

APPENDIX B – PLAN 1 DATA

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 1 - Pipe Hydraulics (minimum hydraulic head)

Table B-1
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Notes: Calculate minimum hydraulic head at powerplant at Sunnyside Canal.

Reservoir Water Surface Elevation =	1500
Pipe diameter (feet) =	12
Peak delivery flow (cfs) =	1262
Hazen-Williams coefficient =	135

Minimum Hydraulic Grade Line

Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Hydraulic Grade Line Elevation	Pressure Head (feet)
0+00	1155.00				1365	210
1+27	1153.00	-0.015691	127.48	0.21	1365	212
5+41	1153.00	0	413.10	0.68	1364	211
13+09	1163.00	0.013022	768.02	1.26	1363	200
15+19	1173.00	0.047436	211.05	0.35	1363	190
16+00	1183.00	0.123946	81.30	0.13	1362	179
20+30	1183.00	0	429.88	0.71	1362	179
22+58	1163.00	-0.087712	228.90	0.38	1361	198
27+23	1163.00	0	465.02	0.76	1361	198
28+92	1160.65	-0.01394	168.60	0.28	1360	200
33+68	1157.01	-0.007647	476.04	0.78	1359	202
36+69	1157.64	0.00209	301.50	0.50	1359	201
44+78	1163.00	0.006629	808.54	1.33	1358	195
53+74	1175.84	0.014328	896.26	1.47	1356	180
75+26	1222.62	0.021737	2152.65	3.54	1353	130
78+81	1210.83	-0.033198	355.34	0.58	1352	141
89+96	1194.05	-0.015052	1114.95	1.83	1350	156
100+67	1207.74	0.01278	1071.30	1.76	1348	141
103+81	1223.00	0.04856	314.62	0.52	1348	125
106+56	1283.22	0.219101	281.37	0.46	1347	64
110+07	1283.00	-0.000626	351.25	0.58	1347	64
115+00	1213.04	-0.142016	497.56	0.82	1346	133
120+99	1187.58	-0.042506	599.52	0.99	1345	157
122+27	1187.46	-0.00094	127.69	0.21	1345	157
124+89	1195.66	0.031275	262.32	0.43	1344	149
129+24	1178.25	-0.040019	435.39	0.72	1344	165
139+02	1203.00	0.025315	977.98	1.61	1342	139
147+81	1243.00	0.045479	880.44	1.45	1341	98
152+26	1280.00	0.083116	446.69	0.73	1340	60
154+41	1280.00	0	215.00	0.35	1340	60

Preliminary Pipe Profile Data

Table B-1
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Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Static Head Elevation	Pressure Head (feet)
154+94	1270.00	-0.189394	53.74	0.09	1339	69
158+10	1243.00	-0.085492	316.97	0.52	1339	96
161+35	1243.00	0	324.91	0.53	1338	95
163+24	1260.00	0.089952	189.75	0.31	1338	78
163+90	1260.00	0	66.09	0.11	1338	78
165+12	1249.15	-0.089073	122.29	0.20	1338	89
167+00	1250.00	0.004514	188.32	0.31	1337	87
169+85	1272.00	0.077266	285.58	0.47	1337	65
171+00	1272.00	0	115.27	0.19	1337	65
174+54	1247.12	-0.070338	354.59	0.58	1336	89
175+58	1243.60	-0.033697	104.52	0.17	1336	92
183+14	1283.00	0.052158	756.42	1.24	1335	52
185+22	1283.00	0	208.91	0.34	1334	51
186+73	1263.00	-0.133049	151.64	0.25	1334	71
189+36	1243.00	-0.07604	263.78	0.43	1334	91
192+55	1237.61	-0.016906	318.87	0.52	1333	96
195+37	1243.00	0.019076	282.61	0.46	1333	90
199+42	1281.25	0.094603	406.13	0.67	1332	51
204+67	1309.84	0.05445	525.85	0.86	1331	21
206+12	1309.65	-0.001308	145.26	0.24	1331	21
207+25	1303.00	-0.059032	112.85	0.19	1331	28
209+35	1303.00	0	210.89	0.35	1331	28
212+95	1281.57	-0.059536	360.59	0.59	1330	48
218+33	1266.00	-0.028953	538.00	0.88	1329	63
222+64	1243.00	-0.053411	431.23	0.71	1328	85
224+32	1243.00	0	167.85	0.28	1328	85
225+00	1248.12	0.074832	68.61	0.11	1328	80
226+00	1248.12	0	100.00	0.16	1328	80
227+57	1227.57	-0.130659	158.62	0.26	1328	100
228+51	1221.32	-0.066688	93.93	0.15	1327	106
233+00	1210.00	-0.025212	449.14	0.74	1327	117
234+28	1191.60	-0.143302	129.71	0.21	1326	135
236+33	1178.39	-0.0646	204.92	0.34	1326	148
238+86	1168.03	-0.0409	253.51	0.42	1326	158
241+49	1160.00	-0.030578	262.73	0.43	1325	165
242+96	1159.73	-0.001839	146.79	0.24	1325	165
246+00	1172.34	0.041424	304.67	0.50	1324	152
246+67	1171.96	-0.005701	66.65	0.11	1324	152
248+57	1156.98	-0.078536	191.33	0.31	1324	167
249+86	1158.71	0.013437	128.76	0.21	1324	165
251+10	1162.54	0.030922	123.92	0.20	1324	161
260+45	1023.00	-0.149261	945.23	1.55	1322	299
279+91	963.00	-0.030838	1946.58	3.20	1319	356
283+44	963.00	0	353.50	0.58	1318	355
287+44	985.00	0.055004	400.57	0.66	1318	333

Preliminary Pipe Profile Data

Table B-1
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Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Static Head Elevation	Pressure Head (feet)
292+51	953.00	-0.063111	508.05	0.84	1317	364
303+70	935.44	-0.015695	1118.95	1.84	1315	380
311+37	934.28	-0.001512	767.20	1.26	1314	379
314+23	946.96	0.044277	286.66	0.47	1313	366
318+00	945.52	-0.003824	376.57	0.62	1313	367
319+38	923.00	-0.162882	140.08	0.23	1312	389
322+84	922.57	-0.001245	345.47	0.57	1312	389
324+00	903.00	-0.168315	117.91	0.19	1312	409
328+37	893.00	-0.022887	437.03	0.72	1311	418
330+45	883.00	-0.048045	208.38	0.34	1311	428
333+47	875.00	-0.026511	301.87	0.50	1310	435
335+92	871.64	-0.013686	245.52	0.40	1310	438
Total friction loss =				55.34 feet		

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 1 - Pipe Hydraulics (maximum hydraulic head)

Table B-2
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Notes: Calculate the maximum delivery head at the powerplant at Sunnyside Canal.

Reservoir Water Surface Elevation =	1775
Pipe diameter (feet) =	12
Peak delivery flow (cfs) =	1262
Hazen-Williams coefficient =	135

Maximum Hydraulic Grade Line

Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Hydraulic Grade Line Elevation	Pressure Head (feet)
0+00	1155.00				1670	515
1+27	1153.00	-0.015691	127.48	0.21	1670	517
5+41	1153.00	0	413.10	0.68	1669	516
13+09	1163.00	0.013022	768.02	1.26	1668	505
15+19	1173.00	0.047436	211.05	0.35	1668	495
16+00	1183.00	0.123946	81.30	0.13	1667	484
20+30	1183.00	0	429.88	0.71	1667	484
22+58	1163.00	-0.087712	228.90	0.38	1666	503
27+23	1163.00	0	465.02	0.76	1666	503
28+92	1160.65	-0.01394	168.60	0.28	1665	505
33+68	1157.01	-0.007647	476.04	0.78	1664	507
36+69	1157.64	0.00209	301.50	0.50	1664	506
44+78	1163.00	0.006629	808.54	1.33	1663	500
53+74	1175.84	0.014328	896.26	1.47	1661	485
75+26	1222.62	0.021737	2152.65	3.54	1658	435
78+81	1210.83	-0.033198	355.34	0.58	1657	446
89+96	1194.05	-0.015052	1114.95	1.83	1655	461
100+67	1207.74	0.01278	1071.30	1.76	1653	446
103+81	1223.00	0.04856	314.62	0.52	1653	430
106+56	1283.22	0.219101	281.37	0.46	1652	369
110+07	1283.00	-0.000626	351.25	0.58	1652	369
115+00	1213.04	-0.142016	497.56	0.82	1651	438
120+99	1187.58	-0.042506	599.52	0.99	1650	462
122+27	1187.46	-0.00094	127.69	0.21	1650	462
124+89	1195.66	0.031275	262.32	0.43	1649	454
129+24	1178.25	-0.040019	435.39	0.72	1649	470
139+02	1203.00	0.025315	977.98	1.61	1647	444
147+81	1243.00	0.045479	880.44	1.45	1646	403
152+26	1280.00	0.083116	446.69	0.73	1645	365
154+41	1280.00	0	215.00	0.35	1645	365

