APPENDIX A

Final Results for Refined Options 4 and 5

Table A-1. Comparison of Reductions to Target Flow Shortages for Combined Reservoir Operations Options 4 and 5

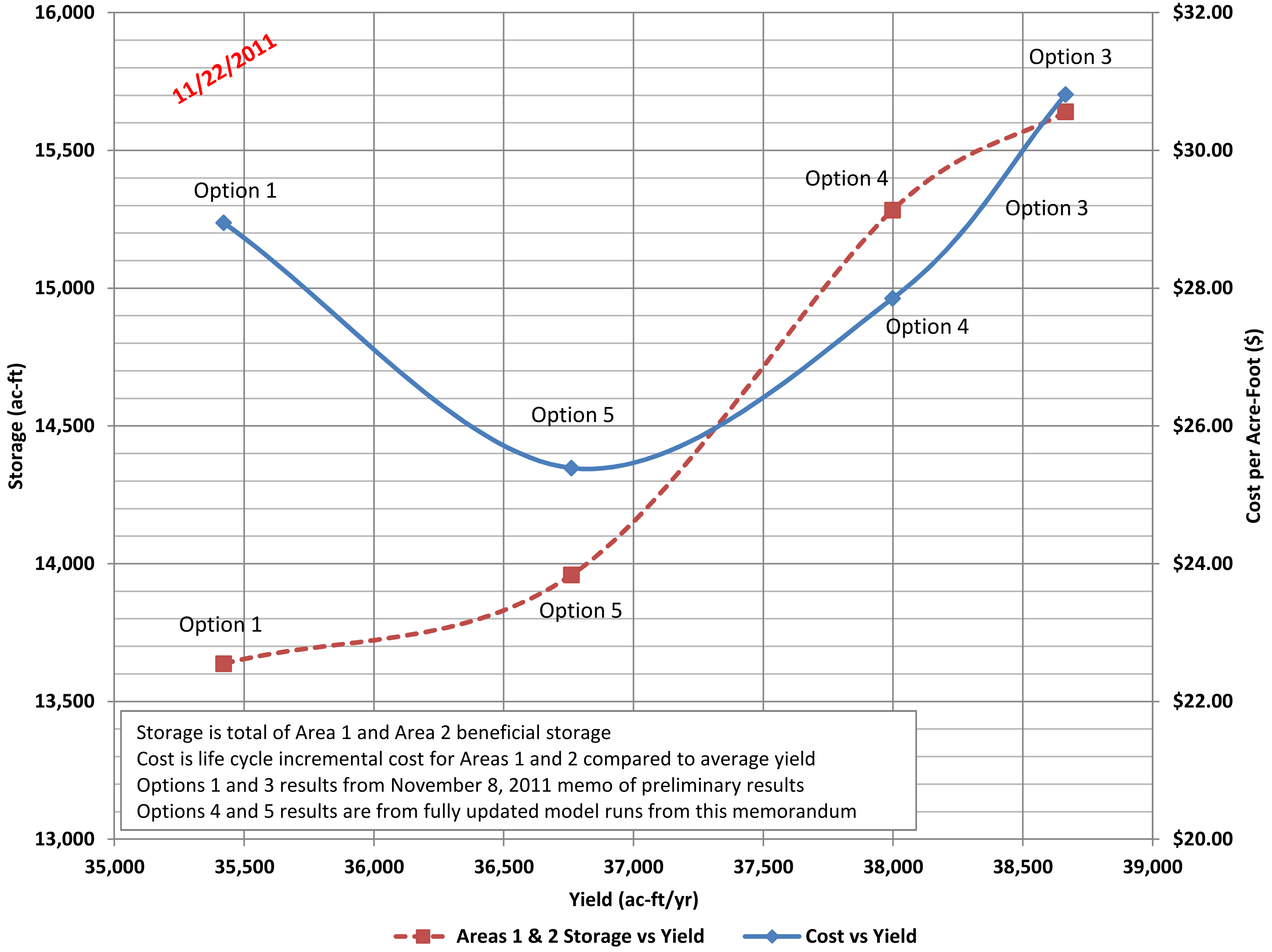
11/22/2011

		OPTION 4[1]		OPTION 5[2]		Comparison of Options 4 and 5	
		Phelps Canal Capacity=1,000 cfs, Area 2 Available Outside of June 15-August 31 Irrigation Season	Phelps Canal Capacity=1,675 cfs, Area 2 Available Outside of June 15-August 31 Irrigation Season	Phelps Canal Capacity=1,000 cfs, Area 2 Available Outside of June 15-August 31 Irrigation Season	Phelps Canal Capacity=1,675 cfs, Area 2 Available Outside of June 15-August 31 Irrigation Season	Reduction in Yield for Phelps Canal Capacity= 1,000 cfs	Reduction in Yield for Phelps Canal Capacity= 1,675 cfs
Year	Year Type	Yield (ac-ft)	Yield (ac-ft)	Yield (ac-ft)	Yield (ac-ft)		
1997	Wet	52,725	52,393	51,343	51,082	2.6%	2.5%
1998	Wet	70,479	76,989	66,496	73,024	5.7%	5.2%
1999	Wet	48,830	48,795	46,297	46,263	5.2%	5.2%
2000	Wet	64,468	67,763	61,924	65,225	3.9%	3.7%
2001	Normal	57,685	60,138	55,806	57,199	3.3%	4.9%
