APPENDIX B

Appendix B
Proposed Conditions
Onsite Channel Capacity

Upstream Station	Downstream Station	Channel Attributes							10-year	10-year	10-year	10-year	10-year
		Length (ft)	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Side Slope (H:V)	Channel Slope (ft/ft)	Manning's N	Peak Flow (CFS)	Normal Depth (ft)	Velocity (fps)	Hydraulic Radius (ft)	Shear Stress (1b/ft^2)
50+50	36+35	1415	15	0	2.5	3.00	0.036	0.036	2.77	0.54	3.16	0.26	0.58
73+50	50+50	2300	40	0	2	10.00	0.029	0.036	3.48	2.34	2.34	0.19	0.34
73+50	85+95	1245	40	0	2	10.00	0.014	0.036	2.28	0.38	1.60	1.60	1.44
102+50	85+95	1655	40	0	2	10.00	0.017	0.036	3.01	0.40	1.84	0.20	0.21
115+50	102+50	1300	40	0	2	10.00	0.022	0.036	2.42	0.35	1.92	0.18	0.24
124+80	115+50	930	40	0	3	6.67	0.017	0.036	2.74	0.45	1.99	0.22	0.24
139+50	124+80	1470	40	0	3	6.67	0.031	0.036	6.26	0.55	3.07	0.27	0.52
159+00	139+50	1950	40	0	3	6.67	0.030	0.036	4.34	0.49	2.76	0.24	0.45
180+00	159+00	2100	40	0	3	6.67	0.031	0.036	3.33	0.44	2.62	0.22	0.42
202+00	180+00	2200	40	0	3	6.67	0.009	0.036	3.64	0.57	1.68	0.28	0.15
220+00	202+00	1800	40	0	3	6.67	0.010	0.036	5.41	0.65	1.93	0.32	0.20
236+50	220+00	1650	40	0	3	6.67	0.022	0.036	2.87	0.44	2.22	0.22	0.30
253+80	236+50	3334	40	0	3	6.67	0.011	0.036	3.16	0.52	1.75	0.26	0.18
273+50	253+80	1970	40	0	3	6.67	0.021	0.036	3.53	0.48	2.29	0.24	0.32
288+50	273+50	1500	20	0	1	10.00	0.029	0.036	5.32	0.66	3.27	0.32	0.57
303+00	288+50	1450	20	0	1	10.00	0.053	0.036	2.56	0.45	3.42	0.22	0.73
319+10	303+00	1610	20	0	1	10.00	0.053	0.036	3.09	0.57	4.09	0.28	0.93
329+80	319+10	1070	20	0	1	10.00	0.054	0.036	1.22	0.34	2.86	0.16	0.54
340+10	329+80	1030	20	0	1	10.00	0.052	0.036	4.17	0.37	3.05	0.18	0.59
401+80	396+10	570	20	0	2	5.00	0.018	0.036	2.87	0.51	2.20	0.25	0.27
438+00	427+00	1100	20	0	2	5.00	0.043	0.036	3.04	0.44	3.09	0.22	0.59
446+50	438+00	850	20	0	2	5.00	0.040	0.036	2.36	0.41	2.83	0.20	0.50
458+20	446+50	1170	20	0	2	5.00	0.024	0.036	3.30	0.51	2.54	0.25	0.37
510+10	491+00	1910	20	0	1	10.00	0.014	0.036	3.07	0.42	1.72	0.21	0.18
511+50	524+50	1300	10	0	2	3.50	0.042	0.036	2.00	0.44	2.99	0.21	0.54
524+40	540+00	1560	20	0	2	5.00	0.059	0.036	5.44	0.52	4.03	0.25	0.92
540+00	555+00	1500	20	0	2	5.00	0.060	0.036	4.41	0.48	3.85	0.23	0.86
555+00	570+00	1500	20	0	1.5	6.67	0.049	0.036	4.41	0.45	3.33	0.22	0.68
582+00	586+00	400	20	0	2	5.00	0.020	0.036	3.36	0.48	2.97	0.23	0.29
620+50	638+00	1750	20	0	2	5.00	0.080	0.036	4.02	0.44	4.19	0.21	1.05
638+50	658+50	2000	25	0	2	6.25	0.070	0.036	2.26	0.33	3.27	0.16	0.70
658+50	679+50	2100	25	0	2	6.25	0.017	0.036	6.16	0.63	2.47	0.31	0.33
679+50	692+70	1320	20	0	2	5.00	0.050	0.036	3.29	0.44	3.34	0.22	0.69

No shading indicates only soil stabilization nessecary for channel lining
Channel to be gravel lined
Channel to be lined with Class 150 Riprap

Upstream Station	Downstream Station	Type	Length (ft)	Longitudinal Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning's n	10-Year			
							Peak Flow (cfs)	Spread (ft)	Allowable Spread (ft)*	Depth (ft)
95+30 Rt.	91+30 Rt.	Concrete Barrier Rail	400	0.018	0.027	0.015	0.84	4.8	14.0	0.1
96+70 Lt.	93+10 Lt.	Concrete Barrier Rail	360	0.017	0.021	0.015	0.76	5.7	14.0	0.1
103+40 Rt.	100+00 Rt.	Concrete Barrier Rail	350	0.034	0.035	0.015	0.76	5.0	13.0	0.1
112+90 Rt.	109+90 Rt.	Concrete Barrier Rail	300	0.005	0.021	0.015	0.59	4.9	14.0	0.1
114+10 Lt.	111+20 Lt.	Concrete Barrier Rail	290	0.005	0.014	0.015	0.60	8.3	14.0	0.1
124+00 Rt.	115+90 Rt.	Concrete Barrier Rail	810	0.017	0.028	0.015	1.73	6.3	14.0	0.2
123+10 Lt.	117+10 Lt.	Concrete Barrier Rail	600	0.017	0.014	0.015	1.20	5.5	14.0	0.2
222+00 Rt.	220+40 Rt.	Concrete Barrier Rail	160	0.013	0.014	0.015	0.34	5.3	14.0	0.1
261+00 Rt.	251+00 Rt.	Concrete Barrier Rail	1000	0.022	0.016	0.015	2.34	9.6	14.0	0.2
256+00 Lt.	252+00 Lt.	Concrete Barrier Rail	400	0.021	0.019	0.015	0.83	5.9	14.0	0.1
297+40 Rt.	276+30 Rt.	Concrete Barrier Rail	2110	0.040	0.010	0.015	3.57	13.5	15.0	0.1
315+00 Rt.	309+70 Rt.	Concrete Barrier Rail	530	0.053	0.020	0.015	1.30	5.7	14.0	0.1
328+10 Lt.	307+20 Lt.	Concrete Barrier Rail	2090	0.055	0.020	0.015	3.76	11.0	14.0	0.1
320+00 Rt.	315+00 Rt.	Concrete Barrier Rail	500	0.052	0.020	0.015	1.23	5.6	15.0	0.1
330+00 Rt.	320+00 Rt.	Concrete Barrier Rail	1000	0.053	0.020	0.015	2.12	6.8	15.0	0.1
337+50 Rt.	330+10 Rt.	Concrete Barrier Rail	740	0.053	0.023	0.015	2.06	6.2	15.0	0.1
345+10 Rt.	337+50 Rt.	Concrete Barrier Rail	760	0.057	0.020	0.015	1.80	6.3	15.0	0.1
353+70 Rt.	345+10 Rt.	Concrete Barrier Rail	860	0.051	0.013	0.015	2.01	8.8	15.0	0.2
348+00 Lt.	342+60 Lt.	Concrete Barrier Rail	540	0.052	0.020	0.015	1.30	5.7	15.0	0.1
353+50 Lt.	348+00 Lt.	Concrete Barrier Rail	550	0.053	0.020	0.015	1.33	5.7	15.0	0.1
364+60 Lt.	353+50 Lt.	Concrete Barrier Rail	1110	0.044	0.020	0.015	2.62	7.7	15.0	0.2

Upstream Station	Downstream Station	Type	Length (ft)	Longitudinal Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning's n	10-Year			
							Peak Flow (cfs)	Spread (ft)	Allowable Spread (ft)*	Depth (ft)
364+60 Rt.	353+70 Rt.	Concrete Barrier Rail	1940	0.025	0.020	0.015	2.76	8.7	15.0	0.2
373+60 Lt.	366+90 Lt.	Concrete Barrier Rail	670	0.009	0.019	0.015	1.46	8.6	11.0	0.2
372+50 Rt.	366+80 Rt	Concrete Barrier Rail	570	0.014	0.019	0.015	1.28	7.5	11.0	0.1
373+50	372+00	Concrete Barrier Rail	160	0.003	0.025	0.015	0.31	4.9	10.0	0.1
373+60	388+80	Concrete Barrier Rail	1520	0.010	0.025	0.015	3.70	10.0	10.0	0.3
388+00 Rt.	394+05 Rt.	Concrete Barrier Rail	605	0.012	0.019	0.015	1.85	8.9	11.0	0.2
373+60 Lt.	382+90 Lt.	Concrete Barrier Rail	930	0.009	0.038	0.015	1.70	5.9	11.0	0.2
382+90 Lt	392+10 Lt.	Concrete Barrier Rail	910	0.009	0.019	0.015	1.76	9.2	11.0	0.2
411+30 Rt.	401+80 Rt.	Concrete Barrier Rail	950	0.043	0.013	0.015	2.29	9.3	11.0	0.1
410+10 Lt.	404+70 Lt.	Concrete Barrier Rail	540	0.040	0.013	0.015	1.28	9.8	11.0	0.1
414+50 Lt.	410+10 Lt.	Concrete Barrier Rail	440	0.041	0.013	0.015	2.20	9.8	11.0	0.1
418+10	410+10	Concrete Barrier Rail	790	0.044	0.019	0.015	1.96	7.1	10.0	0.1
420+00 Lt.	414+50 Lt.	Concrete Barrier Rail	550	0.044	0.013	0.015	1.31	7.7	11.0	0.1
425+00 Rt.	418+10 Rt.	Concrete Barrier Rail	690	0.043	0.013	0.015	1.67	8.5	11.0	0.1
425+70 Lt.	420+00 Lt.	Concrete Barrier Rail	570	0.039	0.013	0.015	1.46	8.2	11.0	0.1
427+00	424+40	Concrete Barrier Rail	260	0.035	0.020	0.015	0.65	4.7	11.0	0.1
436+60 Lt.	429+80 Lt.	Concrete Barrier Rail	680	0.046	0.013	0.015	1.47	8.1	11.0	0.1
439+00 Rt.	433+00 Rt.	Concrete Barrier Rail	600	0.038	0.024	0.015	1.42	5.6	11.0	0.1
449+80 Rt.	443+00 Rt.	Concrete Barrier Rail	680	0.040	0.013	0.015	1.11	7.4	11.0	0.1
452+20 Lt.	445+70 Lt.	Concrete Barrier Rail	650	0.022	0.013	0.015	1.50	9.3	11.0	0.1
464+00 Lt.	458+40 Lt.	Concrete Barrier Rail	560	0.018	0.020	0.015	1.38	7.1	11.0	0.1

Upstream Station	Downstream Station	Type	Length (ft)	Longitudinal Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning's n	10-Year			
							Peak Flow (cfs)	Spread (ft)	Allowable Spread (ft)*	Depth (ft)
461+10	458+50	Concrete Barrier Rail	250	0.016	0.013	0.015	0.68	7.3	11.0	0.1
470+60 Rt.	461+20 Rt.	Concrete Barrier Rail	940	0.012	0.020	0.015	1.97	9.1	11.0	0.2
469+00	463+70	Concrete Barrier Rail	530	0.015	0.020	0.015	1.18	6.9	11.0	0.1
475+00	469+00	Concrete Barrier Rail	600	0.020	0.020	0.015	1.43	7.1	11.0	0.1
493+60 Rt.	472+80 Rt.	Concrete Barrier Rail	2080	0.054	0.038	0.015	4.13	5.8	11.0	0.2
481+00 Lt.	475+00 Lt.	Concrete Barrier Rail	600	0.022	0.013	0.015	1.54	9.3	11.0	0.1
489+10 Lt.	481+00 Lt.	Concrete Barrier Rail	1410	0.057	0.013	0.015	1.82	8.3	11.0	0.1
491+00	488+50	Concrete Barrier Rail	250	0.056	0.020	0.015	0.60	4.2	11.0	0.1
510+50 Rt.	493+60 Rt.	Concrete Barrier Rail	1690	0.044	0.035	0.015	3.47	6.0	16.0	0.2
510+60 Rt.	511+90 Rt.	Concrete Barrier Rail	30	0.067	0.013	0.015	0.19	3.5	16.0	0.1
518+00 Lt.	524+30 Lt.	Concrete Barrier Rail	630	0.057	0.013	0.015	1.38	7.5	16.0	0.1
516+30 Rt.	526+80 Rt.	Concrete Barrier Rail	1050	0.055	0.025	0.015	2.44	6.2	16.0	0.2
518+00 Lt.	524+30 Lt.	Concrete Barrier Rail	630	0.059	0.013	0.015	1.38	7.5	16.0	0.1
516+30 Rt.	526+80 Rt.	Concrete Barrier Rail	1050	0.041	0.013	0.015	2.44	9.8	16.0	0.1
537+00 Rt.	540+30 Rt.	Concrete Barrier Rail	330	0.048	0.013	0.015	0.77	6.3	16.0	0.1
542+50 Lt.	539+00 Lt.	Concrete Barrier Rail	350	0.069	0.013	0.015	0.69	5.6	16.0	0.1
569+00 Rt.	575+90 Rt.	Concrete Barrier Rail	690	0.042	0.038	0.015	1.51	4.2	15.0	0.2
572+10 Lt.	573+50 Lt.	Concrete Barrier Rail	140	0.029	0.013	0.015	0.29	2.9	15.0	0.1
583+00	585+10	Concrete Barrier Rail	210	0.043	0.020	0.015	0.58	4.4	11.0	0.1
585+00 Lt.	604+50 Lt.	Concrete Barrier Rail	1950	0.038	0.020	0.015	3.45	10.4	11.0	0.2
588+10 Rt.	604+50 Rt.	Concrete Barrier Rail	1640	0.038	0.020	0.015	3.48	8.7	11.0	0.2

Upstream Station	Downstream Station	Type	Length (ft)	Longitudinal Slope (ft/ft)	Road Cross Slope (ft/ft)	Manning's n	10-Year			
							Peak Flow (cfs)	Spread (ft)	Allowable Spread (ft)*	Depth (ft)
604+50 Lt.	620+50 Lt.	Concrete Barrier Rail	1600	0.038	0.020	0.015	4.02	9.2	11.0	0.2
604+50 Rt.	620+50 Rt.	Concrete Barrier Rail	1600	0.038	0.020	0.015	3.25	8.5	11.0	0.2

Notes:

Refer to Appendix A for feature Peak Flow Estimates.

*Allowable Spread is shoulder width plus half the width of 1 lane

Only barrier rail that collects flow is whon in the table

Appendix B
Proposed Conditions
Onsite Drop Inlet Capacity and Bypass

Approximate Station	Inlet Type	Location	Roadway Longitudinal Slope (ft/ft)	Pavement Cross-Slope (ft/ft) or Channel Side Slope (H:V)	Manning's n	# of Grates	Grate Width (ft)	Grate Length (ft)	10-Year					
									Peak Flow (cfs)	Additional Bypass Flow (cfs)	Total Flow (cfs)	Drop Inlet Interception (cfs)	Bypass Flow (cfs)	Bypass Destination
36+35	Type 2	Channel	0.033	7.5	0.036	2	2	3	2.77	0.25	3.02	3.02	0.00	Offsite
50+50	Type 2	Channel	0.038	10	0.036	2	2	4	3.48	0.00	3.48	3.23	0.25	36+35
86+00	Type 2	Channel	0.012	10	0.036	2	2	4	5.29	0.55	5.84	5.75	0.09	Offsite
102+50	Type 2	Channel	0.039	10	0.036	1	2	4	2.42	0.26	2.68	2.13	0.55	86+00
115+50	Type 2	Channel	0.005	10	0.036	1	2	4	2.74	0.17	2.91	2.65	0.26	102+50
124+80	Type 2	Channel	0.030	6.7	0.036	2	2	4	6.26	0.98	7.24	7.07	0.17	115+50
139+50	Type 2	Channel	0.031	6.7	0.036	1	2	4	4.34	0.69	5.03	4.05	0.98	124+80
159+00	Type 2	Channel	0.030	6.7	0.036	1	2	4	3.33	0.72	4.05	3.36	0.69	139+50
180+00	Type 2	Channel	0.023	6.7	0.036	1	2	4	3.64	0.75	4.39	3.67	0.72	159+00
202+00	Type 2	Channel	0.006	6.7	0.036	1	2	4	5.41	1.17	6.58	5.83	0.75	180+00
220+00	Type 2	Channel	0.024	6.7	0.036	1	2	4	2.87	0.59	3.46	2.41	1.05	202+00
220+40 Rt.	Type 5	Barrier Rail	0.015	70	0.015	1	2	2.5	0.34	0.00	0.34	0.22	0.12	202+00
236+50	Type 2	Channel	0.022	6.7	0.036	1	2	4	3.16	0.76	3.92	3.33	0.59	220+00
253+80	Type 2	Channel	0.020	6.7	0.036	1	2	4	3.53	1.19	4.72	3.96	0.76	236+50
273+50	Type 2	Channel	0.022	6.7	0.036	1	2	4	5.32	0.89	6.21	5.02	1.19	253+80
288+50	Type 2	Channel	0.050	10	0.036	1	2	4	2.56	1.00	3.56	2.67	0.89	273+50
303+00	Type 2	Channel	0.055	10	0.036	1	2	4	3.09	0.68	3.77	2.77	1.00	288+50
309+70 Rt.	Type 5	Barrier Rail	0.044	70	0.015	3	2	2.5	1.30	0.20	1.50	1.34	0.16	303+00
315+00 Rt.	Type 5	Barrier Rail	0.044	70	0.015	3	2	2.5	1.23	0.43	1.66	1.46	0.20	309+70 Rt.
319+10	Type 2	Channel	0.053	10	0.036	1	2	4	1.22	1.22	2.44	1.92	0.52	303+00
329+80	Type 2	Channel	0.052	10	0.036	1	2	4	4.17	0.20	4.37	3.15	1.22	319+10
320+00 Rt.	Type 5	Barrier Rail	0.044	70	0.015	3	2	2.5	2.12	0.43	2.55	2.1	0.45	309+70 Rt.
330+10 Rt.	Type 5	Barrier Rail	0.055	70	0.015	3	2	2.5	2.06	0.39	2.45	2.02	0.43	315+00 Rt.
337+50 Rt.	Type 5	Barrier Rail	0.055	70	0.015	3	2	2.5	1.80	0.48	2.28	1.89	0.39	330+10 Rt.
342+60 Lt.	Type 5	Barrier Rail	0.044	75	0.015	3	2	2.5	1.30	0.27	1.57	1.37	0.20	329+80
348+00 Lt.	Type 5	Barrier Rail	0.044	75	0.015	3	2	2.5	1.33	0.51	1.84	1.57	0.27	342+60 Lt.
353+50 Lt.	Type 5	Barrier Rail	0.044	75	0.015	3	2	2.5	2.62	0.00	2.62	2.11	0.51	348+00 Lt.
345+20 Rt.	Type 5	Barrier Rail	0.053	75	0.015	3	2	2.5	2.01	0.55	2.56	2.08	0.48	337+50 Rt.
353+50 Rt.	Type 5	Barrier Rail	0.053	75	0.015	3	2	2.5	2.76	0.00	2.76	2.21	0.55	345+20 Rt.
372+00	Type 2	Barrier Rail	0.014	40	0.015	1	2	3	0.31	0.00	0.31	0.25	0.06	Offsite
382+90 Lt.	Type 5	Barrier Rail	0.010	40	0.015	2	2	2.5	1.70	0.00	1.70	1.44	0.26	392+10 Lt.
388+80	Type 2	Barrier Rail	0.018	45	0.015	3	2	4	3.70	0.00	3.70	3.56	0.14	394+10 Rt.
392+10 Lt.	Type 5	Barrier Rail	0.005	50	0.015	3	2	2.5	1.76	0.26	2.02	1.93	0.09	394+10
394+10	Type 2	Channel	0.005	28	0.015	2	2	4	0.94	0.09	1.03	1.02	0.01	Low Point-no bypass
394+00 Rt.	Type 5	Barrier Rail	0.005	28	0.015	2	2	2.5	1.86	0.00	1.86	1.72	0.14	Low Point-no bypass
396+10	Type 2	Channel	0.015	5	0.036	2	2	4	2.87	0.23	3.10	3.1	0.00	394+00 Rt.
404+70 Lt.	Type 5	Barrier Rail	0.033	75	0.015	3	2	2.5	1.28	0.42	1.70	1.47	0.23	396+10
410+00 Lt.	Type 5	Barrier Rail	0.033	75	0.015	2	2	2.5	1.07	0.40	1.47	1.05	0.42	404+70 Lt.
410+10	Type 2	Barrier Rail	0.043	75	0.015	3	2	4	1.96	0.23	2.19	2.01	0.18	Across Rd
414+50 Lt.	Type 5	Barrier Rail	0.043	50	0.015	3	2	2.5	2.78	0.27	3.05	2.65	0.40	410+00 Lt.