Preliminary Pipe Profile Data

Table B-2
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Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Static Head Elevation	Pressure Head (feet)
154+94	1270.00	-0.189394	53.74	0.09	1644	374
158+10	1243.00	-0.085492	316.97	0.52	1644	401
161+35	1243.00	0	324.91	0.53	1643	400
163+24	1260.00	0.089952	189.75	0.31	1643	383
163+90	1260.00	0	66.09	0.11	1643	383
165+12	1249.15	-0.089073	122.29	0.20	1643	394
167+00	1250.00	0.004514	188.32	0.31	1642	392
169+85	1272.00	0.077266	285.58	0.47	1642	370
171+00	1272.00	0	115.27	0.19	1642	370
174+54	1247.12	-0.070338	354.59	0.58	1641	394
175+58	1243.60	-0.033697	104.52	0.17	1641	397
183+14	1283.00	0.052158	756.42	1.24	1640	357
185+22	1283.00	0	208.91	0.34	1639	356
186+73	1263.00	-0.133049	151.64	0.25	1639	376
189+36	1243.00	-0.07604	263.78	0.43	1639	396
192+55	1237.61	-0.016906	318.87	0.52	1638	401
195+37	1243.00	0.019076	282.61	0.46	1638	395
199+42	1281.25	0.094603	406.13	0.67	1637	356
204+67	1309.84	0.05445	525.85	0.86	1636	326
206+12	1309.65	-0.001308	145.26	0.24	1636	326
207+25	1303.00	-0.059032	112.85	0.19	1636	333
209+35	1303.00	0	210.89	0.35	1636	333
212+95	1281.57	-0.059536	360.59	0.59	1635	353
218+33	1266.00	-0.028953	538.00	0.88	1634	368
222+64	1243.00	-0.053411	431.23	0.71	1633	390
224+32	1243.00	0	167.85	0.28	1633	390
225+00	1248.12	0.074832	68.61	0.11	1633	385
226+00	1248.12	0	100.00	0.16	1633	385
227+57	1227.57	-0.130659	158.62	0.26	1633	405
228+51	1221.32	-0.066688	93.93	0.15	1632	411
233+00	1210.00	-0.025212	449.14	0.74	1632	422
234+28	1191.60	-0.143302	129.71	0.21	1631	440
236+33	1178.39	-0.0646	204.92	0.34	1631	453
238+86	1168.03	-0.0409	253.51	0.42	1631	463
241+49	1160.00	-0.030578	262.73	0.43	1630	470
242+96	1159.73	-0.001839	146.79	0.24	1630	470
246+00	1172.34	0.041424	304.67	0.50	1629	457
246+67	1171.96	-0.005701	66.65	0.11	1629	457
248+57	1156.98	-0.078536	191.33	0.31	1629	472
249+86	1158.71	0.013437	128.76	0.21	1629	470
251+10	1162.54	0.030922	123.92	0.20	1629	466
260+45	1023.00	-0.149261	945.23	1.55	1627	604
279+91	963.00	-0.030838	1946.58	3.20	1624	661
283+44	963.00	0	353.50	0.58	1623	660
287+44	985.00	0.055004	400.57	0.66	1623	638

Preliminary Pipe Profile Data

Table B-2
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Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Static Head Elevation	Pressure Head (feet)
292+51	953.00	-0.063111	508.05	0.84	1622	669
303+70	935.44	-0.015695	1118.95	1.84	1620	685
311+37	934.28	-0.001512	767.20	1.26	1619	684
314+23	946.96	0.044277	286.66	0.47	1618	671
318+00	945.52	-0.003824	376.57	0.62	1618	672
319+38	923.00	-0.162882	140.08	0.23	1617	694
322+84	922.57	-0.001245	345.47	0.57	1617	694
324+00	903.00	-0.168315	117.91	0.19	1617	714
328+37	893.00	-0.022887	437.03	0.72	1616	723
330+45	883.00	-0.048045	208.38	0.34	1616	733
333+47	875.00	-0.026511	301.87	0.50	1615	740
335+92	871.64	-0.013686	245.52	0.40	1615	743
Total friction loss =				55.34 feet		

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 1 - Pipe Hydraulics (pipe wall thickness)

Table B-3
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Notes: Static head is based on no pipe flow and maximum reservoir water surface elevation.
 Transient head is based on a linear varying water surface elevation between the following points:
 Sta. 0+00 = El.1947, Sta. 206+12 = El.2038, Sta. 335+92 = El.2143.
 Steel pipe wall thickness by AWWA M11.
 ASTM A572 Gr. 60 steel pipe, Fa = 30,000 psi.

Pipe diameter (feet) =	12
Maximum Reservoir Water Surface Elev. =	1775

Maximum Pipe Internal Pressure

Station	Pipe Invert Elevation	Static Head (feet)	Transient Elevation	Transient Head (feet)	Design Pressure (psi)	Required Thick. (in.)	Design Thick. (in.)	Absolute Length (feet)	Steel Weight (tons)
0+00	1155.00	620	1947	792	343	0.82	0.8750		
1+27	1153.00	622	1948	795	344	0.83	0.8750	127	86.30
5+41	1153.00	622	1949	796	345	0.83	0.8750	413	279.67
13+09	1163.00	612	1953	790	342	0.82	0.8750	768	519.95
15+19	1173.00	602	1954	781	338	0.81	0.8125	211	132.64
16+00	1183.00	592	1954	771	334	0.80	0.8125	81	51.10
20+30	1183.00	592	1956	773	335	0.80	0.8125	430	270.18
22+58	1163.00	612	1957	794	344	0.83	0.8750	229	154.96
27+23	1163.00	612	1959	796	345	0.83	0.8750	465	314.82
28+92	1160.65	614	1960	799	346	0.83	0.8750	169	114.14
33+68	1157.01	618	1962	805	349	0.84	0.8750	476	322.28
36+69	1157.64	617	1963	806	349	0.84	0.8750	302	204.12
44+78	1163.00	612	1967	804	348	0.84	0.8750	809	547.38
53+74	1175.84	599	1971	795	344	0.83	0.8750	896	606.77
75+26	1222.62	552	1980	758	328	0.79	0.8750	2153	1457.34
78+81	1210.83	564	1982	771	334	0.80	0.8750	355	240.56
89+96	1194.05	581	1987	793	343	0.82	0.8750	1115	754.82
100+67	1207.74	567	1991	784	340	0.82	0.8750	1071	725.27
103+81	1223.00	552	1993	770	334	0.80	0.8125	315	197.74
106+56	1283.22	492	1994	711	308	0.74	0.8125	281	176.84
110+07	1283.00	492	1996	713	309	0.74	0.8125	351	220.76
115+00	1213.04	562	1998	785	340	0.82	0.8750	498	336.85
120+99	1187.58	587	2000	813	352	0.85	0.8750	600	405.88
122+27	1187.46	588	2001	814	353	0.85	0.8750	128	86.45
124+89	1195.66	579	2002	806	349	0.84	0.8750	262	177.59
129+24	1178.25	597	2004	826	358	0.86	0.8750	435	294.76
139+02	1203.00	572	2008	805	349	0.84	0.8750	978	662.09
147+81	1243.00	532	2012	769	333	0.80	0.8125	880	553.36
152+26	1280.00	495	2014	734	318	0.76	0.8125	447	280.75
154+41	1280.00	495	2015	735	319	0.76	0.8125	215	135.13

Preliminary Pipe Profile Data

Table B-3
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Station	Pipe Invert Elevation	Static Head (feet)	Transient Elevation	Transient Head (feet)	Design Pressure (psi)	Required Thick. (in.)	Design Thick. (in.)	Absolute Length (feet)	Steel Weight (tons)
154+94	1270.00	505	2015	745	323	0.78	0.8125	54	33.77
158+10	1243.00	532	2017	774	335	0.80	0.8125	317	199.22
161+35	1243.00	532	2018	775	336	0.81	0.8125	325	204.21
163+24	1260.00	515	2019	759	329	0.79	0.8125	190	119.26
163+90	1260.00	515	2019	759	329	0.79	0.8125	66	41.54
165+12	1249.15	526	2020	771	334	0.80	0.8125	122	76.86
167+00	1250.00	525	2021	771	334	0.80	0.8125	188	118.36
169+85	1272.00	503	2022	750	325	0.78	0.8125	286	179.49
171+00	1272.00	503	2022	750	325	0.78	0.8125	115	72.45
174+54	1247.12	528	2024	777	337	0.81	0.8125	355	222.86
175+58	1243.60	531	2025	781	338	0.81	0.8125	105	65.69
183+14	1283.00	492	2028	745	323	0.77	0.8125	756	475.41
185+22	1283.00	492	2029	746	323	0.78	0.8125	209	131.30
186+73	1263.00	512	2029	766	332	0.80	0.8125	152	95.31
189+36	1243.00	532	2031	788	341	0.82	0.8750	264	178.58
192+55	1237.61	537	2032	794	344	0.83	0.8750	319	215.87
195+37	1243.00	532	2033	790	342	0.82	0.8750	283	191.33
199+42	1281.25	494	2035	754	327	0.78	0.8125	406	255.25
204+67	1309.84	465	2037	728	315	0.76	0.8125	526	330.50
206+12	1309.65	465	2038	728	316	0.76	0.8125	145	91.30
207+25	1303.00	472	2039	736	319	0.77	0.8125	113	70.92
209+35	1303.00	472	2041	738	320	0.77	0.8125	211	132.54
212+95	1281.57	493	2044	762	330	0.79	0.8125	361	226.63
218+33	1266.00	509	2048	782	339	0.81	0.8125	538	338.13
222+64	1243.00	532	2051	808	350	0.84	0.8750	431	291.95
224+32	1243.00	532	2053	810	351	0.84	0.8750	168	113.63
225+00	1248.12	527	2053	805	349	0.84	0.8750	69	46.45
226+00	1248.12	527	2054	806	349	0.84	0.8750	100	67.70
227+57	1227.57	547	2055	828	359	0.86	0.8750	159	107.38
228+51	1221.32	554	2056	835	362	0.87	0.8750	94	63.59
233+00	1210.00	565	2060	850	368	0.88	0.9375	449	325.85
234+28	1191.60	583	2061	869	377	0.90	0.9375	130	94.11
236+33	1178.39	597	2062	884	383	0.92	0.9375	205	148.67
238+86	1168.03	607	2064	896	388	0.93	0.9375	254	183.92
241+49	1160.00	615	2067	907	393	0.94	1.0000	263	1517.15
242+96	1159.73	615	2068	908	393	0.94	1.0000	147	847.64
246+00	1172.34	603	2070	898	389	0.93	1.0000	305	1759.32
246+67	1171.96	603	2071	899	389	0.93	1.0000	67	384.88
248+57	1156.98	618	2072	915	397	0.95	1.0000	191	1104.82
249+86	1158.71	616	2073	915	396	0.95	1.0000	129	743.53
251+10	1162.54	612	2074	912	395	0.95	1.0000	124	715.57
260+45	1023.00	752	2082	1059	459	1.10	1.1875	945	871.03
279+91	963.00	812	2098	1135	492	1.18	1.1875	1947	1793.78
283+44	963.00	812	2101	1138	493	1.18	1.1875	354	325.75
287+44	985.00	790	2104	1119	485	1.16	1.1875	401	369.13