2002	Dry	25,043	25,244	23,868	24,052	4.7%	4.7%
2003	Dry	10,667	13,165	10,669	13,165	0.0%	0.0%
2004	Dry	2,464	2,776	2,464	2,776	0.0%	0.0%
2005	Dry	13,075	15,081	13,075	15,081	0.0%	0.0%
2006	Dry	8,619	9,755	8,619	9,755	0.0%	0.0%
2007	Dry	39,639	45,837	37,851	45,466	4.5%	0.8%
2008	Normal	27,187	38,041	27,187	38,041	0.0%	0.0%
	Average All:	35,073	37,998	33,800	36,761	3.6%	3.3%
	Average Wet:	59,126	61,485	56,515	58,898	4.4%	4.2%
	Average Normal:	42,436	49,090	41,496	47,620	2.2%	3.0%
	Average Dry:	16,584	18,643	16,091	18,382	3.0%	1.4%
Area 1 Beneficial Storage, ac-ft[3]		10,473	10,473	10,473	10,473		
Area 2 Beneficial Storage, ac-ft[3]		4,810	4,810	3,486	3,486		
Areas 1 & 2 Beneficial Storage, ac-ft[3]		15,283	15,283	13,959	13,959		

Notes:

1. Hydrocycling mitigation is included, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Option 4 stage-storage
2. Hydrocycling mitigation is included, no pumping into Area 2, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Option 5 stage-storage
3. Options 4 and 5 storage areas included a dead pool over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage volume.