Appendix B
Proposed Conditions
Onsite Drop Inlet Capacity and Bypass

Approximate Station	Inlet Type	Location	Roadway Longitudinal Slope (ft/ft)	Pavement Cross-Slope (ft/ft) or Channel Side Slope (H:V)	Manning's n	# of Grates	Grate Width (ft)	Grate Length (ft)	10-Year					
									Peak Flow (cfs)	Additional Bypass Flow (cfs)	Total Flow (cfs)	Drop Inlet Interception (cfs)	Bypass Flow (cfs)	Bypass Destination
418+10 Rt.	Type 5	Barrier Rail	0.035	70	0.015	3	2	2.5	1.67	0.22	1.89	1.66	0.23	410+10
420+00 Lt.	Type 5	Barrier Rail	0.042	50	0.015	2	2	2.5	1.46	0.00	1.46	1.19	0.27	414+50 Lt.
424+50	Type 2	Barrier Rail	0.020	75	0.015	1	2	4	0.65	0.00	0.65	0.43	0.22	418+10 Rt.
427+00	Type 2	Channel	0.042	5	0.036	2	2	4	3.04	0.63	3.67	3.65	0.02	Across Rd/Offsite
433+00 Rt.	Type 5	Barrier Rail	0.033	45	0.015	2	2	2.5	1.42	0.00	1.42	1.17	0.25	427+00
438+00	Type 2	Channel	0.043	5	0.036	1	2	4	2.36	0.68	3.04	2.66	0.38	427+00
445+70 Lt.	Type 5	Barrier Rail	0.030	75	0.015	3	2	2.5	1.50	0.00	1.50	1.32	0.18	438+00
446+50	Type 2	Channel	0.035	5	0.036	1	2	4	3.30	0.00	3.30	3.06	0.24	438+00
461+20 Rt.	Type 5	Barrier Rail	0.005	50	0.015	3	2	2.5	1.97	0.00	1.97	1.71	0.26	438+00
463+70	Type 2	Barrier Rail	0.009	75	0.015	2	2	4	1.18	0.37	1.55	1.39	0.16	Across Rd/Offsite
469+00	Type 2	Barrier Rail	0.014	25	0.015	1	2	4	1.43	0.17	1.60	1.23	0.37	463+70
475+00 Lt.	Type 5	Barrier Rail	0.031	50	0.015	3	2	2.5	1.54	0.47	2.01	1.84	0.17	469+00
481+00 Lt.	Type 5	Barrier Rail	0.060	50	0.015	2	2	2.5	1.82	0.21	2.03	1.56	0.47	475+00 Lt.
488+50	Type 2	Barrier Rail	0.062	45	0.015	1	2	3	0.60	0.00	0.60	0.39	0.21	481+00 Lt.
491+00	Type 2	Channel	0.057	10	0.036	2	2	4	3.07	0.00	3.07	3.01	0.06	Across Rd/Offsite
493+60 Rt.	Type 5	Barrier Rail	0.060	20	0.015	2	2	2.5	3.47	0.00	3.47	3.08	0.39	Offsite
524+30 Lt.	Type 5	Barrier Rail	0.057	77	0.015	3	2	2.5	1.38	0.00	1.38	1.22	0.16	540+00
524+50	Type 2	Channel	0.042	3.5	0.036	1	2	3	2.00	0.00	2.00	1.79	0.21	540+00
540+00	Type 2	Channel	0.059	5	0.036	1	2	4	5.44	0.37	5.81	4.63	1.18	555+00
540+30 Rt.	Type 5	Barrier Rail	0.048	77	0.015	2	2	2.5	0.77	0.00	0.77	0.62	0.15	555+00
555+00	Type 2	Channel	0.060	5	0.036	2	2	4	4.41	1.33	5.74	5.66	0.08	570+00
570+00	Type 2	Channel	0.036	6.67	0.036	1	2	4	4.71	0.08	4.79	3.84	0.95	582+90
573+50 Lt.	Type 5	Barrier Rail	0.029	77	0.015	1	2	2.5	0.29	0.00	0.29	0.18	0.11	582+90
582+90	Type 2	Channel	0.036	5	0.036	2	2	4	2.38	1.06	3.44	3.43	0.01	586+00
586+00	Type 2	Barrier Rail	0.015	5	0.036	2	2	3	3.48	0.01	3.49	3.37	0.12	604+50 Lt.
604+50 Lt.	Type 5	Barrier Rail	0.038	67	0.015	2	2	2.5	3.48	0.06	3.54	2.11	1.43	Offsite
604+50 Rt.	Type 5	Barrier Rail	0.038	67	0.015	2	2	2.5	3.54	0.06	3.60	2.13	1.47	Offsite
638+00	Type 2	Channel	0.037	6.25	0.036	1	2	4	4.02	0.00	4.02	3.32	0.70	658+50
658+50	Type 2	Channel	0.037	6.25	0.036	1	2	4	2.26	0.70	2.96	2.53	0.43	679+50
679+50	Type 2	Channel	0.017	6.25	0.036	1	2	4	6.16	0.43	6.59	5.46	1.13	692+60
692+60	Type 2	Channel	0.050	5	0.036	2	2	4	3.29	1.13	4.42	4.31	0.11	Offsite

Approx. Upstream Station	Approx. Downstream Station	Channel Length (ft)	Invert Elevations		Channel Slope (ft/ft)	25-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)	Assumed D_{50}	Stable Depth, D_s	Assumed Bottom Width (ft)	Assumed Left Side Slope (H:V)	Assumed Right Side Slope (H:V)	Channel Depth (ft)	Top Width (ft)	Cross-Sectional Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Manning's n	Velocity (fps)	Q (cfs)	Is Channel Sizing Optimized?	Max Shear Stress, td (lbs/sf)	Reynold's Number	Shields Parameter, Fx	Safety Factor, SF	Permissible Shear Stress, tp (lbs/sf)	CK Permissible Shear Stress STABLE or UNSTABLE?	Rip Rap Size	Notes
			Upsteam (ft)	Downstream (ft)																									
509+89 Rt.	521+87 Rt.	1087	5665.41	5625.31	0.037	51.6	83.9	0.620	1.347	0	6	4	1.33	13.3	8.8	13.6	0.65	0.036	5.883	52.0	Yes	3.06	3.0E+05	0.15	1.5	9.54	Stable	Class 150	
521+87 Rt.	533+65 Rt.	1178	5625.31	5554.97	0.060	51.6	83.9	1.370	1.838	0	2	2	1.84	7.4	6.8	8.2	0.82	0.042	7.659	51.9	Yes	6.86	8.6E+05	0.15	1.5	21.08	Stable	Class 300	
533+65 Rt.	539+98 Rt.	633	5554.97	5517.98	0.058	104.9	170.3	1.780	2.441	0	2	2	2.45	9.8	12.0	11.0	1.10	0.043	8.779	105.4	Yes	8.93	1.3E+06	0.15	1.5	27.39	Stable	Class 400	
539+98 Rt.	555+08 Rt.	1510	5518.00	5429.44	0.059	104.9	170.3	1.790	2.446	0	2	2	2.45	9.8	12.0	11.0	1.10	0.044	8.787	105.5	Yes	8.97	1.3E+06	0.15	1.5	27.55	Stable	Class 400	
555+08 Rt.	556+81 Rt.	173	5429.40	5418.64	0.062	104.9	170.3	1.900	2.448	0	2	2	2.45	9.8	12.0	11.0	1.10	0.044	8.959	107.6	Yes	9.51	1.4E+06	0.15	1.5	29.24	Stable	Class 400	
556+81 Rt.	577+00 Rt.	1909	5418.60	5329.88	0.046	1175.1	1813.0	2.700	4.655	3	6	2	4.60	39.8	98.4	40.9	2.40	0.047	12.336	1214.4	Yes	13.34	2.7E+06	0.15	1.5	41.55	Stable	Class 700	
577+00 Rt.	585+82 Rt.	992	5329.88	5287.94	0.042	1176.7	1814.5	2.400	4.549	4	4	4	4.50	40.0	99.0	41.1	2.41	0.046	12.010	1189.0	Yes	11.87	2.4E+06	0.15	1.5	36.94	Stable	Class 550	
585+82 Rt.	588+90 Rt.	308	5287.94	5273.18	0.048	1181.1	1818.9	2.300	3.846	6	6	4	3.90	45.0	99.5	45.8	2.17	0.045	12.024	1195.8	Yes	11.66	2.3E+06	0.15	1.5	35.40	Stable	Class 550	
518+41 Lt.	524+65 Lt.	624	5639.53	5615.76	0.038	111.2	182.1	1.200	2.524	0	2	4	2.24	13.4	15.1	14.2	1.06	0.041	7.416	111.6	Yes	5.32	7.3E+05	0.15	1.5	18.47	Stable	Class 300	
524+65 Lt.	529+47 Lt.	482	5615.76	5593.41	0.046	111.2	182.1	1.300	2.246	0	2	4	2.17	13.0	14.1	13.7	1.03	0.041	7.905	111.7	Yes	6.28	8.4E+05	0.15	1.5	20.01	Stable	Class 300	
529+47 Lt.	537+49 Lt.	802	5593.41	5529.49	0.080	177.9	293.6	2.400	2.413	0	2	4	2.43	14.6	17.7	15.4	1.15	0.046	10.090	178.7	Yes	12.09	2.0E+06	0.15	1.5	36.94	Stable	Class 550	
537+49 Lt.	549+31 Lt.	1182	5529.49	5456.90	0.061	195.2	323.7	2.400	3.131	0	2	2	3.13	12.5	19.6	14.0	1.40	0.046	10.082	197.5	Yes	11.99	2.0E+06	0.15	1.5	36.94	Stable	Class 550	
549+31 Lt.	569+96 Lt.	2065	5456.90	5346.00	0.054	266.9	446.5	2.400	3.581	0	2	2	3.60	14.4	25.9	16.1	1.61	0.046	10.349	268.3	Yes	12.06	2.0E+06	0.15	1.5	36.94	Stable	Class 550	
569+96 Lt.	582+49 Lt.	1253	5346.00	5305.92	0.032	266.9	446.5	1.500	3.758	0	2	2	3.90	15.6	30.4	17.4	1.74	0.042	9.111	277.2	Yes	7.78	1.1E+06	0.15	1.5	23.09	Stable	Class 400	
582+49 Lt.	584+50 Lt.	200	5305.00	5295.00	0.050	266.9	446.5	2.300	3.686	0	2	2	3.64	14.6	26.5	16.3	1.63	0.045	10.131	268.5	Yes	11.36	1.9E+06	0.15	1.5	35.40	Stable	Class 550	
584+50 Lt.	598+00 Lt.	1350	5303.00	5239.00	0.047	344.6	577.3	2.400	4.056	0	2	2	4.05	16.2	32.8	18.1	1.81	0.046	10.518	345.0	Yes	11.98	2.1E+06	0.15	1.5	36.94	Stable	Class 550	
598+00 Lt.	601+10 Lt.	310	5239.00	5226.15	0.041	564.4	925.6	2.600	5.026	0	2	2	5.10	20.4	52.0	22.8	2.28	0.046	11.317	588.7	Yes	13.19	2.4E+06	0.15	1.5	40.01	Stable	Class 700	
601+10 Lt.	611+38 Lt.	1028	5226.15	5189.74	0.035	570.3	939.9	2.300	5.203	0	2	2	5.20	20.8	54.1	23.3	2.33	0.045	10.816	584.9	Yes	11.49	2.0E+06	0.15	1.5	35.40	Stable	Class 550	
611+38 Lt.	636+97 Lt.	2559	5189.74	5092.00	0.038	573.9	948.4	2.440	5.119	0	2	2	5.20	20.8	54.1	23.3	2.33	0.046	11.122	601.5	Yes	12.39	2.2E+06	0.15	1.5	37.55	Stable	Class 550	
636+97 Lt.	637+86 Lt.	90	5092.00	5090.12	0.038	573.9	948.4	2.440	5.145	0	2	2	5.20	20.8	54.1	23.3	2.33	0.046	11.093	599.9	Yes	12.33	2.2E+06	0.15	1.5	37.55	Stable	Class 550	
637+86 Lt.	645+67 Lt.	781	5090.12	5067.45	0.029	737.1	1222.2	1.800	4.969	0	2	4	4.91	29.5	72.3	31.1	2.33	0.044	10.210	738.4	Yes	8.89	1.5E+06	0.15	1.5	27.70	Stable	Class 400	
616+16 Rt.	622+92 Rt.	677	5182.34	5154.84	0.041	1181.2	1819.1	2.400	4.734	4	4	3	4.74	37.2	97.6	38.5	2.53	0.046	12.180	1188.7	Yes	12.01	2.4E+06	0.15	1.5	36.94	Stable	Class 550	
622+92 Rt.	629+84 Rt.	692	5154.84	5122.94	0.046	1182.4	1937.6	2.300	3.998	8	6	2	4.00	40.0	96.0	41.0	2.34	0.045	12.399	1190.3	Yes	11.51	2.3E+06	0.15	1.5	35.40	Stable	Class 550	
634+98 Rt.	645+43 Rt.	1045	5102.18	5071.20	0.030	1182.4	1820.5	1.650	4.460	6	6	2	4.50	42.0	108.0	43.1	2.51	0.043	10.991	1187.0	Yes	8.32	1.5E+06	0.15	1.5	25.39	Stable	Class 400	
645+43 Rt.	650+05 Rt.	462	5071.20	5057.90	0.029	1182.4	1820.5	1.800	5.010	2	6	2	5.00	42.0	110.0	43.2	2.54	0.044	10.786	1186.4	Yes	8.98	1.6E+06	0.15	1.5	27.70	Stable	Class 400	
650+05 Rt.	659+88 Rt.	983	5057.90	5020.20	0.038	1270.2	1937.6	2.400	5.014	2	6	2	5.00	42.0	110.0	43.2	2.54	0.046	11.866	1305.3	Yes	11.97	2.3E+06	0.15	1.5	36.94	Stable	Class 550	
659+88 Rt.	678+80 Rt.	1892	5020.20	4992.93	0.014	1504.2	2368.6	0.990	5.504	3	8	2	5.50	58.0	167.8	59.1	2.84	0.039	9.070	1521.5	Yes	4.95	7.4E+05	0.15	1.5	15.24	Stable	Class 150	
678+80 Rt.	692+81 Rt	1400	4992.93	4927.54	0.047	1734.5	2716.3	2.900	4.975	6	6	2	5.00	46.0	130.0	47.2	2.75	0.047	13.371	1738.2	Yes	14.57	3.2E+06	0.15	1.5	44.63	Stable	Class 700	
677+07 Lt.	694+30 Lt.	1723	5003.88	4921.68	0.048	6.4	9.9	0.400	0.672	0	6	2	0.62	5.0	1.5	5.1	0.30	0.034	4.297	6.6	Yes	1.85	1.4E+05	1.30	0.1	53.30	Stable	Earthen Channel	
509+80 Rt.	492+77 Rt.	1703	5667.36	5579.31	0.052	100.7	169.0	1.570	2.433	0	2	2	2.45	9.8	12.0	11.0	1.10	0.043	8.432	101.2	Yes	7.90	1.1E+06	0.15	1.5	24.16	Stable	Class 400	
509+50 Lt.	493+70 Lt.	1580	5665.28	5596.00	0.044	39.2	65.3	0.940	1.718	0	2	2	1.72	6.9	5.9	7.7	0.77	0.039	6.682	39.5	Yes	4.71	5.2E+05	0.15	1.5	14.47	Stable	Class 150	
493+70 Lt.	488+79 Lt.	491	5596.00	5562.55	0.068	39.2	65.3	1.100	1.294	0	4	2	1.35	8.1	5.5	8.5	0.64	0.040	7.180	39.3	Yes	5.74	6.5E+05	0.15	1.5	16.93	Stable	Class 300	
468+94 Lt.	465+88 Lt.	306	5435.99	5436.10	0.005	10.0	10.0	0.080	1.282	0	4	2	1.12	6.7	3.8	7.1	0.53	0.026	2.658	10.0	Yes	0.35	1.7E+04	0.05	1.0	0.39	Stable	Earthen Channel	
472+34 Rt.	465+76 Rt.	658	5465.66	5426.82	0.059	320.3	533.7	1.600	2.172	6	4	4	2.16	23.3	31.6	23.8	1.33	0.043	10.210	322.9	Yes	7.96	1.3E+06	0.15	1.5	24.62	Stable	Class 400	
465+76 Rt.	462+01 Rt.	375	5426.82	5415.00	0.032	320.3	533.7	1.000	2.542	3	6	4	2.51	28.1	39.0	28.6	1.36	0.040	8.218	320.7	Yes	4.94	6.8E+05	0.15	1.5	15.39	Stable	Class 300	
458+80 Rt.	457+71 Rt.	109	5406.00	5398.86	0.066	716.8	1151.9	2.400	2.936	6	6	4	2.94	35.4	60.9	36.0	1.69	0.046	11.812	718.8	Yes	12.02	2.3E+06	0.15	1.5	36.94	Stable	Class 550	
452+55 Rt.	448+60 Rt.	405	5454.00	5440.00	0.035	0.5	0.5	0.200	0.464	0	4	2	0.27	1.6	0.2	1.7	0.13	0.030	2.324	0.5	Yes	0.58	3.8E+04	0.05	1.0	0.96	Stable	Earthen Channel	
452+59 Lt.	447+30 Lt.	529	5449.86	5436.07	0.026	32.6	54.5	0.470	1.445	0	4	2	1.44	8.6	6.2	9.1	0.68	0.035	5.342	33.2	Yes	2.34	2.1E+05	0.15	1.5	7.23	Stable	Class 150	
447+30 Lt.	446+63 Lt.	67	5436.07	5407.00	0.434	32.6	54.7	2.490	0.460	4	6	2	0.50	8.0	3.0	8.1	0.37	0.046	10.956	32.9	Yes	13.54	2.2E+06	0.15	1.5	38.32	Stable	Class 550	
445+50Rt.	440+200Rt.	475	5428.00	5406.00	0.046	1.9	1.9	0.250	0.433	0	4	2	0.43	2.6	0.6	2.7	0.20	0.031	3.534	2.0	Yes	1.24	7.3E+04	1.09	0.1	28.03	Stable	Earthen Channel	
445+80 Lt.	438+03 Lt.	777	5431.04	5397.36	0.043	8.1	13.3	0.400	0.739	0	4	2	0.77	4.6	1.8	4.9	0.37	0.034	4.662	8.3	Yes	2.08	1.5E+05	1.33	0.1	54.78	Stable	Earthen Channel	
437+00Rt.	431+20Rt.	578	5394.00	5372.00	0.038	0.7	0.7	0.200	0.421	0	4	2	0.31	1.9	0.3	2.0	0.15	0.030	2.674	0.8	Yes	0.74	4.4E+04	1.01	0.0	20.66	Stable	Earthen Channel	
428+75Rt.	425.50Rt.	297	5362.00	5346.00	0.054	0.3	0.3	0.200	0.297	0	4	2	0.21	1.3	0.1	1.3	0.10	0.030	2.453	0.3	Yes	0.71	4.0E+04	1.00	0.0	20.44	Stable	Earthen Channel	
438+03 Lt.	426+00 Lt.	1203	5397.36	5349.91	0.039	6.4	10.2	0.350	0.711	0	4	2	0.71	4.3	1.5	4.5	0.34	0.033	4.308	6.5	Yes	1.75	1.2E+05	1.25	0.1	44.77	Stable	Earthen Channel	
426+00 Lt.	424+50 Lt.	150	5349.91	5312.91	0.247	6.4	10.2	1.990	0.646	0	2	2	0.66	2.6	0.9	3.0	0.30	0.044	7.385	6.4	Yes	10.16	1.2E+06	0.15	1.5	30.63	Stable	Class 400	
422+04 Lt.	420+55 Lt.	149	5331.21	5324.47	0.045	9.6	16.1	0.400	0.709	0	4	2	0.81	4.9	2.0	5.1	0.38	0.034	4.926	9.7	Yes	2.29	1.6E+05	1.36	0.1	55.84	Stable	Earthen Channel	
420+55 Lt.	414+56 Lt.	599	5324.47	5299.03	0.042	15.9	26.6	0.500	0.943	0	4	2	1.01	6.1	3.1	6.4	0.48	0.035	5.328	16.3	Yes	2.68	2.2E+05	0.15	1.5	7.70	Stable	Class 150	
414+56 Lt.	402+52 Lt.	1204	5299.03	5249.77	0.041	10.6	17.3	0.400	0.783	0	4	2	0.86	5.2	2.2	5.4	0.41	0.034	4.876	10.8	Yes	2.20	1.6E+05	1.36	0.1	55.64	Stable	Earthen Channel	
402+52 Lt.	401+57 Lt.	95	5249.77	5231.88	0.188	10.6	17.3	1.970	0.838	0	2	2	0.84	3.4	1.4	3.8	0.38	0.044	7.591	10.7	Yes	9.87	1.2E+06	0.15	1.5	30.32	Stable	Class 400	
399+64 Lt.	396+45 Lt.	320	5244.90	5239.83	0.016	14.6	24.4	0.210	1.062	0	4	2	1.11	6.7	3.7	7.0	0.53	0.030	4.005	14.8	Yes	1.10	6.9E+04	1.08	0.1	23.32	Stable	Earthen Channel	
396+45 Lt.	391+52 Lt.	493	5239.83	5229.16	0.022	4.9	7.9	0.170	0.629	0	4	2	0.69	4.1	1.4	4.3	0.32	0.029	3.514	4.9	Yes	0.93	4.9E+04	1.02	0.1	17.83	Stable	Earthen Channel	
381+20 Lt.	386+10 Lt.	53	5229.54	5226.43	0.059	17.1	28.2	0.650	0.888	0	6	2	0.88	7.0	3.1	7.3	0.43	0.037	5.551	17.2	Yes	3.22	3.0E+05	0.15	1.5	10.00	Stable	Class 150	
381+20 Lt.	377+59 Lt.	330	5229.54	5225.98	0.011	12.4	20.1	0.200	1.486	0	2	2	1.32	5.3	3.5	5.9	0.59	0.030	3.595	12.5	Yes	0.89	5.9E+04	1.05	0.1	21.59	Stable	Earthen Channel	
373+58 Lt.	377+59 Lt.	390	5245.08	5225.98	0.049	12.4	20.1	0.550	0.900	0	4	2	0.90	5.4	2.4	5.7	0.43	0.036	5.214	12.7	Yes	2.75	2.4E+05	0.15	1.5	8.46	Stable	Class 150	
373+00 Rt.	365+48 Rt.	749	5254.00	5225.95	0.037	11.7	19.3	0.500	1.070	0	4	2	0.89	5.3	2.4	5.6	0.42	0.035	4.598	10.9	No	2.08	1.9E+05	1.44	0.1	73.96	Stable	Class 150	
365+48 Rt.	359+51 Rt.	597	5225.95	5206.23	0.033	14.1	23.4	0.400	0.970	0	4	2	0.99	5.9	2.9	6.3	0.47	0.034	4.812	14.1	Yes	2.04	1.6E+05	1.35	0.1	55.38	Stable	Earthen Channel	
359+51 Rt.	357+87 Rt.	164	5206.23	5197.29	0.055	20.8	34.9	0.900	1.323	0	2	2	1.30	5.2	3.4	5.8	0.58	0.039	6.226	21.0	Yes	4.42	4.6E+05	0.15	1.5	13.85	Stable	Class 150	
355+24 Rt.	353+85 Rt.	139	5201.43	5192.93	0.061	12.8	21.5	0.800	1.048	0	2	2	1.05	4.2	2.2	4.7	0.47	0.038	5.833	12.9	Yes	4.01	3.8E+05	0.15	1.5	12.31	Stable	Class 150	
353+85 Rt.	336+62 Rt.	1723	5192.93	5094.68	0.057	69.6	116.5	1.450	2.038	0	2	2	2.10	8.4	8.8	9.4	0.94	0.042	8.097	71.4	Yes	7.47	9.6E+05	0.15	1.5	22.32	Stable	Class 300	
336+62 Rt.	330+23 Rt.	640	5094.68	5061.60	0.052	63.8	107.5	1.330	2.062	0	2	2	2.05	8.2	8.4	9.2	0.92	0.041	7.696	64.7	Yes	6.61	8.4E+05	0.15	1.5	20.47	Stable	Class 300	
329+92 Rt.	313+03 Rt.	1689	5064.28	4974.96	0.053	58.8	98.2	1.300	1.970	0	2	2	1.97	7.9	7.8	8.8	0.88	0.041	7.610	59.1	Yes	6.50	8.1E+05	0.15	1.5	20.01	Stable	Class 300	
313+03 Rt.	303+10 Rt.	993	4974.96	4918.65	0.057	72.8	121.9	1.490	2.105	0	2	2	2.13	8.5	9.1	9.5	0.95	0.042	8.115	73.6	Yes	7.54	9.9E+05	0.15	1.5	22.93	Stable	Class 300	
302+54 Rt.	299+78 Rt.	276	4920.21	4901.58	0.068	20.5	34.4	1.050	1.246	0	2	2	1.26	5.0	3.2	5.6	0.56	0.040	6.614	21.0	Yes	5.31	5.7E+05	0.15	1.5	16.16	Stable	Class 300	
299+78 Rt.	273+64 Rt.	2614	4901.58	4796.16	0.040	47.9	80.6	0.950	1.888	0	2	2	1.88	7.5	7.1	8.4	0.84	0.039	6.787	48.0	Yes	4.73	5.3E+05	0.15	1.5	14.62	Stable	Class 150	
273+64 Rt.	264+92 Rt.	872	4796.16	4779.09	0.020	29.2	49.4	0.310	1.269	0	6	2	1.26	10.1	6.4	10.4	0.61	0.032	4.608	29.3	Yes	1.54	1.2E+05	1.23	0.1	39.03	Stable	Earthen Channel	
264+92 Rt.	261+39 Rt.	353	4779.09	4769.01	0.029	29.2	49.4	0.410	1.150	0	6	2	1.20	9.6	5.8	9.9	0.58	0.034	5.142	29.6	Yes	2.14	1.7E+05	1.39	0.1	58.67	Stable	Class 150	
261+39 Rt.	255+65 Rt.	574	4769.01	4753.84	0.026	728.6	1837.4	1.220	3.699	6	6	2	3.71	35.7	77.3	36.6	2.11	0.041	9.741	753.2	Yes	6.12	9.8E+05	0.15	1.5	18.78	Stable	Class 300	Assumes 3/4 of flows get to channel
255+65 Rt.	253+74 Rt.	191	4753.84	4750.65	0.017	242.9	612.5	0.530	2.543	6	2	4	2.55	21.3	34.8	22.1	1.57	0.036	7.309	254.4	Yes	2.66	3.2E+05	0.15	1.5	8.16	Stable	Class 150	Assumes 1/4 of flows get to channel
253+74 Rt.	251+24 Rt	250	4750.65	4750.41	0.010	242.9	612.5	0.340	2.724	2	6	4	2.75	29.5	43.3	30.0	1.44	0.033	5.746	248.9	Yes	1.72	1.6E+05	1.36	0.1	47.32	Stable	Class 150	Assumes 1/4 of flows get to channel
251+24 Rt.	238+23 Rt.	1301	4750.41	4721.30	0.022	50.3	94.2	0.370	1.325	0	6	6	1.32	15.8	10.5	16.1	0.65	0.033	4.989	52.2	Yes	1.84	1.5E+05	1.33	0.1	50.49	Stable	Earthen Channel	
238+23 Rt.	220+51 Rt.	1772	4721.30	4683.04	0.022	57.1	106.2	0.400	1.484	0	6	4	1.49	14.9	11.1	15.2	0.73	0.034	5.223	58.0	Yes	2.01	1.7E+05	1.39	0.1	57.05	Stable	Class 150	
218+97 Rt.	212+53 Rt.	644	4687.65	4669.20	0.029	20.7	47.5	0.305	0.853	0	8	6	0.84	11.8	4.9	11.9	0.42	0.032	4.323	21.4	Yes	1.50	1.1E+05	1.20	0.1	37.55	Stable	Earthen Channel	
212+53 Rt.	203+60 Rt.	893	4669.20	4665.81	0.004	166.3	285.0	0.130	2.744	4	2	6	2.70	25.6	40.0	26.3	1.52	0.028	4.308	172.1	Yes	0.64	4.6E+04	1.01	0.0	13.51	Stable	Earthen Channel	
203+60 Rt.	194+79 Rt.	881	4665.81	4660.00	0.007	203.7	338.1	0.265	3.220	0	2	6	3.20	25.6	41.0	26.4	1.55	0.032	5.110	209.3	Yes	1.32	1.1E+05	1.21	0.1	32.87	Stable	Class 150	
192+71 Rt.	180+09 Rt.	1262	4661.57	4638.26	0.018	56.3	92.7	0.276	1.197	0	12	6	1.20	21.6	13.0	21.7	0.60	0.032	4.489	58.2	Yes	1.38	1.0E+05	1.18	0.1	33.43	Stable	Earthen Channel	
180+09 Rt.	161+80 Rt.	1829	4638.26	4586.95	0.028	56.3	92.7	0.440	1.257	0	12	2	1.26	17.6	11.1	17.8	0.62	0.034	5.274	58.6	Yes	2.21	1.9E+05	1.45	0.1	65.32	Stable	Class 150	
123+26 Rt.	118+50 Rt.	476	4474.68	4467.99	0.014	6.2	10.0	0.200	1.140	0	6	4	0.65	6.5	2.1	6.6	0.32	0.030	2.721	5.7	No	0.57	4.5E+04	1.01	0.0	20.71	Stable	Earthen Channel	
114+77 Rt.	118+50 Rt.	373	4479.73	4467.99	0.031	102.7	172.1	0.770	1.960	0	6	2	1.96	15.7	15.4	16.2	0.95	0.038	6.740	103.6	Yes	3.85	4.3E+05	0.15	1.5	11.85	Stable	Class 150	
114+77 Rt.	112+12 Rt.	265	4465.91	4465.79	0.000	16.3	27.3	0.020	3.539	0	2	6	1.75	14.0	12.3	14.4	0.85	0.021	1.377	16.9	Yes	0.05	2.3E+03	0.05	1.00	0.10	Stable	Earthen Channel	
112+12 Rt.	102+59 Rt.	953	4465.79	4429.71	0.038	47.0	79.0	0.890	1.884	0	2	2	1.90	7.6	7.2	8.5	0.85	0.039	6.695	48.3	Yes	4.49	4.9E+05	0.15	1.5	13.70	Stable	Class 150	
100+63 Rt.	102+59 Rt.	196	4431.77	4429.71	0.011	47.0	79.0	0.220	1.677	0	6	2	1.66	13.3	11.0	13.7	0.81	0.031	4.296	47.4	Yes	1.09	7.8E+04	1.11	0.1	25.01	Stable	Earthen Channel	