Preliminary Pipe Profile Data

Table B-3
(Page 3 of 3)

Station	Pipe Invert Elevation	Static Head (feet)	Transient Elevation	Transient Head (feet)	Design Pressure (psi)	Required Thick. (in.)	Design Thick. (in.)	Absolute Length (feet)	Steel Weight (tons)
292+51	953.00	822	2108	1155	500	1.20	1.2500	508	493.06
303+70	935.44	840	2117	1181	512	1.23	1.2500	1119	1085.94
311+37	934.28	841	2123	1189	515	1.24	1.2500	767	744.57
314+23	946.96	828	2125	1178	511	1.23	1.2500	287	278.20
318+00	945.52	829	2129	1183	513	1.23	1.2500	377	365.46
319+38	923.00	852	2130	1207	523	1.25	1.2500	140	135.95
322+84	922.57	852	2132	1210	524	1.26	1.3125	345	352.21
324+00	903.00	872	2133	1230	533	1.28	1.3125	118	120.20
328+37	893.00	882	2137	1244	539	1.29	1.3125	437	445.56
330+45	883.00	892	2139	1256	544	1.31	1.3125	208	212.44
333+47	875.00	900	2141	1266	549	1.32	1.3750	302	322.54
335+92	871.64	903	2143	1271	551	1.32	1.3750	246	262.34

Total Steel Weight (tons) = 31,072

APPENDIX C – PLAN 2 DATA

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Pipe Hydraulics (hydraulic head)

Table C-1

Notes: Calculate hydraulic head at powerplant at point of delivery on Sunnyside Canal.
 Design Head assumes a 40% transient head increase

Pipe diameter (feet) =	12
Peak delivery flow (cfs) =	1262
Hazen-Williams coefficient =	135

Preliminary Pipe Profile Data

Station	Pipe Invert Elevation	Pipe Slope	Absolute Length (feet)	Friction Loss (feet)	Hydraulic Grade Line Elevation	Pressure Head (feet)	Design Head (feet)
0+00	1085.00				1100	15	21
2+05.33	1073.00	-0.0584	205.68	0.34	1100	27	37
2+36.29	1063.24	-0.3152	32.46	0.05	1100	36	51
3+35.97	1043.00	-0.2031	101.71	0.17	1099	56	79
4+66.59	1023.68	-0.1479	132.04	0.22	1099	76	106
6+67.32	1023.00	-0.0034	200.73	0.33	1099	76	106
9+97.45	983.00	-0.1212	332.54	0.55	1098	115	161
12+11.79	943.00	-0.1866	218.04	0.36	1098	155	217
15+42.53	923.00	-0.0605	331.34	0.54	1097	174	244
19+40.75	905.82	-0.0431	398.59	0.66	1097	191	267
21+11.91	906.68	0.0050	171.16	0.28	1097	190	266
22+42.98	913.00	0.0482	131.22	0.22	1096	183	257
23+90.84	925.00	0.0812	148.35	0.24	1096	171	239
25+00.00	924.79	-0.0019	109.16	0.18	1096	171	240
26+69.49	911.35	-0.0793	170.02	0.28	1096	184	258
28+28.15	910.15	-0.0076	158.66	0.26	1095	185	259
29+31.96	913.81	0.0353	103.87	0.17	1095	181	254
30+55.88	913.37	-0.0036	123.92	0.20	1095	182	254
33+74.72	893.52	-0.0623	319.46	0.53	1094	201	281
35+65.00	888.89	-0.0243	190.34	0.31	1094	205	287
38+94.78	873.00	-0.0482	330.16	0.54	1094	221	309
43+80.25	871.23	-0.0036	485.47	0.80	1093	222	310

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Steel Pipe Wall Thickness

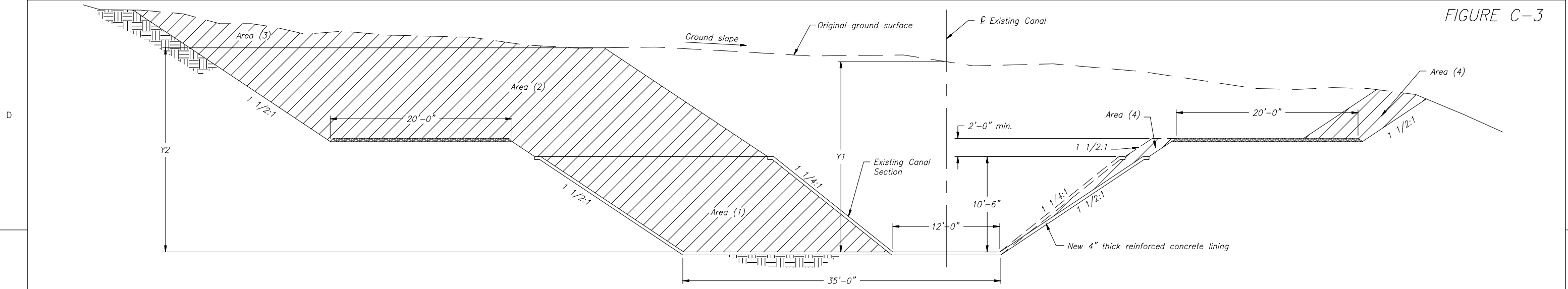
Table C-2

Notes: Steel pipe wall thickness by AWWA M11.
Yield stress, $F_y = 36,000$ psi; Ultimate stress, $F_u = 58,000$ psi
Allowable stress, $F_a = 18,000$ psi

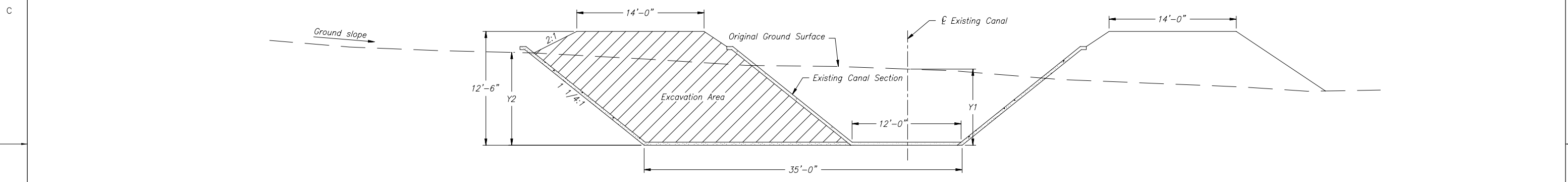
Steel Pipe Quantities

Station	Design Head (feet)	Design Pressure (psi)	Required Thick. (in.)	Design Thick. (in.)	Pipe Length (feet)	Steel Weight (tons)
0+00	21	9	0.41	0.4375		
2+05	37	16	0.41	0.4375	205	69.30
2+36	51	22	0.41	0.4375	32	10.96
3+36	79	34	0.41	0.4375	102	34.33
4+67	106	46	0.41	0.4375	132	44.56
6+67	106	46	0.41	0.4375	201	67.74
9+97	161	70	0.41	0.4375	333	112.23
12+12	217	94	0.41	0.4375	218	73.59
15+43	244	106	0.42	0.4375	331	111.82
19+41	267	116	0.46	0.4375	399	134.52
21+12	266	115	0.46	0.4375	171	57.76
22+43	257	111	0.44	0.4375	131	44.29
23+91	239	104	0.42	0.4375	148	50.06
25+00	240	104	0.42	0.4375	109	36.84
26+69	258	112	0.45	0.4375	170	57.38
28+28	259	112	0.45	0.4375	159	53.55
29+32	254	110	0.44	0.4375	104	35.06
30+56	254	110	0.44	0.4375	124	41.82
33+75	281	122	0.49	0.50	319	123.27
35+65	287	125	0.50	0.50	190	73.44
38+95	309	134	0.54	0.50	330	127.40
43+80	310	134	0.54	0.50	485	187.33

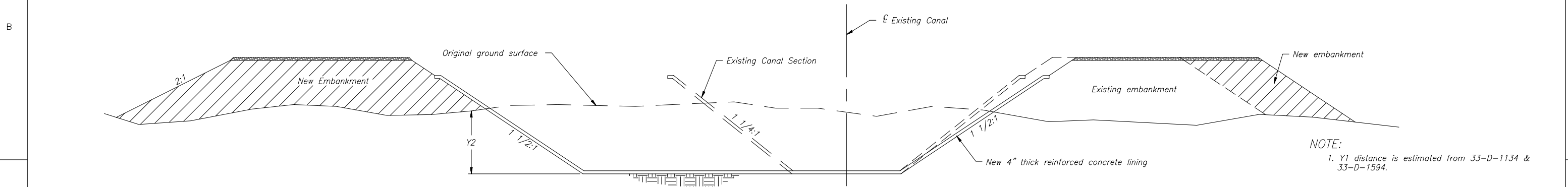
Total Steel Weight = 1,547.24 tons



TYPICAL MODIFIED ROZA CANAL SECTION—CASE I EXCAVATION AREA GEOMETRY
Y2 > 10'-6"

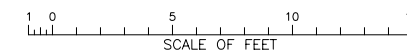



TYPICAL MODIFIED ROZA CANAL SECTION—CASE II EXCAVATION AREA GEOMETRY
Y2 < 10'-6"



TYPICAL MODIFIED ROZA CANAL SECTION—EMBANKMENT AREA GEOMETRY

NOTE:
1. Y1 distance is estimated from 33-D-1134 & 33-D-1594.