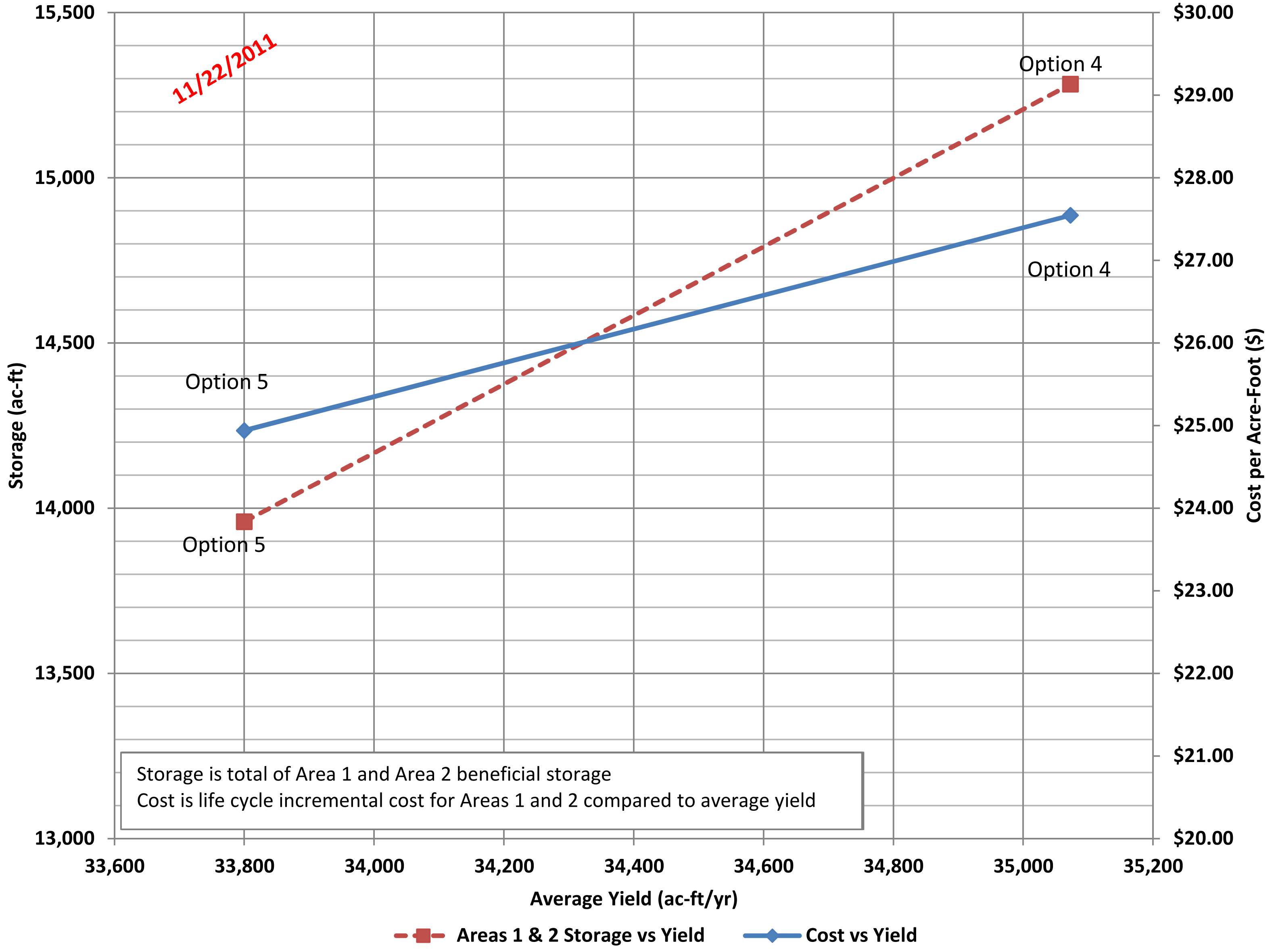
Figure A-1. Comparison of Incremental Costs of J-2 Options 1, 3, 4 and 5 with Phelps Canal



11/22/2011

Storage is total of Area 1 and Area 2 beneficial storage
Cost is life cycle incremental cost for Areas 1 and 2 compared to average yield
Options 1 and 3 results from November 8, 2011 memo of preliminary results
Options 4 and 5 results are from fully updated model runs from this memorandum

Figure A-2. Comparison of Incremental Costs of J-2 Options 4 and 5 without Phelps Canal



11/22/2011

Storage is total of Area 1 and Area 2 beneficial storage
Cost is life cycle incremental cost for Areas 1 and 2 compared to average yield

Table A-2. J-2 Alternatives Operation and Maintenance Costs without Phelps Canal

11/22/2011

Alternative	Beneficial Storage, acre-feet	Capital Costs ($000)	Operation Cost Rate	Pumped acre-feet	Pumping Costs @ $1.60/ac-ft ($000)	Pump Replacement ($000)	Annual Operating Cost ($000)	Equivalent Annual Cost ($000)	SDHF Augmentation, cfs	SDHF Augmentation, ac-ft/yr	Reductions to Shortages to Target Flows, Average Year ac-ft/yr	Delivered total ac-ft/yr	Life Cycle Cost per ac-ft
J -2 Option 4	15,283	$45,949	0.75%	5,300	8.48	10	$374.76	$1,293.95	2,000	11,901	35,073	46,974	$27.55
J -2 Option 5	13,959	$41,446	0.75%	0	0	0	$310.85	$1,139.77	2,000	11,901	33,800	45,701	$24.94

Assumptions

1. Option 4 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,000 cfs
2. Option 5 includes hydrocycle mitigation, no pumping into Area 2, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,000 cfs
3. Options 4 and 5 storage areas included a dead pool of water over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage volume.
4. Life Cycle is 50 years.
5. Interest is not included in cost calculation.
6. Annual operations and maintenance cost of reservoirs is 0.75% of initial construction cost plus an additional 0.5% for the pump station.
7. Pumps will need to be replaced every 25 years.
8. Cost of pumping is $1.60 per acre-foot.
9. SDHF Augmentation is based on 3 days at 2000 cfs. Though the units are ac-ft per year, the values presented are the total volume of SDHF aufmentation flows provided by the alernative over three days.
10. Water to reduce shortages to target flows is excess flows in CNPPID's system that could be stored during times of excess, and released during periods of shortage.