Approx. Upstream Station	Approx. Downstream Station	Channel Length (ft)	Invert Elevations		Channel Slope (ft/ft)	25-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)	Assumed D_{50}	Stable Depth, D_s	Assumed Bottom Width (ft)	Assumed Left Side Slope (H:V)	Assumed Right Side Slope (H:V)	Channel Depth (ft)	Top Width (ft)	Cross-Sectional Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Manning's n	Velocity (fps)	Q (cfs)	Is Channel Sizing Optimized?	Max Shear Stress, td (lbs/sf)	Reynold's Number	Shields Parameter, Fx	Safety Factor, SF	Permissible Shear Stress, tp (lbs/sf)	CK Permissible Shear Stress STABLE or UNSTABLE?	Rip Rap Size	Notes
			Upsteam (ft)	Downstream (ft)																									
99+25 Rt.	98+35 Rt.	90	4428.13	4424.00	0.046	6.6	11.0	0.350	0.611	0	2	6	0.62	5.0	1.5	5.1	0.30	0.033	4.309	6.6	Yes	1.78	1.2E+05	1.25	0.1	44.77	Stable	Earthen Channel	
98+35 Rt.	96+13 Rt.	222	4424.00	4422.86	0.005	3.6	6.8	0.200	3.121	0	2	6	0.66	5.3	1.7	5.4	0.32	0.030	1.650	2.9	No	0.21	2.7E+04	0.05	1.0	0.96	Stable	Earthen Channel	
96+13 Rt.	94+68 Rt.	165	4422.86	4421.04	0.011	105.0	176.5	0.315	2.288	0	2	6	2.27	18.2	20.6	18.7	1.10	0.033	5.107	105.3	Yes	1.56	1.3E+05	1.27	0.1	41.10	Stable	Class 150	
93.44 Rt.	88+82 Rt.	462	4419.24	4404.80	0.031	24.4	42.6	0.486	1.246	0	4	2	1.25	7.5	4.7	7.9	0.59	0.035	5.294	24.8	Yes	2.44	2.1E+05	0.15	1.5	7.48	Stable	Class 150	
73+39 Rt.	83+92 Rt.	1053	4426.60	4409.80	0.016	49.1	82.3	0.320	1.607	0	2	6	1.60	12.8	10.2	13.2	0.78	0.033	4.852	49.7	Yes	1.59	1.3E+05	1.26	0.1	41.29	Stable	Earthen Channel	
73+39 Rt.	65+49 Rt.	790	4426.20	4414.40	0.015	19.7	32.8	0.210	1.127	0	2	6	1.12	9.0	5.0	9.2	0.54	0.030	3.970	19.9	Yes	1.04	6.9E+04	1.08	0.1	23.28	Stable	Earthen Channel	
65+49 Rt.	52+00 Rt.	1349	4414.40	4363.20	0.038	25.9	43.1	0.520	1.098	0	2	6	1.10	8.8	4.8	9.1	0.53	0.035	5.376	26.0	Yes	2.61	2.3E+05	0.15	1.5	8.00	Stable	Class 150	
52+00 Rt.	23+21Rt.	2879	4363.20	4281.50	0.028	140.3	238.1	0.800	2.259	0	2	6	2.26	18.1	20.4	18.6	1.10	0.038	6.993	142.9	Yes	4.00	4.6E+05	0.15	1.5	12.31	Stable	Class 150	

Channel Size Differs from Plan - Optimzing Channel may reduce Riprap Size

Channel Sizing and Rip Rap Design

Based on Federal Highway Administration September 2005 HEC #15, Third Edition
(Design of Roadside Channels with Flexible Linings)

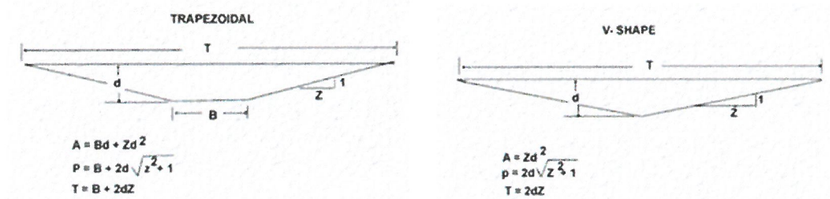
Procedure:

1. Compute Channel Flow & Slope
2. Assume a D_{50}
3. Estimate depth by computing preliminary stable depth of flow (d_s)

$$d_s = 5\left(\frac{D_{50}}{\gamma S}\right)$$

d_s – Stable depth of flow (ft)
γ - Density of Water (62.4 lb/ft³)
S – Channel Slope (ft/ft)
D_{50} – Rock Diameter (ft) where 50% is larger than D_{50}

4. As a starting point, determine the appropriate channel dimensions based on stable depth.



Irregular Trapezoidal Channel with varying side slopes

$$A = Bd + \frac{1}{2}d^2(z_1 + z_2) \qquad P = B + 2d\sqrt{\left(\frac{z_1 + z_2}{2}\right)^2 + 1} \qquad T = B + dz_1 + dz_2$$

d=d_s (Calculated)
A= Channel Cross Sectional Flow Area (ft²)
P=Wetted Perimeter (ft)
T=Top Width of Channel (ft)
B=Bottom Width of Channel (ft)
Z= Based on roadway/channel design criteria and constraints (if no criteria use 4:1)

5. Using the Manning's Roughness Coefficient equation based on D_{50}, compute the channel velocity.

$$n = 0.0395 D_{50}^{\frac{1}{6}} \qquad v = \frac{1.4859}{n} R^{2/3} S^{1/2}$$

v – Velocity of the Channel (ft/s)
R – Hydraulic Radius (Area/Wetted Perimeter)
S – Channel Slope (ft/ft)
n – Manning's roughness coefficient

6. Check capacity.

$$Q = VA$$

7. Adjust D_{50} and/or channel dimensions until channel size/rock size are optimized (5% of calculated flow rate).
8. Determine Safety Factor SF

$$R_e = \frac{V * D_{50}}{v}$$

R_e – Reynolds Number
V – Velocity in channel (ft/s)
D_{50} – Rip Rap Mean Diameter (ft/ft)
v – Viscosity of Water (1.217 X 10⁻⁵ft²/s)

Table 6.1. Selection of Shields' Parameter and Safety Factor

Reynolds number	F*	SF
≤ 4x10⁴	0.047	1.0
4x10⁴<R_e<2x10⁵	Linear interpolation	Linear interpolation
≥ 2x10⁵	0.15	1.5

9. Calculate Maximum Shear Stress (τ_d), Permissible Shear Stress (τ_p)

$$\tau_d = \gamma d S \qquad \tau_p = F(\gamma_s - \gamma)D_{50}$$

T_d – Maximum Shear Stress (lb/ft²)
T_p – Permissible Shear Stress (lb/ft²)
F – Shield's Parameter
SF – Safety Factor
γ_s - Density of Stone (165 lb/ft³)
γ - Density of Water (62.4 lb/ft³)
S – Channel Slope (ft/ft)
D_{50} – Mean Riprap Size (ft)
d – Depth of channel (ft)

10. Check that the Permissible Shear Stress Satisfies the equation below, Otherwise adjust rip rap sizing/Channel dimensions.

$$\tau_p \geq SF\tau_d$$

Appendix B
Proposed Conditions
Summary of Culverts

Approx. Upstream Station	Approx. Downstream Station	Proposed Culvert Description	Length (ft)	Invert Elevations		Slope (ft/ft)	# of Culverts	Culvert Size	Maximum Allowable Headwater (ft)	Capacity (cfs)	Peak Flow (cfs)		
				Upstream (ft)	Downstream (ft)						10-Year	25-Year	100-Year
659.99 Rt.	658.40 Lt.	RCB	223	5021.86	5016.53	0.024	2	4'X8'	5034.40	924.5	469.0	767.3	1264.0
493+69 Rt.	493+43 Lt.	RCP	137	5596.31	5586.51	0.072	1	36"	5601.22	71.9	26.0	39.2	65.3
465+88 Lt.	465+76 Rt.	RCB	267	5436.67	5425.21	0.043	1	5'X5'	5475.76	710.4	400.3	598.8	970.6
458+37 Lt.	458+14 Rt.	RCP	298	5436.47	5401.28	0.118	1	15"	5466.56	46.9	7.1	10.7	17.7
446+63 Lt.	446+07 Rt.	RCP	267	5406.96	5384.02	0.086	1	18"	5436.38	43.8	21.4	32.6	54.5
438+03 Lt.	438+20 Rt	RCP	196	5396.21	5363.96	0.165	1	15"	5403.50	24.8	5.5	8.1	13.3
424+49 Lt.	423+04 Rt.	RCP	284	5311.33	5299.80	0.041	1	36"	5342.22	185.6	67.6	103.6	173.9
420+55 Lt.	418+07 Rt.	RCP	279	5324.57	5304.00	0.074	1	18"	5326.67	11.1	6.3	9.6	16.1
414+55 Lt.	414+26 Rt.	RCP	136	5299.89	5285.28	0.107	1	24"	5303.51	27.1	10.5	15.9	26.6
401+57 Lt.	400+86 Rt.	RCP	205	5230.31	5224.00	0.031	1	6' X 10'	Analyzed using HEC RAS				978.1
396+45 Lt.	396+53 Rt.	RCP	151	5239.00	5227.02	0.079	1	18"	5244.01	19.8	9.7	14.6	24.4
391+49 Lt.	391+52 Rt.	RCP	165	5227.56	5212.86	0.089	1	18"	5239.67	24.4	13.8	20.4	33.5
386+10 Lt.	386+24 Rt.	RCP	210	5224.60	5205.44	0.091	1	15"	5246.65	31.0	11.4	17.1	28.2
377+60 Lt.	378+09 Rt.	RCP	266	5224.03	5202.68	0.080	1	15"	5253.03	44.4	8.5	12.4	20.2
365+56 Rt.	362+31 Lt.	RCP	395	5226.32	5194.49	0.081	1	15"	5244.00	36.3	7.9	11.7	19.3
359+51 Rt.	359+03 Lt.	RCP	224	5205.00	5183.76	0.095	1	15"	5224.53	41.6	9.4	14.1	23.4
357+84 Rt.	356+54 Lt.	RCP	243	5195.26	5173.86	0.088	1	18"	5215.51	31.6	13.7	20.8	34.9
353+85 Rt.	352+79 Lt.	RCP	183	5192.52	5167.38	0.137	1	24"	5195.26	21.6	8.4	12.8	21.5
336+00 Rt.	336+78 Lt.	RCP	206	5094.63	5067.98	0.129	1	36"	5105.70	119.4	45.8	69.6	116.5
330+24 Rt.	329+51 Lt.	RCP	206	5060.00	5036.33	0.115	1	36"	5070.56	116.0	41.6	63.8	107.5
313+06 Rt.	312+66 Lt.	RCP	143	4974.91	4966.39	0.060	2	36"	4978.18	89.9	38.7	58.8	98.2
303+10 Rt.	302+87 Lt.	RCP	221	4917.52	4900.52	0.077	1	36"	4928.28	116.8	47.8	72.8	121.9
299+79 Rt.	299+10 Lt.	RCP	187	4900.73	4883.67	0.091	1	18"	4910.90	29.5	13.4	20.5	34.4
273+64 Rt.	273+66 Lt.	RCP	202	4795.44	4788.59	0.034	1	24"	4807.11	55.4	31.2	47.9	80.6
261+39 Rt.	260+10 Lt.	RCP	239	4767.57	4759.97	0.032	1	24"	4778.95	55.3	19.0	29.2	49.4
255+63 Rt.	253+63 Lt.	RCB	293	4750.58	4745.86	0.016	1	4'X6'	4765.30	197.0*	971.5	1603.2	2449.8
253+72 Rt.	253+30 Lt.	RCB	213	4748.57	4744.03	0.021	3	6'X10'	Analyzed using HEC RAS				2449.8
238+20 Rt.	236+42 Lt.	RCP	249	4721.76	4715.28	0.026	1	36"	4729.56	99.1	29.1	50.3	94.2
220+56 Rt.	219+73 Lt.	RCP	197	4682.83	4677.01	0.030	1	36"	4688.86	79.4	33.1	57.1	106.2
212+48 Rt.	211+71 Lt.	RCP	193	4667.88	4663.90	0.021	1	18"	4674.80	22.3	8.6	20.7	47.5
203+56 Rt.	201+90 Lt.	RCP	253	4661.65	4654.94	0.027	1	48"	4668.75	148.1	106.2	166.3	285.0
194+86 Rt.	194+75 Lt.	RCB	150	4656.02	4651.70	0.029	1	4'X5'	4666.30	219.8	133.8	203.7	338.1
161+73 Rt.	159+09 Lt.	RCP	328	4585.30	4577.02	0.025	1	36"	4592.61	91.0	37.7	56.3	92.7
142+33Lt.	139+62 Rt	RCP	325	4526.73	4519.38	0.023	1	36"	4537.50	92.4	33.8	50.6	83.6

