their hydropower generation, hence regulating flow, LADWP would like to emphasiz that without SCE's cooperation in releasing greater peak floods, the new peak prescriptions cannot be met. LADWP plans to approach SCE and request its cooperation to whatever extent possible. However, LADWP cannot compel such cooperation, as SCE must operate within its own Federal Energy Regulatory Commission (FERC) licensing requirements. The SWRCB's and/or the State's assistance in this matter would greatly be appreciated. Finally, it must be recognized that the pre-1941 condition of the Mono Basin included SCE operations.	The Stream Scientists understand the importance of SCE's cooperation to acheive the recommended SEFs. We suggest that the US Forest Service and SWRCB play a role in facilitating discussions, that communications among these parties should be transparent, and should be conducted with Stream Scientists' participation.
				Excess Water Additionally, we are concerned with the proposed use of "excess" water that should be available for export in the Post-transition period. This excess, o average, is 16,204 af (based on Table 6-3 on page 114 using negative excess values being converted to zero) with a range of 0 in some dry years to 50,000 af during extreme wet years. Because Mono Lake may not reach 6,391 ft soon, it is very likely that the transitional period will continue for more than 10 years. It is suggested by the report to prolong the snowmelt bench for Rush Creek and also stated "But absence of this excess stream flow in post-transition years with higher exports will not cause adverse conditions in Rush Creek". First, a clear guideline for this additional release is necessary. A prolonged bench alone in Rush Creek could adversely affect fish as the snowmelt bench will replace the summer and fall base flows except in Dry runoff years, and in 8 out of 19 modeled years the bench will continue into the winter base flow. Second, the prolonged snowmelt bench will elevate the summer base flows, resulting in higher soil moisture availability through out the summer. This, in turn, could result in expansion of the r acreage were to increase as a result of the prolonged benches, subsequent shrinkage or die back upon return to the normal streamflow regime could be considered as an "environmental setback," triggering a demand for restoration of the excess release, which would limit LADWP's export of water to which it would otherwise be entitled.	In general, excess water delivered to Mono Lake during the pre-transition period will be beneficial to the stream ecosystems. Regarding a clear guideline for release of additional water, we have specified that the snowmelt peak and snowmelt bench are preferred hydrograph components for releases exceeded SEF streamflows; in wetter years with full GLR, if LADWP analyses indicate additional releases are operationally necessary, additional guidance may be provided. Regarding fish resources, we do not anticipate adverse effects from prolonged snowmelt peak or bench releases. For example, in RY2006 Rush Creek bottomlands had a prolonged snowmelt peak and recession streamflows, with 87 days exceeding 200 cfs (May 9-Aug 3), and streamflowsexceeding 80 cfs for most of Aug-Sept; these flows resulted in fish condition factors well above 1.0 in Rush Creek sampling locations. Regarding riparian vegetation, the past 12 years of pre-transition SRF streamflows resulted in riparian acreages that appear to have reached an equilibrium based on our RY2009 sampling; we presume similar acreages will persist under pre-transition SEF streamflows. Additionally, the SEF streamflows were specifically developed to maintain existing riparian acreages in the post-transition period, with expected minor fluctuations (vegetation expansion and die-back) resulting from wet-dry cycles not exceeding 10% of current acreage estimates (pg. 121).
				Ramping Ramping rates need to be 10 cubic feet per second (cfs) or 10 percent whichever is greater for Rush Creek from Grant. The 8 ft gate used to operate flows out of Grant Lake is not suited for small changes in flows. Once the gate is moved during a flow change, the gate must be seated and the seating of the gate by itself can change flows by a few cfs. Also, the flow meter can have a margin of error up to a few cfs, again causing problems with assuring a specific flow down the MGORD (Mono Gate One Return Ditch). With very small flow changes, trying to unseat a massive gate, slightly move it and reseat it, and then waiting several hours for the flows to make their way to the MGORD, all in an environment where flow measurement error is greater than the actual flow change, is impractical, especially in light of the inability to define the ecological implications of a given flow difference, such as that between 35 and 41 cfs, for instance. Flow changes of 10 cfs increments are the smallest that can be made to the MGORD in reliable and operationally reasonable fashion.	The Synthesis Report acknowledged (pg. 58) that the LADWP facilities "cannot be expected to divert [or release] streamflows within as narrow a margin of error as implied". We provided a tool (5% range bracketing streamflows) for LADWP to assess operational feasibility. However, LADWP has previously demonstrated better operational accuracy than 10 cfs (e.g., the August 2008 Rush Creek test-flow releases, Table 5-3, pg. 107 of the Synthesis Report, were within 2-3 cfs of the targeted streamflows in all but one of 10 days).
				Window of Acceptable Flows The analyses performed allowing for some variations in flows that translate to a plus/minus allowable stage change of 2.5 percent (total of 5 percent) were well done and are acceptable to LADWP.	Excellent!

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
				Normal Year Peak Requirement of 380 cfs Analyses by the Stream Scientists appear to have pinned the normal year peak flow requirement at 380 cfs. 380 cfs was the MAXIMUM designed flowrate of the Mono Gate One Return Ditch (MGORD) when the ditch was regraded to increase the capacity in 2001. Since then the growth of vegetation, sediment deposits, scouring in areas, rodent holes etc have adversely impacted the flow capacity. Marked rock experiments, bedload sampling, groundwater monitoring, and floodplain inundation all point to a bankfull flowrate for Lower Rush Creek of 325 to 350 cfs. Equally important is that the new SEF (Stream Ecosystem Flow) of 380 cfs down the MGORD is not attainable. First, the outlet pipe out of GLR has a maximum design flow capacity of 371 cfs. Second, the engineers and hydrology team agree that the MGORD can safely handle only 350 cfs. The main concerns are that 1) at 380 cfs the MGORD is completely full and putting maximum stress on the berm; 2) there are several historical seeps through which water flows out of and under the MGORD; and 3) there continues to be a problem with gophers burrowing through the berm which lead 380 cfs a breach could dewater Rush Creek.	The Stream Scientists acknowledged that "The 380 cfs peak release is not a geomorphic threshold" (pg. 94), rather a concession to attain the highest possible peak releases within the constraints of the LADWP facilities. However, we are unclear as to why LADWP rehabilitated the Return Ditch and upgraded the pipe outlet with USABLE capacities that do not exceed the SWRCB Order 98-05 380 cfs SRF requirements. The recommended Normal Runoff Year peak magnitude of 380 cfs was maintained from the existing SRF requirements, not increased; the duration was reduced from 5 days to 3 days. In addition, 380 cfs may be attainable through spills from GLR in many Normal runoff years, especially with added cooperation from SCE. If facilities constraints allow only 350 cfs peak releases, the NGDs for three geomorphic thresholds (LWD, emergent floodplain, intermediate floodplain) are reduced by 1-2 days in SEFs below the Narrows.
				Flow Scenarios for Different Water Year Types LADWP proposes three modifications to the flow scenarios proposed for Rush Creek: **Dry Normal I and Dry Normal II runoff years should be eliminated and replaced with Dry Normal:** Two Dry Normal year types are biologically and ecologically unnecessary and simply increase operational demands. Instead there should only be a D Normal year type with no peaking flows and a recurrence interval window between 80 and 60 percent of normal runoff. The objectives of the proposed 200 cfs for 3 days peak flow for Dry Normal Type II include minor geomorphic works (gravel mobilization and sediment deposition in the point bars), off channel stream flow connectivity, riparian regeneration and shallow groundwater recharge. However, the gravel mobilization threshold (200 to 250 cfs) is met only below the Narrows and there are no data presented to support the connectivity threshold. Further, three days of surface water connection could be detrimental to the fish population. During redd (spawning nest) surveys conducted in 2009, only four of redds (14 percent) were found in the lower section of Rush Creek while 25 (86 percent) were found in Upper Rush including in Rock Garden and MGO Also very minimum shallow groundwater recharge would occur during a three day peak flow since the water table elevation is closely related to the stage height of the channel, and the water table quickly recedes when peak flows are dropped (Figure C-10 and C-11). According to the successful germination criteria in page 97, the regeneration can occur in interfluves/depression within aggraded floodplain without a side channel and emergent floodplains and aggraded floodplains with side channels. But the proposed duration of the peak is so short that it is very unlikely to achieve seedling establishment in those geomorphic surfaces because of quickly receding water table and also scouring in subsequent years for seedlings in the emergent floodplain and channel margins. Besides, successful regeneration of woody riparian species is known to occur in wet years with approximately 5-10 year periodicity (Baker 1990, Stromberg et al. 1991, Scott et al. 1997, Stromberg 1998, Lytle and Merritt 2004), and often driven by decadal or longer climatic cycles (Baker 1990, Hauer et al. 2007). Wetter years should suffice this regeneration cycle. Thus eliminating 200 cfs for three day will not adversely affect the Rush Creek ecosystem. Instead, the water would be more beneficially used by filling or raising the GRL level to augment supplies of cooler water. By maintaining GLR full, the turbidity and temperature issues can be alleviated or eliminated.	The Stream Scientists considered this point exhaustively, but concluded the current runoff year types and DN-II SEF peak recommendations provide important ecological benefits. The SEF recommendations eliminated the DN-I SRF peak release, a concession to prioritizing water diversions in DN-I years and de-emphasizing geomorphic and riparian functions. Combining DN-I and DN-II would result in elimination of snowmelt floods in 40% of runoff years; in our view this potentially crosses a threshold of ecological impairment. The term "minor geomorphic work" is perhaps a poor descriptor; the functions are no less important than other geomorphic functions accomplished by large magnitude events. There will be some gravel mobilization in Upper Rush Creek (e.g., Appendix B-2 Figure 1c XS 5+45 had 30-50% mobility of D31 and D50 at 200 cfs). Groundwater recharge would certainly be aided by a larger volume of flow accessing side channels. Lower peak discharges earlier in the season (as would be the case for DN-II runoff years) also favor different riparian species: yellow willow germinates earlier in the season than cottonwood and narrowleaf willow, and may colonize lower surfaces and channel margins that contribute to channel confinement and bank stability. Also, we disagree that the 3 day peak duration is too short to achieve seedling establishment; we have witnessed several SRF events in the past 12 years that promoted seedling establishment. We specified a 120 cfs threshold for successful germination and regeneration on emergent floodplains and aggraded floodplains with side channels. Recession rates would preserve shallow groundwater and capillarity to enable regeneration (i.e., survival).

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
					In regards to the fisheries being harmed by three days of surface water connection at the 200 cfs release - what does DWP consider these harmful effects to be? The predicted timing to peak emergence analysis in Appendix D suggests that age-0 brown emerge prior to peak flows in Rush Creek. Off-channel habitat watered at 200 cfs would probably beneficial habitat for fry and a receeding limb that mimics the unimpaired hydrograph should not cause widespread stranding of fry. In regards to the location of redds in 2009-2010, these surveys below the MGORD were just spot checks of several limited reaches, thus any creek-wide inferences to distribution of redd locations should be avoided. During movement study relocations we observed brown trout redds throughout lower Rush Creek when we walked extensive sections between the sheep herder's cabin and Hwy 395 and between the Narrows and the County Road culvert.
				In Dry Normal, (Stream Scientists' Dry Normal Type I for SEFs), the spring bench should be lowered to 70 cfs from 80 cfs. The 80 cfs riparian threshold is based only on the 8 Channel section of Rush Creek. There are some problems with generalizing the results from this reach. A tentatively drawn potentiometric surface map in the reach indicates the section is losing water with very steep hydraulic gradient between the stream and piezometer (Figure C-9 to C-11). The water table elevation at the piezometer 8C-5 is constantly lower than the main channel surface water elevation, ranging from a difference of one foot during peak discharge to more than 4 ft during the low flows, at a distance of around 100 ft as shown Figure C-10. The interpretation of the data shown in Figure C-17 to C-21 may not be accurate, as the drop of the water table seems to occur around 60 cfs rather than 80 cfs. Moreover, the five-foot threshold to the depth to the water table in Figure C-6 is questionable because the number was calculated using the horizontal plane extending from the 91 cfs surface water elevation. The actual value of the depth to the water table should be larger than that shown in Figure C-6. For instance, in the 8 Channel section, the stream is losing water according to the stage height and piezometer comparison shown in the Figure C-10 and C-11. When wells along the same cross section are compared (8C-5 and 8C-6), the water table is lower at 8C-6 (piezometer located further away from the main channel) most of the year even with perennial flows on 8 Channel, thus further supporting the non-horizontal plane of the water table (interestingly Figure C-11, 8C-1 and 8C-3 are not presented to compare to 8C-2 and 8C-4 respectively for comparison along the same transect). In addition, steepness of hydraulic gradient changes with discharge due to changing an aquifer storage. The aerial photos were taken after the peak during the receding limb (from Appendix A-1, a peak for Rush was in the beginning of June) with larger storage. Thus, the water table levels during 91 cfs, even with properly modeled water table elevation, reflect the depth to the water table at the discharge only during the receding limb, but not at other times of the year, particularly in the mid to late summer. The depth thresholds should be greater than 5 feet for riparian patches. Most of the water table elevation is maintained within 6 feet of the capillary fringe in all the piezometer figures even during low flow seasons. Therefore, there will be very little effect, if any, on riparian plant communities if the spring bench is lowered to 70 cfs from 80 cfs.	The 80 cfs threshold is not based only on the 8 channel groundwater data. Groundwater data collected the 3d channel above the Narrows, the 10 channel piezometers data collected by MLC and the synoptic streamflow measurements all point to a rapid decline in groundwater when flows reach 90-70 cfs. These figures were likely misunderstood. Figures C10 and 11 show the groundwater data collected in piezometers in the spring and summer 2009. Groundwater is shown as a function of date. The streamflow elevation at the 8 channel entrance and exit are included in the figure to show the water surface elevation difference between the top and bottom of the reach. The ground water measured at various piezometers are also plotted from upstream to downstream. Both graphs show that groundwater elevation rapidly and dramatically responds with very small changes in discharge. It is precisely the type of relationship described at Piezometer C-5 that helped identify that streamflows at 80 cfs would be most protective of the shallow groundwater in locations where there are no side channels (and therefore the most protective of established riparian vegetation). The high flows in the graph where groundwater is within 1 ft of the ground surface is 423 cfs, and really drops quickly at 51 cfs in November. The prolonged effect of 80 cfs is also visible on these graphs as a short bench before flows drop to 54 cfs at the beginning of August.

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
				In Dry runoff years, the spring bench should be lowered to 40 cfs from 70 cfs. In 2008, when the average flow between May 1 and July 26 (the snow melt bench period proposed for SEFs) was 42.7 cfs, no dieback was observed in Rush Creek. Figure C-10 shows the water table elevation never dropped 4 ft below the ground level when the average daily discharges ranged from 30 cfs to 40 cfs between Dec 19 and March 31. The discharges of proceeding four month period ranged between 15 and 50 cfs, and the flow was as low as 14.6 cfs before Dec 19, suggesting the water table elevation can be sustained within the "riparian threshold" by 40 cfs without prior recharge of the groundwater. Figure C-12 and C-13 also show the water table level being within 5 feet of the capillary fringe in 2008. Even if the water table elevation were to drop more than 5 feet from the ground level, the riparian vegetation should be able to survive. The 5 foot threshold presented in Figure C-6 may not accurately represent the depth to the water table in general; an actual value of the depth to the water table should be larger than that shown in Figure C-6. A steep hydraulic gradient between the main channel and piezometers is observed in the "representative reach" of Rush Creek (Channel 8 section). Thus, the horizontal plane extension does not represent what the water table elevation should be, and the depth to the water table should be greater than five feet for many patches shown in Figure C-6. This would explain why no dieback was observed during the average flow of 42.7 cfs during the would-be snow bench period of 2008 even though the water table or capillary fringe may have dropped 5 feet below the ground level.	The range in flows below the Narrows during the May 1, July 26, 2008 window referred to in the comment had daily average discharges above 80 cfs below the Narrows after May 16 and below MGORD after May 26th. Perhaps the commenter meant 2007? The range in flows below the Narrows during the May 1, July 26, 2008 window referred to in the comment had daily average discharges above 80 cfs below the Narrows on May 17 and never went above 45 cfs below the MGORD. Dieback was observed for growth associated with 2007 and this lead us to think that flows on the 45 and 50 cfs range were insufficient except under extremely dry conditions (3 out of 50 years). Riparian woody plants are usually dormant between Dec 19 and March 31 along Rush and Lee Vining Creeks. RY2008 shown in the graph is much different than RY2007 a Dry year. Runoff year 2008-2009 was classified a normal year and peaked above 380 cfs for two days. The overall volume of recharge into the shallow groundwater was much greater in 2008 and also occurred during the peak of the growing season.. RY2007 had 80% of the water that RY2008 did. The streamflow recommendations were tailored to accommodate the differences in water year types. In a normal year the SEF's recede to 58 cfs below MGORD by July 27th. By the end of July growth is maximized for a year and reserves are being built for the next year. In a dry year SEF streamflows facilitate growth for the early part of the growing season (the most critical), but recede by the first week in July. The projected plane from the 91 cfs waters edge is a simplification of the ground water profile. The stage difference between 80 and 91 cfs is no more than 0.10 ft below MGORD and the Narrows. Not surprisingly there is a portion of the vegetation within each corridor that are much higher away from the 91 cfs water edge; however it generally is less than 20% of the riparian vegetation within the Rush Creek corridor. The depth to the 91 cfs water surface suggested that riparian vegetation could be maintained if it grew within 5 ft of the 91 cfs water surface which in areas not adjacent to the channel was translated into 5 ft above the groundwater. In the absence of a side channel, if the groundwater or streamflows are maintained within 5 ft of the ground surface then the shallow groundwater function that riparian vegetation relies on would also be maintained.
				Termination Criteria & Monitoring: LADWP agrees with the Stream Scientists' suggestion that "the current termination criteria specified in Order 98-07 have served their purpose …." (Executive Summary page 3, 2nd paragraph). Also, LADWP understands and agrees that a monitor program will be necessary to determine the efficacy of the new flow regimes. However, we are concerned that the proposed monitoring program is more extensive than the existing program and that there is no sunset on the monitoring. LADWP's proposed changes to the monitoring described in the Synthesis Report are oulined in LADWP's cover letter.	While we recommend that the TC specified in Order 98-05 have served their pupose, we still recommend that annual monitoring is conducted for adaptive management purposes. In regards to DWP's proposed changes to the proposed continued monitoring - the proposed changes to the monitoring program are not acceptable to the Stream Scientists. Our response is summarized in the Appendix Introduction.
			Executive Summary		

LA DWP

EXHIBIT A. LADWP's SPECIFIC COMMENTS
Mono Basin Stream Restoration & Monitoring Program:
"Synthesis of Instream Flow Recommendations" Public Review Draft Report

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
1	2	2		The winter holding habitat in Lee Vining was greatest with the lowest discharge (12 cfs). The ice formation may not be a major problem in Lee Vining.	Since submitting the draft Synthesis Report we have now reviewed the 2009-10 winter monitoring of icing conditions on LV. While there were few concerns observed during this single-season study, we are not lowering our winter flow recs based solely on maximizing holding habitat. The recommended range of 16-20 cfs (by RY type) provides 78-88% of the maximum habitat. We feel that the potential ecological risks associated with further dropping the flows out-weighs the additional 5% gain in habitat area if the 16 cfs flow was dropped to 14 cfs. We recommend continued monitoring of winter icing potential and synoptic flows through at least the 2010-2011 winter season. The winter baseflow for 2010-2011 should be set based on RY type as recommended in the Synthesis Report.
2	3	1		"*A minimum GLR elevation of 7,100 **should be** maintained during July, August, September of all runoff years*" - This may be difficult/not possible during dry years.	We request LADWP's analyses with an updated LAASM to estimate the frequency with which this threshold cannot be maintained.
			SECTION 1: Introduction		
3	10	last	1.3	"LADWP then plans to submit a request to implement..presumably as early as 2011" - LADWP needs approx. 2 years to install all potentially required infrastructure after the agreement is finalized. There is only a 4-5 month construction work window with good weather	Synthesis Report text updated to reflect changes discussed during February 2010 meeting.
4	11	Table 2-1	1.3	The drainage area of Lee Vining Creek above the Intake is not 34.9 mi^2, but 40.6 mi^2. The gauge (10287900) near Lee Vining is actually way above the Intake, but the gauge (10288000) near Mono Lake is at the Intake.	Synthesis Report text updated accordingly.
			SECTION 2: Stream Ecosystem and Flow Recommendation		
5	11	Table	2.1	"*Source: USGS" at bottom of table. This data is from LADWP measuring stations.	Synthesis Report text updated accordingly.
6	12	1	2.1	LADWP only occasionally diverts water from Parker/Walker creeks.	Comment noted, no text changes made.
7	15	2	2.1	"*A radial gate exists in the LV Conduit*" - The radial gate and stop logs have historically been used to block all flow through the conduit. Stop-logs crudely regulate the flow to the conduit, requiring manual installation/removal to regulate flows	Synthesis Report text updated accordingly.
8	15	1	2.1	Stream Restoration Flows (SRFs) -- "*flow can be diverted into the conduit or spilled over the weir to continue down the creek*." It should say "*flow can be diverted into the conduit or passed through the Langemann Gate to continue down the creek*"	Synthesis Report text updated accordingly.
9	16		Table 2-3a	Table heading columns should be wider to allow May and June to stay on the same line.	Changes made
10	32		Table 2-4	RY2009, if LADWP missed the peak how was 101% of the peak passed? Also the table needs to be a little wider it is cut off on the right side.	As you are aware, DWP submitted a report to the SWRCB dated August 4, 2009 explaining the impaired Lee Vining peak and DWP operations. As we understand, the primary 'Lee Vining above Intake' peak on June 1 was impaired by diversion, but a prior (May 18) 'above Intake' peak produced a 'below Intake' daily average peak of similar magnitude as the June 1 peak.
11	35		2.2.4	"..current water export allocations.." - Sounds like this would change current export volumes, LADWP has concerns about no exports due to downstream needs.	The Stream Scientists are not suggesting any changes to current water export allocations. Those are determined by SWRCB authority.
12	36	1	2.3	"Releases are constrained by the 380 cfs max capacity of MGORD" - Need to flow test the new structure at Mono Gate One. Need a 350 cfs max to prevent damage to return ditch. Also pages 42 and 61 state "..constrained by 380 cfs max of the MGORD" - this needs to be flow tested, but the limitation is the 371 cfs max design of the outlet pipe from Grant Shafthouse to MGORD	See comment above regarding the Normal RY 380 cfs recommendation.
13	38	2	2.3	"*Grant lake at spillway elev for a 2 week period between June 15th and July 15th*." - May not be possible if SCE operations and runoff year type requires them to hold back for storage per their FERC license requirements.	We understand, and look forward to discussing this with USFS, SCE, and SWRCB.
14	38		2.3	A May 1 forecast would be impractical for several reasons: 1) our forecasting models with their polynomial equations and their associated constants and coefficients, were developed using April 1st snow survey information; 2) in the past 60 years, there have been no May 1st snow surveys performed with the exception of a couple of extremely wet years, so there exists no database with which to develop May 1st forecasting equations; 3) even if May 1st runoff equations for Mono Basin could be somehow developed, like their April 1st forecast counterparts, they would depend on the snow courses in the Mono Basin, which are measured by Southern California Edison, and Southern California Edison does not perform May 1st snow surveys. Also, looking at appendix A-5 Table 2, the 38 year period from 1970 to 2008 the April 1 runoff forecast overestimated the runoff year only two years and underestimated the runoff year three years.	Yes, we understand your position regarding May 1 snow course surveys, etc., and as discussed above, we tentatively accept your "surrogate" suggestion for revising borderline runoff years based on precipitation data. Regarding the Appendix A-5 Table 2, our suggestion for May 1 revisions is precisely aimed at correcting those runoff years (5 out of the 38, etc.) that do over- or underestimate the eventual actual yield, because they are the ones that potentially cause undesirable ecological outcomes.

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
15	38		2.3	Last paragraph. "The threshold of 11,500 af is to protect Rush Creek from higher than normal turbidity and water temperatures." The turbidity that came from GLR when it was low was not a problem. The turbidity produced during a SEF peak will be much higher than turbidity from GLR Also, You have stated the turbidity is one of the issues, then why isn't there any number to show how bad the turbidity, such as temporal variation of the turbidity (any threshold value of GLR level which always result in high turbidity, duration and occurrence of the episode), spatial extent of the turbidity (how far down from Mono Gate 1 the turbidity extends), and evidence of fine accumulation in the stream bed (particularly where redds have been observed). Is affecting fish population? Has it caused in aggradation? What are the turbidity values?	First, the comment mis-quotes the sentence in the Synthesis Report. It is higher than "usual" not "normal". Second, between turbidity and water temperature, temperature is of greater concern and this has been well documented and modeled. Third, the turbidity monitoring conducted by the MLC in 2009 did not start until April 23rd when GLR storage was at 13,000 ac-ft; however GLR had dropped to 6,100 ac-ft on Feb 12th. There were no turbidity data collected between these two GLR storage levels, thus it is incorrect to state that there was "no problem". Has LADWP measured turbidity during peak flow releases? If so, please provide these data for the Stream Scientists to review. Fourth, turbidity values were presented in the MLC draft report which has not been formally discussed or reviewed at a restoration meeting. Even if the (unknown) turbidity was not a concern, the documented higher temperatures resulting from low GLR storage would still result in a Stream Scientist's recommendation for a mininum GLR storage threshold.
16	38	2	2.4.1	"Fixed daily diversion rates are determined by the ***daily average flow for the Lee Vining Above*** *- determined at 9 am*." Clarify to say "*At 9 am the previous day's midnight to midnight average flow rate would be used to determine the flows to the conduit.*"	The reference to 9AM was deleted. LADWP can specify in their operational guidelines a mechanism that works best for them.
17	38	2	2.4.1	Also, what happens when the flow dramatically changes from the 9:00 am flow? We could send a very small amount down Lee Vining. And wouldn't big flow changes down the creek (eg 50% or more ramp up or down due to sudden increase/decrease in incoming flow) be undesireable? Or is that fine?	These types of drammatic flow changes would be undesirable, and should be avoided. Perhaps this is another example where good communications with SCE can avoid potential problems.
18	40	2	2.4.1	Table 2-6: LADWP feels the diversion table (for April 1 to Sept 30) needs to be simplified to show cfs vs. diversions in 5 cfs increments as shown below: **LV Above** — **Conduit Flow** 30 - 34 — 0 35 -39 — 5 40 - 49 — 10 50 - 79 — 15 80 - 99 — 20 100 - 129 — 25 130 - 169 — 30 170 - 199 — 35 200 - 239 — 40 240 - 249 — 45 250+ — 50 This will allow for easier programming and troubleshooting of the final structures and help reduce wear and tear on LADWP facilities. With varying creek flow, the technology and accuracy of the control gates are within plus or minus 5% of the flow (or 1 cfs, whichever is greater).	This proposed Diversion Rate Table was evaluted in our Lee Vining Creek NGD analysis spreadsheet, and results in approximately 300-600 acre-ft less diversion in each simulated runoff year (1990-2008). There is no effect on NGDs nor the resulting 'Below Intake' hydrographs. The Stream Scientists are thus in support of this simplified Diversion Table.
19				In order to operate Lee Vining Creek Intake & Conduit as recommended, LADWP will need to install another Langemann Gate in the Lee Vining Conduit and perform programming to tie communications of both Langemann Gates back to the flume above. Other upgrades will be needed to replace the Lee Vining Conduit steel grizzlies, as they catch debris before it goes into the conduit and they are corroding. LADWP is willing to perform the upgrades in order to make the new operations work, but will need 2 years from when the new operations are finalized in order to complete the installation of the upgrades.	This proposal seems reasonable to the Stream Scientists, but would ultimately require approval by the SWRCB.
20	40	Table	Table 2-6	Refer to previous LADWP recommended table showing 5 cfs flow change increments. Also, the Lee Vining Conduit needs an upgrade to allow flows to be set as specified with the new SEF flows. LADWP will attempt to operate without the upgrade in place during it's 1 year temporary permit, but setting constant flow rates down the conduit will be difficult and crude (meaning not very accurate) until the upgrades can be installed. Installation of a new Langemann Gate in the conduit to help manage flow in the conduit will take 2 years after the new operations agreement is finalized.	The Stream Scientists appreciate the effort to operate with the revised streamflows, to allow tests of these operations.

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
21	44		2.4.2.1	During a dry runoff year, LADWP requests a snowmelt bench of 40 cfs instead of the recommended 70 cfs. Evidence shows the 40 cfs baseflow in runoff year 2009 maintained the riparian vegetation along Rush Creek. The lower snowmelt bench will maintain Grant Lake Reservoir water elevations Also if Grant Lake Reservoir does fall below 11,500 af is a snowmelt bench required?	The Stream Scientists do not support the proposed change in magnitude
22	44	3	2.4.2.1	Why isn't the winter baseflow adjusted to the runoff year type as in Lee Vining? The habitat study shows the winter holding habitat below the Narrows (County Road and Bottomlands) is highest at the lower flow of 22 cfs where most of the fishery concern resides. Can the baseflow be lowered to 22 cfs?	Accretions from P+W will provide the RY variability to the winter baseflow in lower Rush Creek. Our corrected Rush Creek winter flow recommendations are located in Section 5.11. In this section we discuss our concerns regarding basing the flow recommendation solely on maximizing the amount of winter holding habitat.
23	46		2.4.2.2	During a Dry-Normal runoff year, LADWP requests a snowmelt bench of 70 cfs instead of the recommended 80 cfs. (discussed further in the cover letter).	The Stream Scientists do not support the proposed change in magnitude
24	47	Table	Table 2-9	The *Spring Ascension* has "30-70" cfs, should be "40-70".	Change made
25	50	3	2.4.2.4	Is it reasonable to assume vigorous riparian vegetating reproduction during the normal year? The exceedance probability of 50% (average)? Each normal year has a different weather pattern, and summer precipitation and temperature is very important for successful establishment. Does vigorous riparian reproduction occur 50% of the time? Aren't we setting up the goal too high?	This comment is confusing two important terms: the recommended SEFs target vigorous growth of riparian vegetation in all runoff year types, but reproduction (termed "recruitment" in Appendix C) only in wetter years (Normal and above). Riparian reproduction (termed "regeneration" in Appendix C) likely occurs in most years, but does not always result in recruitment. Every water-year produces seedlings at some location along the streams. In below normal years seedlings initiate along the water margin where they are vulnerable to scour. The wetter the year the higher on the bank seedlings will germinate and establish. Only in normal and above years do seedlings have chance at germinating and beginning growth on higher surfaces (e.g., interfluves or aggraded floodplains) where they are less vulnerable to scour. It is not unreasonable to expect that normal and above water year classes support regeneration and successful establishment. The streamflow recommendations recognizes that seedling establishment occurs on lower surfaces in normal years and higher surfaces in wetter ye
26	52	2	2.4.2.5	For wet-normal years, the increase associated with the runoff is 130% comparing to the normal year while the peak is up by 145%. So there is a disproportional increase of peak. The geomorphic thresholds intended to exceed with 550cfs are achieved below that discharge (see comments on Section 5.7), so 490 cfs (130% of the normal) would suffice the objective.	We are not clear what the basis for comparison is. We assume the difference you suggest between 490 and 550 cfs is made up by Parker and Walker creek contributions. But this concept will not apply above the Narrows.
27	52	3	2.4.2.5	The ecological objectives are not very clearly stated except that the peak can be adjusted to maximum seed production and exceed the several geomorphic thresholds. What do you want to achieve? What geomorphic objectives do you intend to achieve?	Descriptions of SEF recommendations in Section 2.4 were intentionally kept brief, and are described in more detail in Section 5.0. Bullets on pg. 93 clearly present the ecological/geomorphic objectives intended for each runoff year type.
28	54	3	2.4.2.6	The flow below the Narrows ranges between 20 and 25 cfs for the fall/winter baseflows, but previous paragraphs the range was between 19 and 25 cfs Is this because prolonged higher flows increase discharge rate resulting in lower loss? Is this measured or modeled?	In sections 2.4.2.1 - 2.4.2.7 adjustments were made to Rush Creek winterbase flows based on additional synoptic flow measurements and on P+W fall/winter accretions for RYs 1990-2008. Refer to Section 5.11 for new text regarding flow recs and synoptic flows. Varying measured flows downstream of the Narrows by RY type were based on the increased P+W accretions on wetter RY types (Table located in Appendix A-4).
29	55	Table 2-13	2.4.2.6	Medium Recession (node) should be *"170-70"* instead of *"160-70".*	Change made
30	56	2	2.4.2.7	"*A snowmelt peak of 380 cfs may be released from the MGORD*" - the pipe design capacity is 371 cfs.	See comment above regarding the Normal RY 380 cfs recommendation.

EXHIBIT A. LADWP's SPECIFIC COMMENTS
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NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
31	58	1	2.5	"An upgraded facility on Lee Vining Creek has made a daily diversion rate a viable alternative" - This is not stated correctly, we can set flows only to Lee Vining Below but do not have any flow control to Lee Vining Conduit to bypass flows to Grant. Lee Vining facility is designed to set a constant "bypass" flow not a constant "diversion" flow. Need upgrades to accommodate this.	Text edits made
32	58	2	2.5	It states "as a rule of thumb, no greater than a 5% change in stage bracketing would be an acceptable margin" It should say "Typically 5% is a targeted acceptable margin of error". This statement should be eliminated because it makes it seem like we have inaccurate operations, the 5% is completely relative and unobtainable in lower flow ranges with any type of equipment.	We prefer the Draft Synthesis Report text.
33	58	2	2.5	Stage/Flow bracketing needs to apply to all flow settings at the 3 stations on Lee Vining Creek, should say within 2 cfs plus or minus or 5% whichever i greater, or as recommended by the gate manufacturer.	But our example provided in the text, at the lower baseflow range, allows a 3cfs plus or minus. Do you want the more restrictive 2 cfs range?
34	59		2.6	The excess in average is 16,204 af (using Table 6-3 on page 114 with negative excess values being converted to zero) ranging from none during some dry years to 50,000 af during extreme wet years during the transitional period. This is more than a half of the Dry Year simulated Rush Creek annual runoff. Can Rush Creek alone handle all the excess flows just by prolonging snowmelt benches, but not by augmenting the flows? Simple calculations show in 8 out of 19 modeled years the bench will continue into the winter base flow (mainly wet years) and except Dry Year the bench will replace the summer baseflows completely. Are you planning to change diversion rates for Lee Vining Creek such as lowing the diversion upper limit from 250cfs to 200cfs to accommodate this excess water during the transition period? This issue needs to be addressed further.	We do not discount to opportunity to augment SEFs, that is, release higher magnitude flows duirng the snowmelt peak and bench. We also don't discount the option of diverting less water from Lee Vining Creek during the snowmelt diversion season, assuming GLR is at capacity and LVC diversion would require Rush Creek releases to exceed winter baseflow recommendations. This is a good example of where additional modeling analyses by LADWP could and should be able to demonstrate the feasiblity of meeting the SEF recommendations.
35	59	2	2.6	Mono Lake may take more than 10 years to reach the 6,391 elevation. The difference in the simulations going from 30,000AF exports (the scenario under which the Rush Creek flows were set) a year to 16,000AF exports (the current and likely a more realistic value for a long time to come) a year amounts to an additional release of 40 cfs for a 6 month duration. Is this additional water going to be left at the discretion of LADWP for when it is released to Rush Creek from Grant Lake? What guidelines do we have regarding this additional release? If LADWP is supposed to just let Grant Lake spill the extra, then there will be concerns over increased damn stresses as Grant Lake will remain at or near full for most of the year during most years under the 16,000AF scenario.	We understand LADWP's comments and assume they will address these issues during their feasibility analysis.
36	59		2.6	Is there really no adverse condition when the excess flows are no longer available? Mono Lake won't reach the targeted height in a few years. Prolonged bench will elevate the summer base flows, maintain higher soil moisture availability through out the summer, and can result in expansion of the riparian patches to the places where the expansion would be typically checked by limited water availability. The prolonged benches can also cause different groundwater flowing patterns during summer months which riparian vegetation can adapt to. Therefore, when the target Mono Lake level is met, the dependence on the excess flows can shrink the riparian patches. If the riparian acreage increases as a result of the prolonged benches, then the shrinkage or die back afterward can be considered as a setback, and some interest parties may demand implementation of some management practices to increase the acreage back to the prolonged bench level.	We disagree. The riparian corridors have been receiving most of this extra water during the past 12 years of SRF flows. There may be a slight increase in annual volumes released under the recommended SEF flows resulting from increased diversions from Lee Vining Creek, and there may be a slight shift in how water is seasonally allocated to Rush Creek, with reduced baseflows and a consequent slight increase in spring snowmelt flows. However, there are surfaces in the Rush Creek riparian corridor where "extra water" in the pre-transition period may allow riparian vegetation to establish, that ultimately may be able to survive in the post-transition. But the SEF recommendations are intended to maintain the existing 2009 riparian vegetation acreages in the post-transition period, with +/- 5% fluctuations.
37	59		2.6	Can prolonged snowmelt bench and peak be used interchangeably? Does it have to be one or the other? How about decreasing the rate of recession limb during wet years (Wet-Normal to Extreme Wet) to alleviate a sharp decline of water table? Instead of using 20%, can the recession limb be prolonged by reducing the rate to, say, 12% or 15%?	Yes, these are all acceptable alternatives for use of "extra water"
			SECTION 3: General Analytical Strategy		
38	61	2	3.1	Stage height can change over time. Channel geometry and hydraulic characters are not constant (erosion, aggradation, migration, narrowing, change i roughness, shear stress), and also hysteresis can lead to different stage height readings depending on the timing of reading (hopefully difference is within 5% of the error limit). Are you planning to survey the cross section every two years or so, or after the big flow to adjust the rating curve?	NO, an important point is that the cross section rating curve was simply used as a starting point for generating diversion rates that were then evaluated with the NGD analysis. We do not propose or recommend changing the Diversion Rates in the future.