Table A-3. Option 4 without Phelps Canal Upgrade

Option 4

J-2 - Alternative 2, Area 1 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

11/22/2011

Subtotal = **$ 13,966,291**

30% Construction Contingency = **$ 4,189,887**

Probable Construction Costs = **$ 18,156,178**

Design (8%) = **$ 1,452,494**

Permitting (2.5%) = **$ 453,904**

Administrative and Legal (2.5%) = **$ 453,904**

Construction Management and Administration (7%) = **$ 1,270,932**

Land Acquisition Costs (718 ac @ $4,000 per ac plus three structures) = **$ 3,472,000**

Total Estimated Project Cost = **$ 25,259,414**

Option 4

J-2 - Alternative 2, Area 2 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 264,947.20	$ 264,947.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	20' w x 24' h Radial Gate Outlet (1@20'w x 24'h) with Controls, Elec. & Assoc. Work	1	EA	$ 1,479,000.00	$ 1,479,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
15	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
16	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
17	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
18	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00

11/22/2011

Subtotal = **$ 12,378,075**

30% Construction Contingency = **$ 3,713,423**

Probable Construction Costs = **$ 16,091,498**

Design (8%) = **$ 1,287,320**

Permitting (2.5%) = **$ 402,287**

Administrative and Legal (2.5%) = **$ 402,287**

Construction Management and Administration (7%) = **$ 1,126,405**

Land Acquisition Costs (345 ac @ $4,000 per ac) = **$ 1,380,000**

Total Estimated Project Cost = **$ 20,689,797**

Total Area 1 and 2 **$ 45,949,211**

Table A-4. Option 5 without Phelps Canal Upgrade

Option 5

J-2 - Alternative 2, Area 1 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

11/22/2011

Subtotal = $ **13,966,291**

30% Construction Contingency = $ **4,189,887**

Probable Construction Costs = $ **18,156,178**

Design (8%) = $ **1,452,494**

Permitting (2.5%) = $ **453,904**

Administrative and Legal (2.5%) = $ **453,904**

Construction Management and Administration (7%) = $ **1,270,932**

Land Acquisition Costs (718 ac @ $4,000 per ac plus three structures) = $ **3,472,000**

Total Estimated Project Cost = $ **25,259,414**

Option 5

J-2 - Alternative 2, Area 2 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 194,542.00	$ 194,542.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	842,000	CY	$ 4.00	$ 3,368,000.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	20' w x 24' h Radial Gate Outlet (1@20'w x 24'h) with Controls, Elec. & Assoc. Work	1	EA	$ 1,479,000.00	$ 1,479,000.00
10	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
11	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
12	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
13	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
14	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
15	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
16	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
17	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
18	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00