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 YAKIMA PROJECT—WASHINGTON
BLACK ROCK RESERVOIR STUDY
 DELIVERY SYSTEM TO SUNNYSIDE DIVISION
 PLAN 2—CANAL MODIFICATION
 TYPICAL CANAL AND WASTEWAY SECTIONS
 FOR QUANTITY CALCULATIONS
 Concept Designer: Steve Montague
 Drafter: Leland Boekweg, EDM
 BOISE, IDAHO SHEET 1 OF 1 2004-02-02

CAD SYSTEM: AutoCAD Rev. 16.0
CAD FILENAME: FIGURE C-3.DWG
DATE AND TIME PLOTTED: JANUARY 28, 2005 15:13
PLOTTED BY: LEBWIKES

Table C-4

Date: 02/01/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Expand Roza Canal

Notes: Calculate excavation area at each station to enlarge the existing Roza Canal from Sta. 1238+00 (MP22.54) to Sta. 1689+89.60 (Wasteway No. 3). For Typical Sections see Figure B-3.

Case I - Geometry Calculations								
Station	Y1 (feet)	Ground Slope	Y2 (feet)	Area (1) (sq. ft.)	Area (2) (sq. ft.)	Area (3) (sq. ft.)	Area(4) (sq. ft.)	Total Area (s.f.)
1364+40	10.75	0.00	10.75	255.28	6.41	0.00	19.53	281.22
1367+50	42.25	0.00	42.25	255.28	1408.59	0.00	291.00	1954.87
1368+20	34.50	0.00	34.50	255.28	1055.00	0.00	220.28	1530.56
1370+75	35.00	0.00	35.00	255.28	1077.81	0.00	224.84	1557.94
1371+00	40.00	0.00	40.00	255.28	1305.94	0.00	270.47	1831.69
1374+40	15.00	0.00	15.00	255.28	165.31	0.00	42.34	462.94
1390+00	13.00	0.02	13.47	255.28	95.58	21.46	24.09	396.41
1468+70	9.50	0.30	19.11	255.28	353.00	567.72	19.53	1195.53
1474+60	16.00	0.30	30.93	255.28	892.20	567.72	51.47	1766.67
1475+70	11.30	0.30	22.39	255.28	502.32	567.72	19.53	1344.85
1481+00	26.80	0.30	50.57	255.28	1788.11	567.72	150.02	2761.13
1482+00	10.50	0.10	12.75	255.28	62.66	122.45	19.53	459.92
1485+35	11.00	0.05	12.07	255.28	40.34	56.26	19.53	371.41
1487+00	11.00	0.07	12.55	255.28	53.74	81.40	19.53	409.95
1489+25	18.40	0.10	22.04	255.28	486.70	122.45	73.37	937.80
1491+90	13.00	0.10	15.69	255.28	196.85	122.45	24.09	598.67
1494+40	14.20	0.10	17.10	255.28	261.26	122.45	35.04	674.03
1497+80	11.00	0.03	11.62	255.28	28.81	32.70	19.53	336.32
1499+00	16.00	0.10	19.22	255.28	357.88	122.45	51.47	787.07
1504+00	16.00	0.07	18.14	255.28	308.62	81.40	51.47	696.78
1506+20	10.00	0.03	10.58	255.28	1.98	32.70	19.53	309.48
1508+00	13.50	0.07	15.35	255.28	181.18	81.40	28.66	546.52
1514+50	58.50	0.10	69.22	255.28	2639.13	122.45	439.28	3456.14
1515+80	78.00	0.10	92.16	255.28	3685.82	122.45	617.22	4680.77
1517+40	78.00	0.10	92.16	255.28	3685.82	122.45	617.22	4680.77
1520+00	73.00	0.10	86.28	255.28	3417.44	122.45	571.59	4366.76
1527+00	22.00	0.20	32.39	255.28	958.86	297.38	106.22	1617.74
1530+00	12.00	0.10	14.51	255.28	143.17	122.45	19.53	540.43
1533+50	14.00	0.06	15.61	255.28	193.01	68.63	33.22	550.14
1534+00	17.00	0.06	18.90	255.28	343.43	68.63	60.59	727.92
1534+60	17.00	0.05	18.56	255.28	327.77	56.26	60.59	699.91
1537+60	12.50	0.08	14.51	255.28	143.02	94.62	19.53	512.45
1538+00	12.50	0.08	14.51	255.28	143.02	94.62	19.53	512.45
1540+50	11.75	0.12	14.82	255.28	157.24	152.32	19.53	584.37
1594+72	49.20	0.08	56.22	255.28	2045.79	94.62	354.42	2750.11
1641+15	19.80	0.07	22.39	255.28	502.34	81.40	86.14	925.17
1641+75	19.80	0.07	22.39	255.28	502.34	81.40	86.14	925.17
1643+50	9.50	0.07	10.88	255.28	9.70	81.40	19.53	365.91
1645+95	9.50	0.07	10.88	255.28	9.70	81.40	19.53	365.91
1673+55	35.00	0.07	39.37	255.28	1277.20	81.40	224.84	1838.73
1680+25	62.00	0.07	69.54	255.28	2653.60	81.40	471.22	3461.50
1684+20	32.00	0.07	36.02	255.28	1124.27	81.40	197.47	1658.42

Table C-5
(Page 1 of 2)

2/1/05

Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Expand Roza Canal

Notes: Calculate quantities of material to be excavated to enlarge the existing Roza Canal from Sta. 1351+95 (Siphon) to Sta. 1689+89.60 (Wasteway No. 3).
 For Typical Sections see Figure B-3.

ROZA CANAL - Reference Drawings 33-D-1133, 33-D-1134, 33-D-1594

Excavation Volume

Station	Y1 (feet)	Ground Slope	Y2 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
<SIPHON>						
1351+95	9.00	0.03	9.53	Case II	287.50	0
1364+40	10.75	0.00	10.75	Case I	281.22	13,112
1367+50	42.25	0.00	42.25	Case I	1954.87	12,837
1368+20	34.50	0.00	34.50	Case I	1530.56	4,518
1370+75	35.00	0.00	35.00	Case I	1557.94	14,585
1371+00	40.00	0.00	40.00	Case I	1831.69	1,569
1374+40	15.00	0.00	15.00	Case I	462.94	14,448
1390+00	13.00	0.02	13.47	Case I	396.41	24,826
1430+00	8.75	0.03	9.27	Case II	287.50	50,660
1468+70	9.50	0.30	19.11	Case I	1195.53	106,284
1474+60	16.00	0.30	30.93	Case I	1766.67	32,365
1475+70	11.30	0.30	22.39	Case I	1344.85	6,338
1481+00	26.80	0.30	50.57	Case I	2761.13	40,299
1482+00	10.50	0.10	12.75	Case I	459.92	5,965
1485+35	11.00	0.05	12.07	Case I	371.41	5,157
1486+00	3.50	0.05	3.97	Case II	287.50	793
1486+55	3.60	0.05	4.07	Case II	287.50	586
1487+00	11.00	0.07	12.55	Case I	409.95	581
1489+25	18.40	0.10	22.04	Case I	937.80	5,616
1491+90	13.00	0.10	15.69	Case I	598.67	7,540
1492+67	6.00	0.10	7.46	Case II	287.50	1,264
1494+40	14.20	0.10	17.10	Case I	674.03	3,080
1496+40	1.00	0.02	1.10	Case II	287.50	3,561
1496+45	0.00	0.02	0.07	Case II	287.50	53
1497+30	0.00	0.02	0.07	Case II	287.50	905
1497+80	11.00	0.03	11.62	Case I	336.32	578
1499+00	16.00	0.10	19.22	Case I	787.07	2,496
1504+00	16.00	0.07	18.14	Case I	696.78	13,739
1506+20	10.00	0.03	10.58	Case I	309.48	4,100
1508+00	13.50	0.07	15.35	Case I	546.52	2,853
1514+50	58.50	0.10	69.22	Case I	3456.14	48,180
1515+80	78.00	0.10	92.16	Case I	4680.77	19,589
1517+40	78.00	0.10	92.16	Case I	4680.77	27,738
1520+00	73.00	0.10	86.28	Case I	4366.76	43,562
1527+00	22.00	0.20	32.39	Case I	1617.74	77,577
1530+00	12.00	0.10	14.51	Case I	540.43	11,990
1533+50	14.00	0.06	15.61	Case I	550.14	7,068

Table C-5
(Page 2 of 2)