Appendix B
Proposed Conditions
Summary of Culverts

Approx. Upstream Station	Approx. Downstream Station	Proposed Culvert Description	Length (ft)	Invert Elevations		Slope (ft/ft)	# of Culverts	Culvert Size	Maximum Allowable Headwater (ft)	Capacity (cfs)	Peak Flow (cfs)		
				Upstream (ft)	Downstream (ft)						10-Year	25-Year	100-Year
123+58 Rt.	119+71 Lt.	RCB	404	4471.20	4460.83	0.026	2	4'X8'	4480.00	763.1	287.3	507.7	824.4
118+64 Rt.	117+86 Lt.	RCP	188	4466.22	4461.65	0.024	2	36"	4472.05	139.8	68.0	103.8	173.9
112+28 Rt.	111+65 Lt.	RCP	180	4463.74	4455.58	0.045	1	18"	4468.02	17.9	10.7	16.3	27.3
102+74 Rt.	102+28 Lt.	RCP	199	4428.28	4423.10	0.026	1	24"	4442.11	57.3	31.0	47.1	78.7
98+49 Rt.	97+89 Lt.	RCP	183	4424.55	4413.46	0.061	1	15"	4429.30	19.2	4.4	6.6	11.0
96+04 Rt.	96+27 Lt.	RCP	167	4421.57	4416.43	0.031	1	15"	4425.85	17.9	2.0	3.6	6.8
94+62 Rt.	93+77 Lt.	RCB	161	4415.45	4412.30	0.020	1	3'x4'	4422.89	135.2	68.4	105.0	176.5
88+98 Rt.	88+17 Lt.	RCP	200	4402.62	4396.90	0.029	1	24"	4415.50	56.5	15.4	24.4	42.6
87+24 Rt.	87+26 Lt.	RCP	191	4403.31	4395.94	0.039	1	18"	4413.89	28.2	10.5	15.9	26.6
84+02 Rt.	84+59 Lt.	RCP	191	4408.61	4401.04	0.040	1	36"	4414.81	81.2	32.2	49.1	82.3
73+55 Rt.	72+89 Lt.	RCP	176	4424.33	4419.36	0.028	1	15"	4431.05	22.9	4.6	7.0	11.9
65+51 Rt.	65+24 Lt.	RCP	176	4413.50	4406.76	0.038	1	24"	4418.50	30.3	13.1	19.7	32.8
52+31 Lt.	50+28 Rt.	RCP	263	4362.82	4358.00	0.018	1	24"	4368.20	43.3	17.2	25.9	43.1
12+93 Lt.	13+27 Rt.	RCB	138	4384.29	4378.66	0.041	3	3'X10'	Analyzed w/HEC RAS-Low Flow Design=50cfs				
17+35 Lt.	17+53 Rt.	RCB	107	4380.07	4379.95	0.001	3	15"	Analyzed w/HEC RAS-Low Flow Design=30cfs				
22+39 Lt.	22+51 Rt.	RCB	133	4382.00	4378.62	0.025	3	3'X12'	Analyzed w/HEC RAS-Low Flow Design=345cfs				

*Overflow from this culvert drains directly to 253+74 Rt.

Culvert Outlet RipRap/ Basin Configuration Sizing

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{gD^{2.5}}}\right)^{4/3}\left(\frac{D}{TW}\right) \qquad (10.4)$$

where,

- D_{50} = riprap size, m (ft)
- Q = design discharge, m^3/s (ft^3/s)
- D = culvert diameter (circular), m (ft)
- TW = tailwater depth, m (ft)
- g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Tailwater depth for Equation 10.4 should be limited to between 0.4D and 1.0D. If tailwater is unknown, use 0.4D.

Whenever the flow is supercritical in the culvert, the culvert diameter is adjusted as follows:

$$D' = \frac{D + y_n}{2} \qquad (10.5)$$

where,

- D' = adjusted culvert rise, m (ft)
- y_n = normal (supercritical) depth in the culvert, m (ft)

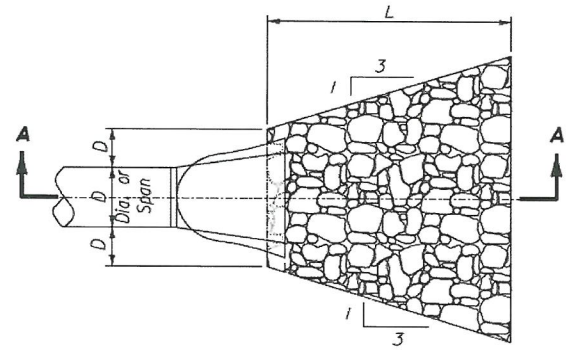
L_a= Fuction of Riprap Size, $L_{a\,Min}$=4D

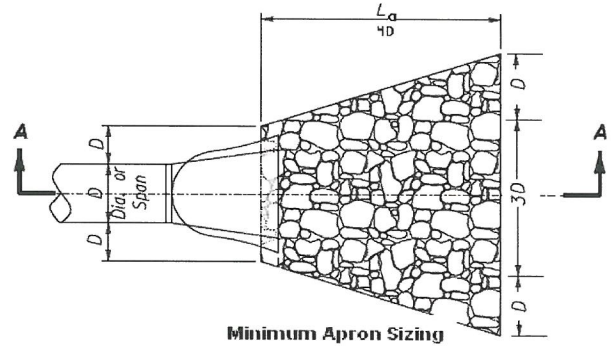
W= 3*D+(2/3)L_a, W_{min}=5*D

D_{50} (in)	Apron Length[1]
5	4D
6	4D
10	5D
14	6D
20	7D
22	8D

PULL DOWN LIST
Not Supercritical
Supercritical

=Tailwater depth of .4D ft used for calculation





Minimum Apron Sizing

1. 493+69 Rt.

Q=	39.20	cfs
TW=	1.360	ft
D_o=	3.00	ft
Flowtype=	Supercritical	
Normal Depth=	0.91	ft

D'=	1.96	ft
d_{50}=	0.79	ft
Riprap Size=	USE CLASS 300	
L_a=	9.78	ft
W=	12.38	ft
Depth=	1.90	ft

Riprap Size=	**USE CLASS 300**	
L=	**12**	**ft**
W=	**15**	**ft**
Depth=	**2**	**ft**

Notes: **Apron sizing is for each culvert and not all culverts combined**

2. 458+37 Lt.

Q=	10.70	cfs	D'=	1.05	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.600	ft	d_{50}=	0.73	ft	**L=**	**6 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8 ft**
Flowtype=	Supercritical		L_a=	5.23	ft	**Depth=**	**2 ft**
Normal Depth=	0.59	ft	W=	6.62	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.76	ft		

3. 446+63 Lt.

Q=	32.60	cfs	D'=	1.35	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.15	ft	**L=**	**11 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**12 ft**
Flowtype=	Supercritical		L_a=	10.80	ft	**Depth=**	**3 ft**
Normal Depth=	1.20	ft	W=	11.25	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.53	ft		

4. 438+03 Lt.

Q=	8.10	cfs	D'=	0.98	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.600	ft	d_{50}=	0.55	ft	**L=**	**6 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8 ft**
Flowtype=	Supercritical		L_a=	4.88	ft	**Depth=**	**2 ft**
Normal Depth=	0.45	ft	W=	6.18	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.33	ft		

5. 424+49 Lt.

Q=	103.60	cfs	D'=	2.42	ft	**Riprap Size=**	**USE CLASS 550**
TW=	1.840	ft	d_{50}=	1.61	ft	**L=**	**17 ft**
D_o=	3.00	ft	Riprap Size=	USE CLASS 550		**W=**	**19 ft**
Flowtype=	Supercritical		L_a=	16.94	ft	**Depth=**	**4 ft**
Normal Depth=	1.84	ft	W=	18.55	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	3.22	ft		

6. 420+55 Lt.

Q=	9.60	cfs	D'=	1.04	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.600	ft	d_{50}=	0.64	ft	**L=**	**6 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8 ft**
Flowtype=	Supercritical		L_a=	5.18	ft	**Depth=**	**2 ft**
Normal Depth=	0.57	ft	W=	6.56	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.54	ft		

8. 414+56 Lt.

Q=	15.90	cfs	D'=	1.62	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.800	ft	d_{50}=	0.52	ft	**L=**	**9 ft**
D_o=	2.00	ft	Riprap Size=	USE CLASS 300		**W=**	**11 ft**
Flowtype=	Supercritical		L_a=	8.10	ft	**Depth=**	**2 ft**
Normal Depth=	1.24	ft	W=	10.26	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.25	ft		

9. 396+45 Lt.

Q=	14.60	cfs	D'=	1.08	ft	**Riprap Size=**	**USE CLASS 400**
TW=	0.620	ft	d_{50}=	1.03	ft	**L=**	**7 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**8 ft**
Flowtype=	Supercritical		L_a=	6.48	ft	**Depth=**	**3 ft**
Normal Depth=	0.66	ft	W=	7.56	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.26	ft		

10. 391+49 Lt.

Q=	20.40	cfs	D'=	1.08	ft	**Riprap Size=**	**USE CLASS 550**
TW=	0.660	ft	d_{50}=	1.51	ft	**L=**	**8 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 550		**W=**	**9 ft**
Flowtype=	Supercritical		L_a=	7.56	ft	**Depth=**	**4 ft**
Normal Depth=	0.66	ft	W=	8.28	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	3.01	ft		

11. 386+10 Lt.

Q=	17.10	cfs	D'=	1.19	ft	**Riprap Size=**	**USE CLASS 400**
TW=	0.600	ft	d_{50}=	1.16	ft	**L=**	**8 ft**
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**9 ft**
Flowtype=	Supercritical		L_a=	7.11	ft	**Depth=**	**3 ft**
Normal Depth=	0.87	ft	W=	8.30	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.55	ft		

12. 377+60 Lt.

Q=	12.40	cfs	D'=	1.13	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.600	ft	d_{50}=	0.81	ft	**L=**	**6**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8**
Flowtype=	Supercritical		L_a=	5.63	ft	**Depth=**	**2**
Normal Depth=	0.75	ft	W=	7.13	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.94	ft		

13 365+56 Rt.

Q=	11.70	cfs	D'=	1.13	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.600	ft	d_{50}=	0.75	ft	**L=**	**6**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8**
Flowtype=	Supercritical		L_a=	5.63	ft	**Depth=**	**2**
Normal Depth=	0.75	ft	W=	7.13	ft	**Notes:**	**Apron sizing is for each culvert and**

Depth= 1.79 ft — not all culverts combined

14. 359+51 Rt.

Q=	14.10	cfs	D'=	1.13	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.620	ft	d_{50}=	0.93	ft	**L=**	**7**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**8**
Flowtype=	Supercritical		L_a=	6.75	ft	**Depth=**	**2**
Normal Depth=	0.75	ft	W=	7.88	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.04	ft		

15. 357+84 Rt.

Q=	20.90	cfs	D'=	1.18	ft	**Riprap Size=**	**USE CLASS 400**
TW=	0.740	ft	d_{50}=	1.24	ft	**L=**	**9**
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**10**
Flowtype=	Supercritical		L_a=	8.23	ft	**Depth=**	**3**
Normal Depth=	0.85	ft	W=	9.01	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.48	ft		

16. 353+84 Rt.

Q=	12.80	cfs	D'=	1.38	ft	**Riprap Size=**	**USE CLASS 150**
TW=	0.800	ft	d_{50}=	0.48	ft	**L=**	**8**
D_o=	2.00	ft	Riprap Size=	USE CLASS 150		**W=**	**10**
Flowtype=	Supercritical		L_a=	5.50	ft	**Depth=**	**1**
Normal Depth=	0.75	ft	W=	7.79	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.60	ft		

17. 336+00 Rt

Q=	69.60	cfs	D'=	2.03	ft	**Riprap Size=**	**USE CLASS 700**
TW=	1.200	ft	d_{50}=	1.84	ft	**L=**	**17 ft**
D_o=	3.00	ft	Riprap Size=	USE CLASS 700		**W=**	**17 ft**
Flowtype=	Supercritical		L_a=	16.20	ft	**Depth=**	**5 ft**
Normal Depth=	1.05	ft	W=	16.88	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	Use Altern	ft		

18. 330+24 Rt.

Q=	63.80	cfs	D'=	2.02	ft	**Riprap Size=**	**USE CLASS 550**
TW=	1.200	ft	d_{50}=	1.64	ft	**L=**	**17 ft**
D_o=	3.00	ft	Riprap Size=	USE CLASS 550		**W=**	**17 ft**
Flowtype=	Supercritical		L_a=	16.16	ft	**Depth=**	**4 ft**
Normal Depth=	1.04	ft	W=	16.83	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	3.29	ft		

19. 313+06 Rt.

Q=	58.80	cfs	D'=	1.91	ft	**Riprap Size=**	**USE CLASS 550**
TW=	1.200	ft	d_{50}=	1.59	ft	**L=**	**14**
D_o=	3.00	ft	Riprap Size=	USE CLASS 550		**W=**	**15**
Flowtype=	Supercritical		L_a=	13.37	ft	**Depth=**	**4**
Normal Depth=	0.82	ft	W=	14.64	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	3.18	ft		

20. 303+10 Rt.

Q=	72.80	cfs	D'=	2.78	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.28	ft	**L=**	**23 ft**
D_o=	3.00	ft	Riprap Size=	USE CLASS 400		**W=**	**24 ft**
Flowtype=	Supercritical		L_a=	22.24	ft	**Depth=**	**3 ft**
Normal Depth=	2.56	ft	W=	23.17	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.56	ft		

21. 299+79 Rt.

Q=	20.50	cfs	D'=	1.36	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.820	ft	d_{50}=	0.90	ft	**L=**	**9**
D_o=	1.50	ft	Riprap Size=	USE CLASS 300		**W=**	**10**
Flowtype=	Supercritical		L_a=	8.16	ft	**Depth=**	**2**
Normal Depth=	1.22	ft	W=	9.52	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.97	ft		

22. 273+64 Rt.

Q=	47.90	cfs	D'=	1.61	ft	**Riprap Size=**	**USE CLASS 550**
TW=	1.220	ft	d_{50}=	1.49	ft	**L=**	**12**
D_o=	2.00	ft	Riprap Size=	USE CLASS 550		**W=**	**13**
Flowtype=	Supercritical		L_a=	11.27	ft	**Depth=**	**4**
Normal Depth=	1.22	ft	W=	12.34	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.99	ft		

23. 261+42 Rt.

Q=	29.20	cfs	D'=	2.29	ft	**Riprap Size=**	**USE CLASS 300**
TW=	1.030	ft	d_{50}=	0.57	ft	**L=**	**12**
D_o=	2.00	ft	Riprap Size=	USE CLASS 300		**W=**	**15**
Flowtype=	Supercritical		L_a=	11.45	ft	**Depth=**	**2**
Normal Depth=	2.58	ft	W=	14.50	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.37	ft		

24. 238+27 Rt.

Q=	50.30	cfs	D'=	2.79	ft	**Riprap Size=**	**USE CLASS 300**
TW=	1.200	ft	d_{50}=	0.78	ft	**L=**	**14**
D_o=	3.00	ft	Riprap Size=	USE CLASS 300		**W=**	**18**
Flowtype=	Supercritical		L_a=	13.95	ft	**Depth=**	**2**
Normal Depth=	2.58	ft	W=	17.67	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	1.87	ft		

25. 220+62 Rt.

Q=	57.10	cfs	D'=	2.18	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.28	ft	**L=**	**16**
D_o=	3.00	ft	Riprap Size=	USE CLASS 400		**W=**	**17**
Flowtype=	Supercritical		L_a=	15.26	ft	**Depth=**	**3**
Normal Depth=	1.36	ft	W=	16.71	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.56	ft		

26. 212+56 Rt.

Q=	20.70	cfs	D'=	1.43	ft	**Riprap Size=**	**USE CLASS 400**
TW=	0.600	ft	d_{50}=	1.16	ft	**L=**	**9**
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**11**
Flowtype=	Supercritical		L_a=	8.58	ft	**Depth=**	**3**
Normal Depth=	1.36	ft	W=	10.01	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.56	ft		

27. 203+66 Rt.

Q=	166.30	cfs	D'=	3.28	ft	**Riprap Size=**	**USE CLASS 700**
TW=	1.600	ft	d_{50}=	2.32	ft	**L=**	**27 ft**
D_o=	4.00	ft	Riprap Size=	USE CLASS 700		**W=**	**28 ft**
Flowtype=	Supercritical		L_a=	26.24	ft	**Depth=**	**5 ft**
Normal Depth=	2.56	ft	W=	27.33	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	Use Altern	ft		

28. 161+86 Rt.

Q=	56.30	cfs	D'=	2.18	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.26	ft	**L=**	**16**
D_o=	3.00	ft	Riprap Size=	USE CLASS 400		**W=**	**17**
Flowtype=	Supercritical		L_a=	15.26	ft	**Depth=**	**3**
Normal Depth=	1.36	ft	W=	16.71	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.51	ft		

29. 142+31 Rt.

Q=	103.90	cfs	D'=	2.75	ft	**Riprap Size=**	**USE CLASS 550**
TW=	1.400	ft	d_{50}=	1.79	ft	**L=**	**22**
D_o=	3.50	ft	Riprap Size=	USE CLASS 550		**W=**	**23**
Flowtype=	Supercritical		L_a=	22.00	ft	**Depth=**	**4**
Normal Depth=	2.00	ft	W=	22.92	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	3.58	ft		

30. 118+51 Rt.

Q=	51.35	cfs	D'=	2.25	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.07	ft	**L=**	**14**
D_o=	3.00	ft	Riprap Size=	USE CLASS 400		**W=**	**16**
Flowtype=	Supercritical		L_a=	13.47	ft	**Depth=**	**3**
Normal Depth=	1.49	ft	W=	15.72	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.35	ft		

31. 112+14 Rt.

Q=	16.30	cfs	D'=	1.25	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.740	ft	d_{50}=	0.82	ft	**L=**	**7**
D_o=	1.25	ft	Riprap Size=	USE CLASS 300		**W=**	**8**
Flowtype=	Supercritical		L_a=	6.25	ft	**Depth=**	**2**
Normal Depth=	1.25	ft	W=	7.92	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	#REF!	ft		

32. 102+61 Rt.

Q=	47.00	cfs	D'=	2.00	ft	**Riprap Size=**	**USE CLASS 550**	
TW=	0.800	ft	d_{50}=	1.66	ft	**L=**	**14**	
D_o=	2.00	ft	Riprap Size=	USE CLASS 550		**W=**	**16**	
Flowtype=	Supercritical		L_a=	14.00	ft	**Depth=**	**4**	
Normal Depth=	2.00	ft	W=	15.33	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**	
			Depth=	2.35	ft			

33. 98+36 Rt.

Q=	6.60	cfs	D'=	1.38	ft	**Riprap Size=**	**USE CLASS 150**	
TW=	0.600	ft	d_{50}=	0.27	ft	**L=**	**6**	
D_o=	1.50	ft	Riprap Size=	USE CLASS 150		**W=**	**8**	
Flowtype=	Supercritical		L_a=	5.50	ft	**Depth=**	**1**	
Normal Depth=	1.25	ft	W=	7.79	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**	
			Depth=	1.97	ft			

34. 96+13 Rt.