11/22/2011

Subtotal = $ **9,491,462**

30% Construction Contingency = $ **2,847,439**

Probable Construction Costs = $ **12,338,901**

Design (8%) = $ **987,112**

Permitting (2.5%) = $ **308,473**

Administrative and Legal (2.5%) = $ **308,473**

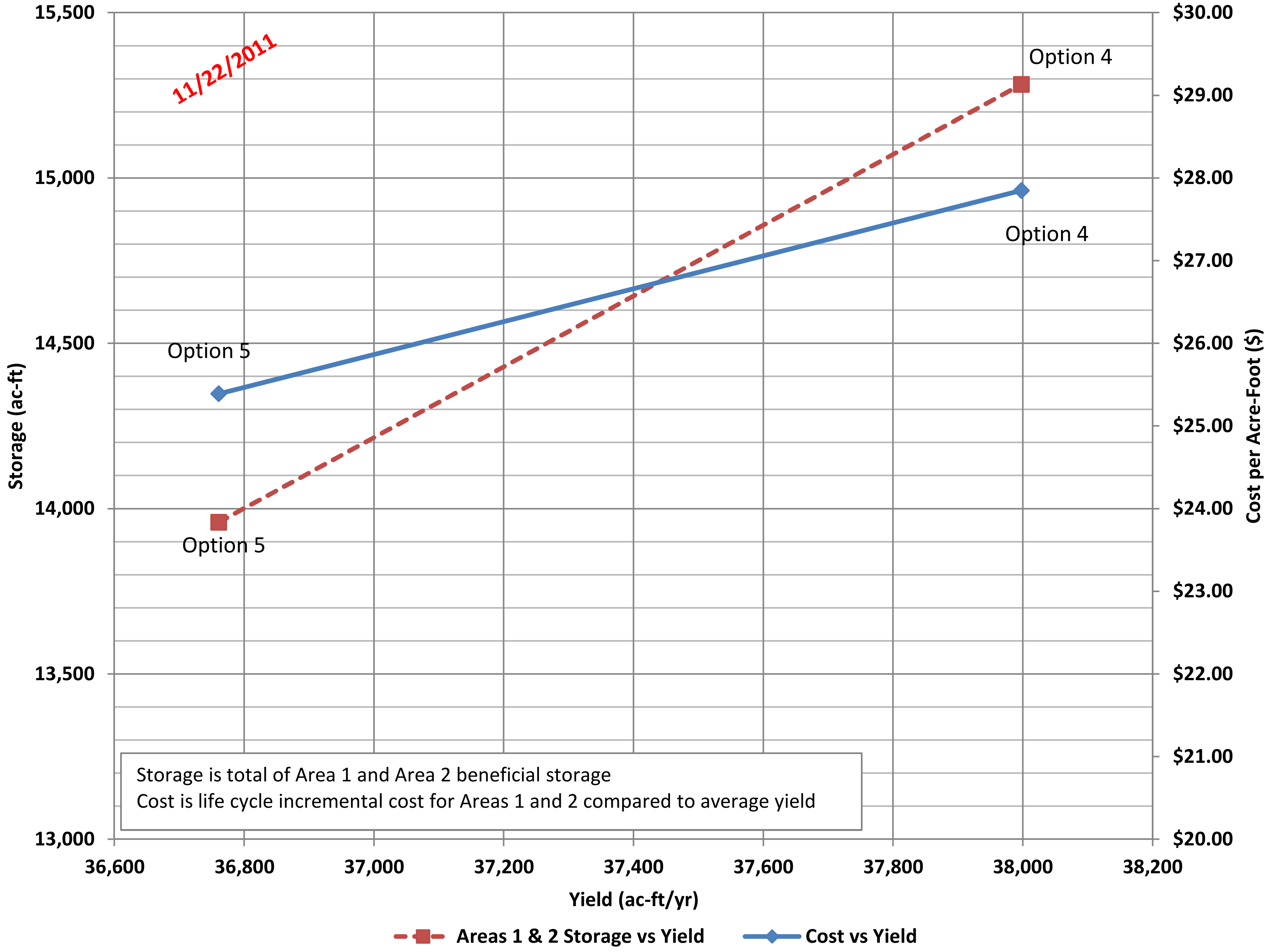
Construction Management and Administration (7%) = $ **863,723**

Land Acquisition Costs (345 ac @ $4,000 per ac) = $ **1,380,000**

Total Estimated Project Cost = $ **16,186,681**

Total Area 1 and 2 $ **41,446,095**

Figure A-3. Comparison of Incremental Costs of J-2 Options 4 and 5 with Phelps Canal



11/22/2011

Storage is total of Area 1 and Area 2 beneficial storage
Cost is life cycle incremental cost for Areas 1 and 2 compared to average yield

Table A-5. J-2 Alternatives Operation and Maintenance Costs with Phelps Canal

11/22/2011

Alternative	Beneficial Storage, acre-feet	Capital Costs ($000)	Operation Cost Rate	Pumped acre-feet	Pumping Costs @ $1.60/ac-ft ($000)	Pump Replacement ($000)	Annual Operating Cost ($000)	Equivalent Annual Cost ($000)	SDHF Augmentation, cfs	SDHF Augmentation, ac-ft/yr	Reductions to Shortages to Target Flows, Average Year ac-ft/yr	Delivered total ac-ft/yr	Life Cycle Cost per ac-ft
J -2 Option 4 with Phelps Canal	15,283	$48,894	0.75% 1.25%	5,300	8.48	10	$396.85	$1,389.66	2,000	11,901	37,998	49,899	$27.85
J -2 Option 5 with Phelps Canal	13,959	$44,391	0.75% 1.25%	0	0	0	$332.93	$1,235.48	2,000	11,901	36,761	48,662	$25.39