ROZA CANAL - Reference Drawings 33-D-1133, 33-D-1134, 33-D-1594

Station	Y1 (feet)	Ground Slope	Y2 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
1534+00	17.00	0.06	18.90	Case I	727.92	1,183
1534+60	17.00	0.05	18.56	Case I	699.91	1,586
1535+25	0.00	0.03	0.11	Case II	287.50	1,189
1537+60	12.50	0.08	14.51	Case I	512.45	3,481
1538+00	12.50	0.08	14.51	Case I	512.45	759
1538+30	5.00	0.08	5.99	Case II	287.50	444
1540+50	11.75	0.12	14.82	Case I	584.37	3,552
1567+50	8.60	0.03	9.11	Case II	287.50	43,593
1594+72	49.20	0.08	56.22	Case I	2750.11	153,118
<Tunnel No. 5>						
1641+15	19.80	0.07	22.39	Case I	925.17	
1641+75	19.80	0.07	22.39	Case I	925.17	2,056
1643+50	9.50	0.07	10.88	Case I	365.91	4,184
1645+95	9.50	0.07	10.88	Case I	365.91	3,320
<Existing Unlined Section>						
1673+55	35.00	0.07	39.37	Case I	1838.73	
1680+25	62.00	0.07	69.54	Case I	3461.50	65,762
1684+20	32.00	0.07	36.02	Case I	1658.42	37,451
<Existing Unlined Section>						
1689+89.6	<Wasteway No. 3>					

Total Volume = 938,093 cu. yds

Table C-6

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downsteam Plan 2 - Expand Roza Canal

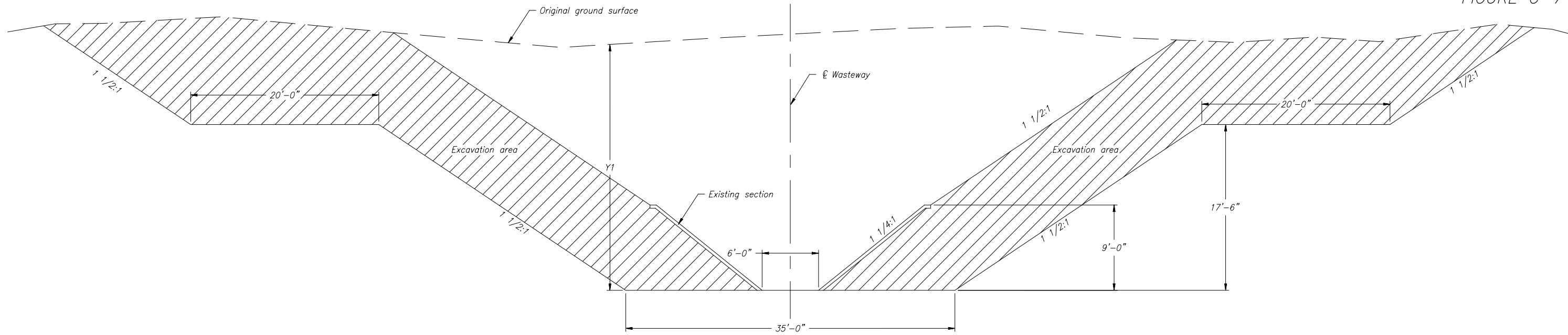
Notes: Calculate embankment volume to enlarge the existing Roza Canal from Sta.1351+95 (Siphon) to Sta.1689+89.60 (Wasteway No. 3). For Typical Sections see Figure B-3.

ROZA CANAL - Reference Drawings 33-D-1133, 33-D-1134, 33-D-1594

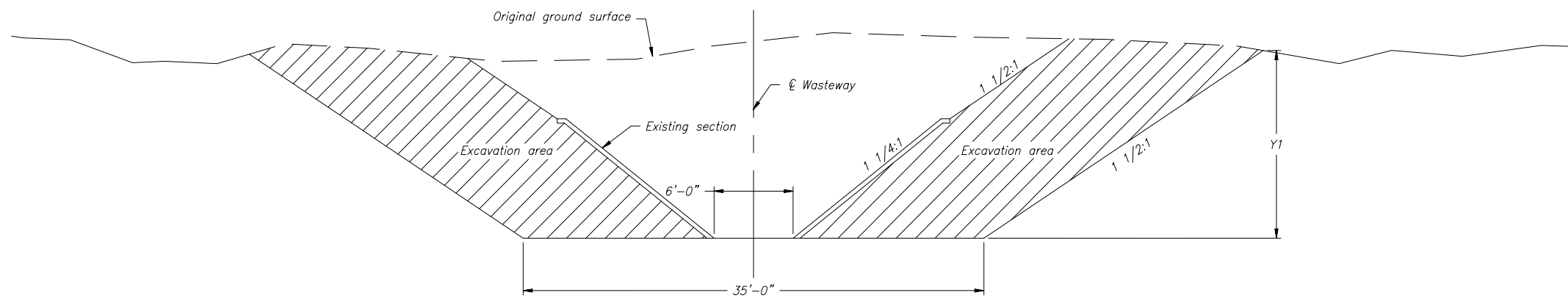
Embankment Volume

Station	Y1 (feet)	Y2 (feet)	Area (sq. ft.)	Volume (cu. yds.)
1351+95	9.00	9.53	104.6	
1364+40	10.75	10.75	55.6	3,692.1
1365+00	12.5	12.5	0.0	61.7
1416+00	12.5	12.5	0.0	0.9
1430+00	8.75	9.27	114.5	2,969.2
1452+00	12.5	12.50	0.0	4,665.9
1485+35	11.00	12.07	22.5	1,388.5
1486+00	3.50	3.97	362.0	462.9
1486+55	3.60	4.07	356.2	731.6
1487+00	12.5	12.50	0.0	296.9
1492+00	12.5	12.50	0.0	0.0
1492+67	6.00	7.46	198.4	246.1
1494+00	12.5	12.50	0.0	488.6
1496+40	1.00	1.10	527.9	2,346.0
1496+45	-8.00	-8.00	1,227.4	162.5
1497+30	-8.00	-8.00	1,227.4	3,864.2
1497+80	11.00	11.62	32.4	1,166.5
1498+50	12.5	12.50	0.0	41.9
1505+00	12.5	12.50	0.0	0.0
1506+20	10.00	10.58	66.8	148.5
1508+00	12.5	12.50	0.0	222.7
1643+00	12.5	12.50	0.0	0.0
1643+50	9.50	10.88	63.8	59.0
1645+95	9.50	10.88	63.8	578.5
1652+50	12.5	12.50	0.0	<u>773.4</u>

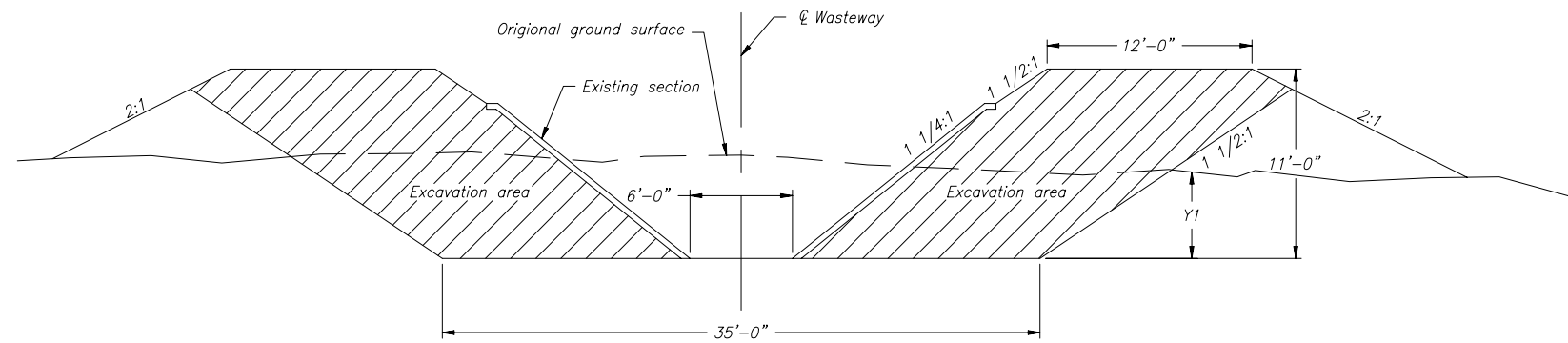
Total Embankment Volume = 24,367.8 cu. yds.



TYPICAL MODIFIED WASTEWAY NO. 3 SECTION-CASE I EXCAVATION AREA GEOMETRY
 $Y1 > 17'-6''$



TYPICAL MODIFIED WASTEWAY NO. 3 SECTION-CASE II EXCAVATION AREA GEOMETRY
 $11'-0'' < Y1 < 17'-6''$



TYPICAL MODIFIED WASTEWAY NO. 3 SECTION-CASE III EXCAVATION AREA GEOMETRY
 $Y1 < 11'-0''$

NOTE:
1. Y1 distance is estimated from 33-D-1716.

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BLACK ROCK RESERVOIR STUDY
DELIVERY SYSTEM TO SUNNYSIDE DIVISION
PLAN 2-CANAL MODIFICATION
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FOR QUANTITY CALCULATIONS

Concept Designer: Steve Montague
Drafter: Leland Boekweg

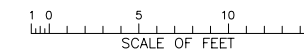


Table C-8
(Page 1 of 3)

2/1/05

Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Expand Roza Canal

Notes: Calculate quantities of material to be excavated to enlarge the existing Roza Wasteway No. 3 from Sta. 2+17.72 to Sta. 95+00. For Typical Sections see Figure B-7.