Q=	3.60	cfs	D'=	1.38	ft	**Riprap Size=**	**USE CLASS 150**	
TW=	0.600	ft	d_{50}=	0.12	ft	**L=**	**6**	
D_o=	1.50	ft	Riprap Size=	USE CLASS 150		**W=**	**8**	
Flowtype=	Supercritical		L_a=	5.50	ft	**Depth=**	**1**	
Normal Depth=	1.25	ft	W=	7.79	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**	
			Depth=	3.33	ft			

35. 88+85 Rt.

Q=	24.40	cfs	D'=	1.68	ft	**Riprap Size=**	**USE CLASS 300**	
TW=	0.800	ft	d_{50}=	0.88	ft	**L=**	**11**	
D_o=	2.00	ft	Riprap Size=	USE CLASS 300		**W=**	**12**	
Flowtype=	Supercritical		L_a=	10.08	ft	**Depth=**	**2**	
Normal Depth=	1.36	ft	W=	11.76	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**	
			Depth=	1.93	ft			

36. 87+10 Rt.

Q=	19.70	cfs	D'=	1.31	ft	**Riprap Size=**	**USE CLASS 400**	
TW=	0.710	ft	d_{50}=	1.03	ft	**L=**	**8**	
D_o=	1.50	ft	Riprap Size=	USE CLASS 400		**W=**	**10**	
Flowtype=	Supercritical		L_a=	7.86	ft	**Depth=**	**3**	
Normal Depth=	1.12	ft	W=	9.17	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**	
			Depth=	2.27	ft			

37. 83+88 Rt.

Q=	49.10	cfs	D'=	2.18	ft	**Riprap Size=**	**USE CLASS 400**
TW=	1.200	ft	d_{50}=	1.05	ft	**L=**	**14**
D_o=	3.00	ft	Riprap Size=	USE CLASS 400		**W=**	**16**
Flowtype=	Supercritical		L_a=	13.08	ft	**Depth=**	**3**
Normal Depth=	1.36	ft	W=	15.26	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.30	ft		

38. 73+41 Rt.

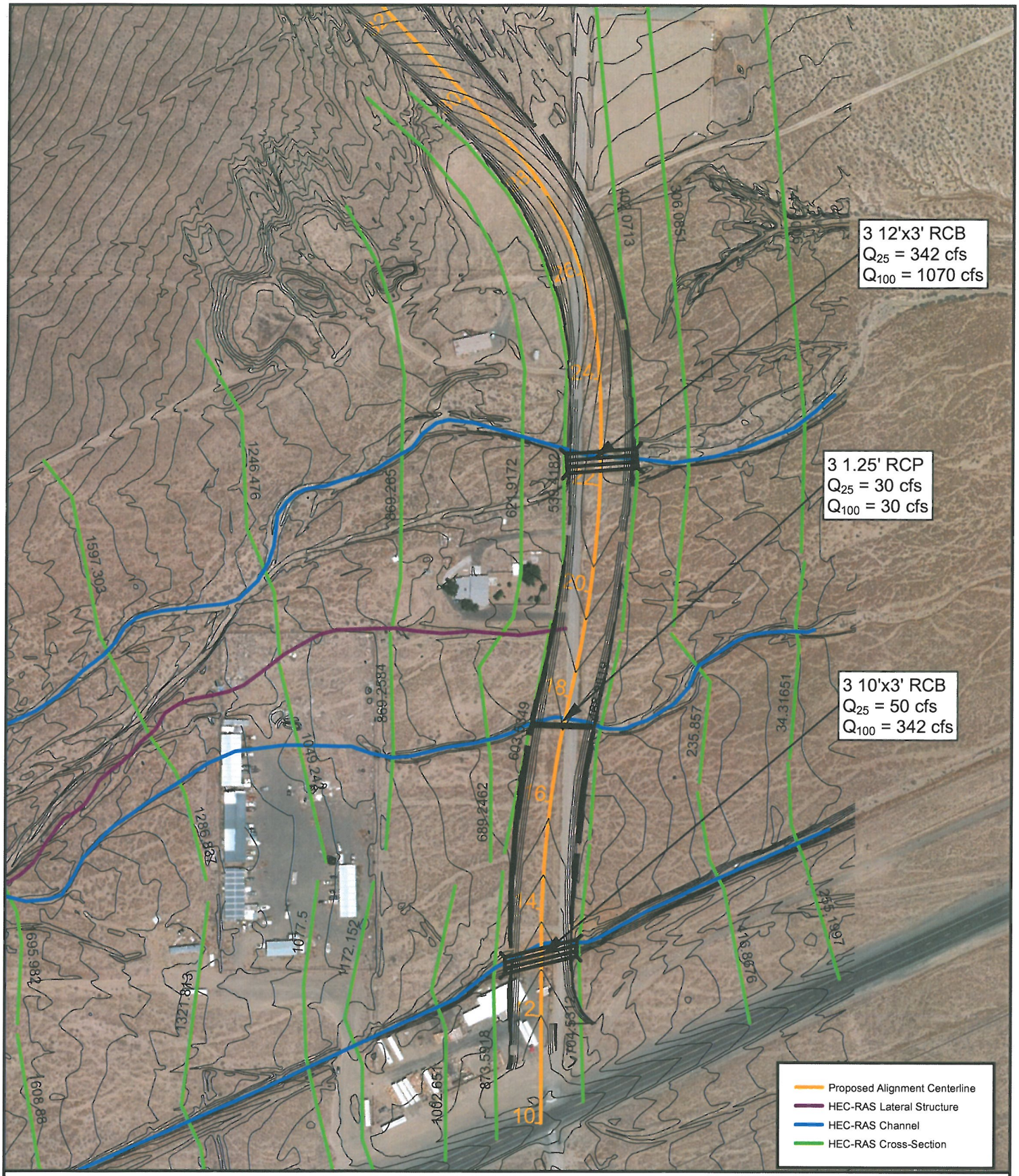
Q=	7.00	cfs	D'=	1.43	ft	**Riprap Size=**	**USE CLASS 150**
TW=	0.600	ft	d_{50}=	0.27	ft	**L=**	**6**
D_o=	1.50	ft	Riprap Size=	USE CLASS 150		**W=**	**9**
Flowtype=	Supercritical		L_a=	5.72	ft	**Depth=**	**1**
Normal Depth=	1.36	ft	W=	8.10	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	0.96	ft		

39. 65+51 Rt.

Q=	19.70	cfs	D'=	1.32	ft	**Riprap Size=**	**USE CLASS 300**
TW=	0.800	ft	d_{50}=	0.91	ft	**L=**	**8**
D_o=	2.00	ft	Riprap Size=	USE CLASS 300		**W=**	**10**
Flowtype=	Supercritical		L_a=	7.92	ft	**Depth=**	**2**
Normal Depth=	0.64	ft	W=	9.24	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.00	ft		

40. 50+44 Lt

Q=	25.90	cfs	D'=	1.32	ft	**Riprap Size=**	**USE CLASS 400**
TW=	0.800	ft	d_{50}=	1.31	ft	**L=**	**10**
D_o=	2.00	ft	Riprap Size=	USE CLASS 400		**W=**	**11**
Flowtype=	Supercritical		L_a=	9.24	ft	**Depth=**	**3**
Normal Depth=	0.64	ft	W=	10.12	ft	**Notes:**	**Apron sizing is for each culvert and not all culverts combined**
			Depth=	2.61	ft		



Appendix B
HEC-RAS Input Data
30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER 2013

NOTES

NORTH

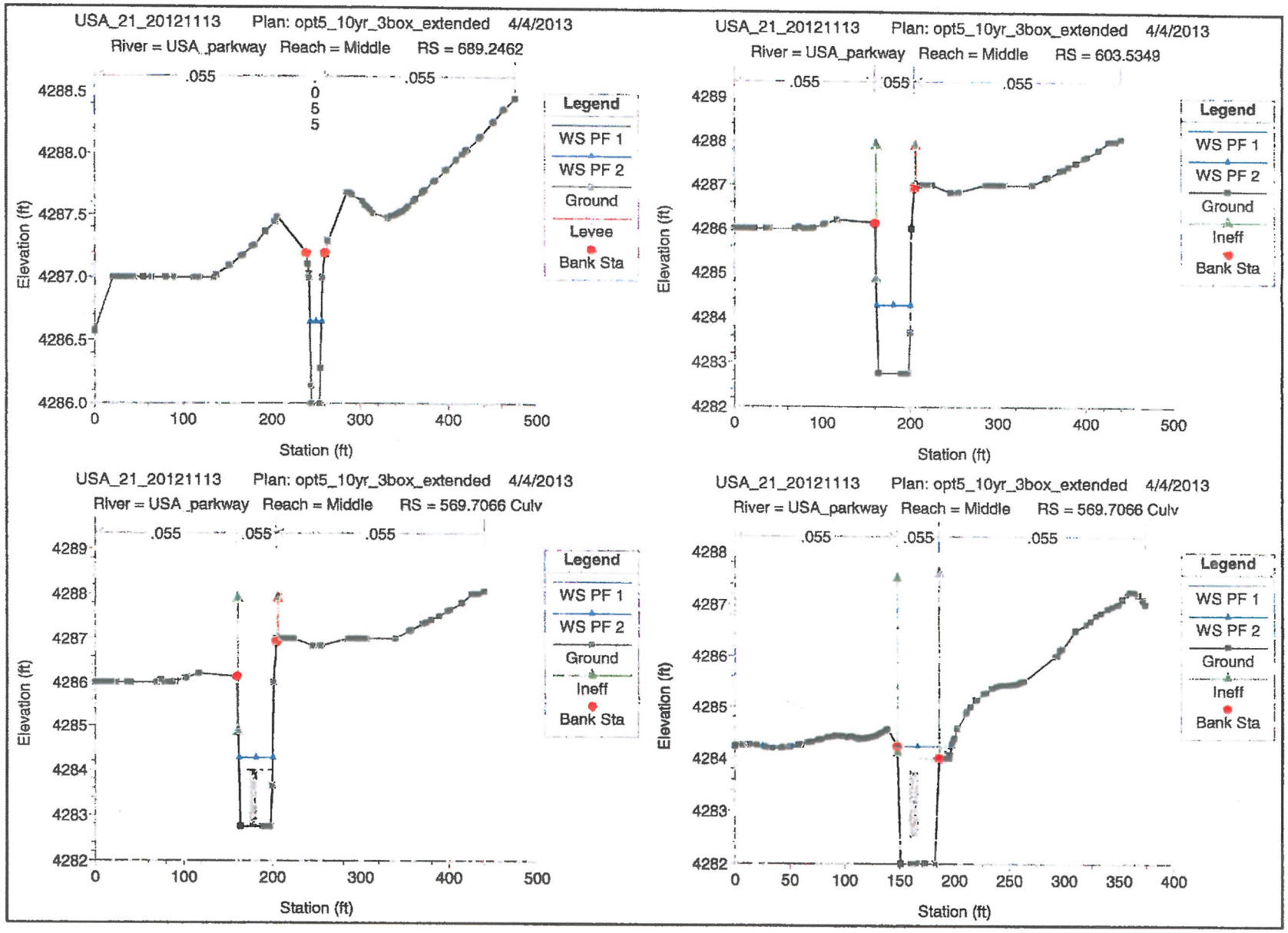
0 200 400
FEET

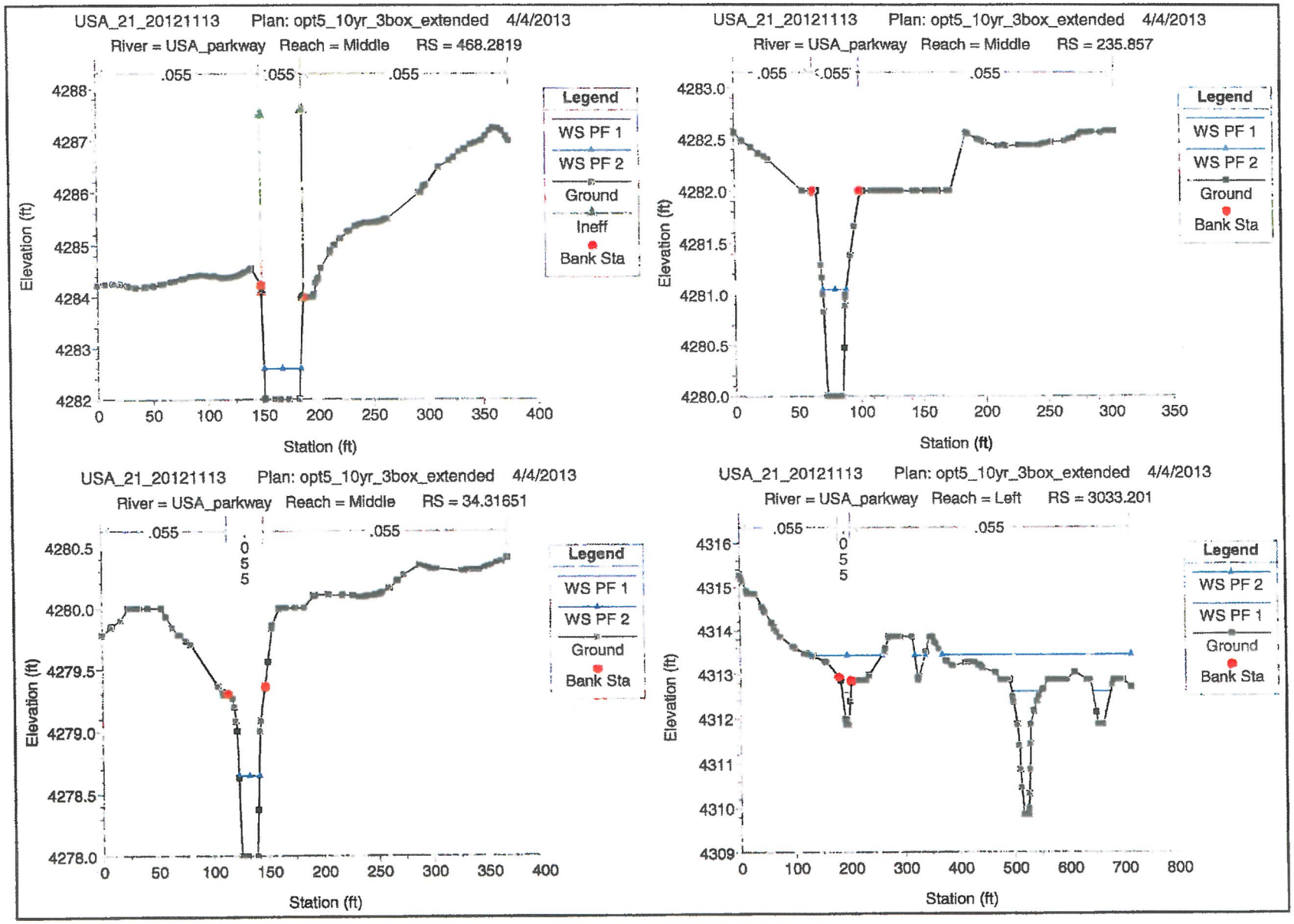
PRELIMINARY

WOOD RODGERS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J:\Jobs\8480_USA Parkway\8480.001_USA Parkway\GIS\Tasks\21_RAS_20130517_V1.mxd 11/25/2013 11:14:57 AM asanti