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
39			3.1	80 cfs threshold: This number is only based on 8 Channel section and there are some problems with generalized the results from this reach. First, the interpreation of the data shown in C-17 to C-21 may not be accurate as the drop of the watertable seems to be around 60 cfs rather than 80 cfs. There is a very little change around 80 cfs until the flow drops to 60 cfs. Figure C-17 shows that for RY2004, when 8 Channel was inundated for 14 days, the water table never dropped below 5 ft of the ground surface. Second, 8 Channel section is located in a losing reach. Tentatively drawn potentiometric surface indicates the section is losing water with very steep hydraulic gradient. One foot during peak discharge to more than 4 ft of elevation difference in 100 ft of distance as shown C-10. Third, the steepness is highly variable in time depending on a time of the year because of change in a volume of water stored in the aquifer as indicated in Appendix C (page 6), suggesting variable spatial flow patterns. Thus, groundwater flows are highly variable in both time and space.	We agree that groundwater is highly variable in space and time. We did not pursue more detailed (and expensive) investigations of groundwater throughout the riparian corridors (i.e., multiple sites, modeling, etc.), but instead captured data at a few sites that would lend evidence for thresholds we identified. Clearly there is a range of interpretation with the given data, and we erred on the conservative side, favoring resource protection (riparian and groundwater maintenance). We have since analyzed the Rush Creek synoptic flow data collected by LADWP that tend to support the (approximately) 80 cfs threshold (presented below), and so do not agree to changing the recommended 80 cfs threshold. However, we are open to further experimentation, data collection, interpretation (i.e., adaptive management) and the possibility for refinement of the thresholds identified in the Synthesis Report.
				Fourth, the data are too incomplete to draw any conclusion. The existence of the deeper water table or aquifer is mentioned in Appendix C-2 but no supporting evidence is presented. Kondolf (1988) mentioned gaining stream flow below the County Road. Thus, losing maybe a general trend between the Narrow and the County Road, but the creek can gain some water back below the County Road. However, there should be more complex losing and gaining pattern in finer scales, and those fine scale patterns can affect woody riparian species growth shown by Harner and Stanford (2003). Therefore the well data from a losing reach should not be generalized over the entire section of Lower Rush Creek.	To develop conservative protective streamflow recommendations its better to use a losing reach than a gaining reach in a flow impaired system. The proposed SEF's protect riparian vegetation maintenance needs in losing reaches and gaining reaches. The area downstream of the county road was under water in 1929 and surface water distribution patterns were also much different via irrigation valley wall contributions.
40			3.1	Another comment on 80 cfs threshold: Figure C-17 clearly shows different water table behaviors between pre- and post perennial flows of 8 Channel. Steep decline in the water table does not occur until around 60 cfs for all years shown in the figure, but the magnitude of the decline is much less for th post perennial flow as at 50 cfs the water table remains within 4 ft of the ground surface. Particularly in 2008 the water table remains within 4 ft of the ground surface all year long even with discharges as low as 20 cfs. Thus, by maintaining the opening of 8 Channel as long as possible, less water is needed to keep the water table high (<5ft of the ground surface as proposed in the report). This scenario contradicts with LADWP's plan to leave alone 8 Channel after 2012, but it sheds light on a benefit of maintaining the side channel in order to lower the summer baseflow.	We disagree. In our view, there is no such clear interpretation of the data at 50 or 60 cfs. With regard to proximity of groundwater to ground surface at piezomter 8C-1, we are not managing flows to maintain GW within 5 ft of GS AT THIS SITE. This particular site is only 200 ft from the mainstem. We are instead managing flows to balance/sustain high GW stage with the least amount of flow, thus targeting the minimum threshold that presumably sustains groundwater elevations across the corridor. Likely a bench of 100 cfs would sustain slightly higher GW, but according to our interpretations, a 60 cfs bench is a more drammatic change. We fully agree with the statement that "Thus, by maintaining the opening of 8 Channel as long as possible, less water is needed to keep the water table high (<5ft of the ground surface as proposed in the report). This scenario contradicts with LADWP's plan to leave alone 8 Channel after 2012, but it sheds light on a benefit of maintaining the side channel in order to lower the summer baseflow" which is why we made the recommendation to maintain side channel oper

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
41	63	2	3.2	The duration above the thresholds is irrelevant for geomorphic objectives as most of sediment transport and deposition accomplished in first few days. Avulsion and LWD transport and recruitment are highly episodic. There is no number provided for LWD transport in Appendix (just pictures, no mention of length, diameter, a distance traveled, etc). Does the experiment realistically reflect nature of LWD in both creeks? What type of LWD do we expect in Rush and Lee Vining creeks (willows, sage brush, cottonwood, etc.?). If smaller pieces are expected to be recruited, then the threshold should be adjusted accordingly. The distance the pieces traveled is not very relevant because recruitment is necessary in the first place. A jam can form at the point of recruitment if the recruited piece can withstand the force of moving water and small pieces are recruited upstream.	We disagree that "duration above the threshold is irrelevant...." In our analysis, the duration was fundamentally important, hence the "number of Good Days" analysis, which quantified the duration for each Desired Ecological Outcome. Regarding the LWD information provided, there was more detailed information presented in the Annual Report, and we were in agreement to reference the Annual Reports, and not re-present data in the Synthesis Report. The question: "Does the experiment realistically reflect nature of LWD in both creeks?" NO. The pre-settlement and pre-41 conditions were likely quite different, but the prevailing condition is all that is available for observation. But, more data, more analysis, modeling, writing, etc. likely wouldn't change thresholds/conclusions all that much. We observed LWD transport for three years, observed that things start to happen at around 350 cfs (in RY2004, the one-day 372/412 cfs peak above/below Narrows mobilized 11 of 36 LWD pieces (M&T RY2004 Annual Report, pg. 38). Yes, we agree the distance moved is less important than actual recruitment.
			SECTION 4: Lee Vining Creek Analysis		
42			4.2.1	Since 1990, there are four Dry Normal I and II years during which the discharge exceeded 300 cfs only once. The listed desired ecological outcomes are gravel mobilization, emergent floodplain deposition, channel maintenance, fine bed material transport, point bar extension, and minor riffle mobilization. The threshold for gravel mobilization is much lower flows than 300 cfs (150-200 cfs). The largest point bar deposition was observed during 103 cfs (0.3 ft). Channel maintenance normally coincides with bankfull discharge, which is approximately 200 cfs (the theoretical fit). Fine bed material transport only applies to Rush (even then it only applies during very low GLR storate level). Point bar extention is related to erosional processes, which can be achieve with flows below the bankfull. Minor riffle mobilization needs to clarified, but I assume not a total movement (100%). Some movements were observed for flows between 160 and 200 cfs. Therefore, the thresholds may be lower than listed in Table 3-1. Thus, for those dry years, the flow can be diverted up to 300 cfs without affecting any desired ecological outcomes.	Appendix B-2 Figure 2 shows all bed mobility data collected on Lee Vining Creek. Clearly SOME bed mobility occurred below 250 cfs AT SOME SITES, but the mobility threshold was higher for other sites. We define full mobilization when 80% or more of the tracer particles mobilize ("Complete bed mobilization will be considered when 80% mobilization of the D84 occurs." M&T RY2001 Annual Report, Figure 12 Legend). This did not occur in the 150-200 cfs range suggested in the comment. The Lee Vining Creek unimpaired bankfull discharge (Q1.5 to 2.0)=300 to 375 cfs, not the 200 cfs suggested.
43	76	1	4.2.3	It should be *Figure 7*, not *Figure 6*. If you include the conceptual model, then it should be *Figure 5* and *Figure 7*.	Thank you.
44	76	1	4.2.3	It sounds like the surface water elevation was obtained, but I don't see how you transform that data into the groundwater surface elevation. The way the sentence is written, the surface water elevation and groundwater elevation are synonymous. Which is very unlikely in this semi-arid environment. In the Figure 4-7, it is explained, so clarification is necessary in the main text. What kind of the model was used to predict the water table elevation?	The water surface elevation (obtained from the aerial photograph and digital terrain model) was projected across the riparian corridor and used as a proxy for the maximum potential groundwater elevation across the corridor; then the distance was computed from this "modeled groundwater elevation" to the ground surface. This distance thus represents the minimum distance between groundwater and ground surface, and is likely an underestimate. The method used here is thus a crude estimate, and values reported in 1 ft increments.

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45	79	Figure 4-8 or C-22	4.3	How was the 30 cfs elevation line determined? Is it the actual stage elevation of near by cross section? Or is it the water table elevation corresponding to when the flow was 30 cfs? If the line represents the gage elevation, then it is very confusing without knowing the exact location of the cross section relative to the well. Is the water table supposed to be equal to the stage height? There are some periods with the water table level dropping below 6510 ft. Did it really drop below that elevation or the data do not exist during those periods? What were corresponding discharges or stage heights? Why wa the water table higher from 95 to 01, then all of sudden dropping below 6510 ft elevation from 02 to 10 after the growing seasons? Prolonged and high peak flows above 350 cfs were observed 2005 and 2006, but the water table did not respond to those prolonged and high peak flows as it did during 1995 and 1996. Why is there such a large discrepancy in the water table response to the high and prolonged flows?	1) The C piezometer array is located near cross section 6+61, between the A4 channel and the mainstem. The groundwater elevation at 30 cfs is shown on the graph. 2) No, groundwater is not expected to be same as the stream stage height. 3) We fixed the graphs to be more clear. Initially the graph was intending to show that the well went dry at stages below about 6513.5ft which also ha[ppened to correlate to when the stream dropped below 30 cfs. There is a trend in all the c-array wells that they generally go dry at 30 cfs. In both the b-array and c-array piezometers, those that are closest to the mainstem show a rapid groundwater recession at 50 cfs (see new graphs?). Piezometers closest to the A4 channel do not show the same rapid decline at 50 cfs, instead they level off at presumably because the stage change in A4 is negligible after flows recede (or the stage change at the A4 entrance is very small once flows get below about 100 cfs). Groundwater that is fed via the A4 channel does not change much flows recede (the stage changes on the mainstem are much greater th 4) The groundwater response represented by C2 probably reflects the long term trend of the A4 channel gradually shutting itself off. Piezometer C2 is closest to the A4 channel. Additionally, runoff years 1995 and 1996 were extremely wet years and wet normal years. The two years before 19956 were dry and wet-normal. RY 2005 and 2006 were wet normal and wet years. Four below normal years preceded flows in 2005. The years that precede a wet period influence groundwater in a given year. If a wet period occurs after a prolonged dry period, then the groundwater conditions must make up for the deficit in groundwater conditions created by many dry years in a row. 5) Yellow willow regeneration: As you mentioned, successful establishment event can be favored by a longer period of 100 cfs, but it needs to be accessed annually, either successful or unsuccessful, because there are other factors affecting seedlings, such as summer precip and temp. Did longer period of above 100 cfs result in successful establishment? Did successful riparian regeneration occur during the years with favorable NGD analysis result?
46	80	3	4.3.1	The range used in *Table E-1* to *E-4* of Appendix E (E10) is 15-30cfs, not 15-25cfs.	Changes made.
47	81	Figure 4-9	4.3.2	Why were two vertical dashed lines drawn between 15 cfs and 25 cfs? For the winter base flow, we are concerned about foraging habitat in primary pools, so foraging habitat in pocket pools is unnecessary information here. With dashed lines along with the pocket pool information, the table seems to support the flow range between 15 and 25 cfs for winter holding habitat.	Figure 4-9 refers to text in Section 4.3.1, not 4.3.2, thus we are discussing foraging habitat in LV. These Section #'s were also changed in the final Syn Report. Also, the dashed vertical line at 25 cfs was increased to 30 cfs. The area between the dashed lines now accounts for 75-98% of the mapped foraging habitat.
			SECTION 5: Rush Creek Analysis		
48	85	Premise 4	5.1	Does the increase in the stage translate into larger inundation extent?	Yes
49	86	Premise 7	5.1	Even with high flows, there is always laminar or viscous sublayer at the stream bottom and hyporheic zone where macroinvertebrates can survive.	TRUE
50	88	Figure 5-3	5.4	After the reconstruction of the 8 Channel entrance, the drop of the water table seems to be around 60 cfs rather than 80 cfs. There is very little change around 80 cfs until the flow drops to around 60 cfs. The sharp drops around 60 cfs are also depicted in C-17.	But the 80 cfs threshold would still be necessary for maintaining groundwater in stream reaches without side channels

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
51	88	4	5.4	It is true that the water table is higher for 80 cfs than for lower flows, and the water table must rise further. However, Figure C-10 shows that the water table closely follows or almost mimic the discharge and therefore the data is not supporting the snow melt bench. Why are higher snow benches necessary for wetter years? You have mentioned the deeper groundwater recharged by precipitation, then in wetter years there should be a greater amount of lateral flows to raise the deeper water. Therefore, the storage volume in the aquifer should be greater, and the groundwater is ready by itself for the peak.	Yes, groundwater fluctuates relatively rapidly in response to stream stage change, but our data also indicate a further refinement of this concept: the groundwater response is proportionally different at different flow rates. For example, in Figure 5-3, the RY2008 flow change from 160 to 350 cfs resulted in approximately 1 ft groundwater stage change, whereas from 100 to 160 cfs the groundwater stage changed by more than 2 ft. Regarding the deep groundwater aquifer, we have no data describing annual fluctuations or differences among runoff years, although what is described in the comment is
52	89	1	5.4	The 80 cfs mechanics is only observed in the 8 Channel section! Kondolf (1989) said Rush gains water back below the county road due to change in the substrate type. Can this 80 cfs really be generalized? If the wording changes to something like "this section is most sensitive to the water table dynamic due to its recovery stage, and the water table needs to be maintained to such a level...", then it is more acceptable than talking as if this section represents the entire bottom section because there are no data to support it.	Our recent synoptic flow data show that Rush Creek gains streamflow only briefly (perhaps for 2-4 wks?) during the peak runoff, and otherwise loses streamflow to groundwater.
53	89	4	5.4	Yellow willow regeneration: As you mentioned, successful establishment event can be favored by a longer period of 100 cfs, but it needs to be accessed annually, either successful or unsuccessful, because there are other factors affecting seedlings, such as summer precip and temp. Did longer period of above 100 cfs result in successful establishment? Did successful riparian regeneration occur during the years with favorable NGD analysis result?	Successful riparian regeneration occurred in many years during the monitoring program, and many of those years' cohorts survived to initiation, resulting in the vegetation recovery quantified by the riparian mapping.
54	91		5.5	At what cfs does the loss of foraging habitat and the cooler water from the higher flows become a wash? At a point it would be better to have more foraging habitat and warmer temps than to have not enough foraging habitat and cooler temps.	When water temperatures become high enough to limit growth, improving foraging habitat should have limited effects on improving trout growth or condition. The models used for both foraging habitats and for temperature and fish growth predictions do the have a resolution that allows for fine-scale assessments of trade-offs between foraging habitat and water temperatures. We explicitly state that during the rising and falling limbs of the snowmelt hydrograph, channel maintenance and riparian vegetation needs "trump" fish needs. After the riparian vegetation needs are met, to the extent practical, then flow recommendations are based upon water temperature needs of trout. It may be possible during cool summers to reduce flows closer to foraging habitat crieria; however, this would require a much more complex set of recommendations and much more water temperature monitoring that would be used to regulate flows on shorter time-scales (daily or weekly). The entire system could be set up that way if LADWP wants to invest in the flow regulation infrastructure necessary.
55	91	1	5.5	Did those NGYs result in the successful establishment? Have those geomorphic surfaces been converted into the patches of riparian species? Are those discharges and establishment events conceptual or observed in the field?	Successful riparian regeneration occurred in many years during the monitoring program, and many of those years cohorts survived to maturity resulting in the vegetation recovery quantified by the riparian mapping. Th edischarges and estbalishment events were quantified using band transects and are therefore observed and not conceptual.
56	91	5	5.7	Is continuous release of high peak flow sustainable considering of the fact that supply of coarse debris will decrease over time? With a dam blocking the coarse sediment, will narrowing and deepening of the channel be achieved by downcutting overtime? Can the positive loop of aggradation be replaced by the negative loop of downcutting, increasing bankfull flow, and decreasing floodplain aggradation?	Yes, sediment transport and deposition processes are likely sustainable in the long-term. The RY2005 bedload measurements revealed similar rates of sediment transport in upper and lower Rush Creek, indicating bedload supply is being maintained locally from channelbed scour and lateral migration. This conditions prevails despite a natural dam and several decades of GLR.

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57	92		5.7	RCT: this is the first time RCT (riffle crest thalweg) is used even though the term is used in Chapter 7 with a definition.	The term is used in chapters 3 and 4; we will add text to define the term at it's first use.
58	93	2	5.7	Point/lateral bar formation is set to between 500 and 550 cfs. But the bar formation is closely related to the sediment load, transport capacity, and erosion (in the case of point bar), and considering all those factors the bankfull discharge is regarded as the most effective flow to accomplish the bar formation. More than one foot of deposition was observed at 00-86 with 396cfs from Appendix B-2, Table 2, so the data show that the formation can occur with discharge way below 500cfs.	NO. Appendix B-2, Table 2 lists "Discharge at Cross Section" of 396 cfs, which was the discharge in the Lower Rush Creek mainstem, but the mainstem was conveying approximately 60% of the peak discharge and the 10-Channel was conveying approximately 40%. The RY1998 peak discharge below the Narrows was 635 cfs (see M&T RY2002 Annual Report, Table 1: "Peak Summary Table".
59	93	2	5.7	LWD debris transport/jam formation: There are only figures presented in B-3, no numbers. So it is hard to know how 400 and 450 cfs numbers are determined.	We will provide a clear reference to the Annual Report that contains those details.
60	93	2	5.7.1	Fine bedload transport. This number is based on the 2005 bedload study, right? According to Table 12b in Appendix B, D84 barely exceeded 2 mm in the first day whose daily average was 298 cfs. Is this where the threshold based on? If so, then the data only show down to 298 cfs, but no beyond. There seems to exist a trend, but the fine bedload may be transported by the discharge lower than 250 cfs. Thus there is no data to support the lower limit of the threshold.	The lower threshold value is based primarily on multiple years of observed fine bedload deposition on cross sections monitored with frequent surveys and field observations.
61	94	1	5.7.3	If Mono Lake reaches 6391 ft and LADWP is able to export 30,000 af per year, exports will need to begin before the snow melt peak.	The recommendation to curtail exports is explicitly made to increase the probability of spilling GLR. If peak releases can be made in lieu of spill events to achieve recommended peak magnitudes, then export curtailment would not be necessary.
62	95	Table 5-1	5.7.1	The discharge for 25 year recurrence interval should**not** be 100 cfs.	Changes made
63	97	Table 5-2	5.9	Did those NGYs result in the successful establishment? Have those geomorphic surfaces been converted into the patches of riparian species? Are those discharges and establishment events conceptual or observed in the field?	Successful riparian regeneration occurred in many years during the monitoring program, and many of those years cohorts survived to maturity resulting in the vegetation recovery quantified by the riparian mapping. Th edischarges and estbalishment events were quantified using band transects and are therefore observed and not conceptual.
64			5.9	How much regeneration has occurred in the past 12 years? Is it enough to sustain a long term riparian maintenance?	On Rush Creek, vegetation has expanded 27.8 acres (176 in 1999 to 204 in 2009). We are not clear what is meant by "sustain a long term riparian maintenance."
65			5.10	What is the cause of this high diurnal fluctuation? Is it something that can be alleviated by the SEFs except raising the GLR level and diverting off 5-Siphon?	We are unsure exactly what you are referencing in this comment, but will try to answer generically. Diurnal fluctuations in water temperatures are primarily caused by wide diurnal fluctuations in air temperatures. One way to limit the influence of air temperature is to have a larger mass of water, higher flows, moving down the channel because a larger mass of water takes longer to heat and cool. A second, but much less impactive strategy, would be to have more channel shading to limit heating of water during the day.
66			5.10	How much of temperature increase in Lower Rush is alleviated by canopy cover? Has canopy cover over the channel increased or decreased last 12 years? How much of channel complexity exist in Rush Creek, enhancing surface- and groundwater interactions? Will increase in channel length result the channel complexity?	This was answered in Appendix D (page D28). We refer you to this appendix for existing shading conditions and scenarios where shading was increased.
67			5.10	The type of trees providing canopy cover does seem to matter as yellow willows (16 ft) and cottonwoods (40 to 100 ft) progressively provide more cover. It appears that cottonwoods are more abundant in Lee Vining than Rush. Are we somehow missing regeneration opportunities for cottonwoods in Rush? Or are cottonwoods historically less common in Rush?	Yellow willow and cottonwood provide qualitatively different canopy cover. Yellow willow regeneration has dominated Rush Creek's riparian vegetation recovery the past 12 years, possibly due to delayed timing of the snowmelt hydrograph, magnitude and duration of snowmelt floods, and fewer mature cottonwoods providing sead sources for regeneration. Cottonwoods were historically more common in Rush Creek based on examination of the 1929 Fairchild photos.

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68			5.10	What is the lateral heat influx from the artificial side channels or the main channel in the 10 Channel section into the main stem (or 10 Channel)? Is this the primary cause of high diurnal fluctuation?	We explicitly stated that we did not evaluate the influence of side channels on predicted water temperatures (see Shepard et al. 2009c in references). One of the assumptions for the StreamTemp water temperature model was that Rush Creek flowed through a single-thread channel. More detailed and fine-scale water temperature predictions could be undertaken for segments of Rush Creek where side channels occur, but these analyses would take additional time and be moderately costly. A series of thermographs set above, within, and below the 10-Channel would also provide data to answer the questions posed.
69			5.10	What is the microscale variability of temperature? Is there any thermally favorable spots for fish during very stressful summer months?	The temperature model did not evaluate non-uniform mixing of water (see Shepard et al. 2009c in references). The StreamTemp water temperature model assumes uniform mixing of water, and thus water temperature, throughout the water column. There are undoubtedly areas of microtemperature differences, typically associated with groundwater, however, a detailed mapping of all groundwater inputs to the channel would be necessary throughout the summer period to begin to model these influences. We would welcome this type of effort to better assess water temperature effects, but it would require lots of data over several years and a modification of the StreamTemp model to accomodate these details.
70	99	1	5.10.2	What is the temperature regime of Rush Creek above the dam?	We have no data other than some limited data collected by CalTrout in 2009 through mid-July, thus we have recommended water temperature is monitored in Rush Creek upstream of GLR. These data along with GLR thermal profiles should strengthen future temp modeling predictions.
71		Figure 5-8 to 5-10	5.10.2	What is the difference between Full-No and Empty-No? Where is the 5-Siphon scenario?	Perhaps we need to be more explicit in the report; however, on the figure legends (Figure 5-8 through 5-11) it states, "...Grant Lake Reservoir full or empty (Full or Empty), and 5-Siphon Bypass flows added or not added to Rush Creek (Yes or No)." Thus, "Full" indicates that GLR is full, "Empty" indicates that GLR is empty, "Yes" indicates that 5-sipon flows are added to Rush Creek, and "No" indicates that 5-siphon flows are NOT added to Rush Creek.
72	105	2	5.10.4	How would flow out of the 5 siphons be triggered? Would LADWP follow a guideline that if Grant Lake is below 25,000AF storage and diversions were available from Lee Vining Creek, then the 5 siphons should be turned on? Specific guidelines would be helpful for LADWP personnel in deciding whether upgrades are needed or not at the 5 siphons facility. Due to the Grant Lake being at or near full under the recommended operations, the Conduit at the 5 Siphons will be somewhere near 3.5 feet deep at times when the 5 siphons is to be operated. We feel a permanent partial bulkhead needs to be installed covering the bottom 3.5 feet of the Conduit so when the 5 siphons is to be operated, the bulkhead will not have to be installed under the surface of the standing water in the Conduit.	Specific guidelines regarding the operation of the 5-Siphons were added to Section 2.4.2. Because this use of the 5-Siphons is limited to when GLR storage is less than 25,000 af isn't the concern about depth within the conduit not applicable since GLR will not be at or near full?
73				The 5 siphons structure was not designed to flow with flow also going into Grant Lake simultaneously. However, there is a bypass gate just downstream of 5 siphons (called Sand Trap #5) which can be used to flow approximately 5 cfs down the 5 siphons spillway while the rest of the Conduit flow goes into Grant Lake.	We are not recommending a split in the LV diversion between the 5-Siphon flow and GLR.
			SECTION 6: Grant Lake Reservoir Simulation		
74	110	Table 6-1	6.1	Why the number of days when GLR is above 7,090 ft is fewer than those when GLR is above 7,100 ft for the Scenario 3?	There was an error in the excel spreadsheet, corrected now.

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75	110	Table 6-1	6.1	What is the difference between Scenario 4 and 7 as both say that Rush/Lee Vining SEF, 16K export, no curtailment?	They were the same, an older version of the table was mistakenly used. Scenario 7 is deleted from the updated Table.
76	109	Scenario 1	6.1	There are some discrepancies between the actual and predicted levels. Did you do anything to reduce the discrepancies? What is the error for each NGD analysis? What are the errors associated with the volume translated into in the terms of the surface elevation?	Yes, we have discussed the error between our predicted and observed valused in our simple spreadsheet (lack of initial GLR elevation data before 6/1991, evaporation data, etc.). The model calibration was as good as we could make it for the basic-level analyses that we needed to run. However, we strongly support LADWP's efforts and plans to develop more sophisticated modeling ability, to reduce these discrepancies.
77	111	Scenario 4	6.1	An indentation for Scenario 5.	Fixed
78	112		6.1	Scenario 7?	Eliminated
79	111	Scenario 6	6.1	Due to the fact that this is the scenario which is highly likely to occur for a long time, LADWP must make sure it is prepared to operate under the results of this scenario. From the graph of this scenario in the appendix (F9 - page 265) it is obvious Grant Lake will be at or near full for years at a time while scenario 6 is in effect. Improvements to the Grant Lake spillway and the existing wooden vehicle bridge below the spillway will need to be made. The dam at Grant Lake is an earthen dam, just like others LADWP owns and operates. Three of LADWP's dams (Tinemaha, Haiwee, and Bouquet) have had maximum water level restrictions placed on them from the state of California due to dam safety issues. Operating Grant Lake at or near full at all times has the possibility to stress the dam and cause issues in the future which could result in maximum water level restrictions below the spillway of the dam being put in place. The final court accepted operations should reflect some sort of provision in the case of future water level operating restrictions being placed on the Grant Lake dam due to dam safety issues.	Seems an important factor to point out.
			SECTION 7: Termination Criteria and Monitoring		
80	118		7.1.2	Large diurnal fluctuations in Lower Rush can be attributable to low flows, a lack of shading, reduced channel complexity, lateral influx of heat, loss of flows, etc., but not so much to stream temperature except buffering capacity due to lower temp. How much daily fluctuations can stream flows with lower temp (same discharge) reduce? If the flow stays same, how much fluctuation can the 5-Siphon flows reduce? There must be some dysfunctional buffering and insulating processes.	Not sure of the exact question here, but see the reponse to Comment Number 65 above. As far as 5-siphon additions there is not a scenario where addition of 5-siphon water would not change the flow volumes. Addition of 5-siphon flows would potentially accomplish two things. First, it would increase flow volumes, which would reduce daily fluctuations. Secondly, it would add cooler water, reducing the daily maximum water temperatures, which is the primary goal for reducing impacts on trout.
81			7.1.2	What would happen when no intervention will be made to ensure inflows into excavated channels and riparian plants start dying? Because of the acreage criteria of the riparian patches, are we going to enhance inflows even though it has detrimental effects on stream temperature?	Side-channel entrances should be maintained unti the "exit-strategy" of a >2ft differential between mainstem and side-channel entrance is reached, then maintenance can cease. If lack of flow into side-channels then causes die-back of established riparian vegetation, this would be viewed by the Stream Scientists as a natural process in an evolving arid landscape.
82			7.1.5	Why no number on recruitment and survival over the years is not presented in the report? You mentioned that the riparian establishment is lagging behind. Do you mean lagging behind the termination criteria set for the reach? A large number of seedlings (>250 in 2005 report, 358 in 2006 report, 247 in 2007 report) were observed, and frequencies of woody species were somewhat stable, but there was no 3D riparian status in 2008 and 2009 reports. Was no monitoring done in RY 2007 and 2008? High germination rate and high mortality rate are typical of riparian community in the semi-arid regions. So are you assuming the same trend in the subsequent years? 2009 aerial photos show very little vegetation growing in the 3D floodplain. What was the reason to conclude the establishment is lagging behind? Is the ground elevation too high or is water table too low? Is the substrate too coarse? The reason is more likely for both, thus it sounds like successful establish can occur only during consecutive wet years with relatively cool and wet summers just like many other places in Rush Creek.	Annual seedling monitoring and recruitment trends were not assessed during our study. Seedling mortality may be high annually. However, successful riparian regeneration occurred in many years during the monitoring program, and many of those years' cohorts survived establishmnet and has resulted in the vegetation recovery quantified by the riparian mapping. The recovery rate of woody vegetation acres is the measured metric. The presence and absence of seedlings is not recovery- it is the the

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83			7.1.5	The 3D should not be kept open indefinitely, but should be left alone with no maintenance. The exposed 3D section can increase heat load to the main channel. The tentative potentiometric surface based on the well data (2005 Compliance Report) show main channel losing water. Some cross sectiona overviews from subsequent reports confirm it. Thus, for the thermal regime, it is a setback as the main channel losing the flow (increasing the heat load concentration) and the side channel gaining the heat load by being exposed (and by losing water as well). Being a losing reach with very steep hydrau gradient makes very difficult for successful riparian establish to occur. What is the purpose of keeping this side channel? When a big flow comes, it will wash out whatever on its way anyway and the coarse sediments will be redistributed below the Narrows.	Our objective is to give riparian vegetation recovery as big a boost into the future as possible with the available streamflow regime combined with relatively minor mechanical manipulation in the near future. We cannot predict with certainty if established vegetation would be subject to mortaility if perennial flow were cutoff, but there are mature woody trees already surviving on the 3D surface. If large floods cause extensive channel downcutting, the Stream Scientists do not support intensive mechanical work to reopen and maintain perennial flow, hence the threshold based on riffle crest thalweg change. The potential thermal loading caused by side channel flow is likely relatively minor and will slowly be offset with recovery of riparian vegetation along the side channel providing shade relief.
84	124		7.1.6	Is the annual fisheries population monitoring going to continue indefinitely?	The Stream Scientists' recommendation is that annual fisheries monitoring should continue as long as these data are necessary for adaptive management purposes. Annual monitoring should probably occur through the transition period and through the post-transition period until at least each RY type has been experienced. The Water Board will ultimately determine when, and if, fish monitoring should end.
			SECTION 8: Climate Change Implications for Future Streamflow Recommendations and Monitoring		
85			8	If the trend of reduced snowpack and earlier snow melt is observed (which means lower peak flows), will the runoff years be recategorized?	LADWP should propose a periodic adjustment (e.g., every 5 or 10 years) to the mean annual yield, to accommodate responses to climatic changes.
			APPENDIX		
86	A54		Table A-4	How did Lee Vining have a peak of 444 cfs above the intake and a peak 457 below in runoff year 2006?	The data are provided to us by LADWP. Please check with your Bishop hydrographers to answer this question. We assume it's a rating curve issue, not a real difference in magnitude.
87	B2	2	B-1	The mobility threshold at Upper Rush was defined as between 450 and 550 cfs. But the data only exist at around 400 cfs and around 550 cfs. At XS 12+95, the same numbers of largest rocks were moved by 400 and 550 cfs. There is no data between 200 and 550 cfs at XS 5+45. The number of largest rocks moved declined at XS 0+74 from 400 cfs to 550 cfs. Thus, threshold seems to fall somewhere between 400 and 500 cfs, rather than between 450 and 550 cfs.	We made our best estimates based on field observations and the data available. It's not an exact science. In Appendix B-2, Figure 1: at XS 12+95 at 400 cfs, 60-70% of particles mobilized; at XS 5+45, at 530 cfs, 60% of D84s moved while 100% of D50 and D31 particles mobilized; at XS 0+74 at 400 cfs 50% of D84s mobilized while 80-90% of D50s and D31 particles moved.
88	B17	2	B-3	Hypothesis 3 cannot be right. Does one flow transport the all available bedload in a period of 8 days to deplete the sediment supply? The sediment transport can decrease or cease simply due to jerky rates of the bed load transports.	What is meant by sediment supply is the readily available supply at that season and flow magnitude
89	B27	3	3.3.4.3	There is no sediment rating curve presented (supposedly Figure 29) in the section. I found in the following section. It should be noted.	This has been noted.
90	B40	Table 14	3.4.1	There is no Appendix G. Where are the figures?	As explained in the Appendix Introduction, this section is excerpted from the Annual Report. The Appendix G referenced is thus in the Annual Report (M&T 2006).
91	B43	1	3.4.3	It is said that the most deposition occurs in the first two days during the rising limb (200 to 400 cfs), so during the receding limb scouring can occur because of hysteresis you have mentioned. What are total accumulations of sediments before and after?	The hyseresis does not imply scouring (this is the wrong conclusion); it implies redued rates of transport and deposition.
92			B-6	Any text or numbers? It is hard to understand the figures without information such as length, diameter, orientation, and location of each LWD debris, and how far the pieces moved after what flow. Chanel width, slope, stage height, roughness, etc. are nice things to know as well. Is there any relationship between size/distance/number of LWD moved and discharge?	This information was presented in Annual Reports (M&T 2005, 2006); we only provided the transport maps in this appendix.