Wasteway No. 3 - Reference Drawing 33-D-1716

Excavation Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
2+17.72	6.00	Case III	348.25	
8+00	6.00	Case III	348.25	7,510
10+00	8.00	Case III	348.25	2,580
10+70	5.00	Case III	348.25	903
11+00	7.50	Case III	348.25	387
12+00	7.50	Case III	348.25	1,290
13+25	5.50	Case III	348.25	1,612
14+00	9.00	Case III	348.25	967
15+10	5.50	Case III	348.25	1,419
17+05	9.50	Case III	348.25	2,515
18+20	7.00	Case III	348.25	1,483
18+40	9.00	Case III	348.25	258
20+00	6.00	Case III	348.25	2,064
22+00	10.00	Case III	348.25	2,580
28+00	5.00	Case III	348.25	7,739
30+00	11.50	Case II	365.00	2,642
30+50	11.00	Case III	348.25	660
31+55	6.00	Case III	348.25	1,354
33+00	13.00	Case II	415.25	2,050
35+00	2.00	Case III	348.25	2,828
36+15	9.00	Case III	348.25	1,483
37+00	13.00	Case II	415.25	1,202
38+00	10.00	Case III	348.25	1,414
39+20	11.50	Case II	365.00	1,585
40+20	-4.50	Case III	348.25	1,321
40+85	5.50	Case III	348.25	838
41+50	9.00	Case III	348.25	838
45+55	8.50	Case III	348.25	5,224
47+50	17.00	Case II	549.25	3,241
48+00	10.00	Case III	348.25	831
49+00	5.00	Case III	348.25	1,290
50+40	18.00	Case I	602.75	2,466
51+25	16.00	Case II	515.75	1,761
51+75	-1.00	Case III	348.25	800
52+20	14.50	Case II	465.50	678

Table C-8
(Page 2 of 3)

Wasteway No. 3 - Reference Drawing 33-D-1716

Excavation Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
52+55	5.00	Case III	348.25	527
52+90	11.50	Case II	365.00	462
53+30	11.00	Case III	348.25	528
53+60	6.50	Case III	348.25	387
54+00	10.00	Case III	348.25	516
55+45	7.00	Case III	348.25	1,870
55+60	5.50	Case III	348.25	193
56+00	10.00	Case III	348.25	516
57+30	9.50	Case III	348.25	1,677
59+10	14.50	Case II	465.50	2,713
60+00	18.50	Case I	639.50	1,842
61+10	17.00	Case II	549.25	2,422
61+75	6.50	Case III	348.25	1,080
61+99	5.75	Case III	348.25	310
63+10	10.00	Case III	348.25	1,432
64+50	6.75	Case III	348.25	1,806
65+50	14.00	Case II	448.75	1,476
66+00	13.25	Case II	423.63	808
66+50	11.00	Case III	348.25	715
66+80	1.25	Case III	348.25	387
67+15	1.25	Case III	348.25	451
67+50	6.00	Case III	348.25	451
67+80	2.50	Case III	348.25	387
69+00	1.50	Case III	348.25	1,548
70+00	5.00	Case III	348.25	1,290
73+00	10.00	Case III	348.25	3,869
76+00	8.50	Case III	348.25	3,869
78+00	12.00	Case II	381.75	2,704
79+00	16.00	Case II	515.75	1,662
81+35	12.00	Case II	381.75	3,906
81+60	17.00	Case II	549.25	431
82+50	19.50	Case I	713.00	2,104
83+00	13.75	Case II	440.38	1,068
83+55	12.50	Case II	398.50	854
83+85	7.50	Case III	348.25	415

Table C-8
(Page 3 of 3)

Wasteway No. 3 - Reference Drawing 33-D-1716

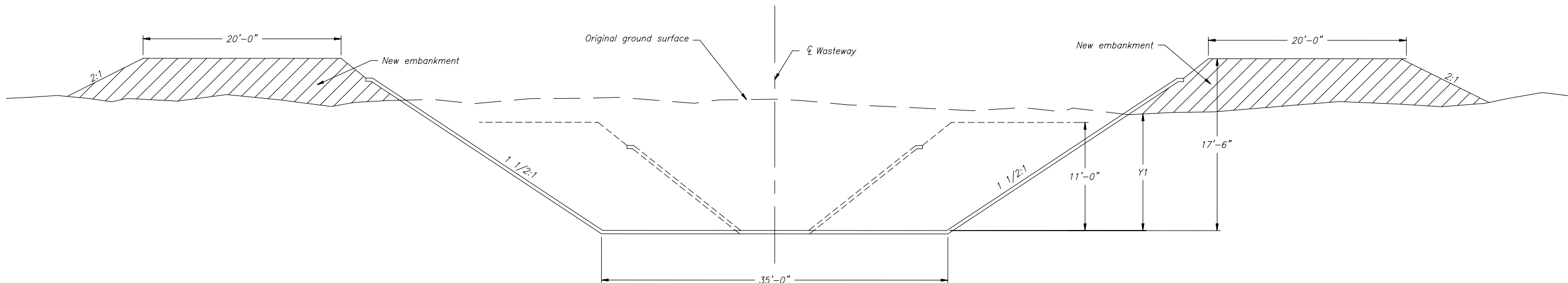
Excavation Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
84+10	10.00	Case III	348.25	322
85+00	9.00	Case III	348.25	1,161
88+00	15.00	Case II	482.25	4,614
88+70	9.50	Case III	348.25	1,077
89+70	8.75	Case III	348.25	1,290
90+90	13.50	Case II	432.00	1,734
92+00	13.00	Case II	415.25	1,726
93+00	26.00	Case I	1190.75	2,974
95+00	25.00	Case I	1117.25	8,548

Total Excavation Volume = 137,933 Cubic yards

D

D



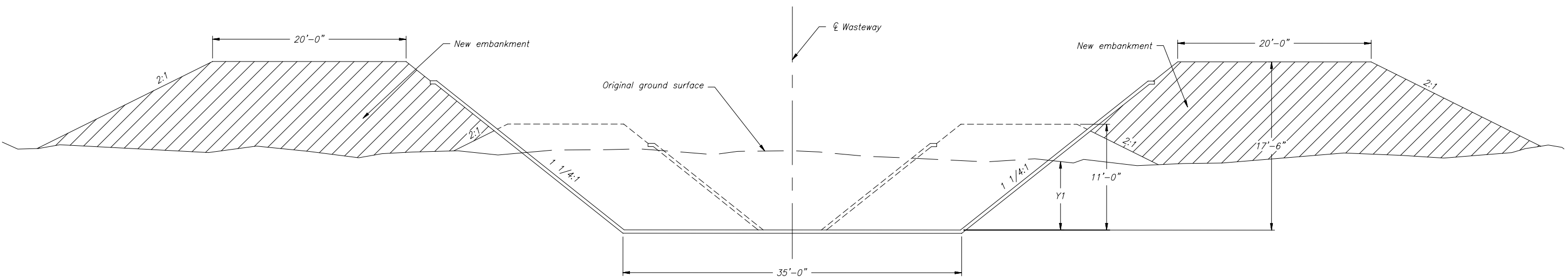
TYPICAL MODIFIED WASTEWAY NO. 3 SECTION—CASE II EMBANKMENT AREA
 $11'-0" < Y1 < 17'-6"$

C

C

B

B

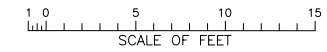



TYPICAL MODIFIED WASTEWAY NO. 3 SECTION—CASE III EMBANKMENT AREA
 $Y1 < 11'-0"$

- NOTES:
1. Case I—No embankment required.
 2. Y1 distance is estimated from 33-D-1716.

DATE AND TIME PLOTTED:
 JANUARY 28, 2005 15:16
 PLOTTED BY:
 LBOEKWEG

CAD SYSTEM:
 AutoCAD Rvl. 16.0
 CAD FILENAME:
 FIGURE C-9.DWG



 ALWAYS THINK SAFETY

UNITED STATES
 DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION
 YAKIMA PROJECT—WASHINGTON

BLACK ROCK RESERVOIR STUDY
 DELIVERY SYSTEM TO SUNNYSIDE DIVISION
 PLAN 2—CANAL MODIFICATION
 TYPICAL CANAL AND WASTEWAY SECTIONS
 FOR QUANTITY CALCULATIONS

Concept Designer: Steve Montague
 Drafter: Leland Boekweg

BOISE, IDAHO SHEET 1 OF 1 2004-07-29 FIGURE C-9

Table C-10
(Page 1 of 3)

Date: 2/1/05
Project: Black Rock Reservoir - Preliminary Design
Feature: Water Delivery to Sunnyside Division
Details: Downstream Plan 2 - Expand Roza Canal

Notes: Calculate embankment quantities required to enlarge the existing Roza Wasteway No. 3 from Sta. 2+17.72 to Sta. 95+00. For Typical Sections see Figure B-9.