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 689.2462
.055
.055
055
Legend
WS PF 1
WS PF 2
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 603.5349
.055
.055
.055
Legend
WS PF 1
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 569.7066 Culv
.055
.055
.055
Legend
WS PF 1
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 569.7066 Culv
.055
.055
.055
Legend
WS PF 1
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 468.2819
.055 .055 .055
Legend
WS PF 1
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 235.857
.055 .055 .055
Legend
WS PF 1
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Middle RS = 34.31651
.055 .055
Legend
WS PF 1
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 3033.201
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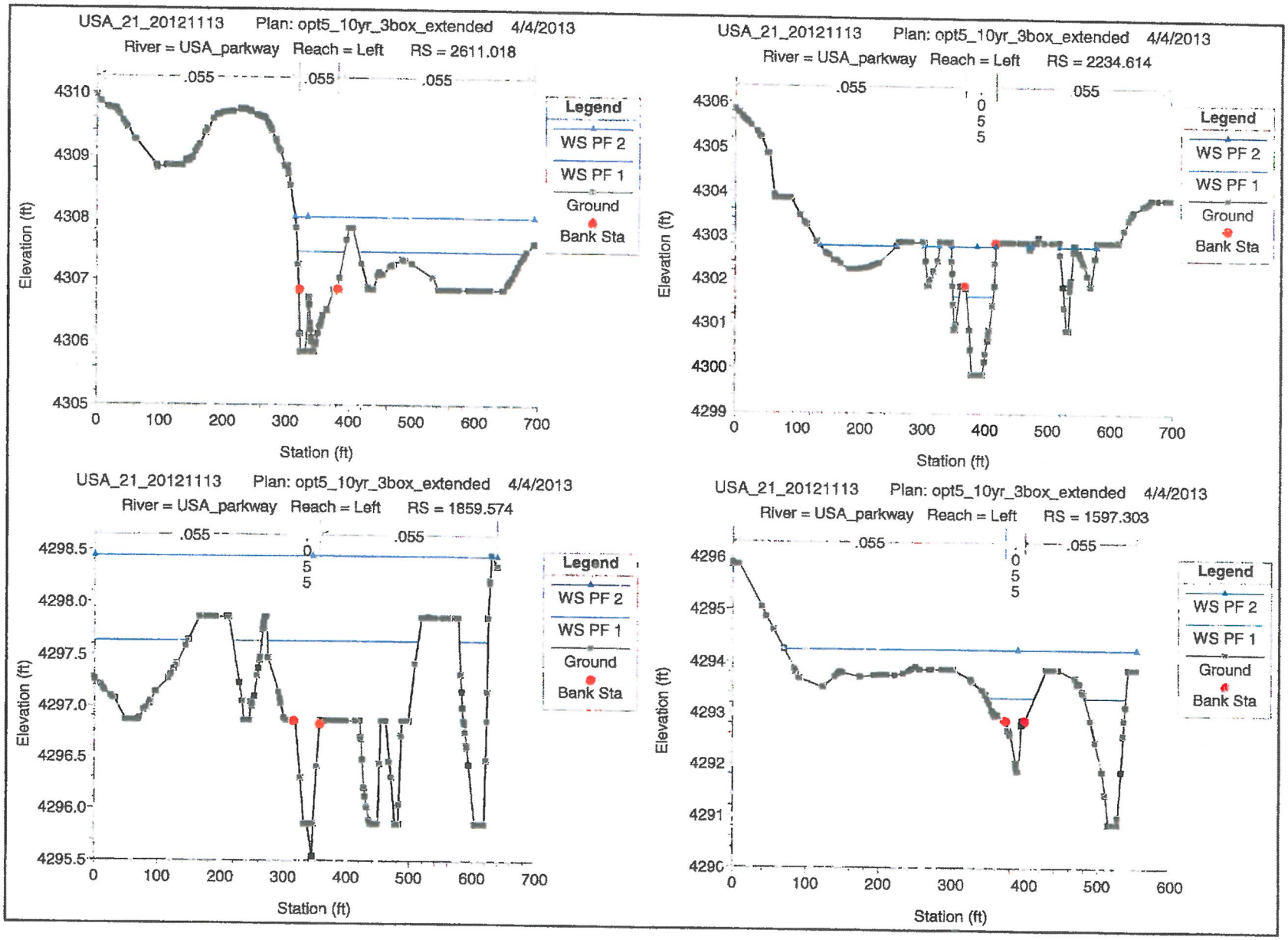
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 2611.018
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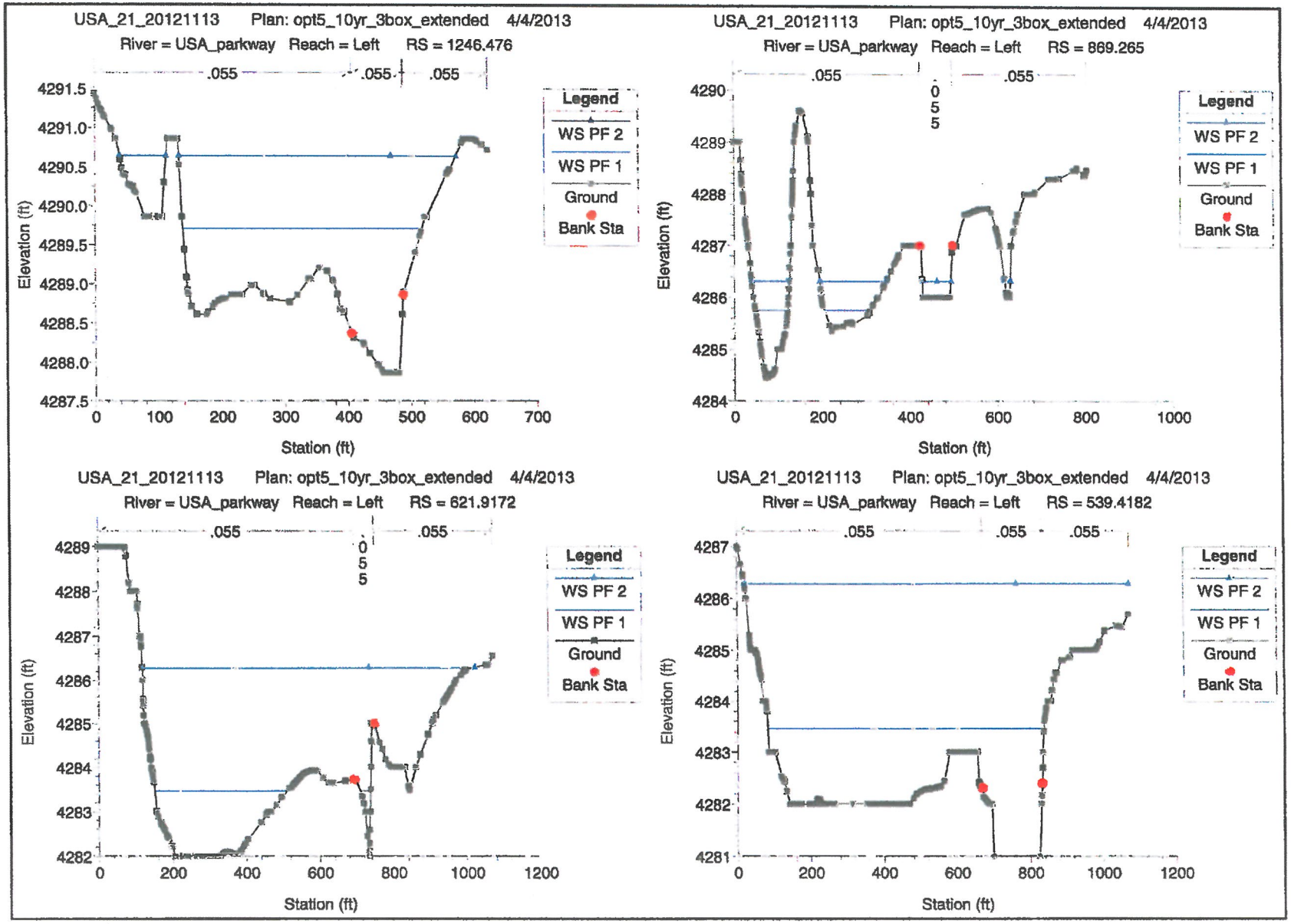
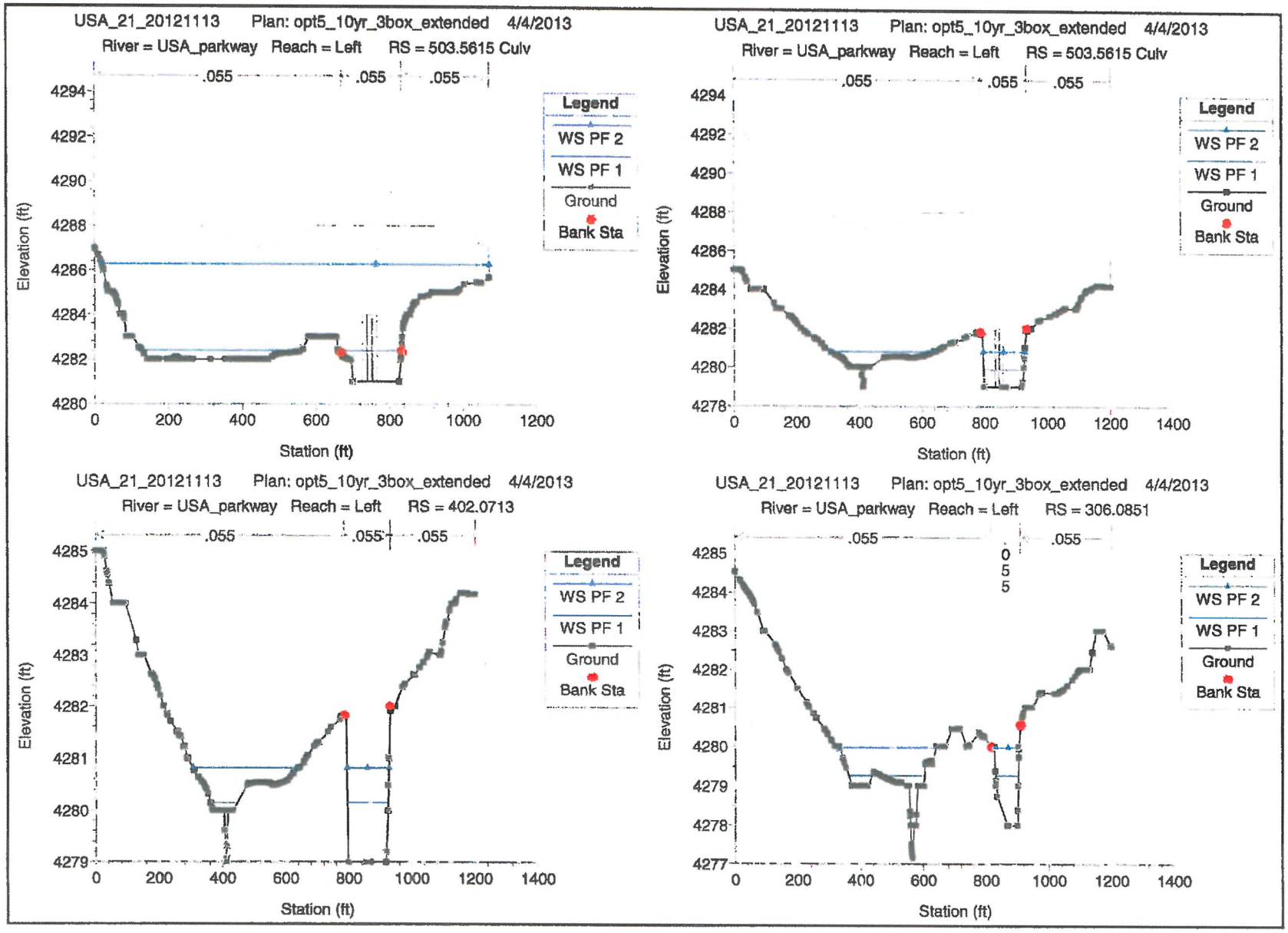
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 2234.614
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 1859.574
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 1597.303
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 1246.476
.055 .055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 869.265
.055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 621.9172
.055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 539.4182
.055 .055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 503.5615 Culv
.055 .055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 503.5615 Culv
.055 .055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 402.0713
.055 .055 .055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 306.0851
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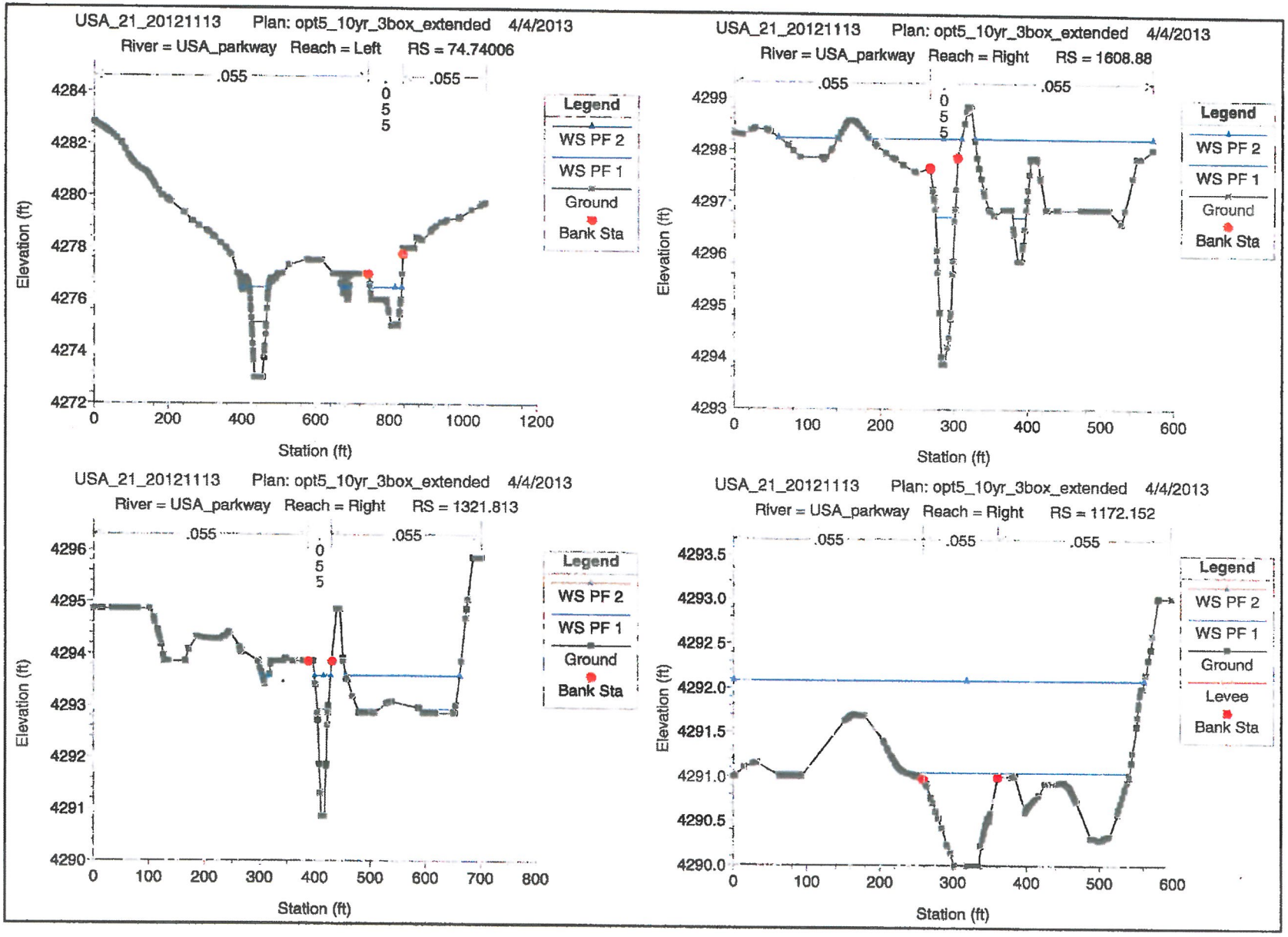
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Left RS = 74.74006
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 1608.88
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 1321.813
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 1172.152
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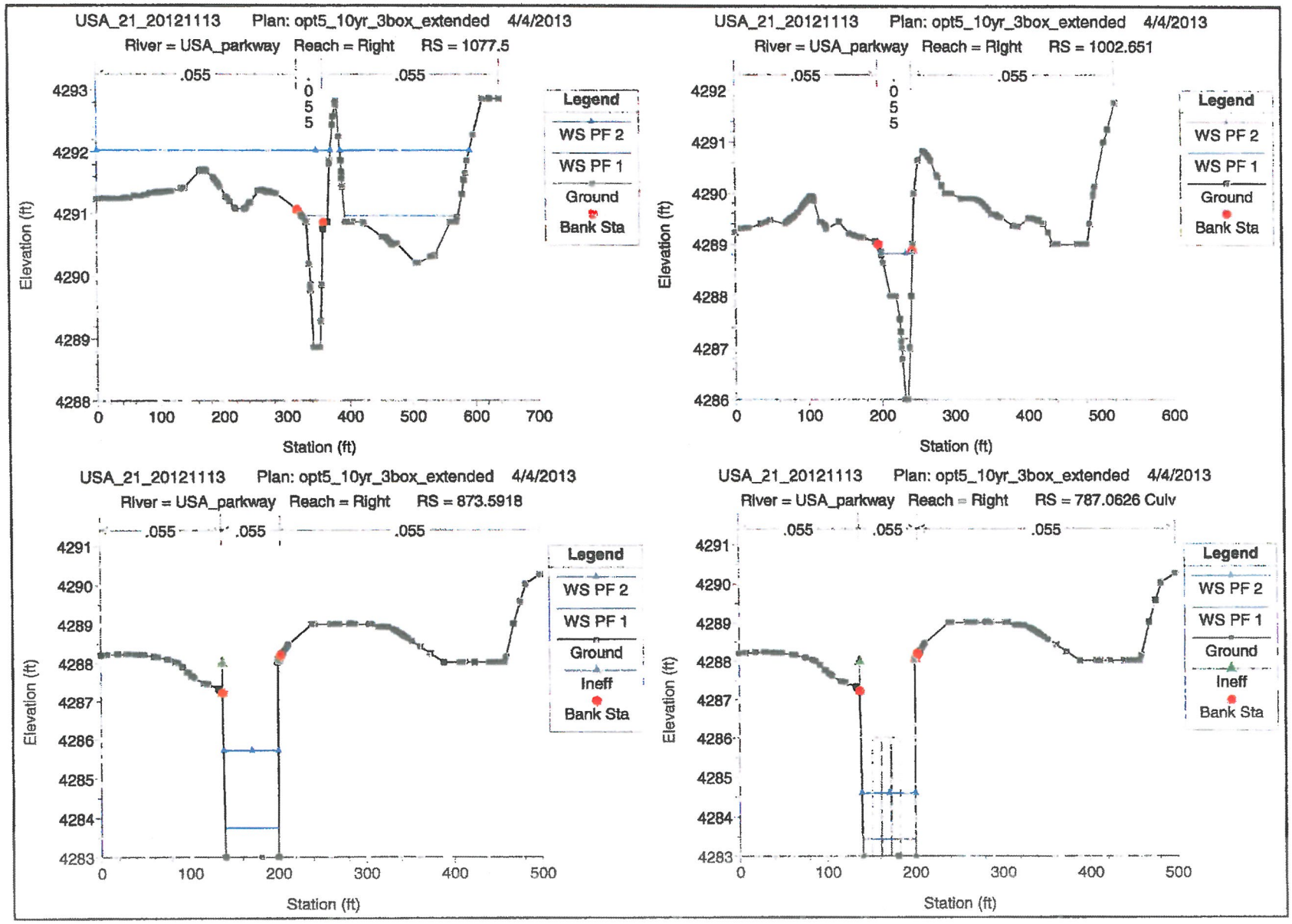
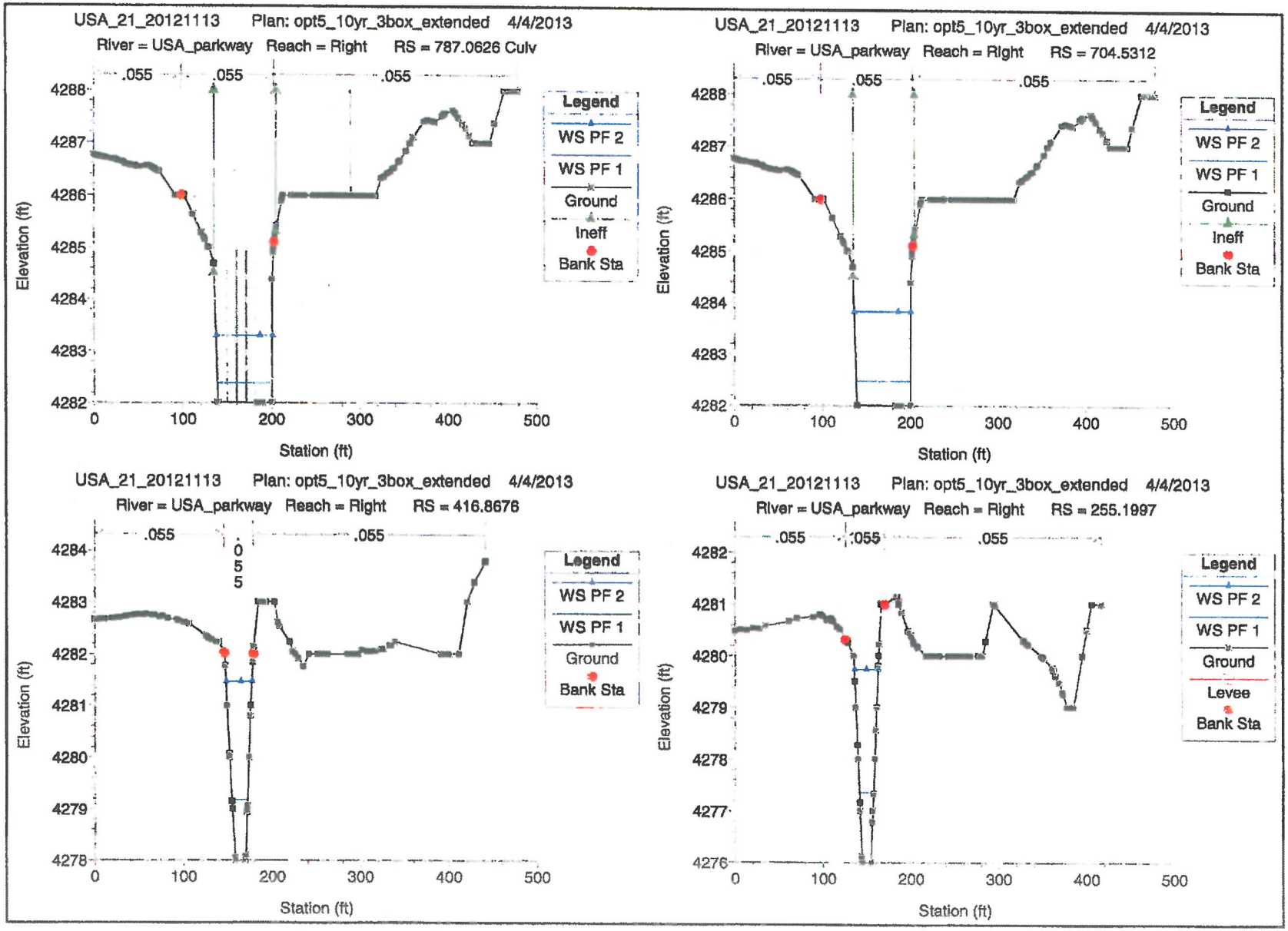
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 1077.5
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 1002.651
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 873.5918
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 787.0626 Culv
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 787.0626 Culv
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 704.5312
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 416.8676
.055
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_21_20121113 Plan: opt5_10yr_3box_extended 4/4/2013
River = USA_parkway Reach = Right RS = 255.1997
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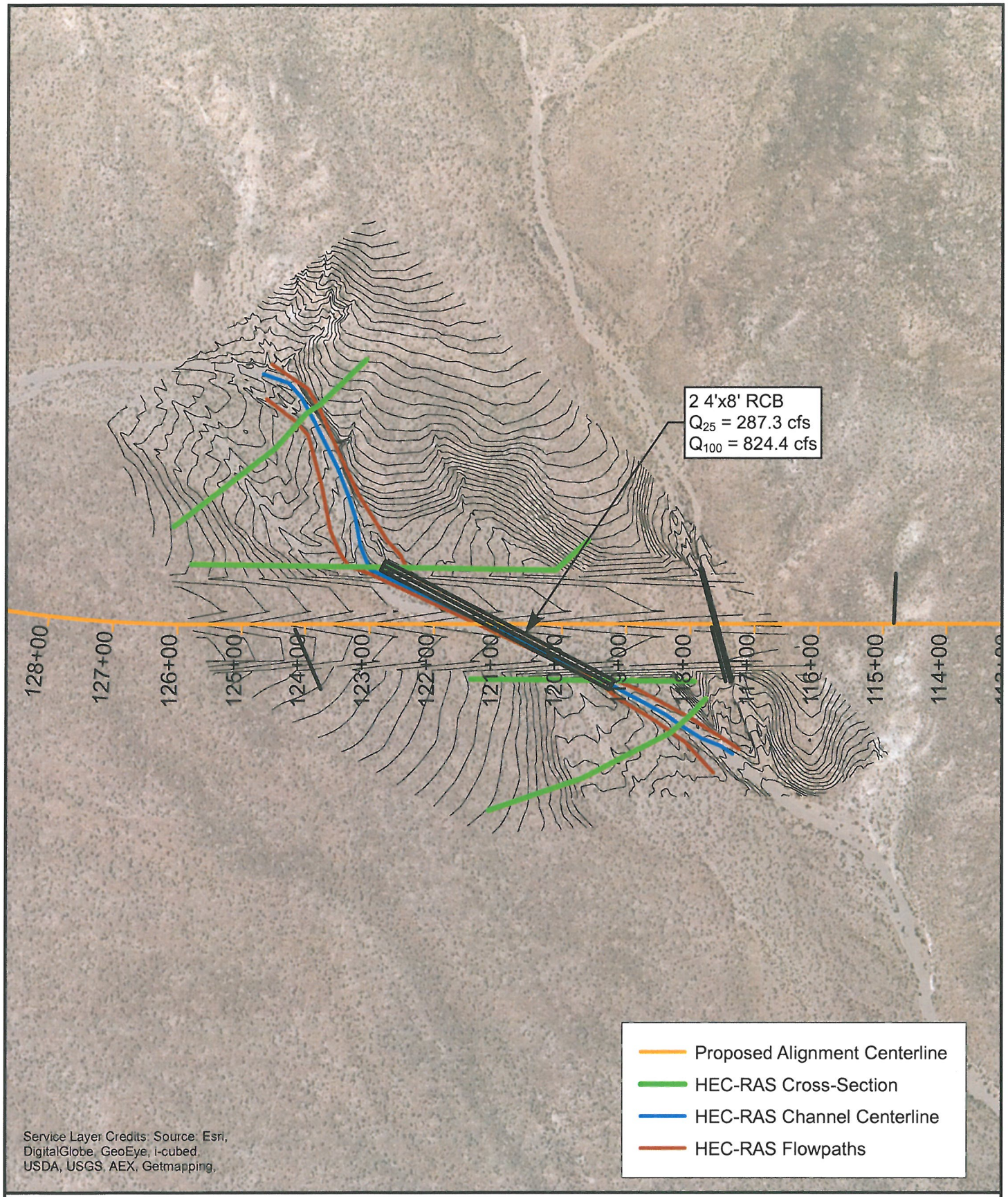
.055
.055
Legend
WS PF 2
WS PF 1
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)