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93	C3		C-3	Figure C-4. Does the age structure of patches correspond to the consecutive wet years? Is it a high peak flow or relatively cooler and wet summer contributing to the success?	We did not analyze the relation between ambient summer climatic conditions, and age structure or growth of riparian vegetation, so are unable to answer this question.
94	C4		C-4	Assumption 2 may not be accurate without knowing recharging and discharging patterns of groundwater along the channels. In the 8 Channel section, the stream is losing water according to the stage height and piezometer comparison shown in the Figure C-10 and C-11. Steepness of hydraulic gradient changes with discharge (lower the flow steeper the gradient). Even with 423 cfs in 2008, the piezometer does not show surface saturation (more than one foot below the ground level). When wells along the same cross section are compared (8C-5 and 8C-6), the water table is lower at 8C-6 most of the year even with perennial flows on 8 Channel, thus further supporting the non-horizontal plane of the water table (interestingly in Figure C-1 8C-1 and 8C-3 are not presented to compare to 8C-2 and 8C-4 respectively for comparison along the same transect). Thus, the watertable should not be projected horizontally across, and the actual values of the depth to the water table for 91 cfs and 63 cfs should be larger in most of the riparian patches. The first paragraph in C-6 talks about the small change in stage height resulting in large change in water table level especially during low flow The change is more pronounced for the latter discharge change of 51 cfs to 21 cfs which resulting in the water table level change of 2.15 ft (page C6) than the former (101 cfs to 24 cfs which resulted in 0.56 ft of the water table drop even though C-10 shows the drop is more like 1.3 ft instead of 0.56 ft). This indicates that groundwater flow velocity is faster than the recharging rate of "the shallow aquifer", thus the hydraulic gradient is in part determined by storage of the aquifer. The aerial photos were taken after the peak during the receding limb (from Appendix A-1, a peak for Rush was in the beginning of June and a peak for Lee Vining was toward the mid June) with higher storage of the aquifers for both streams. Thus, the water table levels during 91 cfs and 63 cfs even with properly modeled water table elevation do only reflect the depth to the water table at these discharges during the receding limb, but not other time of the year, particularly in the mid to late summer. The depths should be greater than 3 ft and 5 ft for riparian patches.	Assumption 2 states the horizontal plane defines an UPPER LIMIT to GW elevation; however, we acknowlege the GW slopes away from the channel in most/all locations and seasons. But because we do not have an estimate of the rate of GW decline with distance from the channel (it's likely non-uniform anyway) we made this assumption to (as stated) simplify our analyses. NOt all XS data and figures are presented, but do indicate the same trend of increasing depth to GW with distance from main channel. The 3 ft and 5 ft depth estimates are generalized, conservative estimates; we agree that greater depths to groundwater can support riparian vegetation in some locations;
95	C5		C-5	The reasons for selecting 8 Channel for extensive groundwater studies are presented, but it is not justification to generalize the results from 8 Channel. We can study all we want at one study site, but we cannot generalize the results over the entire lower section creek without knowing the groundwater flow patterns in the other parts.	But it was also not feasible to study groundwater along the entire stream corridors. The Blue and White Books (Mono Basin Monitoring Guidelines) long ago called for this Study Site approach. In our view, the 8-Channel (and 4Bii floodplain where extensive observations were made) provided the best range of representative conditions.
96	C6		C-6	The primary mechanism for the relationships between stage height and groundwater level is not streamflow rate, but a combination of hydraulic conductivity, hydraulic gradient, sediment size and sorting (or porosity and connectivity), transmissivity, and storativy.	But all those processes are influenced differently by flow rate.
97	C8		C-6	What is the root structure of the woody riparian species? How deep do root penetrate? Cottonwood, in particular, can grow their roots deeper into the substrate. Did the growth really cease under the condition described?	Yes, some species and/or individual trees have deeper root systems, and may be able to grow longer in the season before growth ceases; our analyses made generalizations attempting to manage for multiple species, life stages, and age structures;
98	C8		C-6	The well data does not really support this point about snow bench. The data show extremely high hydraulic conductivity as the water table almost mimicking the stage height. So even without the bench the data suggest that the water table rises. C-12 and C-13 present confounding factors as the comparing 2006 to 2008, the surface areas of inundation has increased by switching 8 Channel to perennial. Can you achieve this spring bench preparation without opening a new channel? Is this trend of faster response observed in other wells near the main channel or other areas with wells without a side channel?	Not sure which point is referred to.
99	C15		C-6	How do you come up with these numbers (5 ft for Rush and 3 ft for Lee Vining)?	Explained in Section C-4
100	C19		C-10	RY is 2008-2009, not 2009-2010. I assume the same for C-11.	date references were corrected
101	C19		C-10	Dates for dashed lines do not coincide with dates along the x-axis. It is confusing.	date references were corrected
102	C20		C-11	Well data from 8C-1 and 8C-3 should be presented in the figure.	there are no datalogger data from those piezometers
103	C21		C-12	It is more informative if the flows during the same period are presented and periods during which water was flowing in 8 Channel are presented, particularly for 2003 to 2005 when the flows were not perennial, instead of having only a number of days.	figure was not changed

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104	C26		C-17	The figure shows that for pre perennial 8 Channel, the water table dropped dramatically around 60 cfs (I can see it starts dropping below 80 cfs), but fo post perennial 8 Channel, the water table does not drop until the flow is below 50 cfs. Therefore, 80 cfs is not clear cut nor indicative of the data you ar showing.	We agree that groundwater is highly variable in space and time. However, our recommendations do NOT always entail managing for the MINIMUM. In some cases, given the need to extrapolate site-specific data to reach-wide conditions, our assumptions or estimates are purposefully conservative. More data collection could conceivably refine boundaries, thresholds, etc.
105	C31		C-22	How was the 30 cfs elevation line determined? Is it the actual stage elevation of near by cross section? Or is it the water table elevation corresponding to when the flow was 30 cfs?	The 30 cfs corresponds to the discharge in the mainstem below which groundwater elevations begin to decline more precipitously
106	D4		D-2	The pool rating method by Platts and others was published in 1983, not 1987.	The referenced date was changed to 1983 in the text and in the Literature Cited.
107			D-4	GLR full is the best scenario for all years, and some years adding 5-Siphon does not make a large difference. Can you change a ratio of MGORD and 5-Siphon flowing into Rush? You have evaluated adding 5 and 10 cfs, but can you add more than that in the case GLR is not full? For instance, for 30 cfs summer baseflow, can you release 15 cfs from MGORD and 15 cfs from 5 Siphon?	These scenarios were exploratory scenarios to illustrate the relative influences of GLR and 5-siphon additions to water temperature predictions. It would be possible to do more of these exploratory scenarios if these are deemed important enough to fund. When we modeled scenarios that were based on water year flow types for flows that would actually be available from Lee Vining Creek via the 5-siphon, these flows ranged from zero to about 37 cfs. However, during some flow year types we opted to divert much of the flow from the 5-siphon was into GLR instead of into upper Rush Creek because filling GLR provided a better means of regulating water temperatures over the long-term. **Additional Response:** regardless of Streamtemp modeling scenarios, we do **not** recommend a reduction of the MGORD flow below 25 cfs at any time of the year and do **not** recommend diverting more LV water down the 5-siphons than is available under the allowable diversion rate.
108	D23		D-4.3	Why are a number of days falling outside the 52 and 67 range is greater for the smaller range (56 and 60) than the larger range (54 and 62.5).	The number of days in the range of 56 to 60 is NOT greater than the number of days in the range of 54 to 62.5 on the Figure.
109	D24		D-4.4	Lower the flow more cooling can take place according to the figures. Thus, if Rush is impaired at MGORD , then augmenting the flow is detrimental.	As we stated in the report, whether cooling or warming of Rush Creek occurs depends upon a complex interaction of air temperatures, initial water temperatures, flow volumes, and other variables. If Rush Creek is impaired at the MGORD (i.e., water temperatures are too high), then adding cooler 5-siphon flows will always be beneficial. If NO 5-siphon flows are available, then the decision to augment flows with additional water from GLR would depend upon air temperatures. When air temperatures were warmer than water temperatures, augmenting flows would result in cooler water temperatures in lower Rush Creek. However, if air temperatures are cooler than water temperatures coming out of GLR, then you are correct in suggesting that adding additional GLR water at the MGORD would be detrimental (not allow water to cool as it flows down Rush Creek due to cooler air temperatures).

NO.	PAGE	PARAGRAPH	SECTION NO.	COMMENTS	SCIENTISTS RESPONSE/ACTIONS
110	D29		D-4.4	The model result that lower flow with higher water temperature can cool down contradicts to the assumption made for the riparian vegetation. Well data from 8 Channel section was used to justify "80 cfs threshold" for the entire Lower Rush, and it is obvious that the section is losing water. Thus, the use of this 80 cfs threshold is admitting the entire Lower Rush is losing water. The loss of water through the channel should offset cooling by Parker and Walker, and the well data also show that the rate of loss is higher or hydraulic gradient is steeper for lower flows at least at 8 Channel section. So lower the flow, more water the creek should lose resulting greater offset of cooling by Parker and Walker. There are slight tendencies of increased temperature downstream from Walker, at least that is what the model says. How much of warming is attributable to heat gain or water loss? Or maybe Rush Creek gains back some water back or there are fine scale hyporheic flows in the Lower Rush section.	The StreamTemp model actually modeled water losses from the Rush Creek channel between Highway 395 and Parker Creek and also modeled additions of water from both Parker and Walker creeks (see Shepard 2009c in the references and read this report). Thus, the model is already using these flow losses and gains to model temperature in lower Rush Creek.
111	D49		D-4.18 and D-4.19	There is no horizontal line at 65̊F. Did all the dates have the same discharge?	You are correct in that the reference lines at 65 F on these graphs did not appear when these graphs were transferred to this document. The flows (discharges) varied by the scenario that was modeled, but the climate was the same for the different flow scenarios.
112	D49		D-4.20 and D-4.21	Where are actual values?	Not sure of what you are asking for here. These are predictions of what the average temperatures would be on various dates by stream kilometer to show how predicted water temperatures would be predicted to change on different dates down the length of Rush Creek. The actual values for temperature are given on the y-axes. Flow values were based on the water year types and date with the scenarios listed.
113	E10		E-1 to E-4	Different terms are used for the last category of riparian growth and maintenance ("groundwater and saturating emergent floodplain surfaces" vs. "minimum streamflows recharging shallow groundwater and saturating emergent floodplain surface"). I think both describe the same thing, but it is confusing.	They are the same thing, the chart legend was fixed to make charts consistent
114	E10		E-1 to E-4	There are two years (1995 and 1996) whose discharges exceeded 500 cfs even under the SCE regulated flow regime (recurrence interval of 15 years or so). However, NGD for mainstem channel avulsion is zero for SCE regulated and SEF. Why are there no channel avulsion flow for those two scenarios? As matter fact, there is one actual day recorded in 1995 but that number does not appear on the average NGD section. 1996 event should appear here too, because a winter flood is as much as competent as a spring flood, and can be more competent because of high saturation of the soil.	The comment is correct, the RY1996 peak winter flood event of 524 cfs should be included as an NGD. SO, in summary, RY1995 and 1996 each had one day exceeding 500 cfs. RY1995 is Wet; RY1996 is Extreme-Wet. In the NGD analysis those RY types are combined, so the average of Wet/Ex-Wet years is 0.4 two out of five wet years); the decimal place was changed in the table to reflect this change.
115	E18		E-5 to E-12	The title of the table should not contain "averages for each runoff year type, and average for all runoff years combined" since no such numbers are presented in those tables.	Yes, the averages are presented in the tables.
116	E34		E-13	Why are some averages for all runoff years zero even though NGDs are non-zero for different runoff year types? How were the all runoff year values calculated?	The NGDs were rounded to a singe digit, so if the NGD was less than 0.5 it was rounded to zero.
117	F1		Appendix F	Where is the description of scenario 7? I don't see any difference between scenario 4B and 7, yet they have slightly different numbers.	This was an error that was corrected. There is no longer a scenario 7, it was the same as scenario 4
118	F2		Appendix F	Table should be F-1, instead of E-1.	fixed
119		Fig F-1 -F11	Appendix F	Grant Lake spillway elevation should be updated to 47,171 af.	fixed

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Overall Approach				
		Primary objectives The draft report identifies ten objectives (p.60) that inform the instream flow recommendations. These objectives identify operational constraints that have been affecting the restoration of Rush and Lee Vining Creeks (e.g. reducing SCE's elevated winter baseflows, encouraging SCE's assistance in releasing higher peak runoff events, and managing Grant Lake Reservoir at a higher level to facilitate spills). The objectives also identify specific needs of the system to reinstate natural processes (e.g. adjusting Rush Creek Stream Restoration Flows to better achieve ecological function, provide a shallow groundwater system necessary for riparian vegetation, and improve trout populations for both creeks by increasing habitat and improving growth rates). We agree with all of them with the exception of number ten—the elimination of termination criteria—as discussed subsequently.	Please see response in Chapter 9 Introduction.	**M&T**
		Desired ecological outcomes The summary of the desired ecological outcomes for Rush and Lee Vining creeks (table 3-1) is very helpful to understanding how each component was evaluated and factored into actual flow recommendations. MLC is pleased to see that a flow range is prescribed for each desired outcome. This represents more accurately the fact that thresholds for biological and physical processes are not discrete but vary spatially and temporally. MLC offers a detailed comment in section III, comment F.17	Thank You.	**M&T**
		Number of Good Days (NGD) analysis approach While MLC is not in a position to render judgment on the universal benefit of the Number of Good Days (NGD) approach to stream restoration throughout the western United States, we observe that this represents the most successful integration to date of the multiple factors that influence Mono Basin stream restoration. Accordingly, MLC recognizes the NGD strategy as a useful approach to the task at hand of producing Mono Basin stream flow recommendations. The NGD approach leads to determination of "good years" and "bad years" for the desired ecological outcomes being evaluated. Bad years are to be expected, yet it is the good years that advance restoration. The draft report, however, is unclear on how many good years are needed over a specified time period to achieve the desired ecological outcomes listed in table 3-1. We suggest adding this information	There should not be a recommended minimum for the number of 'good years' (NGYs). The NGD analytical strategy relies on the natural timing and frequency for each desired outcome in Table 3-1 determined by RY type occurrence, and generally allocates diversions based on acceptable changes to streamflow magnitude and duration. An exception is the recommended loss of low magnitude floods in drier RYs. By stipulating minimum NGYs over a specified time period, we would be creating a new breed of termination criteria (which is not our intention). For recovery and short/long-term sustenance, Rush and Lee Vining creek ecosystems will require all their good and bad years provided by the annual SEFs.	**M&T**
		Rebalancing of export volume between Rush and Lee Vining The draft report proposes to rebalance diversions to more equitably divert water for export to Los Angeles from Lee Vining and Rush creeks (p.35). MLC believes this is a good approach that will go a long way to balancing the restoration progress of both systems. MLC notes that in the present day this will result in a significant reallocation of diversions, and that in the post-transition situation (after Mono Lake has achieved its required management level) exports will be larger and the balance will shift toward greater proportional diversion impact on Rush Creek. The final report should anticipate the need to monitor these situations for possible adaptive management action, and MLC offers a detailed suggestion in section III, comment A.19.	Thank You.	**M&T**
		Abandonment of Rush Creek augmentation MLC agrees that making diversions into the aqueduct to achieve "augmentation of Rush Creek peaks from Lee Vining Creek … is not ecologically sustainable" (p.35). This strategy has been given a 12-year test run to prove viability. Over that time period, it has proven to be inconsistent in success, has caused flow violations and downstream Lee Vining Creek impairment, and has been operationally difficult for LADWP due to the required snowmelt forecasting and short notice operational changes to the aqueduct. MLC concurs that augmentation as a flow delivery strategy should be abandoned.	Thank You.	**M&T**

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Lee Vining Creek				
		1. Hybrid strategy of bypass and diversion MLC generally supports the stream scientists' recommendation that a "hybrid" diversion strategy be employed for Lee Vining Creek to achieve the recommended flows in winter and provide greater natural flow variability in spring and summer. This will result in a specified bypass flow being released between October 1 and March 31, and a defined rate of diversion being employed between April 1 and September 30.	Thank You.	**M&T**
		2. Peak passing strategy MLC supports the strategy outlined of halting diversions at flows above 250 cfs in order to assure passing the peak flow on Lee Vining Creek to achieve downstream ecological and geomorphologic restoration benefits. This approach, however, is only required for April 1- September 30, and we do have concern that the over-winter peaks October 1 – March 31 will not be passed. The draft report (p. 82) states that one rain on snow event in 19 years provides "no justification" for preserving winter peaks. The draft report also states (p. 41) that no specific ecological objectives are solely met by a winter flood. In contrast, we would like to point out that the groundwater recharge and channel avulsions during the January 1997 event were on a scale that has not been matched since. The final report should reconsider the value of passing winter peak flows, and MLC offers a detailed suggestion in section III, comment F.14. The final report should also consider the obstacles to achieving the anticipated SEF peaks, and MLC offers a detailed comment in section III, comment F.12.	We agree the flood of January 1997 was capable of significant geomorphic work; the 1995 snowmelt peak was of comparable magnitude. The historic 1997 flood was passed, albiet with diminished magnitude. Regarding recharge of groundwater, we note there was a significant groundwater response to the January 1997 flood, but groundwater receded relatively quickly after the flood (by March), and required spring snowmelt to again recharge groundwater for summer riparian maintenance functions (i.e., little or no lasting signature in the groundwater). Therefore, the primary ecological outcome resulting from passing winter floods is increased frequency of major geomorphic events. In making our recommendation, we weighed the benefit of this increase in frequency against the net impact to the fishery from a large winter flood. Recent discussions with Brian Tillemans clarified LADWP's perspective that, operationally, diverting large winter peak events is undesirable because of the potential entrainment of coarse sediment into the Conduit. Given these considerations, and making the tradeoffs explicit between accomplishing geomorphic objectives and risking adverse fish population responses, we agree to revise our recommendation and support curtailment of diversions into the Lee Vining Conduit during large-magnitude winter flood events. We suggest the same threshold of 250 cfs at the Lee Vining above Intake gage recommended for preserving snowmelt peaks should apply to winter peaks as well. Text describing this revised recommendation is added to Section 2.4.1	**RTA and M&T**
		3. Reduced winter flow strategy MLC supports the draft report's winter flow recommendations with the caveat that the benefits of lower winter flows to the ability of trout to overwinter are still in the process of being tested and confirmed. The draft report offers the premise that the lower winter flows will not cause any habitat degradation. If this indeed proves to be the case, long term implementation of the recommended winter flows will be appropriate. Of key importance during this testing period is maintaining a comprehensive monitoring program to assess the benefits or impacts to the trout under these flow conditions. Should the lowered flow prove damaging to trout or other stream ecosystem components then the flow should be reconsidered. Additionally, MLC notes that these new, lower baseflows of less than 25-40 cubic feet per second (cfs) will place the system in a condition that is highly vulnerable in the event of operational error; a 5 cfs release reduction error would reduce flow by 25–30% and likely cause significant fishery impacts. Operational precision and reliability will be needed to prevent such situations.	1) We concur with the MLC that additional monitoring of the winter flow recommendations should occur beyond the 2009-10 effort. 2) Continued monitoring of the trout population is recommended including the continued use of PIT tags to assess specific growth rates and condition factors. 3) For Lee Vining Creek we have included specific language in the final Synthesis Report that the winter flows recommended in Table 2.7 are **minimum flows** of DWP's operational range, thus no flows below those specified in Table 2-7 should occur.	**RTA**

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		4. Bypass and diversion flow tables **1. Table 2-6 for April 1 to Sept 30** MLC supports the daily diversion rate table presented (table 2-6) because it reduces the risk of peak flow diversion, is operationally simpler and more reliable, and was developed through an appropriate stage height change analysis (p.39). MLC understands that for operational reasons LADWP may propose modifying the table to utilize steps larger than the 1 cfs increments provided. MLC concurs with the stream scientists' 5% bracketing strategy (p. 58) in this event. MLC underscores that this is not a strategy to allow lower minimum flows. It does provide a good faith measure to accommodate tolerable operational impacts on flow. If LADWP proposes to take advantage of this approach, an accompanying reporting and compliance analysis plan should be developed. The final report should address possible undesirable operational impairment of the peak flows at times when flows are fluctuating around 250 cfs. MLC offers a detailed suggestion in section III, comment F.9.	We agree that a compliance analysis and reporting procedure is developed for implementing the 5% bracketing strategy.	**RTA and M&T**
		4. Bypass and diversion flow tables **2. Table 2-7 for October 1 to March 31** MLC supports the recommended daily bypass table presented (table 2-7) because it shifts water diversions to a less impactful time of year and is expected to benefit fish downstream without causing habitat degradation. For both tables 2-6 and 2-7, the final report should address possible undesirable flow fluctuations during the semiannual transitions between the two strategies. MLC offers a detailed suggestion in section III, comment F.8.	Thank You.	**M&T**
Walker and Parker Creeks				
		1. Continued curtailment of diversions MLC supports the recommendation that there continue to be no diversion of Walker and Parker creeks into the aqueduct conduit (p.37). This flow management approach has been successful to date, resulting in a positive fishery, channel form, vegetation, and other ecosystem attributes documented by the stream scientists. MLC agrees with the stream scientists (p.38) that flow through conditions will also benefit Rush Creek by adding flow volume and natural variability below their confluences in Lower Rush Creek. MLC notes that successful implementation of sediment bypass measures is still pending at the diversion facility on these two creeks. This task, required in Order 98-05, will be in its second year of testing in summer 2010. MLC also notes that maintaining flow through conditions on Parker and Walker creeks will not impair the ability of LADWP to export the full volume of water it is allowed under D1631 from the Mono Basin, either in the transition or post-transition timeframes.	Thank You.	**RTA and M&T**
Rush Creek				

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		1. Flow release strategy Streamflows are the most critical component of stream restoration in the Mono Basin. MLC supports the approach taken in developing the flow release strategy for Rush Creek. As seen in the past 12 years of monitoring, focusing on reinstating natural processes to the greatest extent possible has provided a solid foundation of information to build upon. MLC appreciates the use of the unimpaired hydrograph as a template to shape the regulated hydrograph and prescribe Rush Creek flows, especially the call for higher peak flows to achieve the geomorphic work of channel shaping and pool creation that Rush Creek still needs. We also support the inclusion of refinements such as the recommended snowmelt benches. MLC's greatest concern for Rush Creek continues to be the ability of LADWP to reliably deliver the required flows. Given the capacity limitations of the Mono Gate One Return Ditch (MGORD) and the management issues of Grant Lake Reservoir (GLR) including the necessary coordination with SCE, we have serious concerns that within the existing infrastructure limitations, the flows recommended in this draft report won't be reliably delivered at the time or in the volume required. We anticipate commenting on this further once we receive LADWP's feasibility analysis. The final report should anticipate the need for monitoring to evaluate the success of the recommended flow release strategy and for possible adaptive management action, and MLC offers detailed suggestions in section III, topic A.	Thank You.	**RTA and M&T**
		2. Reduced winter flow strategy MLC supports the draft report's winter flow recommendations with two caveats. First, the benefits of lower winter flows to the trout's ability to overwinter are still in the process of being tested and confirmed. The draft report offers the premise that the lower winter flows will not cause any habitat degradation. If this indeed proves to be the case, long term implementation of the recommended winter flows will be appropriate. Of key importance during this testing period is maintaining a comprehensive monitoring program to assess the benefits or impacts to the trout under these flow conditions. Should the lowered flow prove damaging to trout or other stream ecosystem components then the flow should be reconsidered. Second, at the February 23, 2010 restoration meeting in Sacramento, the stream scientists indicated that the actual values stated in the draft report are incorrect due to a calculation error. MLC understands the numbers will be revised and requests to be notified of the corrected recommendation and associated modeling prior to finalization of the report Additionally, MLC notes for the record that reducing the volume of water reaching Mono Lake in the winter under these recommendations has no effect on the availability of water for export from the Mono Basin; rather any water held back in winter will be available for increased springtime peak flows and will ultimately still be required for release to assure maintenance of Mono Lake's surface elevation as provided in D1631.	The fisheries team corrected the Rush Creek winter baseflow recommendations and circulated the revised Chapter 5.11 to SWRCB, LADWP, CDFG, MLC and CalTrout on 4/13/10. As an addition to Chapter 7, the continued monitoring of winter conditions is recommended, at least through the 2010-11 season. We recommend that in lower Lee Vining Creek that Sections D and F from the 2009-10 study are re-occupied. On Rush Creek, icing should be monitored within the losing reach between Hwy 395 and the Parker Creek confluence.	**RTA**

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		3. Year type forecasting Forecasting of the correct year type is critical to delivering the Stream Ecosystem Flows (SEFs) presented for Rush Creek. Past experience, particularly in 2008, has shown that the lack of a May 1 forecast can cause significant operational problems that affect both stream conditions and LADWP export. Decision 1631 (3) requires a May 1 runoff forecast: "Preliminary determinations of the runoff classification shall be made by Licensee in February, March, and April with the final determination made on or about May 1." May forecasts are very important and must continue to be implemented. For example, Scenario 6 (p.112) "demonstrates that runoff year forecasts require high accuracy" (in this example, a correct 2008 forecast increases GLR storage by 9000 acre feet (af). However the draft report forecasting recommendation on p.38 is unclear. The final report should be consistent with D1631 and be explicitly clear on the need for a May 1 forecast.	Changes were made to May 1 forecast recommendations in Section 2.3 based on LADWPs comments and proposed solution.	**M&T**
		4. Temperature management The draft report (p.36) identifies the temperature of Rush Creek water below the narrows as unfavorable to trout in July and August. This is a new restoration consideration that was not part of Order 98-05 or D1631 but instead has been identified through twelve years of monitoring and analysis by the stream scientists. This is a good example of the strength of the science-based adaptive management approach to restoration in the Mono Basin. MLC commends the stream scientists for making a substantial effort to address temperature management in the draft report. Because management actions designed to address water temperature are a new element to the restoration program, as is the associated modeling, this is an area that will certainly need monitoring and adaptive management adjustments over time. Because of concern about Rush Creek water temperature, the draft report (p.105) recommends the release of Lee Vining Conduit diversions through the 5-Siphons Bypass for cooling Rush Creek in certain rare situations. Only water already scheduled for diversion from Lee Vining Creek would be utilized. MLC sees the limited utility of this approach and accepts it as a possible emergency measure. However we note that the availability of water in the conduit in warmer months is constrained and suggest that this temperature driven release is primarily a distraction from more reliable temperature control alternatives such as maintaining a high GLR, shading the stream, and possibly recharging Vestal Springs. MLC is not in support of increasing Lee Vining diversions beyond what the SEFs allow for the sake of Rush Creek temperature control due to the numerous tradeoffs incurred and suggests the final report recommend firm rules for the emergency temperature control release that explicitly avoid this scenario. MLC also offers specific comments on temperature modeling and management section III, topic C.	1) Temperatures below the Narrows are unfavorable in some RY types in July through August and occasionally into September. In wet years, such as 2006, summer temperatures are not a problem. 2) Continued temperature monitoring and thermal monitoring of GLR should increase our knowledge base and improve the StreamTemp model. 3) Our recommendation to use the 5-siphons in rare cases should be considered an emergency situation. We do not consider this a "distraction" from other thermal controls since our SEF recommendations are actively addressing GLR management and flows for vigorous riparian growth. We are also open to discussions regarding spring recharge, but this discussion must include LADWP, the SWRCB and other stakeholders. 4) We are not recommending 5-siphons flows from LV beyond what the diversion rate and the LV 30 cfs minimum flow can provide. 5) LADWP's comments also requested more specific guidelines to 5-siphons use for Rush Ck thermal relief. This language has been added to Chapter 2.4.2.	**RTA and M&T**
		5. Grant Lake Reservoir management Successful management of GLR to meet multiple objectives is the key to the success of Rush Creek restoration. MLC recognizes that the management objectives may at times be in conflict with each other. Clarity and prioritization of the objective, combined with careful and thorough modeling, are required to assure a comprehensively workable management plan. The draft report makes two recommendations regarding minimum pool levels for GLR. A volume of 11,500 af is recommended as an absolute minimum (p.38) to protect Rush Creek from damaging turbidity and elevated water temperatures. MLC supports this recommendation. SEF flow requirements would be waived when the reservoir is at or below this level and the draft report further calls for a corresponding halt to water exports. MLC supports this requirement as it equitably establishes the minimum pool requirement.	Thank You.	**RTA and M&T**

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		The draft report also recommends a 20,000 af storage volume minimum pool (p.38) for July, August, and September of all runoff years for temperature control reasons. MLC understands the logic and supports the recommendation in general. However, we anticipate this requirement will generate conflict between restoration objectives. For example, delivery of a SEF peak flow might cause the reservoir to drop below the 20,000 af minimum pool; which requirement would take precedence? MLC requests that the final report discuss prioritization and management of possibly conflicting objectives such as pool maintenance, SEF peak delivery, SEF snowmelt bench delivery, export of water to Los Angeles, and other foreseeable conflicts. This discussion should include supporting modeling information to identify the frequency of such conflicts and project the results of recommended prioritizations, especially in the post-transition timeframe. Additionally, MLC agrees with the draft report call for monitoring of GLR water temperatures and dissolved oxygen (p.118) to validate the 20,000 af minimum pool requirement. We recommend adding turbidity to the reservoir monitoring requirements.	The recommendation for a 20,000 af minimum pool is not intended to preclude SEF releases (i.e., the priority should be releasing recommended flows to Rush Creek). This recommendation was based on (1) data presented in Cullen and Railsback indicating an inflection in Grant Lake release temperatures with diminishing GLR storage (Figure XX) and (2) on empirical data from RY2008 during which GLR storage dropped to approximately 16,000 af during spring and summer months and subsequent September 2008 fish population monitoring indicated poor trout condition factors in Rush Creek sampling sites that year. Our modeling indicated a 20,000 af threshold may be attainable in all post-transition runoff years except during periods with multiple dry years such as occurred in the 1990-94 period of analysis (e.g., see Appendix F, Figure F-8). Those Dry and Dry-Normal I years (with 70% and above recurrence frequency) do not have prescribed SEF snowmelt peak releases, and GLR elevations may still drop to the range of 16,000 to 18,000 af storage. In these situations, the Stream Scientists are willing to forego flow releases for geomorphic functions to better preserve suitable water temperature releases, as was done in RY2009. Additional analysis by LADWP with a revised LAASM model would better inform the feasibility of these recommendations and the potential frequency with which these unusual conditions may occur. Until this more refined analysis is conducted by LADWP, we suggest no changes to the GLR threshold.	**RTA and M&T**
		6. SCE coordination strategy The draft report focuses on achieving Rush creek SEFs through a strategy of water management coordination with Southern California Edison (SCE), the upstream hydropower operator. Successful SCE coordination can achieve spills from GLR to produce the recommended SEFs. We support the flows as recommended and are not opposed to the SCE strategy for implementation. However, MLC is not in agreement with the draft report (p.35) statement that spills are "the best alternative for achieving the recommended high flow regime in Rush Creek" as no other alternatives have been presented in the draft report. The final report should note that SCE coordination is one of multiple release strategies that could be used to deliver the SEFs. Because there are other ways to construct the capacity to deliver the recommended SEFs, and DWP may wish to study them in its feasibility analysis, the final report should be clear on all of the critical parameters that would need to be met in analyzing multiple options/alternatives. For example, the recommended spillway elevation requirement (p.38) in wetter year types appears to be tied to SCE coordination, not other objectives, and could be waived under a different SEF delivery strategy. Additionally, the draft report (p.37) states that "for both Lee Vining Creek and Rush Creek, specific opportunities for SCE and the USFS to improve annual hydrographs by enhancing spill magnitudes are identified." MLC has been unable to locate these clearly in the draft report and suggests they be detailed in the final document.	The statement referenced in the comment was changed to say "With the existing GLR infrastructure, spills are the best alternative….". Regarding the specific opportunities for USFS and SCE, we are referring explicitly to the recommended spill magnitudes for Wet-Normal, Wet, and Extreme-Wet runoff years.	**M&T**

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		E. Grant Lake outlet determination One of the core mandates for the synthesis report is an evaluation of the ability of existing infrastructure to deliver restoration flows to Rush Creek. In particular, Order 98-05 requires (p.61): "The stream monitoring team shall evaluate and make recommendations, based on the results of the monitoring program, regarding … the need for a Grant Lake bypass to reliably achieve the flows needed for restoration of Rush Creek below its confluence with the Rush Creek Return Ditch." and "The stream monitoring team shall also evaluate … the need for a Grant Lake outlet after consideration of relevant factors including any material adverse impacts on Lee Vining Creek and reliability of providing SRFs in Rush Creek." By calling for a strategy of SCE coordination to assure that Grant Lake Reservoir spills, the draft report renders judgment that existing Los Angeles Aqueduct infrastructure, in particular the MGORD and the 5-Siphons Bypass, are unable to reliably deliver recommended restoration flows.	Please see response in Chapter 9.	**M&T**
		The draft report flow recommendations stand on their own restoration merits, independent of the delivery method. Should the SCE coordination strategy prove unworkable or unreliable, as has been the case in more limited coordination attempts to date, then a modification of aqueduct facilities will be necessary. In its feasibility study, LADWP may wish to look at strategies in addition to SCE coordination that deliver the recommended Rush Creek SEFs reliably while offering other operational benefits. MLC looks forward to participating in such an analysis.	Thank You.	**RTA and M&T**
		F. Side Channel Exit Strategy The final report should note that the recommended side-channel maintenance strategy extends the current side channel maintenance agreement from another three years to 10–20 years depending on the geomorphic conditions. While MLC was in agreement with the original five-year maintenance plan for the side channels when they were originally opened, we believe that the stream scientists have the expertise and authority to extend the maintenance program based on their evaluation of the system. Based on the information presented in the draft report, particularly the need to encourage perennial flow that will help promote and maintain riparian vegetation, MLC is in agreement with the new recommendation. We also support the measurable triggers in the report that will guide the stream scientists when making the decision to end the side-channel maintenance. However, we believe more detail is needed (see detail in section III, comment A.11 and A.13).	Thank You.	**M&T**
		G. Release of Mono Lake water in transition and post-transition periods During the transition period additional "Mono Lake maintenance" water will supplement the SEFs in order to raise Mono Lake to the management level required in D1631. The draft report provides general guidance (p.59) for how to release this supplemental water for maximum restoration benefit. MLC recommends that the final report provide more detailed guidance. Prioritization, timing, and clarity on the extent to which hydrograph elements should be enhanced will be needed for operational planning. Additionally, the draft report appears to overlook the continued need to release Mono Lake maintenance water in the post-transition timeframe. While this release will not occur every year, it will occur in some; the volume may be 15,000 af or more, according to LADWP's Grant Lake Operation and Management Plan. The final report should recognize this and provide detailed guidance for release of this water. Additional modeling to anticipate the size and frequency of maintenance water releases after SEF implementation would also be helpful. MLC provides addit	We have provided more information describing the release of Mono Lake maintenance water in Chapter 9.	**M&T**

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		H. Termination criteria, adaptive management, and future monitoring The draft report (p.126) recommends that the adaptive management approach to restoration continue "without the termination criteria" set forth in Order 98-07. This recommendation should be omitted from the final report as it is beyond the scope of the tasks assigned to the stream scientists and is inconsistent with the settled law of the case. The draft report also notes (p.126) that the design and specific content of the future monitoring program is beyond the scope of the task given to the stream scientists. However, it is clear that a program will be needed. MLC recommends that such a program be developed during or before the implementation phase of the State Water Board process, and that the stream scientists and stakeholders be closely involved as they have an ongoing critical role to play in the adaptive management process. That said, MLC has reviewed the monitoring and related items presented in the draft report and provides specific comments in section III, topic A.	While respectfully noting your comment, the Stream Scientists disagree that making recommendations regarding the Termination Criteria is "beyond the scope of the tasks assigned...". Our explicit goal is to provide the SWRCB with recommendations that will facilitate management of the Mono Basin streams to achieve recovery and maintenance of healthy stream ecosystems, riparian communities, and fisheries resources. 1) We will defer to the SWRCB regarding our recommendation to eliminate the TC. We do feel that the original purpose is no longer valid (to terminate the monitoring) given that adaptive management will continue into the foreseeable future. 2) We agree that a future adaptive monitoring program should be developed by LADWP, the Stream Scientists and the stakeholders as part of the implementation phase. 3) For fisheries, we still support the criteria recommended by Hunter (2007) as valid metrics to assess the fishery. We also still support the values suggested by Hunter (2007) as indicative of a high-quality Eastern Sierra brown trout stream.	**RTA and M&T**
Suggested additions to the synthesis report				
		A. Goals should include pre-1941 conditions that benefitted the fishery Directives to restore and maintain the pre-1941 fishery in Caltrout II and the State Water Board orders refer to the conditions that benefitted the pre-1941 fishery, and acknowledge that not all pre-project conditions can or should be restored. These directives are important overarching goals and should be included in the final report. MLC provides numerous comments that touch on pre-diversion conditions in some way; for example section IV, comment p.61.	We will respond to the more detailed comments.	**RTA**
		B. Summary of progress toward termination criteria The draft report is mostly prospective—advancing recommendations for stream flows. Order 98-07 established that the primary purpose of the report should be retrospective summarizing how the restoration program has worked to date. The draft report provides summary info on some termination criteria, such as acreage of riparian vegetation, but is silent as to most. MLC would like to see summary information on all Order 98-07 termination criteria in order to assess progress to date. Additionally, the final report would benefit from a review of past major restoration recommendations (such as those in Ridenhour, 1995) to see if they are still relevant.	The Annual Reports submitted during the past 12 years of monitoring, and the numerous additional reports, technical memoranda, meetings, etc. are the primary retrospective aspect of the monitoring program. The Synthesis Report, instead, was specifically intended to integrate that information into prospective flow recommendations for future implementation. The SWRCB Order 98-07 lists as its first "function" that the Stream Scientists will "...evaluate and make recommendations, based on the results of the monitoring program, regarding the magnitude, duration and frequency of the SRFs..." Our understanding is that the type of review of past restoration recommendations suggested is the gist of the SORC (Status of Restoration Compliance) developed between LADWP and MLC. Specific to the fishery, the final two paragraphs of Chapter 2.2.1 describe the state of the fishery and its failure to meet TC.	**RTA and M&T**
		C. Data management – reliability and access MLC recommends that a master data set for the daily and monthly models including the unimpaired data be developed by LADWP and the stream scientists. MLC is troubled by the difficultly of getting a consistent and accurate long term daily data set for the analysis. The final report should include all final data sets used in the analysis as electronic spreadsheet files in an additional appendix. In addition, all of the modeling should be extended at least as far back as 1976 in order to include more extreme wet and dry periods than occurred during the 1990–2008 period which was modeled.	We have discussed with LADWP the need for more data development and review, and support development of this type of data set. We attempted to assemble these data before preparing the Synthesis Report, but it appears we did not achieve an adequately thorough review and revision to those data.	**M&T**