Wasteway No. 3 - Reference Drawing 33-D-1716

Embankment Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
2+17.72	6.00	Case III	832.88	
8+00	6.00	Case III	832.88	17,962
10+00	8.00	Case III	662.88	5,540
10+70	5.00	Case III	917.88	2,049
11+00	7.50	Case III	705.38	902
12+00	7.50	Case III	705.38	2,613
13+25	5.50	Case III	875.38	3,659
14+00	9.00	Case III	577.88	2,018
15+10	5.50	Case III	875.38	2,960
17+05	9.50	Case III	535.38	5,094
18+20	7.00	Case III	747.88	2,733
18+40	9.00	Case III	577.88	491
20+00	6.00	Case III	832.88	4,180
22+00	10.00	Case III	492.88	4,910
28+00	5.00	Case III	917.88	15,675
30+00	11.50	Case II	366.01	4,755
30+50	11.00	Case III	407.88	717
31+55	6.00	Case III	832.88	2,413
33+00	13.00	Case II	250.88	2,910
35+00	2.00	Case III	1172.88	5,273
36+15	9.00	Case III	577.88	3,728
37+00	13.00	Case II	250.88	1,305
38+00	10.00	Case III	492.88	1,377
39+20	11.50	Case II	366.01	1,909
40+20	-4.50	Case III	1725.38	3,873
40+85	5.50	Case III	875.38	3,131
41+50	9.00	Case III	577.88	1,749
45+55	8.50	Case III	620.38	8,987
47+50	17.00	Case II	20.88	2,316
48+00	10.00	Case III	492.88	476
49+00	5.00	Case III	917.88	2,613
50+40	18.00	Case I	0.00	2,380
51+25	16.00	Case II	67.88	107
51+75	-1.00	Case III	1427.88	1,385
52+20	14.50	Case II	151.51	1,316

Table C-10
(Page 2 of 3)

Wasteway No. 3 - Reference Drawing 33-D-1716

Embankment Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
52+55	5.00	Case III	917.88	693
52+90	11.50	Case II	366.01	832
53+30	11.00	Case III	407.88	573
53+60	6.50	Case III	790.38	666
54+00	10.00	Case III	492.88	951
55+45	7.00	Case III	747.88	3,332
55+60	5.50	Case III	875.38	451
56+00	10.00	Case III	492.88	1,014
57+30	9.50	Case III	535.38	2,475
59+10	14.50	Case II	151.51	2,290
60+00	18.50	Case I	0.00	253
61+10	17.00	Case II	20.88	43
61+75	6.50	Case III	790.38	977
61+99	5.75	Case III	854.13	731
63+10	10.00	Case III	492.88	2,769
64+50	6.75	Case III	769.13	3,272
65+50	14.00	Case II	182.88	1,763
66+00	13.25	Case II	233.22	385
66+50	11.00	Case III	407.88	594
66+80	1.25	Case III	1236.63	914
67+15	1.25	Case III	1236.63	1,603
67+50	6.00	Case III	832.88	1,341
67+80	2.50	Case III	1130.38	1,091
69+00	1.50	Case III	1215.38	5,213
70+00	5.00	Case III	917.88	3,950
73+00	10.00	Case III	492.88	7,838
76+00	8.50	Case III	620.38	6,185
78+00	12.00	Case II	325.88	3,505
79+00	16.00	Case II	67.88	729
81+35	12.00	Case II	325.88	1,714
81+60	17.00	Case II	20.88	161
82+50	19.50	Case I	0.00	35
83+00	13.75	Case II	199.22	184
83+55	12.50	Case II	287.51	496
83+85	7.50	Case III	705.38	552

Table C-10
(Page 3 of 3)

Wasteway No. 3 - Reference Drawing 33-D-1716

Embankment Quantities

Station	Y1 (feet)	Typical Section	Area (sq. ft.)	Volume (cu. yds.)
84+10	10.00	Case III	492.88	555
85+00	9.00	Case III	577.88	1,785
88+00	15.00	Case II	121.88	3,888
88+70	9.50	Case III	535.38	852
89+70	8.75	Case III	599.13	2,101
90+90	13.50	Case II	216.01	1,811
92+00	13.00	Case II	250.88	951
93+00	26.00	Case I	0.00	465
95+00	25.00	Case I	0.00	0

Total Embankment Volume = 195,481 Cubic yards

**APPENDIX D – DELIVERY TO SUNNYSIDE WATER
USERS UPSTREAM FROM MP 3.83**

Date: 2/1/05

Table D-1

Project: Black Rock Reservoir - Preliminary Design

Feature: Water Delivery to Sunnyside Division

Details: Pipe Hydraulics - Delivery to Sunnyside Water Users Upstream from MP 3.83

Notes: Flow delivery to individual users upstream from gravity delivery system at MP 3.83. Assumes a pressure flow delivery for possible conversion to pipe system. Assume a Hazen-Williams roughness coefficient C = 150.

Mile	Delivery Flow (cfs)	Total Flow (cfs)	Pipe Diameter (inches)	Pipe Length (feet)	Delivery Pressure (psi)
0.61	0.13	0.13	6	53	35.00
0.62	0.22	0.35	6	317	35.01
0.68	0.10	0.45	6	211	35.26
0.72	0.12	0.57	8	1267	35.53
0.96	0.22	0.79	8	475	36.14
1.05	0.15	0.94	8	1214	36.57
1.28	0.22	1.16	10	1690	38.04
1.60	0.27	1.43	10	1795	39.07
1.94	0.22	1.65	10	739	40.67
2.08	0.29	1.94	10	370	41.53
2.15	0.21	2.15	10	1056	42.12
2.35	2.78	4.93	10	53	44.13
2.36	0.19	5.12	10	53	44.60
2.37	0.21	5.33	16	686	45.10
2.50	0.25	5.58	16	1267	45.82
2.74	0.74	6.32	16	950	47.25
2.92	5.46	11.78	16	1426	48.61
3.19	1.28	13.05	16	1584	55.06
3.49	1.00	14.06	18	422	63.74
3.57	1.76	15.82	18	264	65.23
3.62	0.99	16.81	18	1109	66.40
3.83	<Powerplant>				

**APPENDIX E – FIELD CONSTRUCTION COST
ESTIMATE WORKSHEETS**

Table E-1. ESTIMATE WORKSHEET

FEATURE: <i>Preliminary Appraisal Assessment of Black Rock Delivery System for Sunnyside Division</i> <i>Downstream Plan 1 - Delivery Pipeline</i>		PROJECT: Yakima River Basin Water Storage Feasibility Study, Washington	
		REGION	PRICE LEVEL:
		FILE: D:\Vickie Main Directory\Black Rock Feas Study\Sunnyside Rpt\Appendices\App E\[Table E-1 Estimate Worksheet Option 1w_del.xls]Sheet 2	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		12 ft. Dia. Steel Delivery Pipe					
	1	Clearing and grubbing		93	acres	\$5,000.00	\$465,000.00
	2	Excavation (common)		884,000	CY	\$5.00	\$4,420,000.00
	3	Excavation (rock)		156,000	CY	\$12.00	\$1,872,000.00
	4	Soil cement bedding		7,840	CY	\$75.00	\$588,000.00
	5	Placing and compacting backfill		890,000	CY	\$6.00	\$5,340,000.00
	6	12 ft. dia. steel pipe, A572 GR 60 steel		62,000,000	lbs	\$2.00	\$124,000,000.00
		Check Structure on Sunnyside Canal					
	7	Structural excavation (common)		1,060	CY	\$7.00	\$7,420.00
	8	Placing and compacting backfill		750	CY	\$6.00	\$4,500.00
	9	Concrete in structures		250	CY	\$750.00	\$187,500.00
	10	Langemann gates (26ft. long x 10 ft. tall)		2	ea	\$45,000.00	\$90,000.00
		Sunnyside Upstream Delivery Pipe					
	11	Pumping plant (pump, structure, elec.)		1	LS	\$350,000.00	\$350,000.00
	12	Excavation, pipe (common)		40,500	CY	\$5.00	\$202,500.00
	13	Placing and compacting backfill		39,500	CY	\$6.00	\$237,000.00
	14	PVC pipe (diameter varies 18-inch tp 6-inch)		1	LS	\$440,000.00	\$440,000.00
		Subtotal of Pay Items - Sheet 1 of 2					\$138,203,920.00

QUANTITIES		PRICES	
BY	CHECKED	BY	CHECKED
DATE PREPARED	PEER REVIEW	DATE PREPARED	PEER REVIEW

Table E-2. ESTIMATE WORKSHEET

FEATURE: <i>Preliminary Appraisal Assessment of Black Rock Delivery System for Sunnyside Division</i> <i>Downstream Plan 2 - Modified Roza Canal</i>		PROJECT: Yakima River Basin Water Storage Feasibility Study, Washington			
		REGION	PN	PRICE LEVEL	Appraisal
		FILE: D:\Vickie Main Directory\Black Rock Feas Study\Sunnyside Rpt\Appendices\App E\Table E-2 Estimate Worksheet Option 2.xls]Sheet 1			

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Siphon, Sta. 1349+30 to Sta. 1351+95					
	1	Concrete demolition of existing siphon		620	CY	\$80.00	\$49,600.00
	2	Structural excavation (common)		18,400	CY	\$7.00	\$128,800.00
	3	Concrete		1,070	CY	\$750.00	\$802,500.00
	4	Placing and compacting backfill		15,100	CY	\$6.00	\$90,600.00
		Canal, Sta. 1351+95 to Sta. 1594+72					
	5	Concrete demoloition of existing lining		13,900	CY	\$80.00	\$1,112,000.00
	6	Excavation (common)		830,000	CY	\$5.00	\$4,150,000.00
	7	Embankment		23,000	CY	\$6.00	\$138,000.00
	8	Gravel surfacing		12,000	CY	\$30.00	\$360,000.00
	9	Concrete in canal lining		22,000	CY	\$350.00	\$7,700,000.00
	10	Concrete in bridges		390	CY	\$750.00	\$292,500.00
	11	Structural steel in bridges		455,000	lbs	\$2.00	\$910,000.00
		Tunnel No. 5, Sta.1594+72 to Sta.1634+60					
	12	Tunnel excavation (all classes)		31,500	CY	\$155.00	\$4,882,500.00
	13	Concrete in tunnel lining		7,000	CY	\$500.00	\$3,500,000.00
	14	Concrete in portal structures and transitions		150	CY	\$750.00	\$112,500.00
	15	Steel tunnel supports		450,000	lbs	\$2.00	\$900,000.00
	16	Steel tunnel liner plates		30,000	lbs	\$2.00	\$60,000.00
		Subtotal of Pay Items - Sheet 1 of 4					\$25,189,000.00