APPENDIX B
HEC-RAS INPUT DATA
STATION 121 PROPOSED CONDITIONS

30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER, 2013

NOTES

NORTH

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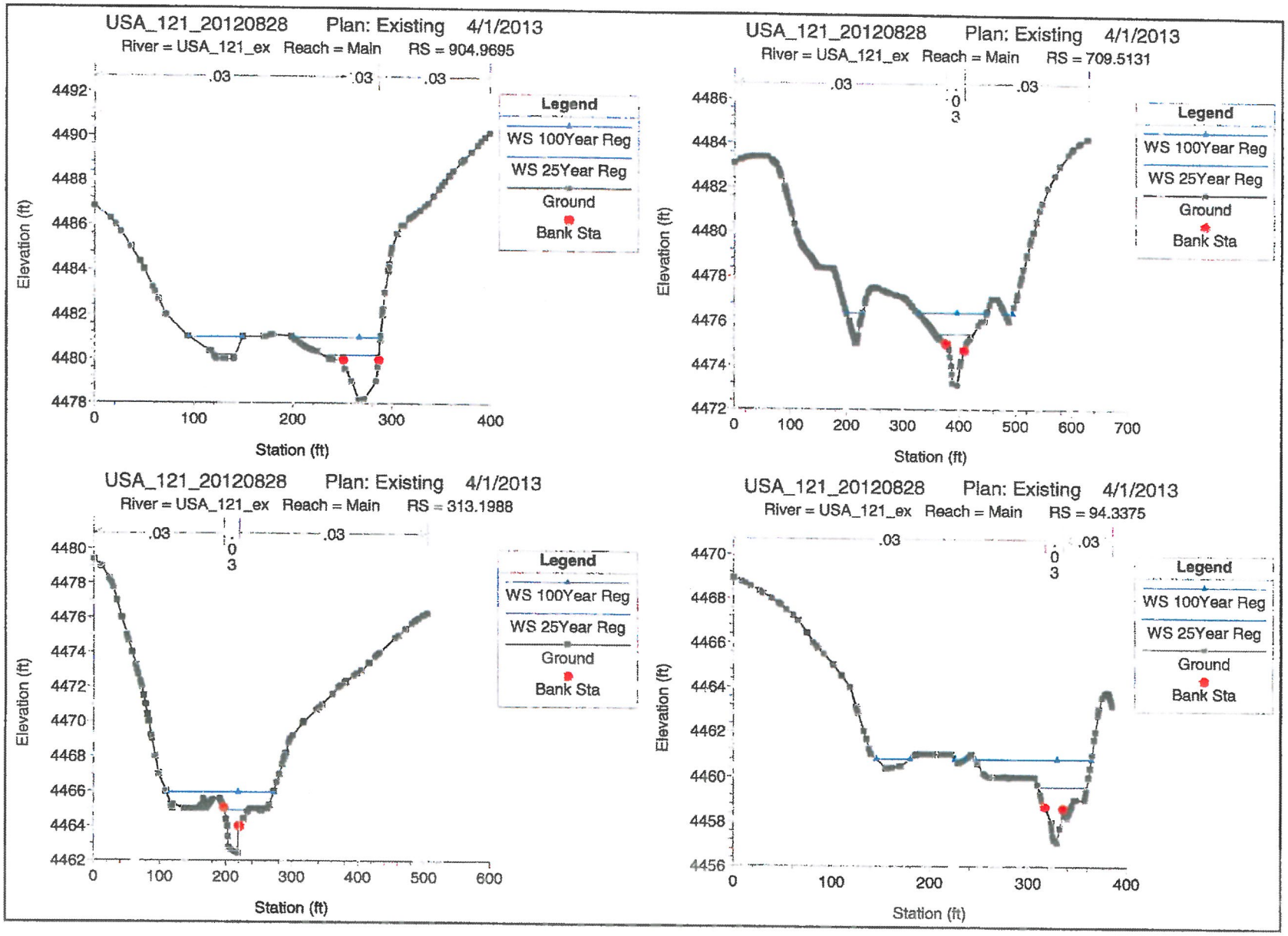
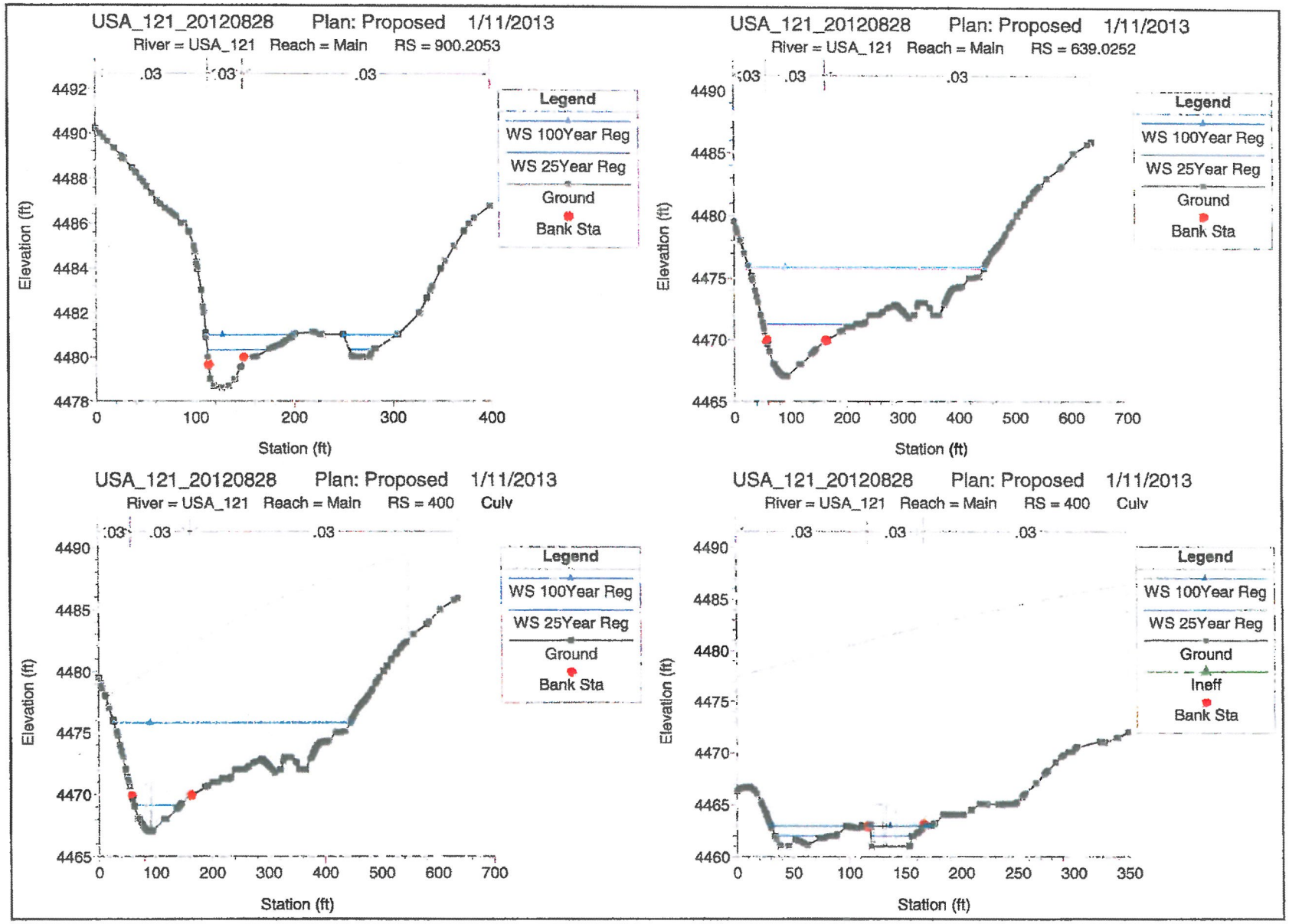
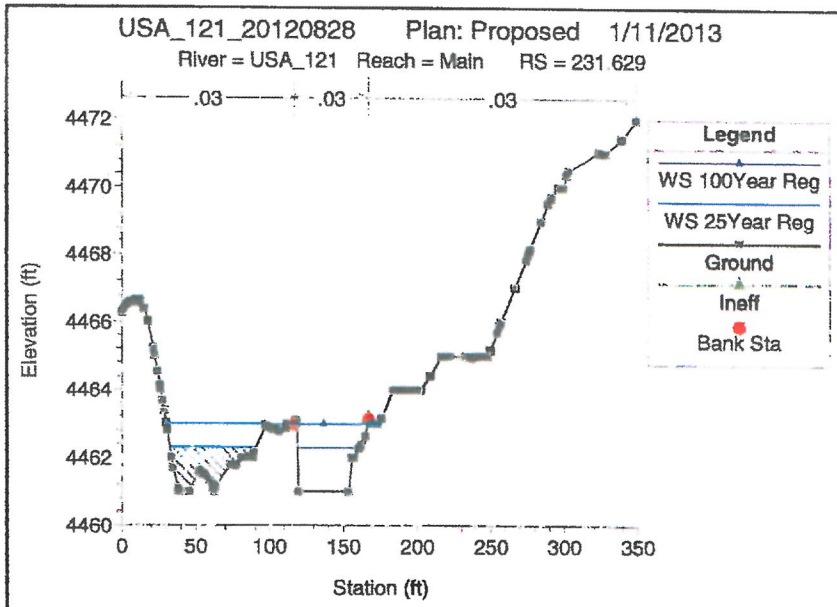
FEET

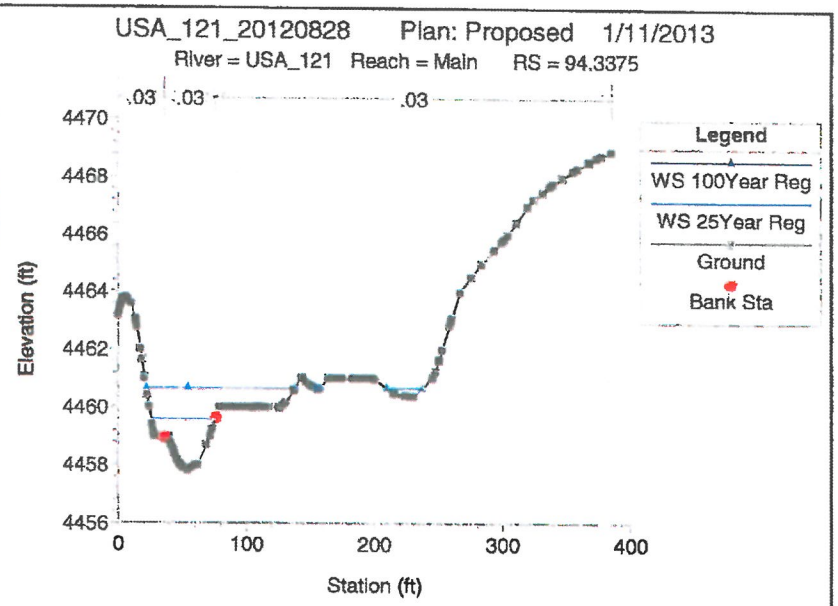
PRELIMINARY

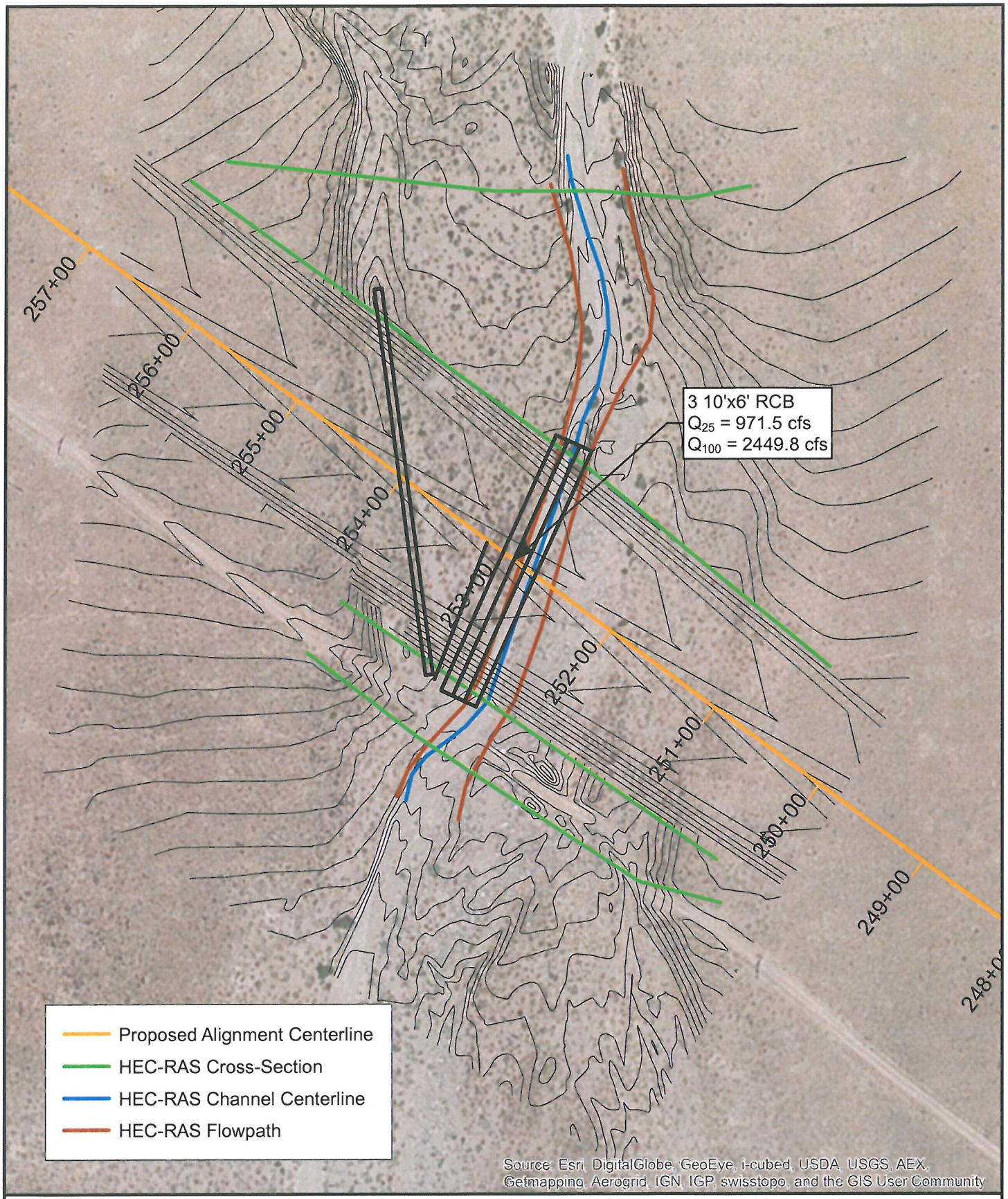
WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive Tel: 775.823.4068
Reno, NV 89511 Fax: 775.823.4066


USA_121_20120828 Plan: Existing 4/1/2013
River = USA_121_ex Reach = Main RS = 904.9695
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Existing 4/1/2013
River = USA_121_ex Reach = Main RS = 709.5131
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Existing 4/1/2013
River = USA_121_ex Reach = Main RS = 313.1988
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Existing 4/1/2013
River = USA_121_ex Reach = Main RS = 94.3375
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 900.2053
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 639.0252
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 400 Culv
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 400 Culv
.03 .03 .03
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 231.629
.03
.03
.03
Elevation (ft)
4472
4470
4468
4466
4464
4462
4460
0
50
100
150
200
250
300
350
Station (ft)
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Ineff
Bank Sta


USA_121_20120828 Plan: Proposed 1/11/2013
River = USA_121 Reach = Main RS = 94.3375
.03
.03
.03
Elevation (ft)
4470
4468
4466
4464
4462
4460
4458
4456
0
100
200
300
400
Station (ft)
Legend
WS 100Year Reg
WS 25Year Reg
Ground
Bank Sta



APPENDIX B
HEC-RAS INPUT DATA
STATION 252 PROPOSED CONDITIONS

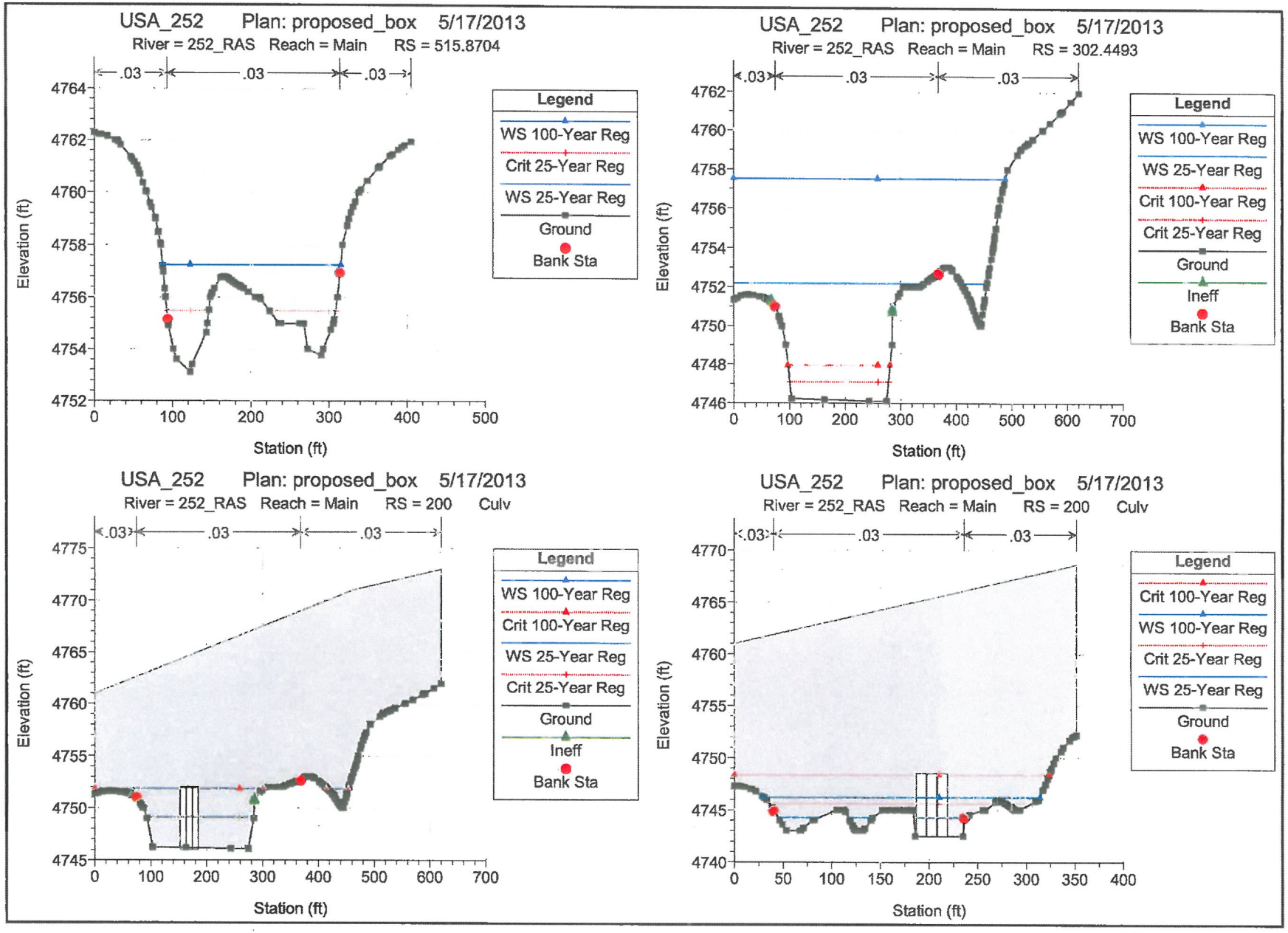
30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER 2013
NOTES