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		D. Additional model tools We recognize that for a given hydrologic sequence there will be differences between the recommended SEFs, the actual SEFs, and the actual achieved streamflows. These differences will depend on 1) feasibility of implementation, 2) the guidelines for implementing the SEFs including the guidelines for delivering "Mono Lake maintenance" water, 3) how the guidelines are implemented, and 4) the level of Mono Lake and the export limits in D1631. We believe that, in order to fully evaluate the SEFs and their feasibility, three things should be included or called for in the final report: i. a better modeling representation of the Mono Basin facilities (e.g. one that represents existing spills better and can also evaluate facility modifications); ii. a good modeling representation of post-transition Mono Lake levels; and iii. a good modeling representation of export limitations in wetter years due to aqueduct system congestion.	We agree, and understand that LADWP is undertaking revisions to its modeling capabilities to meet this need for additional analyses.	**RTA and M&T**
		E. Summary of recommended operational changes The draft report recommends a number of changes to current streamflow and related requirements. The final report should be clear about each specific change and should provide a summary table of the changes recommended to D1631 and Order 98-05.	A simple table comparing the SRF and SEF annual flow regimes for Rush Creek will be added at the end of Chapter 2. Figures 2-8 through 2-14 provide direct comparisons of how SRF vs SEF flow regimes would perform below the Narrows.	**M&T**
		F. Vestal Springs Recharge In recent discussions with the stream scientists and other interested parties, the idea of further evaluating the feasibility of recharging the west-side Vestal Springs has been arisen. Spring recharge offers water temperature benefits as well as many additional ecological benefits. While certain pre-diversion conditions may be impossible to achieve under today's operational scenarios (i.e. no irrigation occurring), the idea of Vestal Springs recharge could help to bring back additional hydrological conditions that existed pre-1941 and thereby contribute to restoring the pre-1941 conditions that benefitted the fisheries. MLC supports the exploration of this idea and requests that the stream scientists include language in the final report that speaks to the potential benefits of the idea, including the call for a feasibility analysis if appropriate. From the MLC's perspective, restoring the largely natural west-side slope spring system would be consistent with the guiding principle of restoring natural processes and for that reason should be considered. In addition, restoring the spring system could either replace or augment the current draft report recommendation of using Lee Vining Creek water for temperature amelioration purposes in Rush Creek.	Although informal discussions regarding spring re-charge have occurred between a couple of the stakeholders and the Stream Scientists, not all parties, including LADWP, SWRCB and CDFG were involved in those discussions. Thus, no language will be added to the final Synthesis Report in regards to a spring re-charge feasibility analysis. However, omission of a written recommendation does not preclude further discussion. The proper manner to proceed towards developing a feasibility analysis would be an all-inclusive meeting to discuss the issue, because re-charging the springs may be a possible management strategy to "bank" water in wetter year-types that would later be expressed in the lower Rush Creek channel, and ultimately Mono Lake. While some of the stakeholders believe that the west-side springs were mostly of natural origin, from the written record (D-1631, the Mono Basin EIR, depositions and 1994 hearings) it appears that irrigation return flow had a contributing, yet unknown, influence to spring flow in Rush Creek. This uncertainty probably influenced the SWRCB's decision to not require a spring re-charge feasibility study when the Stine and Vorster proposal was originally submitted prior to the Orders.	**RTA and M&T**
		G. Climate Change Implications The climate change chapter briefly discusses the potential for warmer temperatures, earlier snowmelt, and more dry years to result in retractions in riparian corridor width. Changes in brown trout growth patterns in wet and dry years are also expected. The final report should include suggestions for how to monitor and possibly address these impacts (e.g. water for late summer vegetation maintenance if vegetation monitoring shows a decline). Monitoring of climate effects should be proposed and possible adaptive management responses discussed in the final report. MLC provides additional detail in section III, comments A.14 and A.15.	A more extensive, though likely no more accurate or precise, analysis of predicted climate implications will not affect the SEF recommendations for 2010 but could suggest how future operations might require special needs. A relatively simple next step analytically, but not contemplated by the stream scientists for this Synthesis Report, is to shift snowmelt recession nodes in each RY type a month earlier and re-run the analyses.	**M&T**
III. Detailed technical comments and questions				

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		The following comments address specific detailed questions MLC has about the draft synthesis report (draft report), omissions noted by MLC, and suggestions for improvements that could be incorporated into the final report. They are grouped by topic and thus are not listed in page order, however page numbers are provided for reference.		
A. Adaptive Management and Monitoring				
Comment A.1	p.28, 57	There are numerous operational recommendations that set the time period for releasing the Rush Creek spring bench and snowmelt bench Stream Ecosystem Flows (SEFs) and for maintaining Grant Lake Reservoir (GLR) elevations (p.38). It should be made very clear if the expectation is that these dates are fixed and not dynamic as the snowmelt flood appears to be (that too should be made even more explicit). We recommend that those dates be operational guidelines with the flexibility to modify them within specified criteria that would be informed by an adaptive management program. For example, the recommendation to maintain GLR at the spillway elevation should be flexible enough to allow it to occur at earlier time periods in case of early snowmelt runoff in wetter years as has occurred recently.	The snowmelt peak release is the only hydrograph component intended to have flexibility in the timing. We specified a "default" date for peak releases in the SEF Tables; we also specified in text the potential range of dates possible given the fixed dates for the snowmelt bench. We believe this is clearly stated, and that LADWP understands the intent of these recommendations adequately to develop their revised operational guidelines that will then be reviewed by all parties.	**M&T**
Comment A.2	p.44	Regarding the timing and magnitude of the riparian bench at 80 cubic feet per second (cfs): targeted monitoring should be proposed to see if 80 cfs is achieving the goal as well as a process for revising the threshold based on an evaluation of the monitoring results. We also need a process for evaluating timing as climate change progresses. Instead of dates, timing should be tied to a natural trigger such as degree days.	We agree that additional monitoring may be warranted to evaluate the proposed spring bench magnitude.	**M&T**
Comment A.3	p.62	Given the importance of table 3-1, factors to the Number of Good Days (NGD) analysis and SEFs, we recommend that the monitoring and adaptive management program include continued periodic evaluation of these thresholds and flow ranges.	We have specified in Chapter 7 the specific categories in which we think the additional monitoring is needed. However, until directed by LADWP and the SWRCB to develop a detailed monitoring and adaptive management program based on LADWP's acceptance of the SEF flow recommendatinos, we believe that additional detail is unwarranted.	**M&T**
Comment A.4	p.81	Fine tuning of the Lee Vining Creek 16–20 cfs winter flow is proposed based on continuing the winter monitoring that began this past winter. Since the 2009–2010 winter was relatively warm, few extreme icing events were observed. At the February 23, 2010 Sacramento meeting there were many questions surrounding an effective monitoring protocol, since there were few experts and papers found. We recommend the stream scientists, based on their evaluation of this winter's data, propose changes to the protocols and additional monitoring if needed in order to answer their questions that will allow them to fine tune the winter flow. This evaluation should not be based solely on fish habitat, but also on groundwater and vegetation and other aspects of the ecosystem dependent on winter flows.	The draft icing report actually documented that the 2009-2010 winter had air temps colder than average. Also, water temps in lower LV main channel were relatively cold compared to data used in Appendix D for the timing to emergence analysis. However, we are reluctant to recommend winter baseflows less than 16 cfs based on a single season of monitoring winter icing. We concur with the MLC that additional monitoring of the winter flow recommendations should occur beyond the 2009-10 effort.	**RTA**
Comment A.5	p.117	Please propose monitoring designed to evaluate the success of LADWP/SCE coordination, as well as compliance monitoring for each of the other recommendations in the report.	Until directed by LADWP and the SWRCB to develop a detailed monitoring and adaptive management program based on LADWP's acceptance of the SEF flow recommendations, we believe that additional detail is unwarranted.	**M&T**
Comment A.6	p.D28	The temperature model suggests as the riparian vegetation gets larger and provides more canopy shading of the streams (as well as the whole valley floor ecosystem), the stream temperatures in lower Rush Creek will be reduced for a given ambient air temperature condition. In addition to canopy cover, monitoring should measure the age and species composition of the riparian vegetation, due to the importance of size and structure of the riparian community to not only temperature but also instream habitat.	We are not certain that monitoring of age and species composition are necessary to conclude that size and structure of the ripairan community are continuing to mature.	**M&T**
Comment A.7	p.46	Recognition of the importance of benthic Macroinvertebrates (BMI) is expressed in the bench flows, however no BMI monitoring is proposed in order to evaluate the effectiveness of that management strategy. Since food affects Condition Factor in trout we recommend BMI monitoring be proposed.	We will not propose BMI monitoring as part of the SEF recommendations because there was no baseline BMI monitoring of currently prescribed flows to use for comparisons. The fisheries team also believes the primary productivity study will provide additional (and better) information on the ability of Rush Creek to produce macroinvertebrates.	**RTA**
Comment A.8	p.120	The report says real time coarse sediment bypass is not warranted, but delaying until a large volume is present "will likely cause problems," however it is difficult to specify a threshold. Please propose something (such as excavating at a 2–5 yr intervals, to be adjusted based on surveys).	We agree, and have added text in the appropriate report section	**M&T**

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Comment A.9	p.118	At the February 23, 2010 restoration meeting in Sacramento, the discussion implied that the lack of Lee Vining Creek groundwater data loggers impaired the analysis compared to Rush Creek. A data logger should be installed in Lee Vining Creek piezometer C3 (usually the last to dry up) and B1; also Rush Creek Channel 10 piezometers 3, 4, or 5 (these three have never dried up). In addition, deeper piezometers in single-thread channel areas should be installed to evaluate whether assumed groundwater levels in these areas match that of the multiple channel areas where piezometers have been installed. They should be installed in a transect extending away from the channel in order to evaluate the reestablishment of a shallow alluvial water table which would be necessary for maintenance of a wide riparian strip.	We support collecting additional groundwater data in existing piezometers, as specified in the report, but do not support installation of additional piezometers at this time.	M&T
Comment A.10	p.121–122	The draft report says additional study may be warranted to quantify vegetation growth and vigor due to year type patterns in piezometer areas. P. 117–126 suggests qualitative assessment of riparian response to dry year flows with shoot lengths in piezometer areas. In a personal communication with Duncan Patten (co-author of Stromberg and Patten, 1990 and 1992) he stated they used ring width (despite the difficulty of the task with cottonwoods) because they found shoot growth "was so variable it was not useful." Please describe your methodology and how you intend to account for this variability. In addition to comparing 2007 and 2009 and qualitative assessment, what would you suggest that is measureable?	The term vigor is qualitative by definition (similar to the word health). Having an observer assign a categorical value of vigor to a tree presents several interpretive problems. However growth rate can be measured and reflects plants vigor. Seasonal water availability controls the growth rate of leaf and branch growth and therefore affects the plants overall vigor. Measuring annual growth is a quantitative form of describing a plants annual vigor. I have used branches to age younger trees and I think that the utility of making vigor measurements would be valuable to characterize shoot growth rates over the last five years. Cottonwoods make short spurs and longer shoots. The short spurs would be useless in measuring annual growth rates. In longer shoots, terminal bud scars are clearly evident and many branches growth for periods of 8-11 years or longer (based on branch age data collected within Rush and Lee Vining creeks). Therefore the record of annual growth is captured in each branch. The growing end of the branch represents this year's growth down to the first set of terminal bud sca	M&T
			The growth rate would be variable within a tree, between trees and between sites. The within tree variability could be characterized through measuring several branches on different sides of the tree (probably between 12 and 24 branches a tree) to quantify the variability related to the sunny or shady side of tree or position in the canopy. The between tree variation would be assessed through randomly selecting 6 to 8 trees within a site and taking the annual growth measurements reflected in the branches. The between site variation would be addressed through the selection of 4 to 6 cottonwood populations between the diversion and the lake.	
Comment A.11	p.117–126	Please provide a better explanation of how the RCT survey works, as well as how often it should be resurveyed, e.g. should it be resurveyed only when a side channel loses significant flow during the growing season (and how would this be monitored?), or in advance of such a development?	If the difference between the invert elevation of the side-channel entrance and the elevation of the mainstem RCT exceeds the threshold (e.g., 2 ft for the 8-Channel), then side-channel maintenance could cease. LADWP would annually inspect the side-channel entrances for maintenance problems before and after peak releases. Maintenance would entail removing any aggradation in the side-channel entrance down to the original side-channel invert elevation. Rather than annually surveying invert and mainstem RCT elevations, a rebar pin(s) with a prominent yellow cap can be installed at the original side-channel invert elevation … thus allowing a simple visual inspection for aggradation. Mainstem RCTs should not require periodic surveys, other than the initial RCT survey to establish a baseline, but would be advised following Wet and Extremely-Wet RYs.	M&T
Comment A.12	p.58	We recognize that stage bracketing allows LADWP to tell the stream scientists what it can do—that the recommendations are an iterative process. How often will the Lee Vining Creek rating curve be resurveyed? Please propose a process for updating the table of diversion rates in the future.	We do not believe this is warranted at this stage. We do not yet know that LADWP has the capability of implementing the SEF recommendations, and that the SWRCB accepts the recommendations. This needs to occur before proposing methods for revising them.	M&T

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Comment A.13	p.85, 123	The Committee agrees there needs to be a measurable trigger for the side-channel exit strategy (premise no. 6). An alternative remedy of a hydraulic control in the main channel is recommended for the 3D but not the other channels. If the other channels were to trigger the exit strategy early in the 10–20 year period (such as next year), would you recommend a physical control structure as you do for the 3D?	The precipitous drop in shallow groundwater soon after surface flows cease flowing down the 3-D side-channel (as higher snowmelt streamflow recede) has prevented extensive woody riparian establishment. A structural solution of using coarse boulder material to backwater perennial streamflow into the 3-D side-channel would be compatible with the coarse boulders composing the steep 3-D mainstem channel itself and the unlikelihood of it migrating anytime soon. In contrast, multiple channels below the Narrows are considerably more dynamic. Waves of upstream downcutting are still occurring, and thus continually changing the relative sharing of streamflows among channels. Structural solutions on the scale considered for the 3-D channel would not be compatible with restoring a dynamic floodplain below the Narrows.	**M&T**
Comment A.14	p.129	The climate change chapter seems to end abruptly after discussing the potential for earlier snowmelt and more dry years to result in retractions in riparian corridor width. We would like to see suggestions for how to monitor and address these impacts, e.g. more water for late summer vegetation maintenance comes from export vs. somewhere else on the hydrograph if vegetation monitoring shows a decline. A more robust analysis of the climate change that has already occurred (both in the 20th century and in the last 1000 years) and is prognosticated to occur in the Eastern Sierra should be included. In particular Stine and others (e.g. Graham and Hughes 2007) have described the past climate change including plausible hydroclimatic sequences (as confirmed by Mono Lake fluctuations) in the Mono Basin. Cayan and Dettinger have already documented changes in the snowmelt timing in adjacent watersheds. We recommend analysis of unimpaired peak snowmelt hydrographs over the last 75 years of record (since 1935) to see if such a signal manifests in the Mono Basin. We also recommend analysis of SEFs and habitat response if climatic sequences of the Stine droughts were to occur, as well as monitoring and adaptive management designed to evaluate and respond to such changes.	We added a section to the climate change chapter with some predicted reductions in trout growth based on increasing air temperature within the StreamTemp model.	**RTA**
Comment A.15	p.128	The climate change chapter fails to address changes in diurnal fluctuations due to reduced nighttime snowmelt in the high country because it no longer is getting below freezing at night as often. These fluctuations would be passed down Lee Vining Creek during the summer under the diversion rate strategy, and below the narrows on Rush Creek due to Parker and Walker Creek fluctuations. With climate change these fluctuations have already lessened greatly and could eventually disappear. <u>The significance to aquatic life for both flow and temperature should be addressed.</u>	While the MLC has probably made a correct interpretation about what may happen under a climate change scenario with warming air temperatures, we are uncertain if it is worth trying to model this potential impact at this time. The StreamTemp model does not do a good job of predicting diurnal fluctuations and we made that clear in the current report. Trying to predict diurnal influences of a climatic model that is predicting decadal or annual changes goes far beyond the resolution of the climatic models and we suggest it would have extremely limited predictive potential at the diurnal time scale. We believe this temporal resolution problem exists for both temperature and flow predictions. Any interpretation would be extremely speculative, and we are reluctant to incude such speculation in the Synthesis Report.	**RTA**
Comment A.16	p.120	We recommend that the detailed pool surveys that include canopy cover data should be undertaken on Rush Creek and Lee Vining Creek from the diversion dams to Mono Lake.	We still recommend that future pool surveys on Rush Creek start at the Narrows, not at the base of the MGORD. The collection of canopy cover data required a two-person crew five days to measure in 2008, thus a three-day pool survey would now require 7-8 full field days to collect both pool and riparian canopy data.	**RTA**
Comment A.17	p.126	We agree with the monitoring metrics in Chapter 7 along with others noted elsewhere in our comments. <u>These metrics should be used to develop indicators of ecological function and process based in part upon the ecological outcomes used in the NGD analysis.</u>	In our view they ARE indicators of ecological function and processes.	**M&T**

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Comment A.18	p.126	While certain pre-diversion conditions may be impossible to achieve under today's operational scenarios (ie. no irrigation occurring), the idea of Vestal spring recharge could help to bring back additional hydrological conditions that existed pre-1941 and thereby contribute to restoring the pre-1941 conditions that benefited the fisheries. These include: 1. Young-of-the-year (YOY) habitat. Assumes the channel that connected springs with Rush Creek could be restored. 2. Summertime temperature mitigation in Rush Creek. Assumes that 5 cfs spring discharge into Rush Creek is possible. 3. Wintertime temperature mitigation. This could be perhaps even more important than summertime temp mitigation. 4. Food source for fish. 5. Increased conductivity from minerals that could help food production. 6. Restoring pre-1941 conditions that benefited fishery (fulfilling judges order) Additionally, non-fishery benefits include: 1. Restoring nature and natural processes 2. Spring ecosystem for its own sake—part of public trust benefits 3. Riparian vegetation enhancement in areas away from immediate main-stem channel. Using Parker and Walker Creek water to recharge the spring has its own set of variables that would need in depth research and analysis. The benefits of implementing the spring recharge would need to be weighed with the known impacts to Parker and Walker and the suspected or possible unintended consequences of redistributing the water.	1) Our 12 yrs of annual monitoring has shown that age-0 recruitment in Rush Creek is ample. 2) Shepard ran a quick StreamTemp scenario with 5 cfs at 48F entering Rush Ck below the Narrows. The scenario was a "worse-case" situation of HOT climate, low GLR storage and no 5-siphons accretion. Growth of a 50g fish was 36.1g compared to 29.7g without the "spring accretion", or only 6.4g. The GLR "full" with and without a 5-siphons accretion had slightly larger effects on growth than a 5 cfs spring flow. 3) Winter temps below Walker Ck were increased by 2.6F by a 5cfs spring flow accretion, but this increased temp was still below 37F where "no-growth" would be expected. 4) Speculative. 5) Speculative, where is the data to show that springs increased conductivity beyond leaching nutrients from sheep and stock feces/urine? 6) Restoring springflow to the pre-1941 conditions (>20 cfs) would require extensive irrigation that would probably be detrimental to Parker and Walker creeks. Also, >20 cfs spring flow on top of winter baseflow release would reduce available holding habitat in lower Rush Ck.	**RTA**
Comment A.19	p.114	The current GLR model output suggests that during the transition period on average 10,000 af will be exported from Lee Vining Creek and 6,000 af will be exported from Rush Creek. This is a significant change from current operations. The model output for the post-transition period indicates 10,000 af will be exported from Lee Vining Creek and 20,000 af will be exported from Rush Creek, which is a significant change from the transition period and results in some years exceeding 30% of the runoff being diverted. <u>We recommend that in addition to a clearly defined adaptive management program that can evaluate these changes in diversions amounts, that periodic detailed reviews (every 7 to 10 years) of the monitoring information and operations be conducted in addition to what will be routinely evaluated in an annual report.</u>	The Stream Scientists expect more discussion in the near future about the approach and timing of adaptive management and monitoring.	**RTA and M&T**
B. Grant Lake Reservoir Management and Modeling				
Comment B.1	p.66	The report needs a longer simulation period. We recommend that the 1990–2008 modeled base period be extended back to at least 1976 for the following reasons: 1) It does not include the 6 year drought that started in 1987; 2) It only includes one extreme year (1995) not two as is stated. 2006 was not an extreme runoff year; 3) The period from 1976–92 had greater and longer extremes of wet and dry than the 1990–2008 period.	We support the actions LADWP is taking to update the LAASM model so it has the capability of these and other analyses and simulations.	**RTA and M&T**
Comment B.2	p.A5	We recommend that a master data set for the daily and monthly models including the unimpaired data be developed by LADWP and the stream scientists. Presumably Mike Deas is putting together a data set that should be the same as what the stream scientists are using for their work. We are troubled by the difficultly to get a consistent and accurate long term daily data set for the analysis. Daily data prior to 1990 was not obtainable even though LADWP developed one for previous versions of GLOMP that was sent to us and that is nearly continuous from 1973 (although 1977 and a few other years in the 1970's may be missing some Lee Vining Creek data). There are also stations that are not included (East and South Parker) or the historical data needs to be modified for making future predictions (such as Parker Creek above conduit, LV above conduit) since Cain Ranch and Horse Meadow irrigation diversions ceased (historical data would include irrigation but for making future predictions, one would want to have a data set that did not include irrigation diversions which were 8 TAF/YR or	We have made a similar request to LADWP. The Stream Scientists developed the best data set available for use in the Synthesis Report, and released this for review and comment in 2009. This comment would have been useful in response to a review of that data set.	**M&T**

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Comment B.3	p.41, Appendix A-1	Hydrographs in Appendix A-1 should be refined to better represent what the expected SEFs would be in the transition and post-transition periods. Our understanding from the March 15, 2010 phone call is that hydrographs in Appendix A-1 are model outputs with only 16,000 af of export and thus do not show what the SEF on Rush Creek would be in the post-transition period. We were also told that the operational guidelines for managing the "extra" water were not explicitly modeled, thus the hydrographs and GLR levels may not be representative of what might occur given the historic runoff input. Another limitation is that the model is a simple input-output model and thus cannot accurately represent the spills. Also the recommended SEFs in the wetter years that are greater than the historic GLR inflow are not shown. We recommend that the LADWP, Mike Deas, and the steam scientists work together to develop more representative hydrographs of the recommended SEFs and GLR levels in both the transition and post-transition periods.	We support this recommendation but believe this should be conducted by LADWP with a more sophisticated model to evaluate the feasibility of the SEF recommendations.	**M&T**
Comment B.4	p.59	The amount of diversions that SEFs allow from Lee Vining and Rush Creek (the flow split) cannot be fully evaluated until a more accurate representation of the both the transition and post-transition SEFs, GLR levels, and LADWP exports is developed. The current model output in Appendix A-1 is not fully representative of the stream hydrographs and no GLR levels are presented (see comment above on Appendix A-1).	Yes, we generally agree, but even with better simulation modeling, there will be unanticipated climatic conditions or other factors that cannot all be evaluated prior to implementing SEFs. In addition, the relative proportion of diversion from each creek is not explicitly relevant, except if strongly biased in one direction; our analyses did not directly focus on this relative proportion, only reported it.	**M&T**
Comment B.5	p.7, 58, 113	The draft report says (p.7) the revised streamflows don't change post-transition export allocations, but with a higher GLR, what is stopping that water from being exported instead of being released or stored? In table 6-2, what is the justification for limiting exports in 2007 when GLR holds 30–37,000 af, and what operational rules would be necessary for implementation of that limitation? Within certain years when Mono Lake is high (i.e. years with no lake level limit on exports), more water is available for export than under the current flow regime. All years except Dry require less water for SEFs than currently (p.58 table 2-15), implying an increase in post-transition export, however additional lake maintenance water would need to be released.	We are not sure what "water" is referred to. Only water that is available in excess of streamflow releases and GLR storage conditions, and allowed within the SWRCB specified Mono Lake elevation conditions, can be exported. Table 6-2 is not intended to suggest limitations to exports (the legend will be clarified). Export would be allowed in 2007 as in other years, but would be relying on storage in those year types.	**M&T**
Comment B.6	p.114 Table 6-3	Lee Vining Creek subsidizes the Rush Creek deficit in 2007 and that makes storage balance and 367 af available for export. We should presume storage decreases by the amount of the LVC subsidy since it would likely be exported.	We think you've misunderstood the Table 6-2. We differentiate "diversion" which is the water potentially available beyond the required streamflow release, and "export". The 367 af "diversion" in Table 6-2 is simply a measure of the amount of yield in excess of streamflow releases. However, export would still be feasible, relying on stored water.	**M&T**
Comment B.7	p.66, 109	The 5-Siphons Bypass release was not modeled in the GLR model. It should be included in GLR Outflow. Releases were: 2005: 1461 af, 2006: 494 af, 2008: 1100 af.	Yes, the 5-Siphons releases were included as part of the model	**M&T**
Comment B.8	p.112, D55	Spills were not modeled in table D-4.1 and elsewhere because the GLR model can't predict spill magnitude accurately and requires more sophisticated modeling by LADWP. We recommend modeling the recommended SEFs, regardless of the conveyance used (spillway or new reservoir outlet), in all the modeling. Without presentation of the SEFs as recommended, it is impossible to accurately evaluate the recommended flows in comparison to the current flow regime. Use of the spillway vs. a new outlet is determined later as part of LADWP's feasibility analysis and should not be presumed here—assumed use of the spillway unfairly limits the analysis of the desired SEFs.	We agree that LADWP should conduct more accurate modeling as part of their feasibility analysis, incorporating Mono Lake elevation.	**M&T**
Comment B.9	p.110–112, F11	Scenario 11 is a reasonable adjustment to Scenario 10 for strings of wet and dry years, however both post transition scenarios show GLR will be above 7110 ft (26,000 af) less often than currently and consequently fewer NGD. The report states that the model overpredicts, therefore this reduction in high reservoir levels is likely even too optimistic. Also, prior to SCE's 1999 FERC license the upstream reservoirs were operated at lower levels during the summer (compare end of August Gem storage here: http://cdec.water.ca.gov/cgi-progs/queryMonthly?GLK&d=18-Mar-2010+11:33&span=20years) which slightly inflates GLR storage during the first half of the scenarios in comparison to today's operations. In addition, Gem Lake Reservoir was empty in 2007 and Waugh Reservoir was empty in 2009, therefore both of these years have higher summer GLR levels than they would have with normal SCE operations. Normal SCE operations (full reservoirs July 1–September 1) for these two years and for the pre-1999 period should be modeled in an additional scenario.	We do not understand the significance of GLR having fewer NGD in post-transition period, assuming LADWP meets storage thresholds specified in the Synthesis Report. In addition, we assume there will always be the potential for future (somewhat random) storage and facility maintenance operations from SCE. We cannot analyze all these possible outcomes.	**M&T**

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Comment B.10	p.A63, Appendix A-5 Table 4	(please note additional problems with this table in the corrections section) The report shouldn't use year-types for this analysis—they are often unrelated to the winter flow (they are effectively based on summer runoff except in wetter years) and wet periods inflate the dry year averages, resulting in an often meaningless analysis. (Note that dry winters prior to a wet year are much wetter than other dry years.) They are incorrect and inconsistent as well, for example 2008 uses a forecasted Normal year and 2005 uses a measured Wet year (measured unimpaired should be used in this analysis if year-type must be used). We recommend ranking the winters instead, e.g. the driest 5 winters have a max 6.2, avg 5.6, min 5.0 (as opposed to an average of 6.2 cfs in the 5 dry years).	Thank you for the detailed comments regarding this table. The purpose of constructing the table of Parker and Walker monthly mean flows for the winter baseflow period was to simply display the range of flows that have occurred. This table shows that we can expect the accretions from Parker and Walker creeks to Rush Creek during the winter may range from about 5 cfs to 12 cfs, and in most cases range from 6 cfs to 10 cfs.	**RTA**
Comment B.11	p.A63	We realize the rationale for doing a year-type analysis is that flow recommendations are by year-type, and this is a convenient criterion upon which to base a winter flow requirement. But winter flows (especially in drier years) are often more affected by precipitation and temperature, which is harder to predict than annual runoff. Our concern is that averaging a wet and dry winter together and calling it a dry year average is not a meaningful analysis—it skews the wettest and driest years towards the middle. We recommend either using the lowest observed flow as a conservative estimate of gains from Parker and Walker Creeks, or setting the Rush Creek release based on real time conditions instead of these year-type averages.	Using the lowest observed value makes no sense when the data clearly shows that in wetter years the accretions from Parker and Walker creeks were higher, more than double the lowest observed value. Because we are setting a single recommended winter baseflow release from the MGORD, these values simply show that in wetter year-types we should expect a bit more flow to be expressed in the lower Rush Creek channel, which will translate into slighly less holding habitat that meets our depth and velocity criteria.	**RTA**
Comment B.12	p.A63	This is not a normal distribution—62% of the months are in the range of the driest 5 and wettest 4 winters (out of 19 total). Use of median instead of average results in 8 driest years, 4 wettest, and only 7 years in the 3 middle categories. Averaging each year's monthly median instead of the monthly mean and using ranked years instead of year types in the Chapter 2 Rush Creek recommendations would result in averages more representative of the real range of flows, especially in the wettest and driest winters, as seen below ***Please see data table in our written comments; it cannot be displayed here*** As stated in the previous comment, a conservative estimate of gains from these creeks would not use median or average, but lowest observed flow for a year-type when setting Rush Creek baseflows. If too high a flow is of concern, the range of flows for a year-type should be used in the analysis.	We never claimed this to be a "normal" distribution. Please refer to the two previous responses regarding the purpose of this table.	**RTA**
C. Temperature Model				
Comment C.1	p.66	The report needs a longer simulation period. We recommend that the 1990–2008 modeled base period be extended back to at least 1976 for the following reasons: 1) It does not include the 6 year drought that started in 1987; 2) It only includes one extreme year (1995) not two as is stated. 2006 was not an extreme runoff year; 3) The period from 1976–92 had greater and longer extremes of wet and dry than the 1990–2008 period.	Temperature modeling was done for year-by-year scenarios with flows set by the water availability and temperatures set by single years of air temperatures. While extended drought periods might affect flows, the range of flows that we modeled should be adequately covered. If more extreme climatic events than were modeled do occur, the modeling would not be valid. The question becomes do we model for unlikely extreme events or try to cover a range of plausible year types. All simulation models rely on "average" conditions and use averages in their predictions. Trying to model the most extreme events is inadvisable because these conditions are outside the predictive capabilities of the models.	**RTA**

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Comment C.2	p. D25	The temperature model added 1F to account for warming in the conduit—what is the average ground temp along the conduit? Is it always warmer than the temperature of the water from Lee Vining Creek?	We had no reliable method for predicting whether water in the conduit would cool or warm as it traveled from Lee Vining Creek at the Intake to Rush Creek. One degree F was added to the temperature to account for a summer condition that we speculated warmed the water. We clearly stated our assumption for this addition as speculative in the Synthesis Report. Groundwater temperatures were assumed to be 48 F based on average annual air temperatures (a criterion recommended for the SNTEMP model; Theurer et al. 1984; Bartholow 1989; Bartholow 1991; Bartholow 2000). However, we did not believe the conduit temperatures remained at 48 F through the summer period. Since we had no reliable method for estimating whether temperatures warm or cool in the conduit, we recommended water temperature monitoring to validate and re-calibrate the temperature model, if needed. Finally, we have recommended a "test" run of the 5-siphons during the summer of 2010 to clarify several assumptions, including potential warming of water while travelling through the Conduit.	**RTA**
Comment C.3	p.D28, D53	The MGORD warms water exiting GLR before it enters Rush Creek. The temperature model showed that 50% shading along the ditch would mitigate this warming. This has a bigger effect than shading along the stream itself. The final report should make a recommendation regarding shading the ditch or other temperature control measures in order to mitigate the temperature impact of the MGORD.	The Stream Scientists clearly displayed the potential effects of shading both the MGORD and adding shade to the Rush Creek channel. We certainly believe these are viable options that should be discussed during the SWRCB decision-making process, but wanted LADWP to respond to the operational feasibility of adding shade to the MGORD as part of that process.	**RTA**
Comment C.4	p.D44	In the global warming scenarios, it appears we should expect a lot more trout growth in wet years and slightly less in dry. Please run a time series to see the overall net effect.	Modeling water temperatures through a time series of several years linked together was not specifically done for any climate scenario because of the nearly unlimited possibilities for different flow and climate types based on water availability and air temperatures. However, if the MLC wishes to link several of the individual year model predictions together, the data are available by year to link years of whatever water availability and flow availability they wish to explore to determine the overall net effect.	**RTA**
Comment C.5	p.D58–60	Do flows as big as 37 cfs in the conduit have any cooling effect on Parker and Walker when running under their spillways? Or vice versa?	This type of modeling was not attempted and is not planned for the Synthesis Report. If all parties believe it is necessary it could be done later; however, we speculate that it would have very limited effects due to the very short distances of contact between the two waters (conduit and creeks) and the speed at which water is flowing both down the conduit and down the creeks..	**RTA**
Comment C.6	p.101	All 10g fish grow at least 5g and 50g fish grow at least 10g in all years with all scenarios. Is this an acceptable minimum growth rate in the bad years? Please state what would be the minimum desired growth in a bad year vs. a good year.	We clearly stated in the Synthesis Report that predicted fish growth based on the StreamTemp and Elliott et al. (1995) models provided data to index the relative effects of different flow management scenarios under different water availability and climatic conditions. While predicted weight gains were tested for a few years with empirical data, we do not believe that these predicted weight gains can, or should, be used as predictions of real weight gains in Rush Creek. The PIT tag study that is now underway will provide much more reliable estimates of actual weight gains and these data could more appropriately be used to determine "good" and "bad" growth years. This PIT tag data could also be used to further calibrate the Elliott et al. (1995) growth model, if desired.	**RTA**
Comment C.7	p.101	Please show how these predicted growth rates compare with similar Eastern Sierra streams. How long would a trout take to reach pre-1941 conditions (termination criteria)?	See our response to Comment C.6 as this response addressed predicted weight gain issues. We clarify that the modeling that was done has very limited use for predicting weight gains for adult brown trout, as this model was designed to estimate weight gains in juvenile brown trout. Trying to predict how long it would take a brown trout to reach 0.75 pounds (~340 grams) would require much more detailed predictive models (by life-stage, food items consumed and energy expended).	**RTA**
D. Groundwater and Vegetation				

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Comment D.1	p.116, 121	Is the assertion that the riparian revegetation goal is unattainable based primarily on the abandonment of the pre-41 floodplain surfaces and cessation of pre-1941 irrigation practices? Given that there has been no wetter years since the channel 8 and 4 bii were rewatered in 2007 and no extreme years since Channel 10 was rewatered in 1996, please inform us if it is premature to say that the trajectory of the riparian revegetation will be flat as shown in Figure 7-1.	Figure 7-1 shows the trajectory of increasing riparian vegetation acreage leveling-off since 1999 on Lee Vining Creek and 2004 on Rush Creek. With the SEFs implemented, small acreage increases within Lower Rush Creek are expected (e.g., 6 to 7 more acres in the 4 Floodplain), but substantial increases (i.e., more than a 10% future increase in a given channel reach) are unlikely on either Rush Creek or Lee Vining Creek.	**M&T**
Comment D.2	p.86	Premise #6 says "upstream change is inevitable, such that present side-channel flow conditions and floodplain groundwater dynamics may not be sustainable." When considered along with Premise #3 on p.83 that says "a multiple channel network will not evolve upstream of the Rush Creek County Road," and later suggests multiple channels may not even persist, this implies a major change from pre-diversion function in the bottomlands is in store, and that a significant future contraction of riparian vegetation in side channel areas is likely. Especially in light of expected retractions in riparian area due to climate change (p.129), do you expect the termination criteria curve for woody vegetation area to not just flatten, as it has recently, but actually decline? P.121 states "Riparian vegetation will not fluctuate more than 10% around the area mapped in RY 2009." Please state what percent change is expected with the likely loss of side-channel areas, and how this goal of less than 10% change is to be met.	SEF's were designed to attain woody riparian vegetation goals within the stream corridor where there are no side-channels. Side-channels are a terrific way of achieving a shallow groundwater table when mainstem streamflows are below 80 cfs, but also are a great uncertainty in terms of longevity. By adopting a conservative strategy, woody riparian acreage should retract no more than approximately 10% should a side-channel cease flowing.	**M&T**
Comment D.3	p.83	Premise #3 on p.83 contains a conceptual framework for delta channels that is not consistent with the work you cite (Stine, 1984). Specifically, it fails to distinguish between exterior and interior deltas. It is our understanding that Dr. Stine will be addressing this in his comments to the State Water Board.	Thank You.	**M&T**
Comment D.4	p.19	The draft report states that tree growth "appears to be bridging the dry years without significant retraction." Please include how this was measured. Can you define significant? Is this true for Rush Creek below the county road? What about in side channel areas such as Channel 13, where Chris McCreedy with PRBO Conservation Science has observed dieback as Channel 10 flow has slowly receded from the area?	Mapping error was 0.5 acres (McBain and Trush 2005). Four consecutive years of below normal water year classes occurred between RY2001 and RY2004. In mainstem channel segments experiencing active headcutting since 1999 (e.g., Rush Creek Reach 4c and Reach 5a), retraction of woody riparian acreage has been documented. In reaches farther upstream, there was an increase in woody vegetation during a period of consecutive below normal years where woody riparian acreage increased (Figure 7-1). This indicated woody riparian vegetation could bridge dry years without significant retraction.	**M&T**
Comment D.5	p.41, 123	The report should clarify that the A-3 side channel should be wetted with the lower fall and winter flows in Lee Vining Creek. Also, are there any recommendations on Lee Vining Creek side channels A-1 and A-2? What is the basis for recommending maintaining the A-4 side channel at a minimum flow of 30 cfs in contrast to other higher or lower flows? Has an evaluation of the fish, invertebrate and riparian habitat in the lower section of A-4 been made at the different flow levels?	Flow was observed in the A-3 side channel at the 12 cfs Lee Vining Creek test flow release in April 2009. Flow recommendations are not below this test flow magnitude, so the A-3 channel should remain wetted.	**M&T**
Comment D.6	p.129	Note the pattern of inverse gains/losses above/below the narrows in 7 out of 9 measurements (and tending to be larger losses in bottomlands in Fall–Winter). With low winter SEFs could we lose the function of winter groundwater recharge, resulting in greater springtime losses? Relative loss Above/Below: March 2008 small/big July 2008 big/small June 2009 big/small July 2009 small/big late Jul 09 big/small Aug 1987 big/small Sep 87 equivalent Oct 87 equivalent Nov 87 small/big We strongly agree with the reactivation of the bottomlands flow gauge in order to better understand the groundwater system.	Thank You.	**M&T**