QUANTITIES		PRICES	
BY	CHECKED	BY	CHECKED
DATE PREPARED	PEER REVIEW	DATE PREPARED	PEER REVIEW

Table E-2. ESTIMATE WORKSHEET

FEATURE: <i>Preliminary Appraisal Assessment of Black Rock Delivery System for Sunnyside Division</i> Downstream Plan 2 - Modified Roza Canal	PROJECT: Yakima River Basin Water Storage Feasibility Study, Washington	
	REGION	PRICE LEVEL:
	FILE: <small>D:\Vickie Main Directory\Black Rock Feas Study\Sunnyside Rpt\Appendices\App E\Table E-2 Estimate Worksheet Option 2.xls\Sheet 1</small>	

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Canal, Sta.1634+60 to Sta.1689+89					
	17	Concrete demolition of existing lining		1,260	CY	\$80.00	\$100,800.00
	18	Excavation (common)		115,000	CY	\$5.00	\$575,000.00
	19	Embankment		1,400	CY	\$6.00	\$8,400.00
	20	Gravel surfacing		2,700	CY	\$30.00	\$81,000.00
	21	Concrete in canal lining		5,000	CY	\$350.00	\$1,750,000.00
		Wasteway No. 3					
	22	Structural excavation for turnout structure		1,670	CY	\$7.00	\$11,690.00
	23	Concrete in turnout structure		300	CY	\$750.00	\$225,000.00
	24	Placing and compacting backfill for turnout structure		650	CY	\$6.00	\$3,900.00
	25	6' x 6' sluice gates		3	ea	\$45,000.00	\$135,000.00
	26	Concrete demolition of existing lining		4,100	CY	\$80.00	\$328,000.00
	27	Excavation for wasteway modification (common)		140,000	CY	\$5.00	\$700,000.00
	28	Embankment		195,000	CY	\$6.00	\$1,170,000.00
	29	Gravel surfacing		4,500	CY	\$30.00	\$135,000.00
	30	Concrete in canal lining		10,500	CY	\$350.00	\$3,675,000.00
	31	Structural excavation for check structures		12,700	CY	\$7.00	\$88,900.00
	32	Concrete in check structures		1,230	CY	\$750.00	\$922,500.00
	33	Placing and compacting backfill		3,800	CY	\$6.00	\$22,800.00
	34	Langemann gates (26 ft long x 10 ft tall)		9	ea	\$45,000.00	\$405,000.00
		Subtotal of Pay Items- Sheet 2 of 4					\$10,337,990.00

QUANTITIES		PRICES	
BY	CHECKED	BY	CHECKED
DATE PREPARED	PEER REVIEW	DATE PREPARED	PEER REVIEW

FEATURE: <i>Preliminary Appraisal Assessment of Black Rock Delivery System for Sunnyside Division</i> <i>Downstream Plan 2 - Modified Roza Canal</i>		PROJECT: Yakima River Basin Water Storage Feasibility Study, Washington	
		REGION	PRICE LEVEL:
		FILE: D:\Vickie Main Directory\Black Rock Feas Study\Sunnyside Rpt\Appendices\App E\Table E-2 Estimate Worksheet Option 2.xls\Sheet 1	

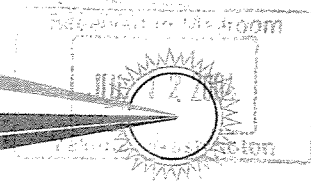
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Pipeline to Sunnyside					
	35	Structural excavation for turnout structure		5,100	CY	\$7.00	\$35,700.00
	36	Concrete in turnout structure		480	CY	\$750.00	\$360,000.00
	37	Placing and compacting backfill		3,000	CY	\$6.00	\$18,000.00
	38	6' x 6' sluice gates		3	ea	\$45,000.00	\$135,000.00
	39	Clearing and grubbing for pipe construction		12	acres	\$5,000.00	\$60,000.00
	40	Excavation for pipe (common)		92,000	CY	\$5.00	\$460,000.00
	41	Soil cement pipe bedding		1,020	CY	\$75.00	\$76,500.00
	42	Placing and compacting backfill for pipe		73,000	CY	\$6.00	\$438,000.00
	43	12 ft dia. Steel pipe (A36 steel)		3,100,000	lbs	\$2.00	\$6,200,000.00
		Check Structure on Sunnyside Canal					
	44	Structural excavation (common)		1,060	CY	\$7.00	\$7,420.00
	45	Placing and compacting backfill		750	CY	\$6.00	\$4,500.00
	46	Concrete in structures		250	CY	\$750.00	\$187,500.00
	47	Langemann gates (26ft. long x 10 ft. tall)		2	ea	\$45,000.00	\$90,000.00
		Sunnyside Upstream Delivery Pipe					
	48	Pumping plant (pump, structure, elec.)		1	LS	\$350,000.00	\$350,000.00
	49	Excavation, pipe (common)		40,500	CY	\$5.00	\$202,500.00
	50	Placing and compacting backfill		39,500	CY	\$6.00	\$237,000.00
	51	PVC pipe (diameter varies 18-inch tp 6-inch)		1	LS	\$440,000.00	\$440,000.00
		Subtotal of Pay Items - Sheet 3 of 4					\$9,302,120.00

QUANTITIES		PRICES	
BY	CHECKED	BY	CHECKED
DATE PREPARED	PEER REVIEW	DATE PREPARED	PEER REVIEW

**APPENDIX F – SUNNYSIDE VALLEY IRRIGATION
DISTRICT COMMENTS**

PR3-1.10

SUNNYSIDE
VALLEY
IRRIGATION
DISTRICT



SERVING AGRICULTURE SINCE 1906

BUREAU OF RECLAMATION
OFFICIAL FILE COPY

MAIL CODE	ACTION	INIT & DATE	COPY
1000			
1100			
1200			
1600			
1750			
2000			
2500			
1120		KJM 7/3/02	
1108			
ACTION TAKEN:			
FOLDER #: 2944			
CONTROL #: 4001229			

July 7, 2004

Kim McCartney, Storage Study Manager
Bureau of Reclamation
1917 Marsh Road
Yakima, WA 98901-2058

Re: Comments on Black Rock Delivery System for Sunnyside Division

Dear Mr. McCartney:

Thank you for the opportunity to comment on the Black Rock Delivery System for Sunnyside Division. As we review the technical material, policy questions arise. Although you or others may not be able to address them immediately the Board of Directors want these issues identified early in the review process so that there is the understanding these issues will be addressed at some point along the way. As a result, the following comments contain both technical and policy issues some of which can be addressed sooner than others.

1. We have been advised informally that the Sunnyside Division will not be allocated any of the capital costs of the reservoir. Does that also include the delivery system?
2. Will the Sunnyside Division be responsible for any of the operation and maintenance costs for the reservoir storage or the delivery system? Even though there is a power generating plant at the point of discharge to the Sunnyside Canal, there will still be a net energy requirement. Has that been quantified?

Letter to Kim McCartney

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3. Will the delivery system be a reserved works or a transferred works? The chance of failure is remote but damages due to failure from either internal or external causes would be substantial and place an unreasonable financial burden on the Sunnyside Division.
4. Given the size of pumps, motors, transformers, valves, etc. replacement equipment will not likely be "off the shelf" items. Will the delivery system be built with any redundancy to provide assurance of service in the event of equipment failure?
5. On page 2, reference is made to the use of 12 foot diameter pipe to "keep velocities under 12 fps." Velocities in that range seem excessive.
6. On page 3, the report notes that 17 cfs is required upstream. 20 cfs was the amount submitted to the study team by SVID.
7. The tabulation of "Delivery Pressure" in Table A-4 in Appendix A shows pressures of less than 40 p.s.i. for the first 8 delivery points. The delivery pressure should be at least 40 p.s.i.
8. We are not aware of current thinking as to the need to keep Columbia River water (to the extent possible) out of the Yakima River. If that concern exists, then the first 3.83 miles of the Sunnyside Canal and its current point of diversion will need to remain in place and maintained to be operable for the months of March and October. This will require a structure to permit passage of water downstream certain months of the year and restrict water from flowing upstream other months of the year.

9. We have no technical comments regarding Option 2 in which the water supply for the Sunnyside Division would be transported through the Roza Canal. However there is a key policy issue of linking the Roza and Sunnyside Canal operations together which the Board of Directors will need to evaluate.

10. Finally, probably the most fundamental policy issues are the effect of the proposed water exchange on the priority dates of the Sunnyside Division water rights and the current contracts between the Bureau of Reclamation and the Sunnyside Division entities. The Sunnyside Division contains an aggregation of priority dates some of which are the oldest in the Yakima Basin. As a practical matter, a later priority date will not be an issue if upon evaluation of the water supply it is determined there would never be curtailments even with a later priority date. However it is sure to be a perception problem to some landowners in the Sunnyside Division. Potential questions concerning new or re-opened contracts seem self evident.

Thanks again for the opportunity to provide comments.

Sincerely,



James W. Trull

District Manager