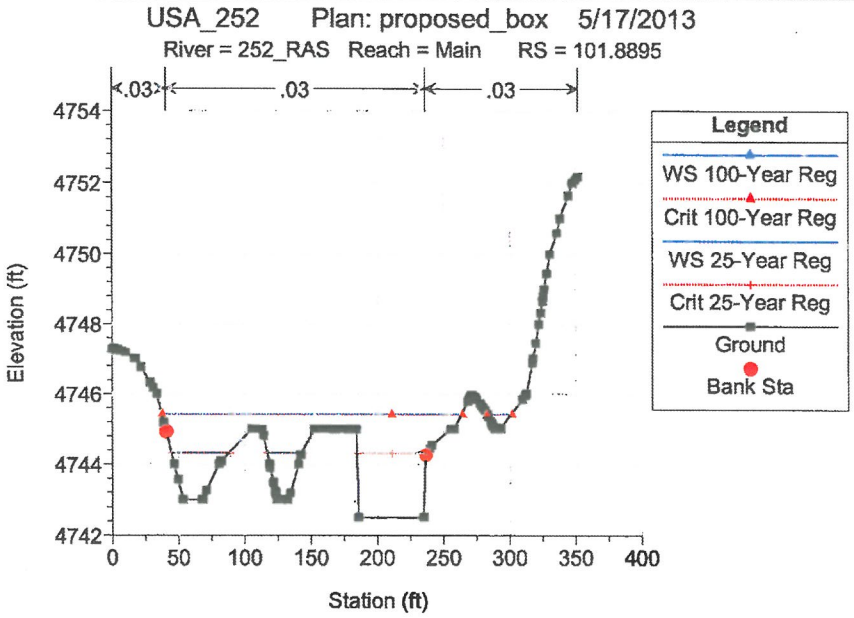
NORTH

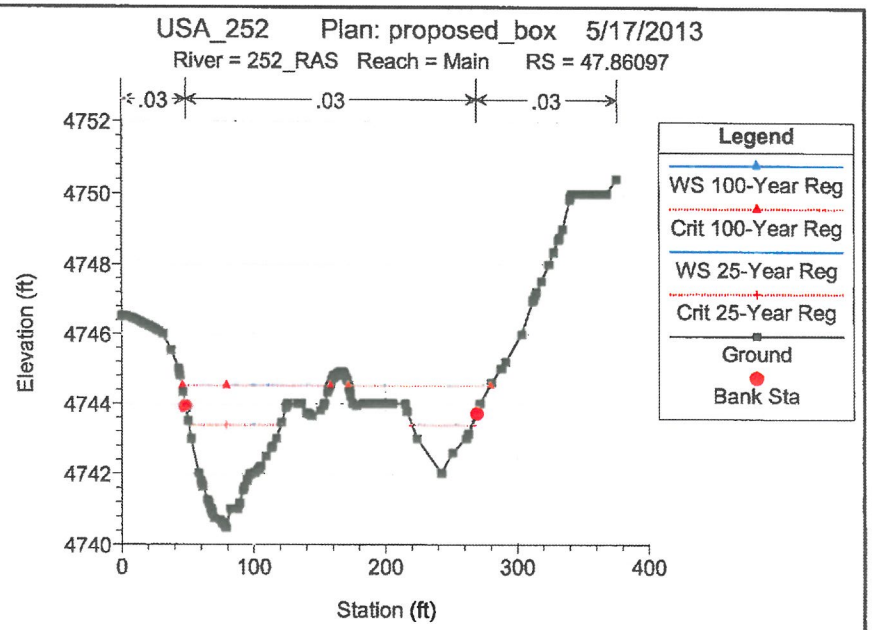
0 100 200
FEET

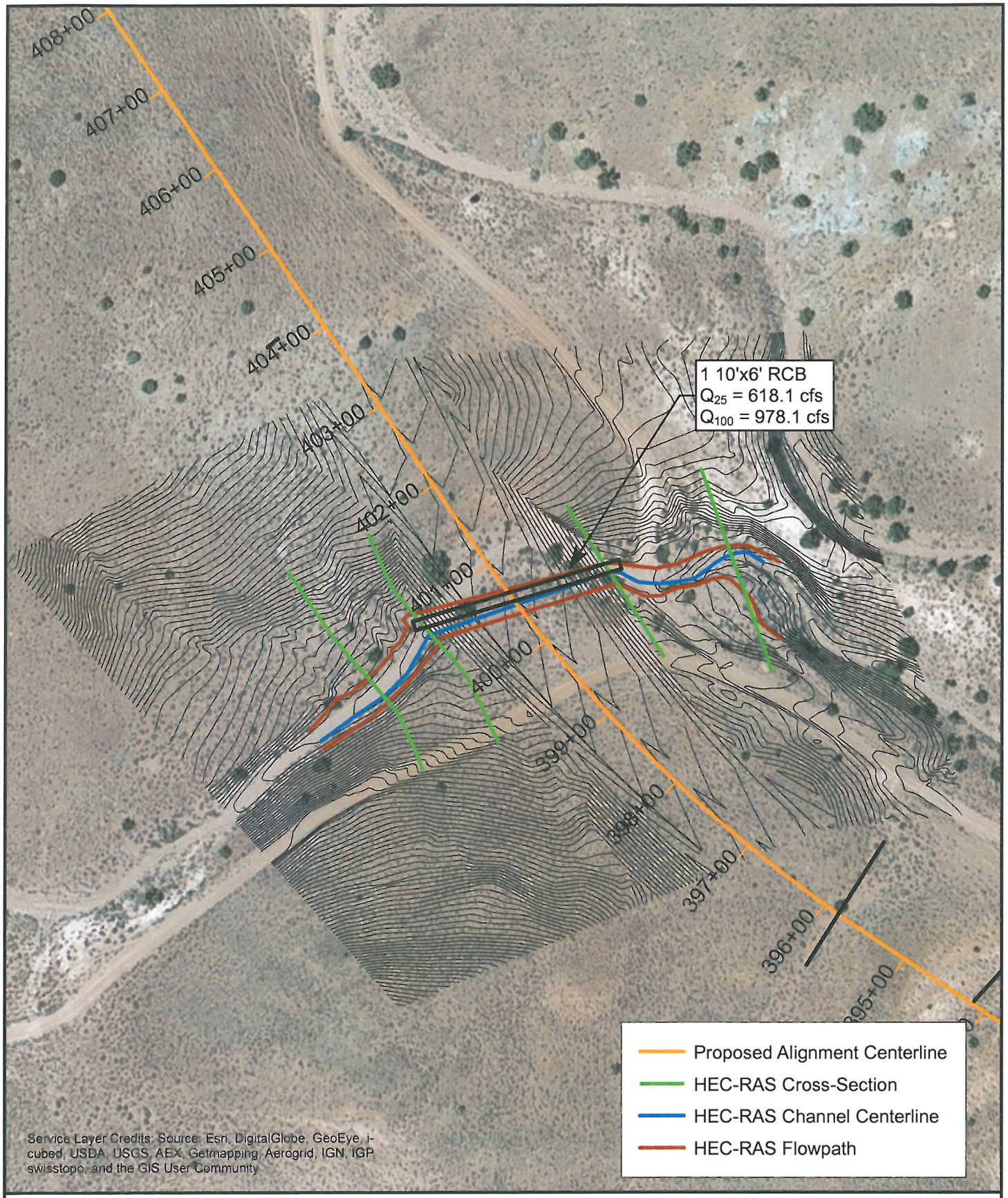
PRELIMINARY

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive Tel: 775.823.4068
Reno, NV 89511 Fax: 775.823.4066


USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 515.8704
.03 .03 .03
Elevation (ft)
Station (ft)
Legend
WS 100-Year Reg
Crit 25-Year Reg
WS 25-Year Reg
Ground
Bank Sta
USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 302.4493
.03 .03 .03
Elevation (ft)
Station (ft)
Legend
WS 100-Year Reg
WS 25-Year Reg
Crit 100-Year Reg
Crit 25-Year Reg
Ground
Ineff
Bank Sta
USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 200 Culv
.03 .03 .03
Elevation (ft)
Station (ft)
Legend
WS 100-Year Reg
Crit 100-Year Reg
WS 25-Year Reg
Crit 25-Year Reg
Ground
Ineff
Bank Sta
USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 200 Culv
.03 .03 .03
Elevation (ft)
Station (ft)
Legend
Crit 100-Year Reg
WS 100-Year Reg
Crit 25-Year Reg
WS 25-Year Reg
Ground
Bank Sta


USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 101.8895
.03
.03
.03
Elevation (ft)
4754
4752
4750
4748
4746
4744
4742
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
WS 100-Year Reg
Crit 100-Year Reg
WS 25-Year Reg
Crit 25-Year Reg
Ground
Bank Sta


USA_252 Plan: proposed_box 5/17/2013
River = 252_RAS Reach = Main RS = 47.86097
.03
.03
.03
Elevation (ft)
4752
4750
4748
4746
4744
4742
4740
0
100
200
300
400
Station (ft)
Legend
WS 100-Year Reg
Crit 100-Year Reg
WS 25-Year Reg
Crit 25-Year Reg
Ground
Bank Sta



APPENDIX B
HEC-RAS INPUT DATA
STATION 401 PROPOSED CONDITIONS

30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER 2013

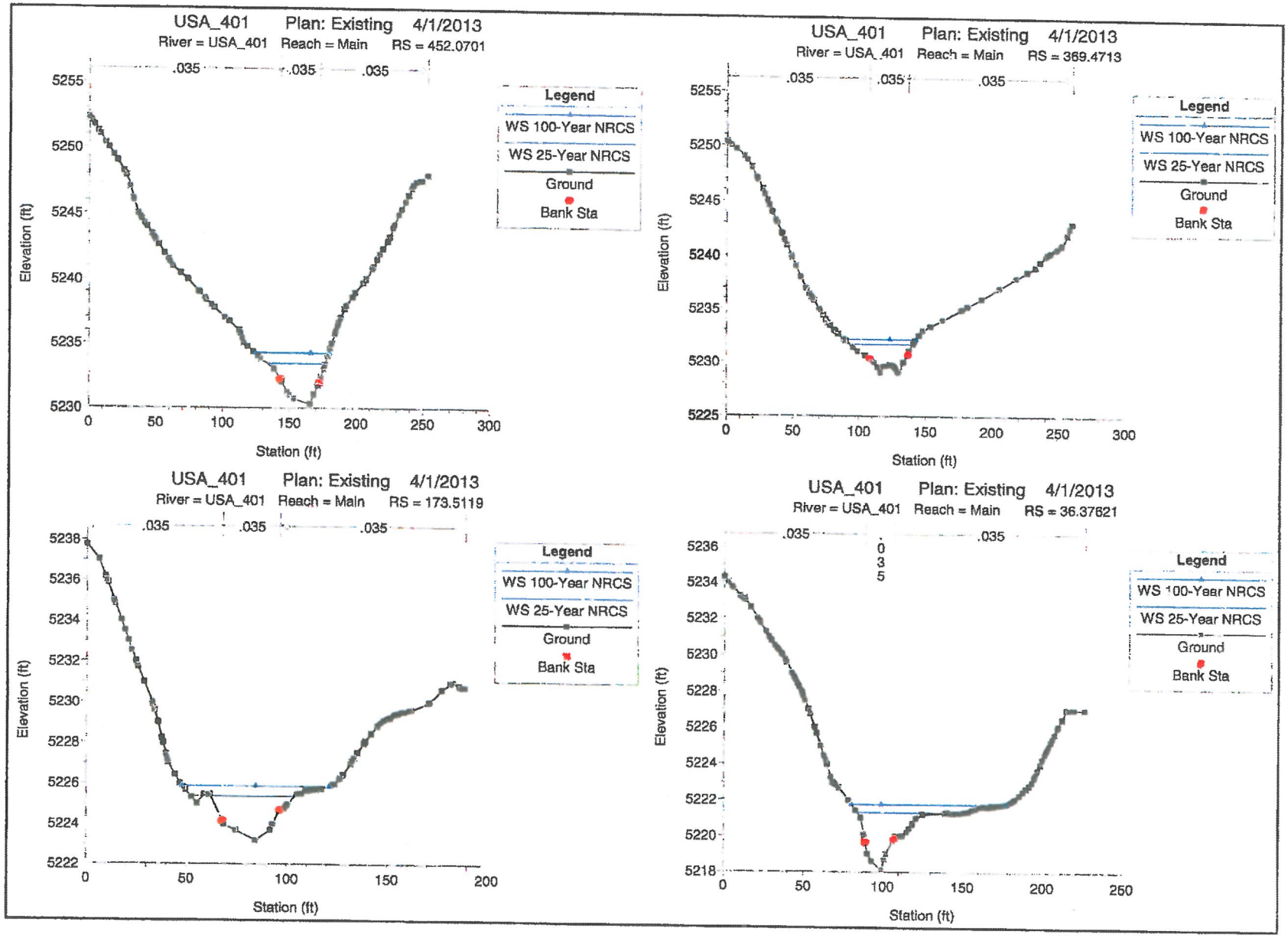
NOTES

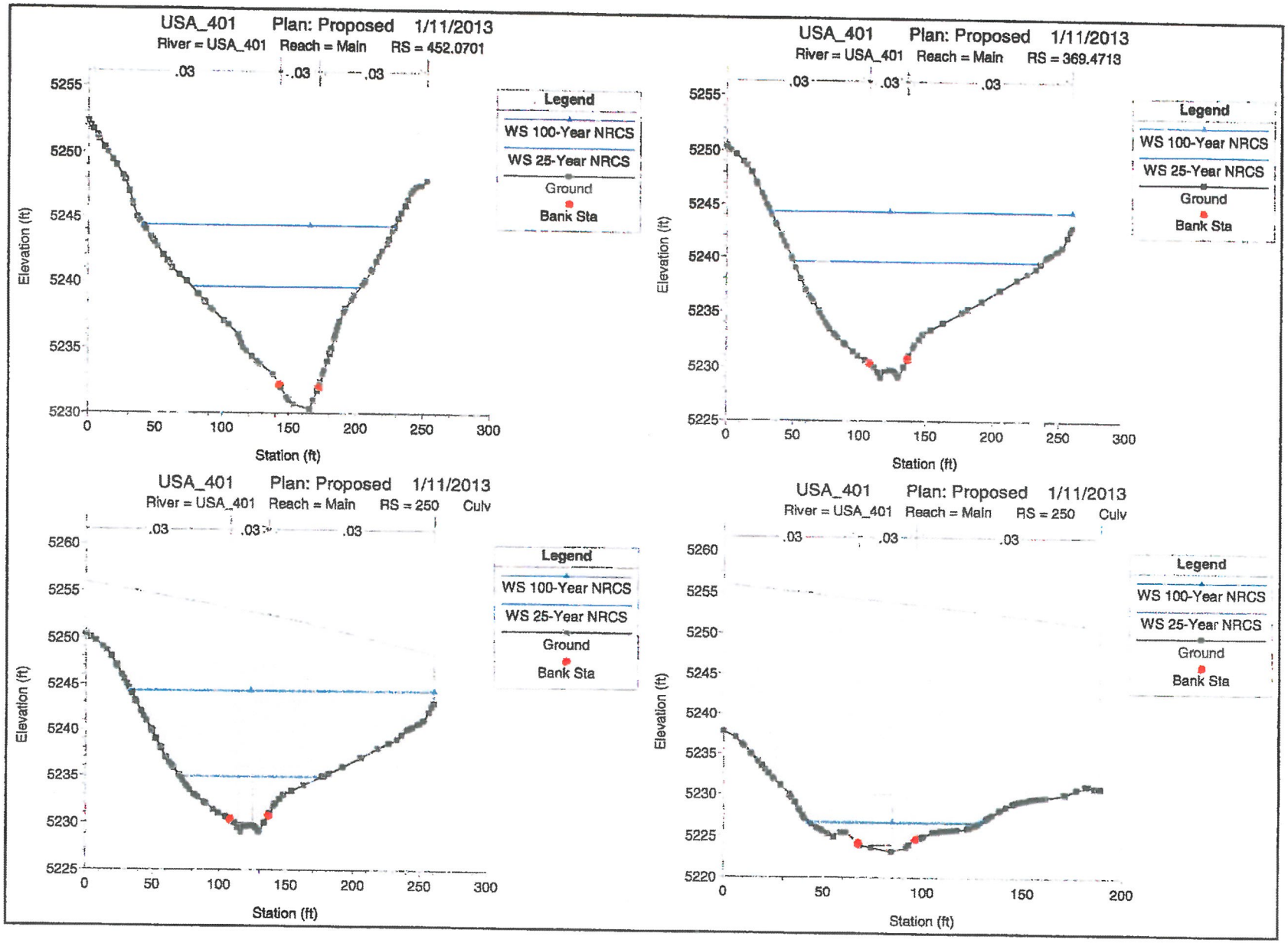
NORTH

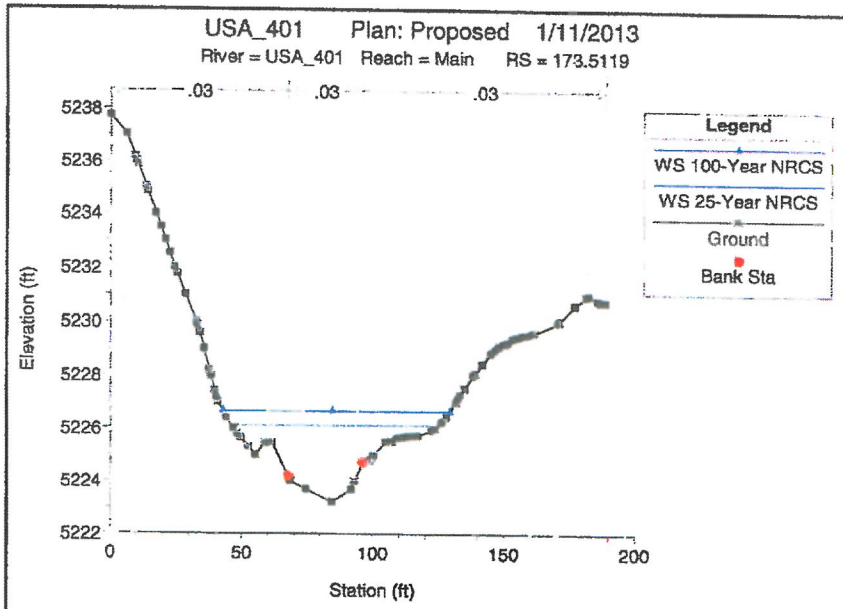
0 100 200
FEET

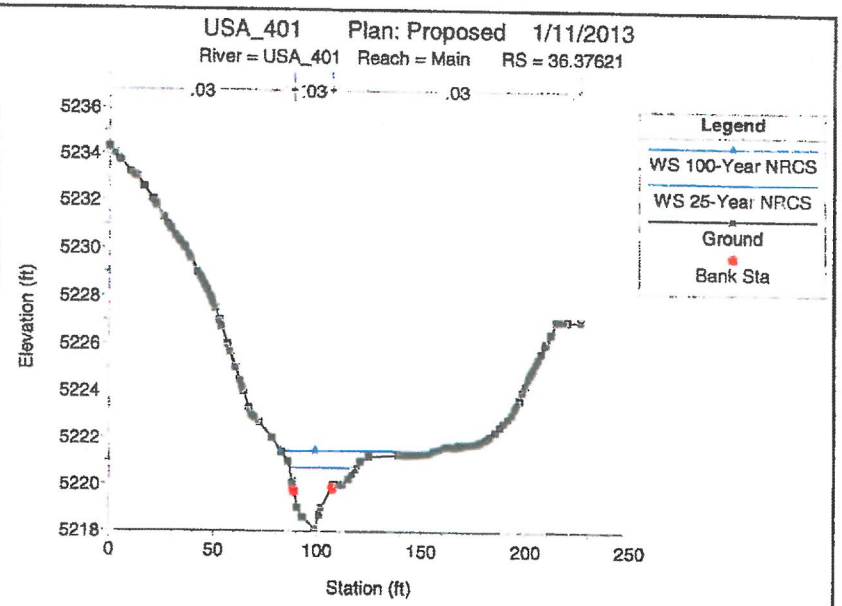
PRELIMINARY

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive
Reno, NV 89511
Tel: 775.823.4068
Fax: 775.823.4066


USA_401 Plan: Existing 4/1/2013
River = USA_401 Reach = Main RS = 452.0701
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
USA_401 Plan: Existing 4/1/2013
River = USA_401 Reach = Main RS = 369.4713
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
USA_401 Plan: Existing 4/1/2013
River = USA_401 Reach = Main RS = 173.5119
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
USA_401 Plan: Existing 4/1/2013
River = USA_401 Reach = Main RS = 36.37621
.035 .035
Elevation (ft)
Station (ft)
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta


USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 452.0701
.03 .03 .03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 369.4713
.03 .03 .03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 250 Culv
.03 .03 .03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
Station (ft)
USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 250 Culv
.03 .03 .03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
Station (ft)


USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 173.5119
.03
.03
.03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
5238
5236
5234
5232
5230
5228
5226
5224
5222
0
50
100
150
200
Station (ft)


USA_401 Plan: Proposed 1/11/2013
River = USA_401 Reach = Main RS = 36.37621
.03
.03
.03
Legend
WS 100-Year NRCS
WS 25-Year NRCS
Ground
Bank Sta
Elevation (ft)
5236
5234
5232
5230
5228
5226
5224
5222
5220
5218
0
50
100
150
200
250
Station (ft)