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Comment D.7	p.19, see also p.123	"….the Rush Creek 3D Floodplain has only regenerated sparse riparian vegetation despite the extensive floodplain project implemented in RY 2002." What would have been expected? Is this presumed pre-diversion condition achievable? Could something have been done to achieve expectations, such as a different flow regime or floodplain configuration or a better seed source? Or, is this an example, like the Trihey pools, of how trying to restore unnatural conditions is not effective over the long term? The presence of older trees far from the channel was presumably supported by the previous location of the channel near those trees. The groundwater conditions in this high gradient reach are different than the low gradient reach downstream of the narrows and are not conducive to maintaining a shallow water table far from the channel.	Given our understanding of how shallow groundwater promotes vigorous woody riparian growth, the 3-D Floodplain will only be successful if a perennially flowing side-channel becomes established. If the shallow groundwater table could be maintained at the 3-D Floodplain, existing established seedlings would rapidly cover the floodplain surface within 10 years.	**M&T**
Comment D.8	p.123	Quickly establishing woody riparian vegetation in the 3D floodplain is recommended with no details for how to approach the task. <u>Please provide details so that we can ensure a successful revegetation.</u> An alternative remedy of a hydraulic control in the main channel is recommended for the 3D but not the other channels—why?	The prescription is perennial side-channel streamflow. Piezometer data show that surface flow in the 3-D side-channel provides highly conducive surface and shallow groundwater conditions for woody riparian germination and establishment.	**M&T**
Comment D.9	p.C25, C26	Why was the groundwater during the snowmelt recession higher in 2004 than 2005 in piezometer 8C-1? This pattern does not seem to show up in 8C-8. Could it have been a post dry year effect depressing 2005 groundwater? For a similar flow, the June 2004 water level was higher than June 2005 in one of the Channel 10 piezometers. Prior year flow in drier years could be important: Bottomlands flow was over 80 cfs through July 2003, but only through July 9 2004. Could a headcut have moved up the main channel in 2005? Could earlier peak timing in 2004 have combined with high post-winter groundwater levels—2008 groundwater was also high, and also experienced a peak with similar timing (early) and magnitude (around 380 cfs) as 2004. June–August rainfall was higher in 2004 than 2005.	We're not sure how you've compared the 8C-1 data to 8C-8 because the 8C-8 piezometer was not installed in RY2004. However, the question re: 8C-1 is still valid, with several possible explanations. The RY sequences could effect this; the RY2004 and 2005 peak timing was quite different (see Figure C-16); also we suspect the channel entrance dynamics, which controls the flow rate into the side channel, may play an important role in groundwater responses.	**M&T**
Comment D.10	p.C26	At the February 23, 2010 restoration meeting in Sacramento it was stated that figure C17-C21 was the primary analysis that generated the 80 cfs riparian maintenance threshold on Rush Creek. <u>We recommend looking at a longer period, such as the 1995–2009 period available from the Rush Creek Channel 10 piezometers, in order to tease out other factors that influence the water table. We also recommend a similar analysis for Lee Vining Creek.</u> Stromberg and Patten 1990 showed that an average annual flow of 80 cfs was necessary to produce normal pre-diversion cottonwood growth in floodplain trees on Rush Creek.	Chapter 9 includes additional analyses of the Rush Creek 3D data, and the MLC Rush Creek 10-Channel piezometer data. The Lee Vining Creek MLC piezometer data were also plotted and included in Chapter 4. Regarding other factors that influence the water table, further data analysis has shown that the distance to a flowing stream channel, whether a side-channel or mainstem channel, is another strong influence on shallow groundwater elevation.	**M&T**
Comment D.11	p.C26	We recommend using average late summer flow as an indicator of the height above which contemporary vegetation is sustained instead of the 63 and 91 cfs stage heights. The shoot growth or other monitoring will presumably pinpoint this threshold (see comment above). John Bair said that it is close to the 80 cfs threshold on Rush, and on Lee Vining it is about 1/2 foot higher than the 30 cfs stage, but that is why the analysis on p.C15–16 was done. But that analysis is still relating to these arbitrary flows. The recommendation that "groundwater should be maintained within 3 feet of the floodplain surface" was derived from the conclusion that "more than 70% [of riparian vegetation] occurred within 3 feet of the projected water surface [at 63 cfs]." But 30 cfs is a 1/2 foot lower stage than 63 cfs—63 cfs would presumably be necessary to maintain groundwater within 3 feet of 70% of the vegetation.	The reason the 63 cfs and 91 cfs flows were used was because the water surface elevation data were available from the aerial photography and digital terrain model at ONLY these flows. The suggested analysis is not feasible because we do not have the stream stage height corresonding to this flow along the entire length of Rush Creek and Lee Vining Creek channels. A flat plane projection of one streamflow elevation inadequately represents dynamic shallow groundwater variation in gaining and losing floodplains. However this tool can detect general trends in vegetation above a fixed point, relating the stage of streamflow in the mainstem channel to the elevation of the shallow groundwater table. It could be any water surface and the trends would be the same. Riparian vegetation maps are a complete census of woody riparian acreage in the stream corridors of Lee Vining and Rush creeks. The maps document general trends of riparian vegetation acreage along the entire creek below the diversions, not just a few specialized locations.	**M&T**
Comment D.12	p.C21	In Figure C-12, a red dashed line indicates the bottom of the 5-foot riparian zone. In this location, the average late summer groundwater stage appears to be about a foot lower than the 91 cfs stage, and about 2 feet above the red line. If we draw the red line below where the average late summer flow has been in good years for growth but above bad years, it looks like a sine wave 2006-2007-2008. Would that be a more appropriate model for the bottom of the riparian zone than a straight line at 5 feet? <u>**Also, on p.C25 please show piezometer 8-C1 stage (found on p.C22) instead of flow or please provide an additional chart with this information.**</u>	Groundwater surface elevation does not equal mainstem water surface elevation.	**M&T**

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Comment D.13	p.41, 114	Are there any concerns about going to 16 cfs baseflows Oct 1 in drier years? What about groundwater and vegetation—how do Oct flows affect that? The Mono Basin Synthesis Report does not appear to take into consideration necessary total annual flow volume, and we recommend that it do so. Stromberg and Patten 1992 considered maintenance of a shallow water table across the floodplain as essential for long-term maintenance of the overall riparian woody community. They showed that annual flow volume explained more variation than April–September volume, with the exception of trees 70–90 meters from the channel. Flows throughout the year contribute to the recharge of the riparian water table. Maintenance flows for Lee Vining Creek floodplain trees were found to be 14.6 taf and attainment flows 29.2 taf. Table 6-3 on p. 114 shows the proposed SEFs meet maintenance of the riparian population in all years and attainment of high biotic potential in only 10 of the 19 years modeled.	The water volume needed to supply the shallow groundwater table is important. We cannot address specifically how 16 cfs in drier years will affect woody riparian vegetation during the dormant period. Shallow riparian groundwater recharge is complex and depends on intra- and inter-annual streamflow variation and climatic trends. We acknowledge that in the Patten and Stromberg work (1992) the radial growth of cottonwood trees had in a few instances a greater coefficient of correlation (i.e., R2 value) for annual streamflow yield than summer streamflow volume (refer to Stromberg and Patten EIR Auxiliary Report Table 5). However the difference between the two is negligible because: 1. On Lee Vining Creek, the difference in the effect of annual streamflow volume or summer-only streamflow volume (April to September) on radial growth is generally near 0 to 3% in the floodplain and near-channel study for the univariate models used; 2. At two near-channel study locations on Rush Creek the total annual streamflow volume described up to 13% more of the variation in the radial growth of cottonwood trees growing near the channel;	**M&T**
		For Rush Creek, maintenance flows for floodplain trees were over 81 taf, indicating higher needs now than pre-diversion due to drought stress and channel incision. The modeling in Figure 6-3 shows this volume would be attained below the narrows in only one of the 19 modeled years, even though it would be attained in 7 years with the flows reaching the aqueduct. Population subsistence flows (associated with some loss of canopy vigor) for Rush Creek floodplain trees below the narrows would be 68.9 taf, achieved in only 5 of the modeled years. For Rush Creek channel side trees, maintenance flows were 12.2 taf above and 24.3 taf below the narrows, achieved in all modeled years. Attainment flows for channel side trees were 32.5 taf above and 48.7 taf below, achieved in 10 modeled years. Summer needs can also be found in the 1992 report on page 46. They also found that lower lows and higher highs are bad—annual fluctuations should be similar to that characteristic of free flowing streams.	3. However, the variation in radial growth of cottonwood trees growing on Rush Creek floodplains was more correlated to summer streamflow volume than annual streamflow volume. At the one floodplain location on Rush Creek, the summer streamflow volume described 8 to 9% more of the variation in the radial growth of cottonwood trees growing on the floodplain. We feel that based on the variation expressed in the Stromberg and Patten data are not compelling or sufficient to warrant re-investigation of the importance of annual streamflow volume. Based on our modeling of RY1990 to RY2009, the SEF's meet at least the streamflow maintenance volume criterion on both Rush and Lee Vining Creek that Stromberg and Patten identified (M&T Table 6-3; Stromberg and Patten Table 9) for near-channel trees on both creeks and floodplains in Lee Vining Creek. The SEF's do not attain the streamflow volume criterion for maintaining Rush Creek floodplains trees except in wetter years, however there is considerable uncertainty in our mind whether streamflow volumes identified for floodplain trees in 1991 compares to what we now are	**M&T**
		Data from other Eastern Sierra streams suggests reduced mortality if no lower than 0.4 times the mean (typical for undiverted streams), for example if Rush mean was set at 40.5 taf then dry year flows shouldn't drop below 16.2 taf. Table 6-3 on p.114 shows the proposed SEFs meet this criteria. They further state that real-time monitoring of plant response to various flow volumes and water availability in piezometers and soil moisture would allow refinement and testing of these relationships. We recommend further monitoring along these lines to test such postulated relationships.		**M&T**
Comment D.14	p 43, 90	Stromberg and Patten, 1990, showed that prior year growth, annual streamflow volume, and annual precipitation predicted 79% of the variation in cottonwood growth on Rush Creek. Prior year growth affected Jeffrey pine even more. They also showed a shift in growth from May to July after diversions began (the peak flow was delayed during the diversion period). We recommend determining if there is any value in shifting this growth back to the pre-diversion condition of May by delivering an earlier peak flow. Stromberg and Patten, 1990 said "reduced growth for *P. jeffreyi* during the diversion period... probably resulted, in part, from the altered seasonal hydrograph. For this species and others having a vernal growth pattern, high spring flows would optimize water-use efficiency." In a personal communication from Patten, he said the peak should occur prior to mid July, not in mid-July as shown in figure 2-7 for the wetter year-types. Much of the growth of trees comes in spring, which can be seen in both rings and shoots.		**M&T**

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		Only two of the 6 wetter than normal year peaks shown in figure 5-4 occurred in July, and Appendix A-3 Figure 1 on p.A50 shows only 5 peaks in the unimpaired record occurred in the first third of July and none later, although this might be an error (see next comment). Since some of the reason for a later peak is to augment cool water temperatures and riparian growth later in the summer, yet these are less in need of augmentation in wetter years, it should be possible to move the peaks earlier so that the wettest year peaks occur in early July at the latest, as they would under natural conditions. Patten suggests that Lee Vining Creek vegetation recovering faster than Rush Creek (aside from willows) may be due to the later timing of the Rush Creek declining limb. In addition, we suggest evaluation of using extra water during the transition period prior to the peak to evaluate the effect of higher flows on vegetation during the spring.	We agree on the importance of early-spring groundwater availability in annual growth. The SEF's provide an increase in streamflows after April 1st to ensure that plants have enough water to maximize growth in most years (i.e., the 70 to 80 cfs spring bench). The need for available water was more important when the plants began growing, than later when plants are developing reserves and done with annual growth. The question of when to deliver the flood peak to Rush Creek certainly should consider cottonwood seed dispersal, however other factors need consideration such as the timing of the natural flood peak, the timing of Walker and Parker flood peaks, and the ability to spill Grant Lake.	**M&T**
Comment D.15	p.A50	The report Appendix A-3 Figure 1 on p. A50 shows no peaks later than the first 1/3 of July. If Figure 2 is correct, then <u>the top graph (Fig.1) is missing at least 14 Rush at Damsite data points contained in the lower graph after early July.</u>	There was an error in the Rush Creek at Damsite dataset in Ap A-3 Figure 1 (using a "line" chart type in excel forced the use of the same x-axis data, despite each dataset referencing different cell ranges). The chart now shows (properly) the much broader distribution of peak timing for the regulated Rush Creek at Damsite data set. The Parker Creek data were also affected by changing the cell references, and now also show a broader date range that previously. I also adjusted the axes so they are the same date range. Thanks for picking this up. The FIgure 2 legend should also read "Runoff Years 1941-2008", not "1990".	**M&T**
Comment D.16	p.43	The highest peaks are in early-to-mid July in Fig. 2-7 in order to take advantage of spilling the reservoir and passing the high peak downstream. Another goal is to match up Rush Creek's peak with Parker and Walker creek peaks in order to maximize the magnitude in the bottomlands. Early June and late June are common times for these tributaries to peak, and July in some of the wettest years. <u>Targeting the timing of seeding (p.97) should match up with the recession limb, not the peak—especially on emergent floodplains where seedlings could be washed away.</u> Therefore, if the seeding is, for example, July 6 to August 17, then the peak should be prior to July 6 with the descending limb beginning on July 6. For emergent floodplains, this period would extend until flows drop below the 120 cfs threshold. The report seems to erroneously call for a peak during those dates, counting days above the threshold on the ascending limb as good days, which may be true for higher areas away from the channel, but would not be true for emergent floodplains.	Figure 2-7 shows examples of the peak timing, but the operational guidelines allow for earlier (or later peaks). The snowmelt peak IS generally emphasized later than earlier, for the reasons mentioned. The peak does not need to occur prior to the entire period of seed release in order for regeneration to occur. The post-recession bench AND the recession are specifically designed to target maintaining conditions for post-peak germination and seedling survival.The highest peaks would likely not be stimulating germination on emergent floodplains, since they are by definition at lower elevations within the bankfull channel.	**M&T**
Comment D.17	p.A50	It seems like overall the report does a pretty good job recommending timing in consideration of all of these factors. But Appendix A-3 Figure 1 (p.A50) shows only 5 peaks in the unimpaired record (7%) are in the first third of July with none later, which implies a natural peak should be prior to mid-July. The centroid of the distribution appears to be early June, not mid to late June as proposed. 23 of the peaks (34%) are in May and no May peaks are proposed. 39 are in June (58%) with 25 in early June and only 14 in late June. <u>Until this graph is corrected, it is difficult to evaluate how the proposal matches up with natural timing. At this point we can say that the main concern appears to be a lack of any May and early June peaks, and perhaps the wettest year peaks might be a bit too late. A shift to earlier peaks is also likely with a warming climate—especially warmer later spring and early summer nighttime temperatures as has already been observed.</u>	In many years Parker and Walker can deliver May and June peaks which may come prior to the main peak but nevertheless provide similar impetus for fish, bmi, and riparian responses. Granted this will not affect upper Rush Creek, and as we've stated, this reach above Narrows will likely have a more static annual hydrograph than below Parker Creek.	**M&T**
Comment D.18	p.92	The equation for these data on Figure 5.5 is incorrect. That equation for Lower Rush Creek is y=57.10x2.00, R2=0.96. ***Please see graph in our written comments*** Using this model (the equation on the above figure) a 2.5 cm (1 in.) per day decline in stage is equal to 60.714*((1/12)*(1/12))-20.071*(1/12)+21.857 which is equal to 20.6 cfs decline per day in discharge. The use of a decline of 2.5 cm/day is based on studies by Stewart Rood and associates on the ability of cottonwood seedlings to grow roots to keep up with a declining shallow alluvial water table. A similar number for willows is about 1 cm/day.	I do not understand the comment. Our equation is directly from the Excel trendline for the -9+82 data set, and appears correct. For example, at stage height of 2 ft, the computed discharge is 228 cfs ((57.1*2^2.00) (are you properly using the power function??); at 2.1 ft, the discharge is 251 cfs, a stage chage of 0.1 ft gets a dischage change of 23 cfs. The relationship is different at higher or lower flow ranges, but the equation appears to be correct.	**M&T**

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Comment D.19	p.43	Please see graph in our written comments The red line placed on Figure 2-7 of the Mono Basin Synthesis Report represents the appropriate discharge decline for the period July 6 to early August (ca. 35 days +/- which apparently is the cottonwood seed dispersal period) at 2.5 cm (1 inch) stage decline per day, this is equal to 21 cfs decline in discharge calculated from the equation developed in the first figure above. This line and the decline and dates is based on the "recruitment box" model concept developed by Mahoney and Rood (1998). The report should re-evaluate the recommended stage decline per day based on this information.	You are comparing your "appropriate" rate of decline for a maximum 1 inch/day stage change to our FAST recession, coming off the peak. We are allowing a stage/discharge decline which (using our correct rating curve at XS-9+82) would allow dischage change from 380 to 220 cfs (in Ex-Wet years) and a corresponding stage change of approx 2.5 to 2.0 ft in FIVE DAYS (380-342-308-277-250-220). In addition, while not relying on the soil moisture for protection, we assume the capillary fringe will not recede as quickly as the groundwater.	**M&T**
E. NGD Analysis				
Comment E.1	p.66	The report needs a longer simulation period. We recommend that the 1990–2008 modeled base period be extended back to at least 1976 for the following reasons: 1) It does not include the 6 year drought that started in 1987; 2) It only includes one extreme year (1995) not two as is stated. 2006 was not an extreme runoff year; 3) The period from 1976–92 had greater and longer extremes of wet and dry than the 1990–2008 period.	We agree that this would be useful with the updated LAASM model developed by LADWP that incorporates the Mono Lake elevations.	**M&T**
Comment E.2	p.97	Table 5-2: The low number of good years seems to be a result of the difficulty modeling GLR spill. Please model NGD and NGY with recommended SEFs (ignoring whether the flow comes from spill or an outlet) so that we can fairly evaluate the effect of the recommended flows.	The NGY analysis was conducted with the SEF flow recommendaitons that included the proposed spills. The flow data set did not include the "extra" water during pre-transition period. However, the peak magnitude should not effect the NGY analysis because the 380 cfs max MGORD peak release is already above the riparian thresholds; adding the proposed spill peak does not change the NGD's that meet the NGY criteria.	**M&T**
Comment E.3	p.C8	The proposed SEFs make a Dry-Normal I (DNI) year type go from a favorable NGD unimpaired to unfavorable for vegetation maintenance. What are the anticipated effects of this change on vegetation, especially during a several year drought?	Your conclusion is not correct. Please re-read the section. The Dry and Dry-Normal NGDs are as follows: Unimpaired: 61, 76; SCE(RCatDamsite): 21, 46; SRFs (belowNarrowsActual): 47, 50; SEFs (belowNarrowsw/spills): 53, 61. So the proposed SEF improves on the SCE regulated flows and the SRF pre-transition flows, but does not attain the unimpaired NGDs. We view this as a necessary compromise. We expect the DN-I runoff years to continue to maintain riparian vegetation vigor on those years.	**M&T**
Comment E.4	p.97	Table 5-2: Aggraded floodplains without side channels get only 1 NGD from the below Narrows SEF (top three numbers right hand column). This is incorrect—flows exceed the 275 cfs threshold during these dates more than once. Does below the narrows one good year in 19 years equal even less (zero) good years above the narrows? How often would a good year occur above the narrows? Please show what flows could be prescribed that would not sacrifice germination on the aggraded floodplains above the narrows. If that 1 in 19 years is missed below the narrows (e.g. due to operational difficulties), is 1 in 38 years an acceptable regeneration frequency for these species? Flows that would do better should be shown, even if they aren't recommended.	Yes, flows exceeded ther 275 cfs threshold more than once (=NGD) but flows needed to exceed the threshold for 21 CONSECUTIVE DAYS to qualify and a Good Year. This occurred only once, in RY1995.	**M&T**
Comment E.5	p.E35	Table E-13: The last two columns are the SEF, but there are zero NGD for the last 3 geomorphic thresholds. This is incorrect, since they are 500 - 600 - 700 cfs events that would have occurred—and the 1995 simulated SEF on p. A25 almost reaches 700 cfs, which would give some NGD. There is no summary column for SEF with simulated "spill" or otherwise-delivered flows above 380 cfs. Please attempt to make a realistic estimate to fill in the table, despite the difficulty in modeling flows above 380 cfs.	The NGD analysis was conducted for the SEFs without and with recommended spills. The table did not previously report the "with spills" NGD, but is now updated with this information.	**M&T**
Comment E.6	p.93	Normal year thresholds (also found in table 3-1) require flows > 450. P. B46 states "As expected, this release magnitude [400 cfs] appeared to be a minimum threshold for measureable fine sediment deposition on incipient floodplains." With the MGORD capacity constrained to 350 cfs (currently, may increase or decrease over time), what will the final Synthesis Report recommend above the Narrows instead of the draft report's 380 cfs? Please discuss how the normal-year recommendation, if different from these thresholds, will affect the functions that require a normal year flow exceeding 400 or 450 cfs.	The Normal RY flood peak threshold of 450 cfs below the Narrows will be more difficult to attain with a 350 cfs release compared to a 380 cfs release (the additional 50 to 80 cfs contributed by downstream tributaries). Anticipating Grant Lake filling much more often in the future, greater flood peaks should occur even in Normal RYs. If greater cooperation with SCE is unsuccessful and enough peak floods in Normal RYs cannot be achieved through spills and/or synchronization with tributary floods, then structural and operational modification to Grant Lake Dam is the only other option for reliably providing SEF peak flood magnitudes to Rush Creek.	**M&T**

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No.	Page	Comments	Scientists' Response/Action	By
Comment E.7	p.E16	Table E-4: SEF NGD appears to be a big improvement for fish over table E-3 (current NGD). Only three conditions decrease: Off channel connectivity (-10 days), spawning gravel mobilization (-1 day), and shallow ground water saturating emergent floodplain (-3 days) on average. This last one primarily is lost in the wetter years, especially wet-normal years (loss of two weeks). What are the implications of losing this in wet-normal years, a year-type when we presumably want to maximize vegetation growth?	The number of days that emergent floodplains are saturated (>80cfs threshold) has less implication for annual riparian growth/success, as long as there are many of those days in the wetter years (which there are) ,than the threshold for protecting vigor of established riparian species (>30 cfs threshold) which is intended to maintain the shallow groundwater for extended growing season availability.	**M&T**
F. Flow Management Recommendations				
Comment F.1	p.42	The Rush Creek winter flows indicated in the report are incorrect as stated at the Sacramento meeting. We look forward to seeing the correct recommendation prior to the finalization of the report as well as new modeling based on the correct figures. <u>This is one of several of our comments that lend themselves to further discussion and information exchange with the stream scientists prior to their finalization of the report, and we expect those discussions to begin soon after these comments are submitted.</u>	The fisheries team corrected the Rush Creek winter baseflow recommendations and circulated the revised Chapter 5.11 to SWRCB, LADWP, CDFG, MLC and CalTrout on 4/13/10.	**Rta**
Comment F.2	p.95	Table 5-1 380 cfs "recommended SEF"—p<u>lease show what the recommendation for the creek is with no assumptions made about infrastructure</u>**.** MGORD capacity could increase or decrease over time—please tell us your recommendation and run NGD analysis and discuss implications of 350 if that becomes the recommendation. The recommendation should drive the infrastructure—wherever we see 380 it looks like the infrastructure is driving the recommendation	The Stream Scientists acknowledged that "The 380 cfs peak release is not a geomorphic threshold" (pg. 94), rather a concession to attain the highest possible peak releases within the constraints of the LADWP facilities. However, prescribing recommended spill magnitudes of 550, 650, and 750 cfs will result in drammatic changes in flood magntidutes above and below the Narrows. Our recommendation will remain a 380 cfs release for Normal years.	**M&T**
Comment F.3	p.44–56	The text for all year types says “at the top of the MGORD” for the winter flow releases. All past SWRCB flow requirements have been for the stream itself, measured at the bottom of the MGORD. <u>The report should be clear if it is recommending a wholesale change in where all requirements are measured—from the bottom to the top of the MGORD, and if augmentation from another facility (such as the 5 Siphons Bypass) should be added to that measurement or if it is in addition to it.</u> The difference is often 1–2 cfs during winter—and if measured at the bottom or released through a new outlet facility, should 1–2 cfs be subtracted from the recommended flow?	We are not making a recommendation that the location of where LADWP's Rush Creek release is measured is changed. Sections 2.4.2.1-2.4.2.7 have been edited and the "at the top of the MGORD" has been changed to "from the MGORD".	**RTA**
Comment F.4	p.A53	The fifth column (below narrows unimpaired) is wrong—it incorrectly adds 6–7 cfs to the numbers in the second column (unimpaired). During peak flow Parker and Walker unimpaired add up to more than 6–7 cfs. <u>If these low Parker and Walker numbers were used elsewhere, or the results of this table entered any other analyses, those should be corrected as well.</u>	There was an error in the data used to compute the values in the Rush Creek below Narrows unimpaired.The table will be updated in the final report. I have confirmed that these data were not used elsewhere.	**M&T**
Comment F.5	p.38	The example of a 70 cfs release resulting in 80 cfs below the narrows is appropriate for the snowmelt bench period, however it does not include losses and may not be an appropriate example for other times of the year. Gains of 10 cfs or more only occur during the last half of May and June–July. Outside of this period, presumably 80 cfs would still be required because only 70 would make it below the Narrows at certain times of year. Appendix A-5 Table 3 (p.A62) shows from the MGORD to the 10 falls many measurements of far lower gains than 10 cfs: ***Note data is presented in a table in our written comments*** Date Gain/Loss 3/20/08 1 cfs gain 8/12/08 2 cfs loss 8/14/08 4 cfs loss 8/16/08 14 cfs loss 8/19/08 7 cfs loss 8/20/02 3 cfs loss 8/21/08 5 cfs loss 8/31/08 4 cfs loss 9/15/08 4 cfs loss 9/29/08 4 cfs loss 5/3/09 2 cfs gain 8/21/87 6 cfs loss 9/5/87 12 cfs loss 10/22/87 4 cfs loss	But the data analysis was made based on the flow release value and the measured response in the bottomlands, so the potential flow losses is already inherent in the release recommendation.	**M&T**

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Comment F.6	p.86	An additional premise should be included about Upper Rush Creek that informs the SEF for Rush Creek. The stream scientists indicated on the March 15, 2010 phone call that Upper Rush has a different dynamic than below the Narrows including greater channel stability than below the Narrows. The report should better articulate why the SEFs are focused on the bottomlands, and why it fails to specify thresholds and flow recommendations for Upper Rush especially given the original stream scientists' recommendations (Ridenhour, 1995) for Upper Rush Creek that had higher SRF's than for lower Rush Creek.	The original Stream Scientist's recommendations were made (Ridenhour 1995) w/out the advantage of extensive monitoring and prolonged observation. An original geomorphic threshold for all Rush Creek was frequent bed surface mobility. Above old Hwy 395 Bridge, the channelbed is noticeably steeper and coarser than below the Narrows. A steeper channel, in theory but not always observed, should be capable of moving larger grain sizes as frequently as a less steep channel with finer grain sizes. Initial bed mobility monitoring showed that the dominant particle size of the channelbed above the old Hwy 395 was not as responsive (to move) as was the channelbed below the Narrows in response to the same flood peak. The mainstem channel above Hwy 395 Bridge basically has immobile banks, through a combination of coarse material and dense woody riparian growth, and is not expected to migrate. In contrast, channelbed mobility and channel migration, together, are more important for recovery below the Narrows. A less frequently mobilized bed surface above Hwy 395 will not impair channel recovery or reduce fish habitat. No specific flood peak thresholds were necessary.	M&T
Comment F.7	p.79	One of the justifications for adopting the Bypass flow approach on Lee Vining Creek in the October through March period is "much of the daily baseflow variability in the SCE regulated hydrographs between October 1 and March 31 is attributable to SCE operations rather than natural variability." Please inform us if this observation was based upon a quantitative analysis of the records, a visual analysis of the records, or a comparison to the Buckeye Creek record (i.e. the back-up for the observation should be provided).	There was no formal "quantitative analysis" of the flow records; artificial flow variability is clearly evident in the Lee Vining above Intake flow records. We also used the Buckeye Creek record, and was stated in the report, Section 4.3 (pg. 80): " The unregulated Buckeye Creek annual hydrographs (Appendix A) between October 1 through March 31 lack appreciable baseflow variability and help support the recommended constant bypass flow."	RTA and M&T
Comment F.8	p.40–41	An operational rule should be provided for the relatively rare times at which the switch March 31–April 1 or Sept 30 to Oct 1 between bypass and diversion tables will result in a unacceptably large variation in stream flow. A basic transitional ramping would be appropriate. Example: on 3/31 LV above is 100 cfs and 20 cfs is being bypassed per table 2-7; on 4/1 at above of 100 cfs, 76 cfs is left in stream per table 2-6. The ramping from 20 cfs to 76 cfs in that situation should be specified.	Good Point. We will add this information.	M&T
Comment F.9	p.40	There should be more explicit direction to LADWP on how diversions should be managed if Lee Vining Creek flow fluctuates around 250 cfs. In order to preserve the integrity of the snowmelt peak hydrograph, if flows go above 250 cfs during the snowmelt peak, and they are likely to be at that level or higher based upon the snowpack, and a short-term cool-down causes the flow to drop below 250 cfs, diversions would be automatically resumed, however it could be operationally desirable to not resume diversions. If so, guidelines should be developed that specify the number of days that the flow would need to be below 250 cfs before diversions resume. We recognize that LADWP will develop the operational guidelines for MBOP but we feel there should be a process to discuss this and other operational guidelines with the scientists and stakeholders before the guidelines are finalized in MBOP.	Yes, we agree that LADWP should develop operational guidelines for the MBOP, and these should be subject to external review by MLC and the Stream Scientists prior to becoming finalized.	M&T
Comment F.10	p.44	When GLR is below 25 thousand acre feet (taf) storage in dry and dry-normal years, how much of Lee Vining Creek diversions should be augmenting Rush? Should a maximum be specified if a sudden thunderstorm or SCE release were to occur? Please provide more detailed recommendations regarding this augmentation.	LADWP's comments also requested more specific guidelines to 5-siphons use for Rush Ck thermal relief. This language has been added to Chapter 2.4.2.	RTA
Comment F.11	p.A66	Third paragraph on p.A66 says Convict Creek was chosen "because it is unregulated." For the record, we'd like to note that Darren Mierau (personal communication, 3-15-10) stated that now he'd probably do it differently based on what he knows. Virginia and Buckeye would tend to match Rush Creek's watershed characteristics better. We don't feel the deficiencies in the ramping analysis are severe enough to require a new analysis, however we would welcome a new analysis if the stream scientists decide it is appropriate.	The Ramping Memo was provided in the Synthesis Report because it contained some analyses that shed light on unregulated ramping rates common to the Eastern Sierra. The availability of other unregulated data sets doesn't change the analyses correctly done with the Convict Creek data. The initial Hydrograph Component Analysis presented in RY2004 Annual Report used Buckeye Creek data and resulted with similar ramping rates as from Convict Creek data. These rates then compared favorably to the updated Hydrograph Component Analysis with the Rush Creek Unimpaired data (Appendix A-3, Table 1)	M&T

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Comment F.12	p.76–77	SCE's cooperation is "necessary" to accomplish the recurrence curve on p.76 and table 4-2 on p.77. SCE data from past years show this is operationally achievable, however a higher release from Saddlebag could impact power generation and may be difficult to achieve politically.	Thanks for this observation	**M&T**
Comment F.14	p.41, 82	On page 82 the report states that one rain-on-snow event in 19 years provides "no justification" for preserving winter peaks. How often would these events be expected? What thresholds and frequencies would be justification? A summer 1984 rain-induced flood event was even larger and would indicate a recurrence of 13–19+ years, and possibly more often under a global warming scenario. Page 41 states that no specific ecological objectives are solely met by a winter flood. We would like to point out that the groundwater recharge and channel avulsions during the January 1997 event were on a scale that has not been matched since. If SCE can't maximize summer peaks, passing rain-induced floods could be an important strategy. The report's reasoning for maximizing summer peaks (p.74 & 76) "speeding recovery" would presumably hold for passing large winter floods. The diversion table on p.77 recommends a 20 cfs increase in the 25-yr flood from 630 to 650 cfs; presumably passing a single Jan 1997 730 cfs flood (instead of diverting it) would be more effective (and possibly more achievable) in "speeding recovery" than adding 20 cfs to a summertime extreme year event. <u>Aside from our concern about the lack of passing winter peaks, we support table 4-2 on p.77 and want to work with LADWP and SCE to encourage and assist with maximizing the peak.</u>	Answered above in Lee Vining Creek Comment #2.	**M&T**
Comment F.15	p.41	The draft report states that large events likely would bypass the conduit. <u>This is incorrect.</u> The conduit can shave 300 cfs off a flood. If LADWP had diverted the maximum in January 1997, 430 cfs would have passed downstream instead of 640 cfs. We recognize the importance of maintaining flexibility to divert flows of this magnitude when necessary for public safety, however even if it is not a requirement to release large winter floods, we recommend encouraging release unless public safety requires otherwise. Presumably the loss of trout reproduction in 1997 would have occurred whether or not 730 cfs or 430 cfs were passed downstream, therefore reducing large winter floods would not have any short-term fishery benefits. <u>We suggest making the summer provision for passing flows above 250 cfs into a year-round provision in order to take advantage of these rare but valuable winter events.</u>	We agree and have modified our recommendation accordingly. However, with respect to the fishery a decision to pass channel-forming flows to the lower creek during the winter that LADWP could divert will most likely lead to poor recruitment of age-0 trout the following spring.	**RTA and M&T**
Comment F.16	p.77, 95	Tables 4-1 and 5-1 recommend decreasing the recurrence interval of flood magnitudes, which we support. However, looking at percent of unimpaired passed results in the following table: ***Note please see data table in our written comments*** Recurrence LV Above LV Rec. Rush Above Rush Rec. 2 70% 80% 41% 69%* 3 71% 88% 47% 75% 5 75% 86% 53% 77% 10 75% 86% 60% 81% 25 93% 96% 64% 75% *69% is 380 cfs; 350 cfs is only 64% of unimpaired Note the recommendation is for passing 80-96% of Lee Vining Creek unimpaired magnitude, however the Rush Creek recommendation is for only 69*-81%. Please discuss why Rush Creek "needs" a much lower proportion of its unimpaired peak than Lee Vining Creek.	The natural duration, magnitude, frequency, and timing of peak floods is the ideal for recovery. In our role as stream scientists, we evaluated where changes could be made in annual flow regimes that would not significantly affect recovery, but that would be less than ideal. The opportunity to provide peak floods closer to the unimpaired condition on Lee Vining was especially valued because Lee Vining Creek will require a considerably longer timeline for stream channel recovery than Rush Creek. The same flood peak recommendations for Lower Rush Creek applied to Lee Vining Creek would still lead to recovery. Our greatest unknown is the significance of the rare, mega-flood on large-scale geomorphic changes and enduring effects to stream ecosystem productivity and fish populations.	**RTA and M&T**
Comment F.17	p.118	At the February 23, 2010 restoration meeting in Sacramento, Bill Trush stated more than once that in general, as you approach diverting 30% of unimpaired flow, you start losing ecological function. Table 6-3 proposes releasing 63-115% of Rush Creek's unimpaired volume below the narrows, with an average of 73%. 7 years are below 70% with two years in a row occurring twice. This appears to be approaching a 30% diversion—lost ecological function appears to be in the design, and <u>those functions the Rush Creek recommendations would abandon should be listed clearly along with the additional flows required for maintaining them so that the trade-offs are clear.</u> The recommendations for Lee Vining Creek result in 69–84% of unimpaired flow being passed downstream, with only two years under the 70% threshold, and an average of 77%. Intuitively, that appears to be a "safer" distance from the 30%, but <u>we would also like to see a list of Lee Vining Creek functions expected to be lost under the proposed flow regime along with additional amounts of water required to maintain them.</u>	Trush has found that projects diverting more than 30% of the unimpaired annual runoff begin to greatly restrain management options for maintaining natural ecological processes. Rush Creek and Lee Vining Creek appear no exception. No ecological processes important to our restoration and fishery goals will be lost or abandoned. The NGD analyses explicitly show which processes are affected by water diversions based on changes in duration and frequency relative to unimpaired hydrographs. We recognize that many if not most of the desired ecological outcomes in Table 3-1 are co-dependent. NGD analyses do not show, and cannot show, what the final outcome will be from altering a process's magnitude, duration, frequency, and/or timing.	**M&T**
IV. Corrections and Clarifications				

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		The following comments note more minor matters that MLC observed in reviewing the report. In order to improve the accuracy, completeness, and clarity of the final report, the stream scientists should address these items. They are provided in order of page number for ease of reference.		
A. Clarifications				
	p. 4	While the Mono Basin Clearinghouse contains many excellent sources for the history of land and water development in the Mono Basin, it does not contain a comprehensive listing. The reader should also be directed to original sources such as Fletcher 1982 and 1987, Hart 1996, and Vorster 1985.	Noted	**M&T**
	p.8	"The Mono Basin monitoring program has exemplified adaptive management." This poorly-worded sentence not only is meaningless as written, but also the intent isn't necessarily true, given numerous difficulties in the adaptive management and monitoring program, e.g. LADWP's difficulty in quickly contracting for additional monitoring on short notice. We do think that there have been aspects of the program in the last 12 years that are good examples of adaptive management such as the decision by all the stakeholders to agree to numerous variances to test different high and low flow regimes, however we wouldn't characterize it as "exemplary."	Given the initial context of acrimony, Court and SWRCB hearings and settlement, and the precedent of modified water rights, difficulties can and should be expected. However, the monitoring program has been well funded, has had consistent comittment from numerous individuals and organizations, and has made significant progress in our understanding of basin tributaries. More importantly, however, initial hypotheses (and many guestimates) on how the streams functioned, the magnitude, timing, duration of flows necessary for restoration have been effectively tested, our knowledge improved, and results integrated into revised hydrographs and operations. In regards to the fisheries program, new studies were initiated as we gained knowledge from the annual sampling data. These new studies were discussed in an open forum and study plans and designs benefited from the input of interested stakeholders. From our perspective and involvement with other restoration programs throughout CA, this activity IS exemplary.	**RTA and M&T**
	p.11	o The bottomlands is not a braided stream course. It is a multiple-channel anabranching stream. o The report should not use "relatively undisturbed" to describe the upper canyon reach of Lee Vining Creek without further explanation. The riparian vegetation in that reach was not eliminated by water diversions because of the seepage below the intake, however the existing vegetation was relatively decadent and not recruiting new vegetation during the diversion period according to Taylor, 1982.	Both terms were deleted from the text.	**M&T**
	p.11 Table 2-1	o This table and all others in the report should either define what it means by "yield" (apparently it is the measured runoff) or not use the term when referring to measured runoff since "yield" can mean the natural runoff from a watershed. We recommend using "Average Annual Measured Runoff" or "Average Annual Unimpaired Runoff." Please also show the unimpaired averages since that is the yield that nature provides. o "Annual" should be "Average Annual" o The average annual runoff for all the base periods used in the report should be listed here. In addition to 1941–90 (which is what the Water Board uses for determining year types) the table should include the 1990–2008 period (used in the model), 1998–2008 (the monitoring period could include 2009 since that will be available very soon). Why is 1941–2008 included? It should be replaced with the longest period of record that is available which is 1937–2008 (or 09). We recommend that footnotes explaining each base period be included.	We have attempted to refine this table and provide the best data available However, we have limited the data presented to what is needed for understanding the SRF streamflow performances, and for subsequent analyses for developing SEF streamflows.We suggest that another iteration of data assembly and reporting from LADWP would be useful.	**M&T**

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No.	Page	Comments	Scientists' Response/Action	By
	p.12–13	Estimated Unimpaired Runoff definition: Because the unimpaired runoff is a key data set in this report we recommend that this paragraph clarify or add the following points: o the statement "converting the storage data to reservoir inflow rates" is not clear and needs elaboration. Instead it should say that "the SCE daily acre-foot storage change is converted to a daily CFS that is combined with the measured flow at Rush Creek Damsite or Lee Vining Creek above Intake" o Please explain that negative values can occur and how they are dealt with. o Hasencamp probably "calculated" not "estimated" that 70% of the total runoff. Please include where the other 30% of the runoff comes from (Reversed Creek, Alger Creek) o the following sentence is not clear "Adding the measured flow at the Rush Creek at Damsite and Lee Vining Creek above Intake gages accounts for flow from unregulated portions of the watershed." o Is 1973 missing from the unimpaired record? o Explain that the estimated unimpaired flows at Narrows does not account for any gains or losses between the Parker and Walker gages and Rush Creek. Parker Creek gains some of South Parker Creek below the gage. Infiltration losses on the two creeks can occur.	The first statement was added to the document; "estimated" was changed to "calculated"; adding the measured flow simply means that some of the measured flow at the downstream gages does not derive from the portion of the watershed that is regulated, but this flow is still accounted for by measurement at the gaging sites; 1973 data are available, text was corrected; yes, streamflow gains and losses can occur.	**M&T**
	p.16	Table 2-3a is unnecessarily complex. There should only be two columns for flows, Apr–Sept and Oct–Mar. There is no need to list each Apr–Sept month separately because the flows are the same.	The table was revised.	**M&T**
	p.19	Please elaborate what is meant by "all the constructed deep [Trihey] pools have deteriorated." Have they all filled in? Are some still deep? Please provide a status update as to what the state of filling-in is.	The status of these constructed pools is in the Pool Report which reported a 33% decrease in lengths, a 18% decrease in depths and a shifting of rootwads to channel margins. All the constructed pools were down-graded from Class 4 or 5 pools in 2002 to Class 3 or 4 pools in 2008. We have added the Pool Report as a citation on page 19.	**RTA**
	p.32	2003 and 2008 were significantly impaired by diversions—why not 2004 or 2009, which had a lower % peak passed than 2003?	These anomalies were corrected in Tables 2-4 and 2-5.	**M&T**
	p.35–36	Mixing time periods: 3500 af diversions since 1990 should match the 16,000 af export period since 1997, which adds up to 1800 af average for the post-1997 period (which emphasizes the imbalance even more).	Good Point.	**M&T**
	p.45, 47, 49, 51, 53, 55, 57	o Proposed SEF Dry in legend (this is a comment for all year types) should specify MGORD release (as opposed to Parker / Walker / 5-Siphons). Also table caption should say Above the Narrows at the top of the streamflow column. Please add a below narrows column since the thresholds in table 3-1 are for that reach and are not easily compared with the recommendations. o The text on the facing pages says "at the top of the MGORD" for the winter flow releases. All past SWRCB flow requirements have been for the stream itself, at the bottom of the MGORD. The report should be clear if it is recommending a wholesale change in where all requirements are measured—from the bottom to the top of the MGORD. The difference is often 1–2 cfs during winter.	These corrections were made.	**M&T**
	p.49–57	In the recommended SEF tables, should separate examples (snowmelt flood timing) from key recommendations (snowmelt bench timing).	The snowmelt peak release is the only hydrograph component intended to have flexibility in the timing. We specified a "default" date for peak releases in the SEF Tables; we also specified in text the potential range of dates possible given the fixed dates	**M&T**
	p.60	Please clarify what is meant by "average annual diversion volumes ranging from 20,000 af up to 35,000 af." The average is 30,641 af. In what scenarios would the average be 20,000 af or 35,000 af? If you are referring to annual diversion volumes, then they range up to 66,000 af.	This sentence was changed to state more generally the exports above the Transition period maximum of 16,000 af.	**M&T**
	p.61	Regarding "Replicating the stream processes occurring before 1941," it should be made clear that directives to restore and maintain the pre-1941 fishery in Caltrout II and the Water Board orders refer to the conditions that benefitted the pre-1941 fishery, and acknowledge that not all pre-project conditions can or should be restored.	Thank You.	**M&T**
	p.62	The 3/15/10 phone call confirmed the Rush Creek column is below the narrows. This should be stated clearly. Where known the thresholds above the narrows should be listed as well.	Change made.	**M&T**

Exhibit A. Mono Lake Committee Comments on the Draft Synthesis of Instream Flow Recommendations

No.	Page	Comments	Scientists' Response/Action	By
	p.62	Table 3-1 should include, where appropriate, the thresholds for the "sufficient" number of good days in an annual period (e.g 50% duration threshold for a growing season is noted on P.63) and the "sufficient" number of good year thresholds.	Thresholds or flow ranges for Rush Creek above the Narrows are not provided. Our data do not allow a firm enough distinction between upper and lower Rush Creek, nor would modeling necessarily be conducted differently if more data were available.	**M&T**
	p.65	The reader of the diagram would benefit from a clearer explanation such as that provided at the February 23, 2010 Sacramento meeting.	We have attempted to make this analytical process as clear as possible.	**M&T**
	p.79	Instead of showing stage ht in main channel at 30 cfs, show actual gw stage ht, which is about 0.75 feet lower. Or make the groundwater data points a different color at and below 30 cfs actual flow on the date read.	This chart was replaced with more informative charts.	**M&T**
	p.81	o "leads to NGD's below reference conditions" should specify for non-trout goal–s—otherwise sentence is confusing. o p.86 "trout reside in the MGORD because of better thermal conditions."—simplistic, should include better velocity and cover as well. As written this would seem to favor removing the MGORD so the favorable temperatures reach the stream directly. o "best way" to produce more large trout is to shift size distribution—do you mean the fastest way? Best way could be to restore the forest, lwd-controlled habitat elements, and springflow	1) This is still referring to trout foraging habitat NGDs. 2) On page 86 the text regarding the MGORD trout has been changed to "One is a migratory life-history in which brown trout reside in the MGORD because of better thermal conditions, complex habitat within the elodea beds, and abundant food sources." 3) "Best" has been deleted.	**RTA**
	p.88	Please produce fig. 5-3 for Lee Vining Creek piezometers as well. There are no graphs in the report or the appendices for Lee Vining Creek that show gw stage vs. flow.	This is done, and presented in Appendix C.	**M&T**
	p.110	Table 6-1 Scenario 1b column values should be filled in for all elevations, not just spill, so they can be compared to actual	Change made.	**M&T**
	p.119	Aerial photos continue for all 4 creeks every 5 years OR after all wet and extreme-wet years—should "or" be changed to "and"? Also change under riffle crest surveys.	Aerial photos are not needed that frequently; every four or five years is fine, OR following wet runoff years.	**M&T**
	p.A25–A28	Caption should clarify that "simulated SEF" is without SCE coordination or simulated higher GLR spills (compare figures 9a and 9b on p.A44-45—9a reaches 850 cfs and 9b never exceeds 500 cfs—why these graphs aren't the same should be made clear—9b. should say without spills). A26 shows the 1998 simulated SEF lower than the actual SRF—this makes no sense based on the recommended SEF for a wet year. Table E-13 on p.E35 doesn't make sense for the same reason—it should state that it doesn't include spills.	The figure captions were clarified. The SEF output in these hydrogrpahs are from the Water Balance model plus Parker and Walker, which is the only data with which to directly compare to the Actual SRF flows below the Narrows.	**M&T**
	p.A48	Appendix A-3 Table 1, please define modeled and computed unimpaired, e.g. modeled uses Buckeye Creek and computed uses SCE storage.	This information is noted in the Figure legend.	**M&T**
	p.A62	Add a footnote for the 4-Jun 2009 column and Net loss narrows to lower Rush row (-5.3) that says "Does not add up due to rounding"	Change made.	**M&T**
	p.C9	LV Veg is in shallower gw areas possibly because of fire, soil loss, and veg die off—what about the effect of steeper slope and coarser substrate? Should these be included as well?	change	**M&T**
	p.C13	Does "normal" include dry-normal and wet-normal, or are those in above/below?	"Normal" is only the Normal, not the "Dry-Normal" nor "Wet-Normal".	**M&T**
	p.C31	o Should show actual stage (color dots below 30 cfs a different color) for each data point. The groundwater stage height at 30 cfs appears to be about 0.75 feet lower than the main channel stage height. o Should also plot stage vs. flow as in preceding Rush Creek graphs (no Lee Vining Creek graphs do this, yet such an analysis was essential for Rush Creek).	This chart was replaced with more informative charts.	**M&T**
	p.C32	Where you quote G. Reis and after, is that referring to Channel 8 or 4bii? Should make it clear—since it is in a table about Channel 8 but follows a statement about 4bii it is unclear.	This table was fixed.	**M&T**
	p.D52	Reduce y-axis to smaller range, e.g. 64–67, so that the lines are easier to see separately.	Done!	**RTA**

Exhibit A. Mono Lake Committee Comments
on the Draft Synthesis of Instream Flow Recommendations

No.	Page	Comments	Scientists' Response/Action	By
	p.D58–60	Either smooth the transitions or show on one page; it is distracting and confusing to show on 3 pages. This could be shown in 6 rows: July 1–15, July 16–31, August 1–15, August 16–31, September 1–15, September 16–30.	Done!	**RTA**
	p.D61	Hot and Global Warming have 2008 + 1F in full Grant with No FSB, except Average—2004. Should 2008 + 1F be removed from all years with no FSB use (all full years)? Or should it be added to the Extreme Wet year type in Average—2004? As it is now, it stands out that that is the only place it is missing and it is unclear why.	You are correct, the FSB (5-siphon Bypass) water temperatures were removed from all scenarios where NO FSB was used.	**RTA**
B. Corrections				
	p.4	Lake recent high 6385.1 in July 1999 and August 2006. Might as well update recent lake level to 6382.0 on April 2010 since it is beginning of runoff year.	Thank You.	**M&T**
	p.6	May 1986 was when Lee Vining Creek was permanently rewatered; October 1990 was Parker and Walker (not March 1987)	Changes were made.	**M&T**
	p.8	2005 was Wet-Normal, not Normal.	Changes were made.	**M&T**
	p.11	four tributaries to Mono Lake should say "five"	Changes were made.	**M&T**
	p.15	o "RY1980 to RY 1989 were available only as mean monthly flow." This statement (for both Rush at Damsite and Lee Vining Above Intake) is incorrect—the daily data is available as an input file to the 1996 GLOM and we have provided it to the stream scientists. "Unimpaired Parker and Walker creek flows are measured at the LADWP conduit…" This statement is incorrect for the period prior to 2004 on Walker Creek, when upstream storage was utilized, and prior to 2001 on Parker Creek, when upstream irrigation diversions removed water from the stream.	No, the statement was correct for the Draft Report. Since issuance of the Draft report, however, we have obtained this daily data and have thus removed this statement from the report. The term "unimpaired" was deleted from the sentence describing measured Parker and Walker creek flows.	**M&T**
	p.13, 32–33	There are numerous problems with tables 2-2, 2-3, and 2-4 that we have communicated to McBain & Trush via email. For completeness we reiterate those comments here. ***Please see the rest of this detailed comment and tabular data in our written comments***	Thank you for the diligence in examining these tables. We have made several corrects to the tables.	**M&T**
	p. 32–33	o Text needs to be updated based on the corrections in the tables as well: o 2003 and 2008 significantly impaired by diverisons – it should also list 2001, 2004, and 2009 which had a lower % passed than 2003 (see table above). o 7 of 11 years meeting Lee Vining requirements needs to be updated based on new conduit calcs. By our calcs it is 6 of 11 years. o Five runoff years following 98-05 peak requirements were not met should be changed to four o Four of the past six runoff years should be changed to five of the past six o No SRF was required in RY2009 not because Grant fell below 11,500 af (it exceeded this level on April 10th and was rising rapidly), but because delivering the SRF could have lowered it below this level.	Changes were made.	**M&T**
	p.33	In 2009 no SRF was required NOT because Grant fell below 11,500 af, but because delivering the SRF could have lowered it below this level.	Changes were made.	**M&T**
	p.13, 32–33, 85, 113, 114, A48, A49	Year type problems recur throughout the document—should be measured when discussing unimpaired, and forecasted when discussing requirements and past management. Table 6-2: 2005 should be "Wet-normal"	Changes made where needed.	**M&T**

Exhibit A. Mono Lake Committee Comments on the Draft Synthesis of Instream Flow Recommendations

No.	Page	Comments	Scientists' Response/Action	By
	p. 36, 42, 61, 94, 95	Max capacity of MGORD is not 380 cfs but 350 cfs, according to LADWP, and was managed that way in 2008. It was only tested once at 380 cfs in 2004 and almost failed. It has never delivered 380 cfs for 5 days—the Normal year peak flow required by Order 98-05. This error recurs throughout the document.	The Stream Scientists specifically inquired with LADWP as to the maximum capacity of the MGORD, and were provided the following correspondence: Bruk Moges: "Have any decisions been made by DWP engineers/operations as to the discharge limits of the MGORD? After the restoration of 2002, the capacity was 380 cfs. Dave has that changed?" Dave Martin: "380 cfs is the limit and 350 cfs is the engineers' preferred flow."	**M&T**
	p.37	"For both Lee Vining Creek and Rush Creek, specific opportunities for SCE and the USFS to improve annual hydrographs by enhancing spill magnitudes are identified." These opportunities were never identified in Chapters 4 and 5.	The sentence is worded awkwardly, but the opportunities ARE to improve hydrographs specifically by enhancing spill magnitudes that are specified in Chapters 4 and 5.	**M&T**
	p. 48–49	Text says 3–6% max ramping down but table says 10% for fast recession. Phone call on 3/15/10 confirmed table is correct when it conflicts with text.	The 10% was deleted from Table 2-10.	**M&T**
	p.60, 115	The stream plan is referred to in more than one place as Ridenhour 1996, however the draft "work plan" is Ridenhour 1995 and the final stream plan is LADWP 1996 (see chapter 9 where they are listed correctly).	Changes were made.	**M&T**
	p.66	The historic low elevation of GLR did not occur in June 2009 when storage ranged from 20,000–32,000 af. It's lowest point in 2009 occurred in February at less than 6,500 af. The historic low occurred in Jan–Feb 1960 when it reached 1597 af of storage.	Changes were made.	**M&T**
	p.67	Zeros at the beginning of the "actual" line should be removed (as Ali mentioned at the Sacramento meeting it is confusing).	Chart was fixed.	**M&T**
	p.70	winter icing evaluation also should list RY2009	Sentence has been edited.	**RTA**
	p.74	o Table 4-1: The bottom number in column B should be 3.12 instead of 0 o Table 4-1: The bottom number in column C should be 3.12 instead of 0 o Table 4-1: Column D should be titled "below intake" instead of "above intake" o Table 4-1: The bottom number in column D should be 251 instead of 0	The last row was included simply to indicate no diversions are recommended above 250 cfs.	**M&T**
	p.94	"owens diversions" should be changed throughout the document to "exports" for consistency	Changes made.	**M&T**
	p.110	In first paragraph, 83 days GLR full should be changed to 20 days	With updates made in this final report, the actual number of days GLR is full is 28.	**M&T**
	p.112	Second sentence under 6.2 reads Only local precip and runoff were excluded—"and 5-siphons-bypass" should be added (although in our technical comments we recommend including this flow—if that were the case this statement would be correct).	Yes, the 5-Siphons releases were included as part of the model	**M&T**
	p.A1	Add Parker and Walker Runoff (estimated unimpaired) to the list of "primary gaging locations."	Changes made.	
	p.A2, A50, A51	Parker and Walker above are not unimpaired. The unimpaired stations which should be used instead are Parker and Walker Runoff. These may not be available for recent years since recent management changes have made above equal to unimpaired, however this is not the case prior to 5–10 years ago.	This information is noted.	**M&T**
	p.A8–A10	1998–2006 graphs show regular fall–winter fluctuations in unimpaired—should be smoothed or processed like data prior to 1998.	We left the data as is as we are unsure how the data were previously "processed" since they are based on conversion of sce reservoir storage volume to flow rate.	**M&T**
	p.A10	2008 Rush Runoff shows a zero on March 1st. This data point should be removed.	Changes made.	**M&T**
	p.A14–A18	Caption should not say "unimpaired." You can see (esp. p. A16 1998–2001) when Walker Lake was emptied in December, and in 1999–2000 when it was filled in June.	Changes made.	**M&T**

Exhibit A. Mono Lake Committee Comments
on the Draft Synthesis of Instream Flow Recommendations

No.	Page	Comments	Scientists' Response/Action	By
	p.A19–A23	Lee Vining Creek Runoff always (except 1999 and 2003) hits zero on March 1st. This erroneous data point should be removed from all graphs.	Changes made.	**M&T**
	p.A23, A30–33	LVC above intake hits zero on March 1, 2009 and also often on pages A30-33. This erroneous data point should be removed. According to daily reports flow was 21–27 cfs all that week (in 2009).	Changes made.	**M&T**
	p.A28	2008 simulated SEF incorrectly changes the 2008 Runoff Year to a dry-normal requirement which is why the lines are so different—The SEF is not for a Normal year as it should be. Other years where forecasted runoff and unimpaired runoff resulted in different year types should be checked as well and the SEF should be consistently shown for the forecasted year type.	Changes made.	**M&T**
	p.A35, A37	o Fig. 1: Unimpaired 2008 data (green line) show an uncharacteristically vertical increase in early February and then a sustained flow much higher than any other year. This is not shown on Fig. 3A below narrows. It appears to be an error. o A blue line increases vertically above all other lines (except 2008) and ends in Feb. on both Fig 1 and 3a. Missing data? Incorrect?	The Rush Creek unimpaired RY 2008 February flows ARE in the data computed from SCE storage change. I removed it from the chart as it may not be correct data. Would require inquiring with SCE to determine the cause of elevated Rush Creek Runoff estimate for this period of year. On second point (blue line) I don't find what you're referring to.	**M&T**
	p.A49	Measured year type should be used instead of forecasted since it is an unimpaired flow analysis.	Technically you may be correct, but it won't change the outcome appreciably, if any.	**M&T**
	p.A17	In the 2006 row, the below number can't be higher than above. This is a measurement error and should not be reproduced here. See previous comments on table 2-4.	This difference in discharge in the Lee Vining Creek above and below Intake is likely a result of rating curve differences, as the two peaks should be the same. Since they are within 3% of each other, well within standard USGS measurement error, and the data were provided by LADWP, we will leave the data unchanged.	**M&T**
	p.A59	The four columns on the right incorrectly have 122,124 at the bottom.	This table was revised.	**M&T**
	p.A61	1) April 1 Runoff Forecast column is incorrect. It is a mix of April (most) and May (1995, 2001, 2006) forecasts. We recommend changing it to "Final" instead of April 1 or else show both as separate columns, as well as correcting the numbers to those below: May 1996=116 April 1997=121 May 1998=133 April 1999=94 May 2000=97 May 2002=82 May 2003=74 April (final) 2004=80 (Since 2004 the only year with a May update is 2006). April 2006=147 2) The forecast error column incorrectly (and unfairly) compares an unimpaired forecast to a measured inflow. The forecast should be compared to unimpaired runoff. In fact, the presence of the Actual (measured) Runoff column is inappropriate in this table. 3) The two year-type columns should be labeled “Final” and “Measured,” respectively.	This table was revised.	**M&T**
	p.A63, Appendix A-5	o Table 4: Unimpaired should be used instead of above – October–November flows could be inflated by the draining of Walker Lake. o Table 4: First column shouldn't be labeled "year" but "Runoff Year. Bottom of that column should say "runoff" instead of "water" year and delete "type" o Table 4: Caption for the table—should delete "and losses." o Table 4: Wet/normal at the bottom should say 3 years instead of 2 (and use median instead of average which excludes that high figure in 1996).	This table was revised.	**RTA**

Exhibit A. Mono Lake Committee Comments
on the Draft Synthesis of Instream Flow Recommendations

No.	Page	Comments	Scientists' Response/Action	By
	p.A65–67, Appendix A-6	For the following errors in this 2002 memorandum, we suggest listing them in an errata sheet at the front: p. A65 - middle paragraph, 71% should be 76%. p. A66 - highest "natural" ramping rates - wrong word, use impaired. p. A66 - last paragraph, selected 2-day average for Convict as median - actually, median 0.775 is halfway between Convict and Parker. p. A67 - Error in second to last sentence of second to last paragraph - 0.6 and 0.7 ft per day should be 0.06 and 0.07.	Thank You.	**M&T**
	p.A68	Last sentence, 20% outside range of natural—should add "except within a day or two of the peak," based on graph on A72.	Thank You.	**M&T**
	p.C5	o RC channels rewatered since 1995 don't include 1A and should include 3A and 3B. LVC should also include A-1, B-1, and B-2, however no channels were rewatered since 1995. A-2, A-3, and A-4 were maintained open as was the left side channel below County Rd. o Description of the 8 Channel opening process (last paragraph) should be consistent that the entrance "evolved" in 2006 as stated in table C-2 (significant work was done on it in August 2006 following that year's peak flow).	Changes were made.	**M&T**
	p.C19–C20	Caption should say 2008 and 2009 Runoff Years (instead of 09–10)	Changes were made.	**M&T**
	p.C28	Caption year cut off—is this graph showing RY 2005 (blue dots according to legend) or RY 2006 (red dots)? If the dots all fall within RY 2006, then the legend is incorrect—the blue dots should say Jan–Mar 2007.	The legend is correct, the dates are Jan-March 2006 which means they are the end of RY2005 data and are the antecedant conditions for the subsequent RY2006 groundwater responses observed.	**M&T**
	p.D39–41	Legend and title are correct at 30–120 but caption says 30–90 cfs and should say 30–120 cfs.	Corrected	**RTA**
	p.D47	Figure D-4.16 caption says SRF flows are held near 44 cfs—this should say "D1631 baseflows" instead of SRF flows, since SRF refers to 98-05 which did not order changes in baseflow.	Corrected	**RTA**
	p.F10	This is the only graph in appendix F with the correct spillway storage—all others should be corrected.	Corrected	
Typographical Errors				
	4, A2	Saddlebag (not Saddleback) lake	Changes made.	**RTA**
	6	principle should be principal	Changes made.	**RTA**
	56	Ramping 20% on chart, but text says peak snowmelt recession rates of 10% above 220 cfs. 3/15/10 phone call confirmed this typo "above" should read "below."	Changes made.	**M&T**
	59	Not "pre" transition, just "transition"	Changes made.	**RTA**
	75	The y-axis labels are cut off	Changes made.	**M&T**
	83	A period is needed at the end of the "Premise No.2." paragraph. Also consistent spacing before the number in the underlined paragraph titles.	Changes made.	**M&T**
	89, 91	the word "alder" should be removed from the document	Changes made.	**M&T**
	95	Table 5-1 should change the last number in the "Rush Creek Unimpaired" column from 100 to 1000	Changes made.	**M&T**
	A49	Extreme wet column "Rys" should be "yrs"	Changes made.	**M&T**
	C1	Change comma to a period after "(May 1 to September 30)."	Changes made.	**M&T**
	D25	Middle of third paragraph, "GLR was near empty in during the summer" should remove the word "in."	Changes made.	**RTA**

April 4th, 2010

Ms. Victoria Whitney
Chief, Division of Water Rights
State Water Resources Control Board
P.O. Box 100
1001 I Street
Sacramento, CA 95812-0100

RE: Mono Basin Draft Synthesis Report

Ms. Whitney:

California Trout is pleased to be submitting comments on the draft document prepared and submitted by the State appointed Stream Scientists entitled *Mono Basin Stream Restoration and Monitoring Program: Synthesis of Instream Flow Recommendations to the State Water Resources Control Board and the Los Angeles Department of Water & Power.*

Per the State Water Resources Control Board's Decision 1631 and the subsequent 98-05 Order, the State appointed Stream Scientists were tasked with evaluating and making recommendations for revised baseflows and Stream Restoration Flows relevant to Rush and Lee Vining Creeks, tributaries to Mono Lake. The respective flow recommendations are targeted towards ensuring the goal of "functional and self-sustaining stream system with healthy riparian ecosystem components" and "trout in good condition" for Rush and Lee Vining Creeks. California Trout appreciates the work of the Stream Scientist and believes as a result of the last 12 years of research and monitoring, Rush Creek and Lee Vining Creeks are on positive trend towards achieving the above stated goals.

California Trout offers the following comments relevant to the draft Synthesis Report which are divided into three categories: (1) general comments, (2) specific comments pertaining to specific issues/elements of the Synthesis Report and (3) process oriented issues. It is noted that many of CalTrout's initial comments and issues pertaining to the draft Synthesis Report have been addressed within comments submitted by others such as the Mono Lake Committee and the Los Angeles Department of Water and Power. CalTrout is not submitting comments that were previously addressed in prior submissions. CalTrout does intend to carefully review *all* of the Stream Scientists' responses to comments, regardless of their origin. CalTrout looks forward furthering restoration of the Mono Basin.

On behalf of California Trout, I look forward to future dialogues with all relevant parties interested in the restoration of Rush and Lee Vining Creeks as well as Walker and Parker Creeks and Mono Lake itself.

Sincerely,

Mark Drew, PhD
Eastern Sierra Program Manager
California Trout

CC: Mr. Steve Herrera, SWRCB
Mr. Greg Brown, SWRCB
Dr. Bill Trush, McBain and Trush
Mr. Ross Taylor, Taylor and Associates
Ms. Lisa Cutting, Mono Lake Committee
Mr. Steve Parmenter, CA Dept. of Fish and Game
Mr. Bruk Moges, LADWP

Category	Page	Comment	Stream Scientists' Response
I. General		(1). General approach and use of information gathered to date: California Trout (CalTrout) believes the Stream Scientists have developed a comprehensive report based on information and data gathered during the course of the last 12 years. CalTrout by and large also supports the methodological approaches that have been used thus far by the Stream Scientists and acknowledge their work to date. CalTrout supports, at this time, the flow recommendations set forth in the draft Synthesis Report. However, CalTrout is not certain there is a complete set of data and understanding of the stream systems necessary to fulfill D1631 and associated Orders, particularly for Rush Creek that may be necessary for final baseflow and Stream Ecosystem Flows (SEFs). More specifically, CalTrout questions the understanding of existing (and potentially future) food web-fishery-energy use relationships in Rush and to a lesser degree Lee Vining Creeks. CalTrout fully supports the approach of designing flow regimes to restore geomorphic processes and riparian habitat and believe it is the best way to maintain a healthy ecosystem and provide good trout habitat. In this case, however, it appears that providing flows suitable for trout, especially large trout, came somewhat secondary to providing flows for restoring the channel's morphological attributes. Fundamentally, CalTrout wonders if the Stream Scientists believe the restoration practices and associated flow recommendations will lead to a robust fisheries in Rush and Lee Vining Creeks. Moreover, CalTrout would like to know if modifications to the flow regime(s), or other passive measures could be used to enhance habitat for trout without compromising the overall goal of ecosystem restoration. In particular, CalTrout is interested to hear from the Stream Scientists how bioenergetics and the population's age and size structure may affect the number of large trout in the population. More specifically, do the Stream Scientists believe that better	CalTrout's involvement in the Mono Restoration process has been, and continues to be, a vital component to the program's success. We appreciate the effort put forth in reviewing the draft Synthesis Report. We also appreciate their support, at this time, of the SEF flow recommendations set forth in the draft Synthesis Report. We also agree that continued monitoring in an adaptive management framework is crucial. In regard to designing the SEF flow regimes, geomorphic and riparian processes were given priority over individual trout during the snowmelt period because these natural processes are the drivers towards long-term restoration of important trout habitats and populations. Because the frequency and magnitude of geomorphic events have already been reduced in Rush and Lee Vining creeks, increasing the frequency and magnitude of these events will be vital. Conversely, winter baseflow recommendations that encompass six months of the year were based on trout habitat requirements. The winter baseflow recommendations were developed by IFS results with considerations given to possible effects of icing. Coincidently, our winter flow recommendations will reduce currently prescribed elevated winter baseflows to levels more consistent with fish habitat needs and the unimpaired hydrograph. We had two primary objectives in recommending lower winter base flows. First, we wanted to provide more habitats for larger brown trout during the winter. Second, we wanted this water conserved to fill

		understanding the bioenergetics, particularly associated with the Rush Creek fishery, would serve as valuable and value added information relevant to both baseflow and Stream Ecosystem Flow (ESFs) recommendations specific to the betterment of trout? In a related manner, CalTrout is not convinced that there are no ecological values to providing high winter flows in Lee Vining Creek and that reducing them will benefit trout. Although mortality of adult trout is occurring in the winter, displacement by high flows may not be the dominant reason. For example, if adult brown trout are in poor condition in the fall, it is possible that the energetic stress of spawning may result in mortality after spawning or in the subsequent months of winter?	Grant Lake Reservoir so more cool water would flow could be released into lower Rush Creek during the summer months. Finally, we also believe continued monitoring will be necessary to gauge effects of the recommended SEF flows as well as to document the ability of LADWP to reliably deliver these flow regimes. We believe that ample information has been collected and analyzed by both Stream Scientists' teams for developing the SEF recommendations. Specific to fisheries, 13 years (including two pilot years) of annual sampling has occurred over a wide range of RY types, climatic conditions, and GLR storage levels. Additional studies such as the trout movement study, the temp-flow-fish report, the temperature model, the IFS, and the pool surveys have added to this knowledge base. During the early planning phase of the IFS, we thoroughly researched several bioenergetics models (such as Van Winkle et al. 1998) and rejected this approach based on the complexity of these models, the data required to use these models, and the uncertainty inherent in modeling outputs (especially when results of other models were required as inputs into the bioenergetics models). We agree there is value in these bioenergetics models, but decided that the direct habitat mapping approach that measured habitat based on criteria from observed habitat use by juvenile and adult brown trout was a more straightforward defensible methodology. The upcoming primary productivity study may provide information to more accurately assess the capability of the creeks to produce larger

			trout. The continued use of PIT tags will also provide better information regarding specific growth rates. Conducting a comprehensive research-level bioenergetics study can add value to understanding the ability, or inability, of Rush and Lee Vining creeks to meet the current fisheries TC or any future metrics indicative of recovery or desired future condition. If a field-based approach does not meet expectations, a modeling approach may be warranted in the future. High winter flows, including infrequent rain-on-snow flood events, would perform geomorphic work. However, extremely large flashy rain-on-snow events can displace fish, plus these flows will scour redds. Lee Vining Creek brown trout condition factors have exceeded 1.00 in mid-September the last 12 years; however post-spawning condition factor may be affecting survival along with the artificially-high winter baseflows and the lack of pool and run habitat. Post-spawning mortality is obviously occurring because we rarely sample fish > age-3 in Lee Vining Creek.
I. General		<u>(2) Adaptive management:</u> CalTrout firmly believes the continued and conscious effort to employ an adaptive management approach is paramount to the successful restoration of the Mono Basin. For one, the flow recommendations within the draft Synthesis Report are *recommendations* and have not been tried and tested. The proposed one-year variance by the LADWP will provide an	As previously stated, we agree that continued monitoring in an adaptive management framework is necessary and recommend monitoring to evaluate the effectiveness of the SEF flow recommendations. However, until LADWP completes their 120-day feasibility study, reports their findings to the SWRCB, and the SWRCB makes a determination we feel it is

		opportunity to examine (over the course of a relatively short period of time) the effects of the Stream Scientists' recommendations. Based on the outcome of the variance, modifications to the flow recommendations may, or may not, need to be made. Additionally, the Stream Scientists are to implement a two-year primary productivity study that should provide information supporting, or otherwise, their recommended flows. Additional monitoring will also be required to determine the potential effects of lower winter baseflows with respect to potential icing events that could have detrimental impacts on both Rush and Lee Vining fisheries. Continued monitoring having to do with ongoing conditions is proposed. The aforementioned monitoring needs are in addition to other recommended monitoring protocols that may influence future revisions to flow recommendations. Lastly, the efficacy and ability to reliably provide SEF recommendations will need to be tested with results possibly requiring changes to infrastructure and water operations for the Los Angeles Department of Water and Power (LADWP). In the longer term, the potential impacts of climate change may require a revisiting of flow recommendations. For these reasons and others, it is critical that functional adaptive management be pursued. Within the Stream Scientists' recommendation for further adaptive management, CalTrout requests that a more in-depth recommendation be provided addressing under what conditions and in what manner adaptive management should be pursued along with recommended principles that guide the adaptive management process itself. CalTrout acknowledges this request may also be within the purview of the SWRCB but does not believe it is so exclusively.	premature to make recommendations on specific monitoring protocols, timeframes for channel and biotic responses and alternate management actions. LADWP will be requesting a one-year variance to test the SEF recommendations for an entire 360-day period. However, in Rush Creek, winter flows close to the SEFs were implemented the past two winters on variances granted by the SWRCB. Thus, after the one-year variance, three seasons of more suitable winter baseflows in Rush Creek will have occurred. We also recommend that a second season of icing monitoring occur during the one-year variance period and a section is monitored in Rush Creek. From our perspective, the primary productivity study will assess the creeks' capability to produce larger trout. The SEF geomorphic recommendations should (1) produce more pool and run habitats, (2) the riparian SEF recommendations should promote more shade and habitat complexity, (3) managing for a consistently fuller GLR should improve trout growth rates and condition factors, and (4) the winter baseflow recommendations should provide more vital holding habitats. The SEF recommendations were based on information collected over the past 13 years, extensive review of the pertinent literature, and professional judgment tempered cumulatively from decades of field experience and observation. We acknowledge that the final flows decreed by the SWRCB may be modified

			by LADWP's feasibility analysis and review of that analysis by the stakeholders.
I. General		<u>(3) Termination Criteria:</u> The draft report states (p. 127): "The adaptive management process begun in Orders 98-05 and 98-07 should continue, but without the termination criteria." This recommendation is beyond the scope of the tasks assigned to the Stream Scientists and inconsistent with the settled law of the case. CalTrout respectfully suggest that the final report omit this recommendation. Order WR 98-07 (pp. 3-4) adopted the termination criteria "for use in determining when stream monitoring may be terminated." These are stated in Ordering ¶ 1.b(5)(a). That order retained different criteria, as stated in Ordering ¶ 1.b(4), to terminate the restoration program as a whole. Order WR 98-07 recounted the history and purpose of the termination criteria. All parties, including LADWP, agreed to the criteria to describe "specified pre-1941 conditions for Rush and Lee Vining Creek..." See p. 3. Although Order WR 98-05 had stated concerns about the time required to achieve them, Order WR 98-07 found that "it is reasonable to expect" that LADWP will continue the monitoring program for a "long period of time." And the parties other than LADWP agreed to dismiss the Board as a party in the Mono Lake Cases, and to dismiss our pending petitions for reconsideration of Order WR 98-05. "Under the existing circumstances, the SWRCB finds that it is in the public interest to avoid further disputes or prolonged proceedings regarding the stream restoration requirements of Order WR 98-05." See p. 3. Ordering ¶ 1.b(5)(f) requires the monitoring program to evaluate	We respectively acknowledge and understand CalTrout's position regarding TC, but will defer to the SWRCB regarding our recommendation to eliminate the TC. We do feel that the original purpose is no longer valid (to terminate the monitoring) given that monitoring for adaptive management purposes will continue into the foreseeable future. We agree that a future adaptive monitoring program should be developed by LADWP, the Stream Scientists, and the stakeholders as part of the implementation phase. For fisheries, we still support the criteria recommended by Hunter (2007) as valid quantifiable metrics to monitor the fishery. We also still support the values suggested by Hunter (2007) as indicative of a high-quality Eastern Sierra brown trout stream. We acknowledge that TC for trout as put forth in the Orders was based on the best available information. However, as scientists being held to quantitative standards in which data must be collected with statistically valid methods we support the Hunter (2007) statement "no data were available that provided a <u>scientifically quantitative</u> picture of trout populations that these streams supported on a self-sustaining basis prior to 1941." This statement is also supported by language within D-1631 and the Mono Basin EIR.

		"progress towards achievement of each of these criteria." It directs: "where an existing condition precludes the restoration of a pre-project condition, a corresponding criterion which is functionally equivalent will be established." Ordering ¶ 1.b(5)(g) provides that the monitoring team, "from time to time, may reevaluate and if appropriate, recommend changes in the quantified forms of these criteria, on the basis of improved understanding of how to evaluate progress in restoring these streams." The draft Synthesis Report evaluated (pp. 121-122) progress in woody riparian vegetation relative to the termination criteria stated in Ordering ¶ 1.b(5)(a)(1) of Order WR 98-07. The Report stated (p. 120) that the acreage "will not likely reach the pre-diversion acreages at least in the foreseeable future." If so, under the provisions of Order WR 98-07, your final report should recommend continued use of that criterion if you believe it is still possible to achieve it, a change to that criterion if appropriate based on improved understanding or a functional equivalent if you conclude that existing conditions will preclude achievement of the existing criterion. The final Synthesis Report should address progress towards achievement of the totality of this criterion. The criterion addresses not only acreage of riparian vegetation, but also whether the vegetation is of "sufficient diameter, height, and location to provide woody debris in streams…" See Ordering ¶ 1.b(5)(a)(1). The draft Synthesis Report does not appear to describe progress across the past 10+ years for most of the termination criteria stated in Ordering ¶ 1.b(5)(a) – specifically, channel length, gradient, sinuosity, confinement or thalweg; or size and structure of fish population. Prior reports of the monitoring program have addressed progress towards these other criteria. *See, e.g.*, "Pool and Habitat Studies on Rush and Lee Vining Creeks" (July 2009),	We do not think, nor was it our intent, that this was an "untimely disagreement" with Orders 98-05 or 98-07. These Orders specifically directed the Stream Scientists to collect data and recommend changes to the TC so that data were collected using accepted quantifiable methods. This directive is included in Ordering ¶ 1.b(5)(g) as identified in CalTrout comments. Again, we contend that the metrics and levels in Hunter (2007) are indicative of a high-quality Eastern Sierra brown trout stream and may not be consistently achieved for decades. Progress across the 11 years of monitoring and the status of the fisheries TC has been a section of each annual report since 1999. Since the 2006 annual report we have evaluated the fisheries TC using the metrics and values proposed by Hunter (2007). These evaluations have followed the tracking of three-year running averages using data sets from 2001 to 2009. Most of page 31 of the draft Synthesis Report is devoted to describing the status of the fisheries and failure to meet TC as described in Order 98-05. In Chapter 8 of the draft Synthesis Report, we describe the criteria that should be used in continued monitoring of the fisheries population. Within the Synthesis Report we do not plan to summarize the annual reports and each of the additional reports. Where appropriate, we cite these reports and believe it is the responsibility of the reviewers to have read and understand the contents and conclusions of these supporting

		"Effects of Flow, Reservoir Storage, and Water Temperatures on Trout in Lower Rush and Lee Vining Creeks" (May 2009). CalTrout suggest that the final report should summarize the analysis from prior reports; should show progress as measured against each criterion; and should recommend continued use of each such criterion, a change if appropriate based on monitoring results and improved understanding, or a functional equivalent if you conclude that achievement of that existing criterion is not possible, all as required by Ordering ¶ 1.b(5)(f)-(g). The draft report restates (p. 116) Mr. Hunter's view that "no data were available that provided a scientifically quantitative picture of trout populations that these streams supported on a self-sustaining basis prior to 1941." We emphatically disagree. In any event, Mr. Hunter's view amounts to an untimely disagreement with Ordering ¶ 1.b(5)(a)(7) and (b), incorporating R-DWP-68B, which includes a quantitative description of those fish populations. The Stream Scientists are not tasked to reopen the record, which is what it is. As provided in Ordering ¶ 1.b(5)(f)-(g), the final report should recommend continued use of that criterion if you conclude it may be achieved in time, a change as appropriate based on your evaluation of post-1998 monitoring results and improved understanding, or a functional equivalent if you conclude that the existing criterion may not be achieved in time. Finally, the draft Report describes possible changes to various monitoring protocols stated in the Blue and White Books (p. 8). For example, it describes (p. 116) metrics of trout biomass, density, condition factor, relative stock density. Order 98-07 permits the Stream Scientists to apply and revise the metrics and other technical protocols which comprise the monitoring program. We underscore that such metrics are complimentary to the termination criteria – indeed, provide the details of the	documents. Our goal in the Synthesis Report was to synthesize this information into as concise a record as possible. The methods used to conduct the additional studies were fully described within each respective report. The methods used to gather data to compute metrics such as standing crops, densities, condition factors and relative stock densities are the same as those described in the Blue and White Books. Specifically mark-recapture and multiple-pass depletion electro-fishing methods continue to be utilized. Thus, there is no need to update or alter the Books for these basic quantifiable metrics. We leave it to the discretion of the SWRBC if these Books must be updated to describe recently employed methods such as PIT tagging, water temperature modeling, and predictions of growth based on temperature modeling results.

		monitoring program by which you evaluate progress towards achievement of the termination criteria. We respectfully request that the final report show any specific changes you may recommend to the metrics and other technical protocols in the Blue and White Books.	
I. General		(4) Coordination with Southern California Edison (SEC): CalTrout supports the emphasis on better Grant Lake Reservoir management and the concept of close coordination with SCE as a focal strategy to ensure reliable SEF recommendations. In doing so, CalTrout also recognizes the inherent challenges that exist with respect to such coordination. Close coordination with SCE is one option to deliver SEFs, although CalTrout does not necessarily believe that it is the only option. CalTrout would appreciate having other possible options presented in the final Synthesis Report with justification provided for why SEC coordination is considered optimal.	Alternatives, such as changes to LADWP's infrastructure at GLR's dam, were added to the Synthesis Report if SCE coordination is not feasible in reliably achieving the SEF peak flows.

I. General		(5) Hybrid diversion rate and bypass flow strategy: California Trout supports the "hybrid" approach of integrating bypass and diversion strategies into the flow recommendations. This approach seems to meet multiple objectives having to do with reducing winter baseflows in Lee Vining Creek and addressing the need for improved management of Grant Lake Reservoir. However, such a strategy will require more frequent transfers and of more water from one basin to another. Are there other considerations beyond those described in the draft Synthesis Report that should be given to the potential biological downfalls of such diversions? For example, are threats associated with the potential for introduced invasive species of concern to the Stream Scientists and if so, are there recommendations to minimize such threats that should be included in the Synthesis Report?	We do not see how increased export of Lee Vining Creek water into GLR will increase the risk of introducing undesirable non-native species to Rush Creek. The accidental introduction of undesirable non-native species to either Rush or Lee Vining creeks will most likely occur due to actions of recreational boaters and/or fishermen. Because of the boating on GLR, Silver, Gull, and June lakes and the generally heavier fishing pressure on Rush Creek we suspect that an accidental introduction of undesirable non-native species is more likely to occur in Rush Creek than Lee Vining Creek. Education is one preventative mean or possibly CDFG implementing regulations restricting the

			inter-basin use of waders and water craft, or regulations requiring the proper disinfecting of equipment. However, these recommendations are beyond the scope of the Synthesis Report.
I. General		<u>(6) Potential value in restoring Vestal Springs:</u> Recently, there have been discussions amongst the Stream Scientists and relevant parties pertaining to the value of trying to restore Vestal Springs. Based on such discussions, the initial analysis conducted to evaluate the potential value of restoring Vestal Springs were primarily, if not exclusively, centered on the spring's potential to benefit Rush Creek temperatures. However, values outside of potential temperature benefits have been noted. For example for the Rush Creek fishery itself, restoration of the Vestal Springs may contribute to young-of-the-year habitat and direct and indirect food sources. More broadly, restoring the Vestal Springs has the potential to simply build on the effort to continually restore natural ecosystem processes and contribute to the enhancement of riparian vegetation adjacent to the main-stem of Rush Creek. CalTrout requests that the Stream Scientists include in the final Synthesis Report a discussion that addresses the potential values and what would be involved with restoring the Vestal Springs along with the perceived tradeoffs of pursuing such restoration.	Although informal discussions regarding spring re-charge have recently occurred between a couple of the stakeholders and the Stream Scientists, not all parties, including LADWP, CDFG, and SWRCB were involved in those discussions. Thus, no language was added to the final Synthesis Report in regard to a spring re-charge feasibility analysis. However, omission of a written recommendation does not preclude further discussion. The proper manner to proceed towards developing a feasibility analysis would be an all-inclusive meeting to discuss the issue, because re-charging the springs may be a possible management strategy to "bank" water in wetter year-types that would later be expressed in the lower Rush Creek channel, and ultimately Mono Lake. While some stakeholders believe that the west-side springs were mostly of natural origin, from the written record (D-1631, the Mono Basin EIR, depositions and 1994 hearings) it appears that irrigation return flow had a contributing, yet unknown, influence to spring flow in Rush Creek. This uncertainty probably influenced the SWRCB's decision to not require a spring re-charge feasibility study when the Stine and Vorster (1998) proposal was originally submitted prior to the Orders.

			A preliminary water temperature modeling scenario that involved a 5 cfs "spring" accretion below the Narrows at 48^{o}F had little effect on improving brown trout growth rates. This 5 cfs accretion was also insufficient to increase winter water temperatures above the threshold where brown trout growth would occur. Increasing spring flow to the 12.5 cfs identified by Stine and Vorster (1998) as the west-side contribution or to the >20 cfs total spring flow in 1947 as described by Eldon Vestal may impact the re-established fisheries in Parker and Walker creeks. As previously stated, since 2004 Walker Creek has consistently produced the highest brown trout biomass estimates of all the annually sampled stream reaches.
I. General		<u>(7) Use of averages vs. other metrics:</u> The use of averages as a metric for analysis has the potential to be misleading as well as masking extreme event considerations be they positive or negative in impact. For example, using daily averages may not fully account for peak flow events that may in turn trigger a desired ecological process whereas taking into consideration instantaneous extreme flows may. The use of averages can be particularly misleading when very few data points are available such as having only two years worth of a particular year-type data in which conclusions are made. Where possible, CalTrout recommends, especially with limited data sets available, other metrics such as instantaneous flows, minimum and maximum flows as well as the potential use of median values be considered and discussed within the final Synthesis Report.	In regards to the StreamTemp model, we used daily average temperatures because this was the time-step in which the model best operates. We closely examined the hourly water temperature data and evaluated how daily average relates to important thresholds such as daily peak temperatures.

I. General		<u>(8) Use of specific dates for recommendations:</u> The Stream Scientist proscribes flow recommendations associated with very specific dates. For example, the Stream Scientists recommend that during wet-years from May 14th to June 11th (Spring Bench period) 80 cfs are provided down Rush Creek. Given weather and future climate variability, might there be value in considering a more dynamic trigger for the various flow recommendations? It seems there could be value in having some level of flexibility based on annual conditions to implement the recommended flows i.e., if weather conditions (range) were such for a given number of days, flow recommendations would be implemented. Doing so may be challenging from an annual water operations perspective. However, are there appropriate and more flexible means that could be established to trigger particular flow recommendations and if so, what are they?	The (1) diversion rate strategy recommended for Lee Vining Creek snowmelt period, (2) our approach for managing lower Rush Creek flows, relying on unregulated (by LADWP) Parker and Walker creek streamflows to provide diurnal, weekly, and seasonal variability, and (3) the intentional flexibility in releasing Rush Creek snowmelt peaks, were all specifically intended to address this issue of providing flow releases that are tied to regional climatic variability and other dynamic cues, so that streamflows are not static from year to year. Several other components are tied into hard and fast dates, primarily for operational consistency.
II. Issue Specific	P. 7-8	(1) In the 98-05-Dr. Dr. Platts testified that there may be a difference regarding the level of flows needed to help restore a degraded stream system and the flows needed to maintain the habitat once the stream system has been reestablished. Dr. Trush acknowledges in 98-05 that there is a distinction between maintenance and restoration flows. As stated in the draft Synthesis Report, Stream Ecosystem Flows (SEFs) are a term used for revised SRF flows. On Page 8 of the draft Synthesis Report in the context of the goal of the stream monitoring program, it is stated that "recommended changes to the magnitude, timing, duration, and frequency of specific hydrograph components to better achieve ecosystem <u>recovery</u> goals…was an important objective.". For clarification, are the SEFs provided in the	The recommended SEF streamflows are intended to perpetuate the ecological processes hypothesized under the unimpaired (natural) streamflow regime. These processes do not differentiate "restoring" vs "maintaining" a stream channel, and thus should continue to do both. The primary distinction that could be made is that a higher frequency of these processes (tending toward the unimpaired frequency) may accelerate recovery (restoration). Our SEF recommendations sought to increase the magnitude of snowmelt floods, thus increasing the frequency with which these processes occur.

		draft Synthesis Report considered restoration flows and/or maintenance flows? If solely oriented towards restoration flows, what about the value and need to establish "maintenance" flows as well?	Thus the SEFs will continue to promote recovery and maintenance of the desired ecological outcomes identified in the report.
II. Issue Specific	P. 13	(2) Data from nearby Buckeye Creek were scaled to Rush Creek watershed area to evaluate unimpaired hydrograph components. Presumably Buckeye Creek is a comparable drainage. However beyond Buckeye's noted close proximity to Rush Creek, there is little information provided within the Synthesis Report regarding comparability of these two drainages. It would be useful to have additional information supporting the comparability of these two areas within the final Synthesis Report.	We discussed the use of Buckeye Creek data in the RY2003 Annual Report (M&T 2004), also within context of several other potentially comparable watersheds. In the end, the data from Buckeye creek were not used for any SEF-related decision of significance. We did consult the pattern of annual hydrographs from Buckeye Creek to evaluate the frequency of winter floods' expression in the hydrograph. Given their similar size and close proximity, we believe this was a useful approach. We are unsure what "additional information" would contribute to a better understanding of the Synthesis Report or the SEF recommendations.
II. Issue Specific	P. 31	(3) Bottom paragraph, column 1 states that Rush Creek below the Narrows is either incapable of supporting large brown trout or this portion of Rush Creek is capable of supporting large brown trout but contemporary flow regimes do not provide conditions compatible for fast enough growth and better winter survival for resident trout to attain large size. CalTrout would appreciate having the justification for such statements included in the final Synthesis Report assuming there is more to it than the hypotheses surrounding limiting winter holding habitat and	This paragraph specifically states that, "Warm summer water temperatures on Rush Creek below the Narrows reduce habitat suitability, trout growth, and may reduce winter trout survival. Trout studies, water temperature modeling, and empirical water temperature data all indicate that Rush Creek baseflow water temperatures become unfavorable to trout during the hottest months of July and August regardless of the baseflow magnitude released because ambient air temperatures exert dominance on

		temperature constraints.	Rush Creek water temperatures." Water temperature data was recorded in this reach of Rush Creek and those data were used to make this inference. We could be more specific in that age data suggests that few brown trout live past age 3 within the main channel of Rush Creek below the MGORD; however, brown trout older than age 3 were commonly documented in the MGORD. At this time we have no empirical evidence that the physical habitat in this reach of Rush Creek is incapable of supporting large brown trout as there appears to be many high class pools developing in this portion of Rush Creek as documented by the pool surveys (Knudson et al. 2009). Thus, we suggested that it may be flows and temperatures that are currently limiting this portion of the stream's ability to support large brown trout. Thus, you were correct in assuming that these statements were based primarily on temperature constraints. We have evidence that brown trout in the County Road and Bottomlands sample sections do not grow in length, weight, or have as good a body condition as brown trout from the Upper Rush sample section.
II. Issue Specific	P. 31	(4) (Follow-up to above comment-top paragraph, 2nd column) Stream Scientists state that brown trout biomasses estimated during the past 12 years represent a population near carrying capacity for the flow regime and physical habitat now present in lower Rush Creek. What is the basis for making such a conclusion? Please expand on this theory. Isn't carrying capacity linked to food web potentials? If so, are there data to support such a statement?	We believe that because the estimates of trout biomass (standing crops) were relatively stable in the County Road Section of Rush Creek from 2000 to 2005 and then rose slightly, but stabilized, from 2006 to 2008, provides reasonable evidence that the brown trout population is near carrying capacity. We interpret these data to suggest that pool development, which we documented with our pool surveys and that likely occurred as a result

			of the moderately high snowmelt runoffs during 2005 and 2006, might have slightly increased this section's carrying capacity. We suggest that estimates of trout biomass incorporate the availability and use of both food and space by the trout and that it is not necessary to actually collect food item information to make inferences about carrying capacity if biomass data are available.
II. Issue Specific	P. 40	(5) CalTrout is not clear on the derivation of the incremental diversion rates included in Table 2-6. There does not appear to be a linear relationship between flows and diversion rates or a defined relationship between stream flow and diversion rates. It would be helpful to have such an explanation in the final Synthesis Report.	We have done our best at describing this process in the report, and presenting it at the meeting in Sacramento. As we have proposed, another verbal discussion one-on-one and we think we can describe this adequately for you to understand.
II. Issue Specific	P. 41	(6) It is stated that diversions are not expected to detrimentally affect water temperatures in lower Lee Vining Creek. What information is there to support the premise a flow of 30 cfs in late summer months will not result in undesirable water temperatures, particularly if very warm ambient air temperatures persist?	The CDFG (1993) IFS for Lee Vining Creek included temperature monitoring and modeling. CDFG results on page 111 stated, "Stream temperatures of Lee Vining Creek were simulated for a warm July. Stream temperatures rose above 64.4^{o}F only when flows were 5 cfs. The stream temperature never exceeded 68^{o}F even when flows were 5 cfs. Stream temperatures remained within the optimal range for trout (53.6 to 64.4^{o}F) for all flows equal to or greater than 10 cfs". Keep in mind that in 1990 CDFG was measuring and modeling summer water temperatures in a wider, shallower channel with much less riparian canopy than what currently exists. We have also closely examined water

			temperature data sets from Lee Vining Creek, including the summer 2007 in which daily average flows were close to 20 cfs through late July and August. Daily maximum temperatures were in the low to mid 60°F range and daily averages were typically less than 60°F.
II. Issue Specific	P. 62	(7) Table 3-1 is very informative in providing brief descriptions of desired ecological conditions. While the ranges provided are informative and help to provide a basis for what constitutes such desired conditions, it would be extremely helpful to have each of the respective ecological conditions more quantifiably defined. Additionally, in the process of developing flow recommendations the draft Synthesis Report identifies which of the ecological desired conditions are taken into considerations for a given year type, there is a lack of information pertaining to the relative weights provided to each of the ecological conditions. It would be useful to have more in-depth discussions in the final Synthesis Report that describe how ecological conditions were prioritized along with an analysis of the potential tradeoffs of such prioritizations.	In the final Synthesis Report, for trout foraging and holding habitat we have added text that quantifies the percent of maximum mapped habitat for the flow ranges provided in Table 3-1. As previously described, geomorphic and riparian processes were prioritized during the snowmelt period, including ascending and descending limbs of the hydrograph. These are natural processes that have already been compromised by various management practices. Fish needs were prioritized during the fall-winter baseflow period. Potential trade-offs were discussed in the draft Synthesis Report and these trade-offs stem, in part, to the fact the trout species are not native to these watersheds and some of the natural watershed processes are not favorable to these non-native fish.
III. Process	P. 10	(1) The Stream Scientists provide a process for completion of the Synthesis Report. The process described by the Stream Scientists has been revised and should be updated in the final Synthesis Report	We added an introduction to Chapter 9 which describes the presentation of the draft report to the stakeholders, the stakeholders review and submission of comments. An appendix was created that contains these comments and the Stream Scientists' response to these comments.

III. Process		(2) As noted above and within the Adaptive Management comment, there are activities relating to the restoration of Rush Creek to be implemented during summer/fall of 2010. Moreover, additional findings from future monitoring may shed light on the need to modify the newly recommended flow regimes. CalTrout requests that to the extent possible, and within the final Synthesis Report, the Stream Scientist include a section that provides more detailed information regarding how future information will be synthesized and potentially incorporated into relevant recommendations.	As previously stated, we are in agreement that continued monitoring in an adaptive management framework is necessary and have recommended monitoring that can be used to evaluate the effectiveness of our flow recommendations. However, until LADWP completes their 120-day feasibility study, reports their findings to the SWRCB, and the SWRCB makes a determination we feel it is premature to make recommendations on specific monitoring protocols, timeframes for channel and biotic responses and alternate management actions.

Van Winkle, W., H. I. Jager, S. F. Railsback, B. D. Holcomb, T. K. Studley, and J. E. Baldrige. 1998. Individual-based model of sympatric populations of brown and rainbow trout for instream flow assessment: model description and calibration. Ecological Modeling 110:175-207.

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The Department is pleased to receive and review the document "Synthesis of Instream Flow Recommendations to the State Water Resources Control Board and the Los Angeles Department of Water and Power, Draft Report for Public Review (Synthesis Report). The Synthesis Report is aptly named in that it attempts to integrate a growing body of insights from a variety of disciplines which have been brought to bear on the Mono Basin restoration during the past 16 years. The work constitutes a quantum step forward in analytical sophistication and advances the restoration of the diverted tributaries of Mono Lake. We appreciate the efforts of the Stream Scientists, and are pleased many of our recommendations, such as stream temperature modeling, were incorporated in their assessment of fish needs and management outcomes. We also appreciate the efforts of the California State Water Resources Control Board staff and the Los Angeles Department of Water and Power in facilitating and encouraging these efforts to date. Such a large undertaking merits and deserves extensive critical analysis. We commend to you the Mono Lake Committee's detailed commentary as a thorough critique which captures the sweep of pertinent technical issues arising from the Synthesis Report. Their concerns and recommendations merit comprehensive scrutiny and consideration. In addition, we offer the following comments:

We would like to again express our appreciation for the opportunity to review the Synthesis Report, and for the cumulative efforts of all who participated in its development. Mono basin restoration has benefited from collaborative and collegial interactions among the concerned parties. The synthesis report in many respects has been helped and informed through past and ongoing collaboration. As the State Board and staff move toward fulfilling their obligations in the attention to Mono basin matters, we hope every opportunity will be made to encourage, induce, and capitalize on continued collaboration, even when that approach may not seem expeditious given the press of time and deadlines.

Sincerely,

Steve Parmenter
Senior Biologist

cc: Ms. Victoia Whitney, SWRCB
Mr. Greg Brown, SWRCB
Mr. Bruk Moges, LADWP
Mr. Ross Taylor, Taylor and Associates
Dr. Bill Trush, McBain and Trush
Ms. Lisa Cutting, Mono Lake Committee
Mr. Mark Drew, Caltrout
Chron

CDFG Comment	Stream Scientist Response	By
1. The Department is receptive to potential specific proposals for temporary experimental evaluation of many of the recommendations of the Synthesis Report, provided adequate monitoring and evaluation is assured.	We appreciate CDFG's support of the SEF recommendations and value their continued input in developing a sound monitoring program to evaluate our flow recommendations.	**RTA and M&T**
2. The Synthesis document needs and deserves extensive editorial revision to transform its arguments into intelligible, unambiguous language accessible a broader audience than the Stream Scientist's themselves. Confusing wording, incompletely expressed arguments, and a general lack of topical and conclusory sentences render the current draft semi-opaque--even to a technically adept reader familiar with most of the issues. As written, too much of the content invites individual interpretation. We strongly recommend enlisting the services of a technical writer who is unfamiliar with Mono basin and fishery issues to overhaul the writing, disinter the substantial technical content, and render a worthy final report.	The content of the Synthesis Report is a combined product of text written by six authors, thus some of the transitions between sections could have been smoother. However, at this late date there is neither the time nor budget to hire a technical writer to "overhaul the writing". We have also received comments that the report was well written.	**RTA and M&T**

CDFG Comment	Stream Scientist Response	By
3. A fundamental goal of the restoration is and should remain restoration of the conditions which benefited the pre-1941 fishery. The incorporation of ecosystem health objectives is compatible and arguably essential to the fishery restoration. However--in the complex environmental, historical, and institutional context of the Mono Lake basin--ecosystem arguments should inform the technical approach, not morph into substitute goals.	While we agree, in essence, to CDFG's comment, we also contend that some the "conditions" that benefited the pre-1941 fishery were the unintended results of irrigation and other management practices which we would not recommend in the context of restoring "functional and self-sustaining stream systems with healthy riparian ecosystem components".	**RTA**
4. Attainment of an appropriate restoration endpoint will continue to require monitoring and adaptive management for the foreseeable future. Two essential elements of adaptive management are: measured progress toward an explicit objective, and commitment to adjust management action(s) in response to measured feedback. We suggest that the appropriate objectives are the termination criteria. These should absolutely be continued, although it may be appropriate to substitute well considered criteria, or revise the monitoring frequency of some measures. In particular, we continue our recommendation to use the concept of proportional stock density (PSD) as an critical measure of trout population status. Any changes to the termination criteria should be predicated on improving their utility to detect objective attainment.	We agree with CDFG's comment. Within the nine sets of comments submitted to the SWRCB, there was broad support for continuing an adaptive management process. We support this process and have recommended monitoring that can be used to evaluate the effectiveness of our flow recommendations. However, until LADWP completes their 120-day feasibility study, reports their findings to the SWRCB, and the SWRCB makes a determination we feel it is premature to make recommendations on specific monitoring protocols, timeframes for channel and biotic responses and alternate management actions.	**RTA**

CDFG Comment	Stream Scientist Response	By
5. We would like to discourage re-interpretation of the hearing record with regard to fishery quality and historical trout body size. The evidence for Rush Creek in particular robustly supports the conclusion that "large" trout were considerably more prevalent in the pre-diversion period than they are now. The expert opinion of Mr. Elden Vestal, Department of Fish and Game (retired) stands. We sympathize with today's researcher's discomfort that parallel population and size structure data are not available for statistical comparison with contemporary data. However, this condition is common to virtually any fishery investigation taking place over all but the shortest time interval. Population estimates today are made with methods and techniques such as electrofishing which were not in use 69 years ago. Brown trout densities and size structures reflect a state of habitat in which large body size and piscivory are effective life history strategies. We recommend monitoring proportional stock density (above). A significant and change in PSD will reflect attainment of the desired habitat state, even though we cannot *a priori* know the precise PSD response, nor entirely prescribe the threshold causal habitat state.	Within the Synthesis Report we believe we have avoided re-interpretation of the hearing record in regards to fishery quality and historical trout body size. Our one statement from the Hunter (2007) TC document was made simply to introduce quantitative metrics to evaluate the fishery, not to question the Orders nor discredit the information used to establish the TC. We have recommended continued monitoring of RSD values to track trends in the proportions of larger fish. Continued PIT tagging will provide better specific growth data as related to SEF recommendations.	**RTA**
6. Finally, we applaud the stream scientists for their recognition of the significance of Grant Lake to the limnology and trout habitat of Rush Creek. Management for higher summer levels in Grant Lake will not only benefit the downstream portion of Rush Creek, it will concomitantly protect the Grant Lake fishery and its benefits to the economy of Mono County. We recognize the difficultly of attaining storage objectives in drier years, and support the recommended management approaches as a sensible compromise between what would be optimal and what is attainable.	Thank you.	**RTA and M&T**

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

MEMORANDUM

TO: Katherine Mrowka, Chief
State Water Resources Control Board
Division of Water Rights, Inland Streams Unit
P.O. Box 100
Sacramento, CA 95812-0100

FROM: Lauri Kemper, P.E.
Assistant Executive Officer
LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

DATE: April 1, 2010

SUBJECT: **COMMENTS ON "SYNTHESIS REPORT" FOR MONO BASIN RESTORATION AND MONITORING PROGRAM**

Thank you for the opportunity to review the January 2010 draft report titled "Mono Basin Restoration and Monitoring Program: Synthesis of Instream Flow Recommendations to the State Water Resources Control Board and the Los Angeles Department of Water And Power" (Synthesis Report). The report summarizes 12 years of scientific study and modeling carried out in response to direction in State Water Board Orders 98-05 and 98-07. It recommends changes in the instream flow prescriptions and monitoring programs for Mono Basin streams in those orders.

Lahontan Water Board staff did not review the annual reports and other preliminary reports on which the Synthesis Report is based. We have no technical comments on the fisheries studies or the flow and temperature models. We do have the following general comments on the recommendations of the report, assuming that the State Water Board may use them to propose revisions to Orders 98-05 and 98-07.

Lahontan Water Board staff would appreciate the opportunity to review future reports on the Mono Basin monitoring and restoration programs, and any proposed changes in Orders 98-05 and 98-07. Please contact Judith Unsicker of my staff at (530) 542-5462 if you wish to discuss these comments.

CRWQCB Comment	Stream Scientist Response	By
1. We are concerned about the potential impacts of proposed lower winter base flows in Lee Vining and Rush Creeks, and increased diversions from Lee Vining Creek on instream beneficial uses. The Synthesis Report indicates that, because of concerns about the effects of winter ice formation at lower flows, the Los Angeles Department of Water and Power (LADWP) is conducting winter monitoring this year. If this study shows potential adverse impacts, we recommend that modifications to the proposed flow prescriptions be considered. We also suggest that State Water Board staff review recent and ongoing research by other parties on aquatic ecology in the Eastern Sierra as part of any update of the flow prescriptions. For example, there is a growing body of literature on climate change impacts in the Sierra Nevada in addition to the statewide modeling literature reviewed in the Synthesis Report.	The monitoring of icing conditions in Lee Vining Creek was conducted by LADWP's Bishop biological staff between November of 2009 and March of 2010. Transects across both pools and riffles were established in five locations downstream of LADWP's diversion. Two experimental flows were released during the study, 18 cfs between November 30 and January 1 and 14 cfs between January 2 and March 31. Methods to categorize types of ice formations and measure extend of formations followed methods in the CDFG Lee Vining Creek instream flow study (CDFG 1993). The Stream Scientists are recommending that another season of monitoring winter flow and ice conditions is conducted in 2010 – 2011.	**RTA**
2. The existing "Stream Restoration Flow" (SRF) prescriptions and the proposed "Stream Ecosystem Flows" (SEFs) both rely on flow management to restore more natural stream channel conditions, fish habitat and riparian vegetation. This approach contrasts with earlier structural and vegetative restoration measures which were only partially successful. The synthesis report notes that complete restoration of riparian vegetation to pre-diversion conditions under the existing and proposed flow regimes may not be feasible due to changes in floodplain elevations. The SEFs would involve increased diversions from Lee Vining Creek to maintain higher elevations and cooler temperatures in Grant Lake Reservoir, and allow summer spills from the reservoir to moderate temperatures in Rush Creek. There are uncertainties associated with the SEFs including the need for cooperation from Southern California Edison in managing flows from upstream hydroelectric facilities, and the LADWP's ability to manage the SEFs as precisely as recommended. We suggest that the State Board review the current "state of the art" floodplain restoration and revegetation methods, and consider the feasibility of active restoration in addition to flow management, whether or not the proposed SEFs are approved.	The ability of LADWP to reliably deliver the SEF peak flows depends on cooperation and coordination with SCE. This, and other issues, will be examined by LADWP during their feasibility analysis of the recommended flows. We have added text to the Synthesis Report regarding other options to deliver the SEF peak flows if cooperation with SCE is not realistic.	**RTA**

CRWQCB Comment	Stream Scientist Response	By
3. The Synthesis Report recommends continued but less intensive trend monitoring to document the progress of stream and riparian restoration. Specific suggestions are made for monitoring hydrology, geomorphology, riparian vegetation acreage, and trout habitat metrics. The only water quality parameters recommended for monitoring are water temperature and dissolved oxygen. We concur with the need for ongoing monitoring, and suggest sampling of additional water quality parameters such as nutrients that could be affecting aquatic habitat in Lee Vining and Rush Creeks, if these are not already being monitored by the LADWP. Water quality sampling to document the impacts of releases from Grant Lake on water quality and beneficial uses of Rush Creek (apart from temperature impacts) should also be considered. If maintaining the reservoir at higher levels leads to stratification, this could affect internal loading of nutrients and other constituents from the sediments to the water column. The 1993 Mono Basin Environmental Impact Report reported the mean concentration of arsenic at the Grant Lake outlet between 1940 and 1990 to be 10.80 micrograms per liter, with a range of 2 to 20 micrograms per liter The mean value exceeds the current drinking water standard. Impacts of flow management on arsenic concentrations in relation to fish health might need to be considered.	The Fisheries Team will be conducting a primary productivity study in 2010 and 2011 in Rush and Lee Vining creeks, and possibly several other regional creeks for comparative purposes. The Cullen and Railsback (1993) concluded that Grant Lake Reservoir is poorly stratified because the reservoir is relatively shallow and that wind easily breaks up whatever weak stratification occurs. We have recommended that LADWP monitor temperature and DO in GLR as well as Rush Creek water temperatures above GLR to further strengthen the StreamTemp model and update several assumptions/conclusions of the 17-year old reservoir study. Limited thermograph data collected by CalTrout in 2009 suggests that water temperatures already are impaired in Rush Creek prior to entering GLR.	**RTA**
4. The Synthesis Report considers the expected change in the elevation of Lee Vining Creek as a result of proposed diversions (0.2 foot) not to be ecologically significant for benthic macroinvertebrates or trout. However, no detailed information on macroinvertebrates or their habitat is provided. We suggest that periodic macroinvertebrate bioassessment be added to the trend monitoring program for the Mono Basin streams. Region 6's bioassessment consultant, Dr. David Herbst of the University of California, Santa Barbara, has developed indices of biological integrity (IBIs) for eastern Sierra streams. The final report on the IBI project was submitted in December 2009 and is available on Region 6's Surface Water Ambient Monitoring Program (SWAMP) web page. It includes assessment of stations on Rush and Lee Vining Creeks that were sampled in 2000. The IBIs emphasize sediment-related habitat metrics rather than water depth, and would provide an additional method of tracking stream restoration.	In September of 2009 we collected macroinvertebrates in Rush and Lee Vining creeks which will be keyed-out to SAFIT level 1. We will analyze the results with the IBI metrics and compare to the 2000 results. We did not recommend any sampling of macroinvertebrate productivity to the trend monitoring of the SEF recommendations because there were no baseline data collected as related to the currently prescribed flows. We are also initiating a primary productivity study in 2010, which we feel will be a better indicator of the ability of the streams' ability to produce food items for trout.	**RTA**

March 29, 2010

Mr. Steve Herrera
Environmental Program Manager
Permitting Section
State Water Resources Control Board
1001 I Street, 14th Floor
Sacramento, CA 95814

COMMENTS ON THE STREAM SCIENTIST'S DRAFT REPORT ON THE SYNTHESIS OF INSTREAM FLOW RECOMMENDATIONS FOR MONO BASIN STREAMS SUBMITTED TO THE STATE WATER RESOURCES CONTROL BOARD

Thank you for the opportunity to review and comment on the Stream Scientist's Draft Synthesis Report regarding instream flow recommendations for Mono Basin Streams that are diverted by the City of Los Angeles (LADWP).

I would like to congratulate the Stream Scientists and their colleagues for their ongoing efforts in implementing the monitoring program over the years. The Stream Scientists are to be applauded for the content and the analysis in the Draft Synthesis Report which is based on results of that monitoring effort.

The focus of my comments concern the necessity of a timely and well thought out Adaptive Management Program. A good working definition for adaptive management is the following:

"Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs" (British Columbia Ministry of Forestry).

The ecological processes of the Mono Basin streams diverted by LADWP are both dynamic and complex and the Draft Synthesis Report makes that point. As a result, our understanding of these stream ecosystems and our ability to predict how they will respond to management actions is evolving. Based on that uncertainty, the Stream Scientists recommended the application of an Adaptive Management Program for making future stream resource management decisions.

Adaptive management is indeed a way of dealing with uncertainty when using a scientific approach to decision making. In the case of the Mono Basin streams the causes of uncertainty include but are not limited to:

- Public Trust Values
- Ecological Knowledge Gaps
- Competing Resource Interests
- Future Economic Costs

Rather than using existing knowledge and selecting a single "best" set of final conditions….. the Stream Scientists have recommended to use an adaptive management approach in implementing any new Stream Ecological Flows (SEF). I strongly support that recommendation and I encourage the State Water Board to require that approach in any subsequent order. The Mono Basin Adaptive Management Program should be completed prior to the implementation of State Water Board ordered SEFs.

The Mono Basin Adaptive Management Program must be collaborative in developing the various management alternatives that could be applied based on the monitoring of the initially required SEFs. For a Mono Basin Adaptive Management Program to be efficient and successful there must be a process by which adaptive management alternatives are developed and applied. In using adaptive management the State Water Board should explicitly recognize the existence of uncertainty and require the implementation of conservative initial SEFs that favor resource protection. Under the direction of State Water Board staff and the Stream Scientists, the process for developing the Mono Basin Adaptive Management Program must have structure. A process should include but not be limited to the following elements:

- Establish a clear and common purpose. All parties must commit to participation and cooperation in the development of good faith management prescriptions
- The process must be subject to an open debate in a multi-stakeholder process in which trade-offs and risks (biological and financial risks) are explored and discussed.
- The goal of the participants should be the development of predefined resource objectives and measures of performance prior to implementation of any SEFs. This would also include to the extent possible predetermined alternative management prescriptions.
- There should be a predetermined decision making process to choose the preferred management prescription(s) and the concomitant monitoring program to measure the outcomes of the management prescription(s). A predetermined decision making process is critical when deciding on changes in management prescription(s) and the necessary monitoring effort which will almost certainly involve trade-offs.
- The selected adaptive management action must be justified on the basis of costs and benefits relative to other possible adaptive management prescriptions.
- There should be good record keeping of the decisions made by the participants.
- The process could include peer review of the results of the monitoring program and recommendations for any future management prescription.

I urge that State Water Board to consider the above points when developing an adaptive management program for the restoration of the Mono Basin streams.

Finally, it should not be forgotten that the Mono Lake Decision was not only based on the requirement for restoration of stream conditions that benefited the fishery but also included conditions to protect other public trust resources. In selecting the appropriate SEFs, the decision must be made in light of the other requirements of the Mono Lake Decision to protect public trust resources.

Thank you for the opportunity to provide these thoughts regarding the application of an adaptive management program as part of the Mono Basin stream restoration efforts.

Sincerely,

Jim Canaday
Senior Environmental Scientist, Retired
P.O. Box 487
Jackson, CA 95642
Email: arc_natres@hotmail.com

Distribution by email:

Steve Parmenter (Department of Fish and Game)
Lisa Cutting (Mono Lake Committee)
Bruk Moges (LADWP)
Bill Trush (Stream Scientist)
Mark Drew (California Trout)

Stream Scientists' Response to Canaday's Comments:

We appreciate the many years of hard work and dedication that Jim Canaday poured into the Mono Basin Restoration program during his tenure at the SWRCB and value his comments on the draft Synthesis Report. We concur with his comments regarding the importance of continued adaptive management that is conducted with the participation and cooperation of all the interested parties. We believe that LADWP must complete their 120-day feasibility study and report their conclusions before the framework and details of a future monitoring program are developed.

March 15, 2010

Mr. Gregory Brown
Environmental Scientist
California State Water Resources Control Board
Division of Water Rights
Sacramento, California

Dear Mr. Brown,

Please include the following comments to the Synthesis of Instream Flow Recommendations (Draft Report) on behalf of the Mammoth Fly Rodders.

Dahlgren Comment	Stream Scientist Response	By
In general it is our opinion that at this time setting a regime of permanent flows for Rush Creek is premature.	Order 98-05 provides specific directions for the Stream Scientists to re-evaluate the SRF regimes after eight to ten years of data collection has occurred. Monitoring to facilitate adaptive management will continue so that the SEF recommendations are evaluated.	**RTA**
I attended a two-day seminar in Sacramento on February 2-3, 2010, representing the Mammoth Fly Rodders. The subject was preliminary discussions of a synthesis report draft. The science presented was excellent. The data complete. But none of it addressed the recovery, or the future sustainability of the trophy trout fishery that existed in pre-1941… the main focus of the 1994 court order, SWRCB 1631.	We appreciate the time you took to attend the Sacramento meeting and were pleased to discuss our research and other topics related to the Mono Basin restoration program with you.	**RTA**
In fact nowhere in the years of endless studies have the requirements that must be present in Rush Creek for the life cycle of a trophy sized brown trout been discussed. Even more important, the conditions that must be present to support a trophy trout fishery have not been discussed. Without a complete understanding of what a community of trophy brown trout "need", from egg to alevin to fry, fingerling, juvenile and the adult stages of life…how can there be recovery?	The primary objective of the 10 years of annual sampling was to generate population estimates and other metrics (density, biomass, condition factor, and size class structure) over a number of runoff year-types, climatic conditions, and reservoir storage levels. We have also learned more about the needs of the fishery through the movement study, the instream flow study, and water temperature monitoring and modeling. These data provided the information to evaluate the SRF flow regimes.	**RTA**
It is most disturbing to read comments within the draft that refer to eliminating the pre-41 trout fishery termination language that presently exists in SWRCB 1631,WR 98-05, and WR 98-07. The court dealt with the pre-41 fishery issue long and hard…and	We will defer to the SWRCB regarding our recommendation to eliminate the TC. We do feel that the original purpose is no longer valid (to terminate the monitoring) given that adaptive management will continue into the foreseeable future.	**RTA**

accepted the testimony of the revered California Department of Fish & Game biologist, Elden Vestal, and others, as proof positive the fishery did exist. If the termination language were removed it could be interpreted as direct defiance of the Third District Court of Appeals decisions. And quite possibly create a new legal problem for LADWP. I site the specific page and comments by the stream scientists concerning elimination of the termination language: Page 3 of the Executive Summary, last paragraph. "Stream scientists suggest that the current termination criteria…in Order 98-07 have served their purpose…" Page 126…Section 7.2 Adaptive Management. "…process begun in Orders 98-05 and 98-07 should continue without the termination criteria…" However on Page 116, mid first column, the stream scientists recommend the termination criteria metrics in a Hunter (2007) memorandum should continue to be annually computed. Then above, the language reverts to the tired argument that there is no scientific or quantifiable data to provide a picture of the trout population that the streams supported on a self sustaining basis prior to 1941 (Hunter 2007). Once again, a disregard for the revered Elden Vestal's testimony that the trophy trout fishery of 1941 did indeed exist. The rest of the section, up to 7.1 Future Monitoring, attempts to lower the expectations for restoration (of the trophy trout fishery) and provides the rationale. Note that Hunter refers to the monitoring of "catchable" trout with no definition of what a catchable trout are. Eight inches, Ten inches. How about monitoring trout over fourteen inches?	For fisheries, we still support the criteria recommended by Hunter (2007) as valid metrics to assess the fishery. We also still support the values suggested by Hunter (2007) as indicative of a high-quality Eastern Sierra brown trout stream. We do not feel these values attempt to lower the expectations for recovery. We suspect it may take the creeks, especially Rush Creek; many years to consistently meet the values proposed by Hunter (2007). We acknowledge that TC for trout as put forth in the Orders was based on the best available information. However, as scientists being held to quantitative standards in which data must be collected with statistically valid methods we still support the Hunter (2007) statement "no data were available that provided a <u>scientifically quantitative</u> picture of trout populations that these streams supported on a self-sustaining basis prior to 1941." This statement is also supported by language within D-1631 and the Mono Basin EIR. The purpose of Hunter's statement was to introduce quantitative metrics to evaluate the fishery, not to question the Orders nor discredit the information used to establish the TC. The development of the Hunter (2007) report was consistent with directives included in the Orders for the stream scientists to collect data and make recommended changes to the TC so that data were collected using accepted quantifiable methods. There is no language within Chapter 7 that attempts to lower the expectations of restoring Rush Creek's fishery. We believe the SEF flow recommendations should improve the growth and survival of brown trout by providing more favorable summer water temperatures in drier year-types and increased amounts of suitable holding habitat during the fall and winter. The proposed fisheries monitoring will generate data to evaluate the response of the trout to the recommended flows.	**RTA** **RTA** **RTA**

Dahlgren Comment	Stream Scientist Response	By
I am puzzled with the methods the Los Angeles Department of Water & Power has chosen to resolve the Rush Creek issue. If Woody Trehey & Associates had been allowed to continue restoration of the creek down to Mono lake the issue would have been resolved over twenty years ago…but DWP chose not to. Instead LADWP chose to continue contesting in the courts, losing, and spending millions of dollars on lawyers and consultants…with court ordered termination language yet to be satisfied.	The decision to adopt a “passive” restoration plan instead of continuing to mechanically dig, trench and manipulate the channel was not made by LADWP solely, it was method promoted by the original RTC team of Bill Trush, Chris Hunter and Richard Ridenhour. This plan was supported not only by LADWP but also by stakeholders such as the MLC, CalTrout and CDFG as well as the SWRCB.	**RTA**
The Rush Creek/Lee Vining Creek issues could yet come to a quick conclusion with the loss of much less water than the “synthesis report” will suggest, create a fantastic trout fishery for the anglers of California, the result of which would be something LADWP would be proud off.	The SWRCB directive to the Stream Scientists was more expansive than just restoring the fishery and this directive is clearly stated in Order 98-05. We quoted the pertinent sections of Order 98-05 in the first paragraph of Section 1.3 of the Synthesis Report.	**RTA**
How? Return to the Woody Trehey & Associates plan of twenty years ago. Bring back the track-hoes and backhoes and construct a series of deep pools throughout Rush Creek to Mono Lake. What do I base my knowledge upon? Over sixty years of walking trout streams with a fly rod, catching and releasing trout by the thousands…and developing a deep love and sense of protection for the fish and the environs they thrive in. I have made trout streams my passion and have been involved with reconstruction or habitat improvement projects on more than a dozen streams, creeks, lakes, and rivers in the past twenty years. On some I simply rolled rocks. On others I paid the bill. Two projects come to mind. The first Boone Creek, a small spring creek on a ranch in central Idaho. The creek was a half-mile in length, 10-15 feet in width, with enough gradients to produce shallow riffle conditions from top to bottom. The trout population was concentrated around three head-gate diversion systems with small pools of water above and below. The fish were mostly 6-8 inch rainbows. Rocks, logs and willow cuttings were stockpiled along the creek. A track hoe	Since the issuing of Orders 98-05 and 98-07, the recovery of Rush and Lee Vining creeks riparian vegetation and channels has occurred as documented by the photos on pages 20-30 in the Synthesis Report and by the Pool and Habitat Studies Report which documented the dramatic increase in high-quality pools in lower Rush Creek as a result of the larger SRF releases in 2005 and 2006. The Pool Report also documented the filling-in and overall deterioration of the “Trihey” pools.	**RTA**

began working at the upper end and dug two ponds about 50’ X 200’ in surface area, and a series of twenty smaller pools, each four to six feet deep down the creek to the lower ranch boundary. A three-man hand crew placed the material in each new pool. No trout were introduced because natural recruitment was excellent. The reconstruction took place in 2004. Today the trout population contains a full range of age classes with dozens of individuals over twenty inches weighing up to five pounds.

The second project is very similar to Rush Creek in characteristics, a tail-water trout stream, the Big Lost River, also in central Idaho, approximately three miles below a reservoir, with flows in the winter of 20 to 98 cfs, and 600 to 700 cfs during the summer irrigation season. The reconstructed stream section was approximately 1000 feet in length and 30 feet in width. The problems were two fold…bank erosion and an almost non-existent trout population. The entire length of stream was a fast shallow riffle-run that swept along a bend cutting away at the bank.

Large rocks, and logs with root wads, were stockpiled. A track-hoe began at the upper end constructing seven bank-barbs; large rocks were placed forming jetty-like structures angling upstream to divert the energy away from the bank. The barbs were placed in a step down manner allowing for different flow regimens. Logs were inserted a foot above the streambed, root wad pointed down stream for trout cover and fry habitat. Other logs, revetments, were placed along the bank creating more trout cover. The stream bottom was not disturbed by the track-hoe. The work was done in the year 2000. Today each bank-barb has water above and below four to six feet in depth. The depth of the entire run averages three feet and there are hundreds of trout averaging 15” in length with dozens over 18” weighing up to five pounds.

All projects mentioned required the use of heavy equipment and created thriving trout populations in a matter of a few years. Granted, at times maintenance has been required to patch a few failures. No more than would be required in the current “let nature do it” approach promoted by

LADWP…which will take decades or centuries to reestablish. It is the mammoth Fly Rodders opinion the intent of SWRCB 1631 was to restore the pre-1941 trophy brown trout fishery much sooner than the decades the experts admit it will take with the present passive process of restoration.		

Respectfully submitted,

Richard Dahlgren
Mammoth Fly Rodder

Scott Stine, Ph.D.
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April 5, 2010

Victoria Whitney
Chief, Division of Water Rights
State Water Resources Control Board
P.O. Box 100
1001 I Street
Sacramento , CA 95812-0100

RE: Mono Basin draft instream flow recommendations

Dear Ms. Whitney,
The Mono stream scientists are to be commended for the thoroughness of their draft report. Below I raise a few matters that I think should be considered prior to release of the final version. Most of these comments concern certain historic and geomorphic misconceptions; a few address matters of syntax that I think will improve the readability of the text. I offer all of these as constructive criticism, and will be more than happy to discuss them in greater detail with the stream scientists or other interested parties.

Sincerely,

Scott Stine
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Berkeley, CA 94702
scott.stine@sbcglobal.net

Stine Comment	Stream Scientist's Response	Response by
Pg. 4, para. 1 says, "Since 1941, the salinity, alkalinity, and water surface elevation [which should be "water-surface elevation," or simply "surface elevation"] of Mono Lake have also been affected by the export of water..." Alkalinity is not like salinity, which concentrates/dilutes in near-direct proportion to changes in lake volume. Mono Lake is buffered at a pH of about 9.8, and so pH changes very little in response to fluctuations in lake volume. Remove the word "alkalinity."	Change made.	M&T
Pg. 11, para. 1, refers to the bottomlands being "braided." By modern definition, the bottomlands channel system is not braided, but rather anabranched. A braided channel tends to be highly dynamic, with position shifts common at the annual (and even sub-annual) time scale. Here is the definition of anabranch (from ESPL Water Resources Res): "A distributary channel which leaves the main channel, sometimes running parallel to it for several kilometers, and then rejoins it; a channel 'separated by vegetated semi-permanent alluvial islands, excised from an existing floodplain, or formed by within-channel or deltaic accretion' (Nanson and Knighton (1998) *ESPL* **21**, 3)."	The term "braided" was deleted from the sentence.	M&T

Stine Comment	Stream Scientist's Response	Response by
Pg. 19, para. 4: This paragraph seems to stem from an incorrect premise--that "at the lake's fringe a delta morphology forms with a network of multiple dominant stream channels." The problem is that deltaic sedimentation, and the formation of a network of anabranching deltaic channels, is not restricted to the lake fringe. Deposition of a delta "at the lake fringe" (such a form is called the "exterior delta") necessitates agradation of the stream and its floodplain--not just at the lake fringe, but headward for a considerable distance (this agraded material constitutes the "interior delta"--its length is typically about 4.5 times that of the exterior delta). Rush Creek's exterior delta extends from just above the county road crossing to the lake; its interior delta extends from just above the county road crossing to the narrows. Importantly, creation of the Rush Creek bottomlands (i.e. the interior delta) did not require that Mono Lake rise into the bottomlands. As long as Mono Lake stood above an elevation of approximately 6400 feet (see below for the significance of that elevation), the Rush Creek exterior delta was prograding, and so the Rush Creek interior delta was agrading.	The statement was corrected to read: "At the lake's fringe and propagating upstream toward the Rush Creek Narrows, a delta morphology forms"	M&T

Stine Comment	Stream Scientist's Response	Response by
Pg. 83, Premise No. 3. The opening sentence ("A multiple channel network will not evolve upstream of the Rush Creek County Road") is misleading. I would find it less so if it were written as follows: "The multiple-channel network that presently exists above the county road evolved as a self-sustaining system during times when Mono Lake stood at moderate and high levels (i.e. above 6400 feet). At the relatively low lake levels mandated by the State Water Board, the multi-channel system of the bottomlands will not continue to evolve" (or something along those lines). Near the end of the paragraph you say that "downcutting precipitated by the downstream shift in delta (during periods of Mono Lake recession) also affects channels ... This was likely happening under pre-1941 conditions." These sentences reflect a misunderstanding of deltaic processes (and their meaning is muddled by the phrase "a downstream shift in delta"). Rush Creek's gently inclined "delta plain" extends lakeward to an elevation of 6400 feet (that number is a measurement, not an estimate). As long as the Mono shoreline (Rush Creek's base level) occupies a position on the delta plain, rises and falls in lake level do not induce channel incision. Such rises and falls do make the stream shorter or longer, but they do not increase the stream gradient. A drop in	Thanks for the clarification. The suggested statement was incorporated into the document. The second statement referenced in the comment was deleted.	M&T

lake level induces stream incision only when the Mono shoreline drops below the delta plain, thereby exposing the abrupt nickpoint that exists where the delta plain meets the steep "delta front." Mono Lake did not drop below the Rush Creek delta plain (ele. 6400 feet) until 1959. Appreciable stream incision did not come until the high-runoff year of 1967, when LADWP ceased diverting, and Grant Lake spilled.		
P. 122, the subsection called "Side-channel maintenance": I think that this should be called "Maintenance of the multiple-channel systems." My reason for thinking this is that a "side channel" of today could easily be the "main channel" tomorrow, just as Rush Creek Channel 10 (today's main channel) used to be a side channel. Distinguishing between side channels and main channels is not important. What is important is that multiple channels be maintained. I would suggest that the terms "side channel" and "main channel" be scrapped, and that individual bottomlands channels simply be referred to by number.	We agree with your premise, however choose to leave the term "side-channel" in the document as this term is embedded in our vernacular of the past 12 years, as proper names in multiple Annual Reports (e.g., the "3D Side-Channel", and in official documents to the SWRCB.	M&T

Stine Comment	Stream Scientist's Response	Response by
P. 123 refers to "catastrophic bedload mobilization ... as occurred in the 1960s." The problem in the 1960s was not that the walls or beds of the channels in the bottomlands were mobilized (though clearly this did occur low-down in the bottomlands, due to wholesale incision). The problem was that the Marzano quarry operation had piled thousands of cubic meters of quarry waste into the middle of the Rush Creek channel a few hundred meters upstream of the narrows. When the flood waters of 1967 poured down Rush Creek they carried all that quarry waste through the narrows and into the bottomlands. It is that quarry waste that plugged the entrances to, and in some cases completely filled, the bottomlands channels. (Deprived of access to these previously-existing channels, the flood waters carved a new "main channel" immediately below the narrows; and it was that same quarry waste that effaced the existing channel immediately above the narrows.)	The term "as occurred in the 1960's" was removed from the sentence.	M&T
There are many two-word adjectives that, without being hyphenated, are ambiguous. <u>Just a few of the instances</u> include "runoff year types" (change to "runoff-year types"); "multiple channel network" (change to "multiple-channel network); "desert patch types" (I'm not sure if this should be desert-patch types, or desert patch-types); "low water column velocity" (I'm not sure whether this should be "low-	Several hyphen changes were made.	M&T

water column velocity," "low water-column velocity," low-water-column velocity," or low-water column-velocity"); "large wood transport experiments" (change to "large-wood transport experiments," or to "large wood-transport experiments" if it was the experiments that were large); and greenhouse gas concentration (change to "greenhouse-gas concentration).		
The word "comprised" is used three times in the report. In all instances it should be changed to "composed."	Suggested changes were made.	M&T
Pg. 31, last para. in column 1: "... supporting large brown trout [insert such as] Order 98-05 desires..."	Suggested changes were made.	M&T
Pg. 37, last para: "Parker and Walker creeks will remain unimpaired below the LV conduit." This needs to be clarified. Specifically, are they, or will they be, impaired above the LVCon?	In response to this comment and others by LADWP, the sentence referenced was changed to read: "Parker and Walker creeks will likely remain unregulated by LADWP operations below the Lee Vining Conduit."	M&T

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Mr. Gregory Brown
Environmental Scientist
State Water Resources Control Board
Division of Water Rights

March 30, 2010

RE: Comments on the Mono Basin Stream Restoration and Monitoring Program: Synthesis of Instream Flow Recommendations to the State Water Resources Control Board and the Los Angeles Department of Water and Power (Draft Report for Public Comment, January 27, 2010)

Dear Mr. Brown:

My family and I have been supporters of the Mono Lake Committee (MLC) for many years. You may be aware that my father, Elden Vestal, a respected inland fisheries biologist with the California Department of Fish and Game for 41 years, provided testimony that critically influenced the landmark decision of the State Water Resources Control Board in 1994, that required the restoration of the Mono Basin including the trout fisheries in Rush and Lee Vining Creeks. In early 2009, I began working as a volunteer with members of the MLC staff, and I attended the Restoration Meeting in Bishop, California, April 28-29, 2009. I also attended the second day of the recent Restoration Meeting in Sacramento, February 22-23. Thus, I am engaged and following the progress of restoration in the Mono Basin with intense interest.

The body of work done by the Stream Scientists and others to create a foundation for understanding the ecology of Mono Lake and its tributaries is truly impressive, and they all are to be congratulated for their work. In particular, the work on Rush and Lee Vining Creeks that is summarized in the "Synthesis of Instream Flow Recommendations to the State Water Resources Control Board and the Los Angeles Department of Water and Power" (Draft Report for Public Review and Appendices, January 27, 2010) in general provides a solid scientific basis for making changes in the flow regimen that hopefully will optimize and accelerate the restoration of the trout fisheries and the associated riparian areas in these two important tributaries to Mono Lake while still permitting the gradual restoration of Mono Lake to the target elevation of 6,391 feet. My review and understanding of the draft Synthesis Report was very much enhanced by the excellent presentations of the Stream Scientists at the meeting in Sacramento. Although there has been definite progress, it is clear from the studies that restoration is far from complete. I have particular concern for the situation with Rush Creek in which the data show that the trout population in the lower section of the steam below the Narrows does not support significant numbers of larger brown trout. According to the "Fisheries for Rush, Lee Vining, Parker, and Walker Creeks 2007-08", none of the annually sampled sections in Rush Creek met the target of meeting four out of the five termination criteria. The County Road and Upper sections met two of the five criteria, whereas the Lower section failed to meet any of the termination criteria. During the period 2000-2007, the Stream Scientists found no brown trout larger than 15 inches in the Lower section (**Stream Scientist Comment:** we have captured and observed brown trout >15 inches in Rush Creek below the Narrows between 2000-2009. In 2002 we observed several large trout during night snorkel surveys in class 4 and 5 pools. In 2005, we caught and radio-tagged a 475mm (≈19 inch) male brown trout in the Bottomlands sampling reach. In 2006, we caught and radio-tagged a 457mm (18 inch) male brown trout and a 410 mm (16 inch) female brown trout in the Bottomlands sampling reach. Finally, in 2009 we captured a 425mm (17 inch) male brown trout in the Bottomlands during our mark-recapture sampling). There were similar problems for Lee Vining Creek.

Although I have a strong medical research and scientific background, my main qualifications to comment on the Synthesis Report are that I am a dedicated fly fisherman, conservationist, and environmentalist. I definitely want the restoration of the entire Mono Basin, which suffered greatly from the diversions of water by the Los Angeles Department of Water and Power (LADWP), to be ecologically sound and sustainable. I do have several modest recommendations:

Vestal Comment #1	Stream Scientist Response	By
Termination criteria should be left in place as written in Order 98-07 and appropriate monitoring at appropriate intervals must continue. The monitoring should acquire data suitable for comparison to the existing data sets in order to continue to evaluate progress. The Los Angeles Department of Water and Power (LADWP) must continue to be accountable for successful restoration of the fishery in Rush Creek and Lee Vining Creek. However, it is reasonable to have additional discussion and try to achieve consensus agreement on what successful restoration will look like. The Synthesis Report is not very clear on this issue. The last paragraph of the Executive Summary on p. 3, states "The Stream Scientists suggest that the current termination criteria specified in Order 98-07 have served their purpose...., but have limited utility in the next phase of instream flow implementation and monitoring" etc. Then on p. 126 in Sect. 7.2 Adaptive Management, the report reads "The adaptive management process begun in Orders 98-05 and 98-07 should continue, but without the termination criteria." On p. 116, however, in the mid-first column, the report reads "The Fisheries Stream Scientists recommend that the termination criteria metrics in the Hunter (2007) memorandum continue to be annually computed..." and then in the section immediately above reiterates the point that there are no scientifically quantifiable data to provide a picture of the trout population that the streams supported on a self-sustaining basis prior to 1941 (Hunter 2007). The rest of that section up to Sect. 7.1 Future Monitoring seemingly attempts to lower the expectations for restoration and provides the rationale. Hunter proposed among several metrics monitoring the number of "catchable trout" (≥9"). It seems to me that this issue of changing or eliminating the current termination criteria is so important that perhaps an independent assessment of the justification for this recommendation should be made.	We will defer to the SWRCB regarding our recommendation to eliminate the TC. We do feel that the original purpose is no longer valid (to terminate the monitoring) given that adaptive management will continue into the foreseeable future. We agree that a future adaptive monitoring program should be developed by LADWP, the Stream Scientists and stake-holders as part of the implementation phase. We have edited the text on page 126 to reduce the confusion regarding the TC and the criteria proposed by Hunter (2007) as valid metrics to assess the fishery based on results of future monitoring, regardless if there are TC, or not. For fisheries, we still support the criteria recommended by Hunter (2007) as valid metrics to assess the fishery. We also still support the values suggested by Hunter (2007) as indicative of a high-quality Eastern Sierra brown trout stream. We do not feel these values attempt to lower the expectations for recovery. We suspect it may take the creeks, especially Rush Creek; many years to consistently meet the values proposed by Hunter (2007). We acknowledge that TC for trout as put forth in the Orders was based on the best available information. However, as scientists being held to quantitative standards in which data must be collected with statistically valid methods we still support the Hunter (2007) statement "no data were available that provided a scientifically quantitative picture of trout populations that these streams supported on a self-sustaining basis prior to 1941." This statement is also supported by language within D-1631 and the Mono Basin EIR. The purpose of Hunter's statement was to introduce quantitative metrics to evaluate the fishery, not to question the Orders nor discredit the information used to establish the TC. The development of the Hunter (2007) report was consistent with directives included in the Orders for the stream scientists to collect data and make recommended changes to the TC so that data were collected using accepted quantifiable methods.	**RTA** **RTA** **RTA** **RTA** **RTA**

Vestal Comment #2	Stream Scientist Response	By
I recommend that the feasibility and advisability of at least partial re-watering of the West-Side Springs in the Rush Creek bottomlands be explored for possible implementation. These springs also are known as the Vestal Springs. This idea was introduced in 1999 by Peter Vorster and Scott Stine in a discussion paper entitled “Feasibility of Rejuvenating the West-Side Springs of the Rush Creek Bottomlands, Mono County, California”. They suggest that an increase in spring flow would provide an indirect benefit to the Rush Creek fishery by helping to stabilize stream temperatures and by increasing conductivity. A direct benefit would accrue if fish were able to swim from Rush Creek into the Vestal Springs.	Although informal discussions regarding spring re-charge have recently occurred between a couple of the stakeholders and the Stream Scientists, not all parties, including LADWP, CDFG and SWRCB were involved in those discussions. Thus, no language was added to the final Synthesis Report in regards to a spring re-charge feasibility analysis. However, omission of a written recommendation does not preclude further discussion. The proper manner to proceed towards developing a feasibility analysis would be an all-inclusive meeting to discuss the issue, because re-charging the springs may be a possible management strategy to "bank" water in wetter year-types that would later be expressed in the lower Rush Creek channel, and ultimately Mono Lake.	**RTA**
	While some of the stakeholders believe that the west-side springs were mostly of natural origin, from the written record (D-1631, the Mono Basin EIR, depositions and 1994 hearings) it appears that irrigation return flow had a contributing, yet unknown, influence to spring flow in Rush Creek. This uncertainty probably influenced the SWRCB’s decision to not require a spring re-charge feasibility study when the Stine and Vorster proposal was originally submitted prior to the Orders.	**RTA**
	A preliminary water temperature modeling scenario that involved a 5 cfs “spring” accretion below the Narrows at 48°F had little effect on improving brown trout growth rates. This 5 cfs accretion was also insufficient to increase winter water temperatures above the threshold where brown trout growth would occur.	**RTA**
	Increasing spring flow to the 12.5 cfs identified by Stine and Vorster (1998) as the west-side contribution or to the >20 cfs total spring flow in 1947 as described by Eldon Vestal may impact the re-established fisheries in Parker and Walker creeks. As previously stated, since 2004 Walker Creek has consistently produced the highest brown trout biomass estimates of all the annually sampled stream reaches.	**RTA**

Vestal Comment #3	Stream Scientist Response	By
If the instream flow recommendations do not result in accelerated progress with restoration of the Rush Creek and Lee Vining fisheries, I recommend that the adaptive management approach be evaluated and perhaps supplemented with careful physical restoration methods, particularly in Lower Rush Creek. This view is shared by Dr. Eric Larsen, a geomorphologist at University of California at Davis. Dr. Larsen, who brings experience with the initial restoration efforts of Trihey and Associates, is a consultant to the Mono Lake Committee. He has reviewed the reports of the Stream Scientists with particular attention to the draft Synthesis Report and the "Pool and Habitat Studies on Rush and Lee Vining Creeks" (July 2009). As stated above, adequate stream and fisheries restoration has not been achieved. The scientifically based flow recommendations proposed by the Stream Scientists deserve a reasonable period of time, preferably including at least one wet year to allow for further improvements in pool formation, to have an impact on the characteristics of the fish population, riparian areas, and stream morphology. If there has been little or no progress, particularly with Lower Rush Creek, the adaptive management approach to restoration deserves reassessment and modification. This will be especially true if LADWP cannot comply or declines to comply with the proposed instream flow recommendations.	Within the nine sets of comments submitted to the SWRCB, there was broad support for continuing an adaptive management process. We support this process and have recommended monitoring that can be used to evaluate the effectiveness of our flow recommendations. However, until LADWP completes their 120-day feasibility study, reports their findings to the SWRCB, and the SWRCB makes a determination we feel it is premature to make recommendations on specific monitoring protocols, timeframes for channel and biotic responses and alternate management actions. In response to "careful physical restoration methods" we do not support the mechanical excavation of pools in either Rush or Lee Vining creeks. The pools created by Trihey and Associates have for the most part filled-in and associated cabled boulder and root-wad structures have shifted or moved. The pool and habitat report (Knudson et al. 2009) documented the deterioration of these man-made pools, as well as the increased numbers of high-quality pools in Rush Creek below the Narrows created by the large SRF releases in 2005 and 2006. We still believe that the best means to achieve long-term (and sustainable) recovery of the stream channels, riparian vegetation, and ultimately good trout habitat is releasing the flow regimes set forth as SEFs in the Synthesis Report.	**RTA and M&T** **RTA and M&T**

Vestal Comment #4	Stream Scientist Response	By
Finally, I strongly urge that all text that calls into question the validity of my father's testimony and that of other individuals on the quality of the trout fishery in Rush Creek be removed from the Synthesis Report and all subsequent documents. This only serves to cast doubt on a fishery that by all description was very impressive and merely provides an excuse for failure to achieve adequate restoration. My father was the District Fishery Biologist in the Inyo–Mono area from 1939 to 1950, interrupted by World War II. My father's meticulous notes, his excellent memory of his own fishing experience, and his records from the Rush Creek Test Stream Project in 1947-51 (see California Fish and Game 40(2):89-104, 1954) as stated in his testimony at the hearings in 1994 and his deposition on January 11, 1990, with a photograph of an 18 inch female Brown trout (E Vestal #5 1-11-90) was corroborated by several other Mono Basin fisherman. There is very persuasive additional photographic evidence on file at the Pamona Public Library (Frasher Postcard Collection) and in the files of the Eastern Sierra Museum of Bishop, California (Henry Golas, curator). I have attached digital files of some of these photographs. Frankly, I am convinced that the evidence that Rush Creek was a trophy trout stream comparable to ones with which I am familiar in Idaho and Oregon (South Fork of the Boise River, Big Wood River, Silver Creek, Big Lost River, Owyhee River) is incontrovertible. To suggest otherwise is disingenuous. Let's focus on restoration of the fishery in Rush Creek, and let's do what it takes to get it done.	The Synthesis Report does not contain text that questions the validity of Elden Vestal's depositions nor the recollections of others regarding the pre-1941 fisheries in Rush and Lee Vining creeks. Your father's depositions and associated field notes, weekly and monthly reports, and the test stream report provided much valuable information about the fishery below the Narrows and above Grant Lake, as well as the demise of the lower Rush Creek fishery as water exports increased. Regarding the photograph of the 18 inch female brown trout that was taken on October 10, 1939 and submitted as CalTrout Exhibit #5, Elden Vestal was questioned about the location of where this fish was from in his 1-11-90 deposition. On pages 81-82, he specifically states this fish was caught at the Rush Creek trap site above Grant Lake. Later in the same deposition (pages 103-104 he describes the lengths of brown that were gill-netted in Grant Lake as averaging 16.2 inches and ranging from 14 inches to 27 inches. He also describes the length of forage fish, chubs, being 5 inches to 11 inches in length. Additional information describes where fisherman had success in Grant Lake using either live bait or trolling to catch the big brown trout. We suspect that some of the Fraser photos are of brown trout caught in Rush Creek upstream of Grant Lake.	**RTA** **RTA** **RTA**

Thank you for considering my thoughts on the stream restoration in the Mono Basin and proposed instream flow recommendations. Please make this letter and the attached photographs part of the public record. I am submitting this letter electronically tonight in order to comply with the deadline of March 30, 2010, for public comment. However, I will forward a printed copy by surface mail.

Sincerely,
Robert E. Vestal, M.D.

Attachments

cc: Steve Herrera, SWRCB
Bruk Moges, LADWP
Lisa Cutting, MLC
Steve Parmenter, CDF&G
Mark Drew, CalTrout
William Trush
Michael Schlafmann
Ross Taylor
Eric Larsen