Assumptions

1. Option 4 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs
2. Option 5 includes hydrocycle mitigation, no pumping into Area 2, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 20 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs
3. Options 4 and 5 storage areas included a dead pool of water over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage volume.
4. Life Cycle is 50 years.
5. Interest is not included in cost calculation.
6. Annual operations and maintenance cost of reservoirs is 0.75% of initial construction cost plus an additional 0.5% for the pump station.
7. Annual operations and maintenance cost of Phelps Canal is 1.25% of initial construction cost.
8. Pumps will need to be replaced every 25 years.
8. Cost of pumping is $1.60 per acre-foot.
9. SDHF Augmentation is based on 3 days at 2000 cfs. Though the units are ac-ft per year, the values presented are the total volume of SDHF aufmentation flows provided by the alernative over three days.
10. Water to reduce shortages to target flows is excess flows in CNPPID's system that could be stored during times of excess, and released during periods of shortage.

Table A-6. Option 4 with Phelps Canal Upgrade

Option 4

J-2 - Alternative 2, Area 1 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	36' w x 10' h Sluice Gate Inlet (3@12'w x 10'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	30' w x 18' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18" CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

11/22/2011

Subtotal =	**$**	**13,966,291**
30% Construction Contingency =	**$**	**4,189,887**
Probable Construction Costs =	**$**	**18,156,178**
Design (8%) =	**$**	**1,452,494**
Permitting (2.5%) =	**$**	**453,904**
Administrative and Legal (2.5%) =	**$**	**453,904**
Construction Management and Administration (7%) =	**$**	**1,270,932**
Land Acquisition Costs (718 ac @ $4,000 per ac plus three structures) =	**$**	**3,472,000**
Total Estimated Project Cost =	**$**	**25,259,414**

Option 4

J-2 - Alternative 2, Area 2 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 264,947.20	$ 264,947.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	36' w x 7' h Sluice Gate Inlet (3@12'w x 7'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	20' w x 24' h Radial Gate Outlet (1@20'w x 24'h) with Controls, Elec. & Assoc. Work	1	EA	$ 1,479,000.00	$ 1,479,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
15	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
16	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
17	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
18	18" CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
20	Phelps Canal	1	LS	$ 1,887,725.00	$ 1,887,725.00

11/22/2011

Subtotal =	**$**	**14,265,800**
30% Construction Contingency =	**$**	**4,279,740**
Probable Construction Costs =	**$**	**18,545,540**
Design (8%) =	**$**	**1,483,643**
Permitting (2.5%) =	**$**	**463,639**
Administrative and Legal (2.5%) =	**$**	**463,639**
Construction Management and Administration (7%) =	**$**	**1,298,188**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	**$**	**1,380,000**
Total Estimated Project Cost =	**$**	**23,634,648**
Total Areas 1 and 2	**$**	**48,894,062**

Table A-7. Option 5 with Phelps Canal Upgrade

Option 5

J-2 - Alternative 2, Area 1 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal = **$ 13,966,291**

30% Construction Contingency = **$ 4,189,887**

Probable Construction Costs = **$ 18,156,178**

Design (8%) = **$ 1,452,494**

Permitting (2.5%) = **$ 453,904**

Administrative and Legal (2.5%) = **$ 453,904**

Construction Management and Administration (7%) = **$ 1,270,932**

Land Acquisition Costs (718 ac @ $4,000 per ac plus three structures) = **$ 3,472,000**

Total Estimated Project Cost = **$ 25,259,414**

11/22/2011

Option 5

J-2 - Alternative 2, Area 2 Updated 11-22-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 194,542.00	$ 194,542.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	842,000	CY	$ 4.00	$ 3,368,000.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	20' w x 24' h Radial Gate Outlet (1@20'w x 24'h) with Controls, Elec. & Assoc. Work	1	EA	$ 1,479,000.00	$ 1,479,000.00
10	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
11	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
12	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
13	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
14	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
15	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
16	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
17	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
18	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
19	Phelps Canal	1	LS	$ 1,887,725.00	$ 1,887,725.00

Subtotal = **$ 11,379,187**

30% Construction Contingency = **$ 3,413,756**

Probable Construction Costs = **$ 14,792,943**

Design (8%) = **$ 1,183,435**

Permitting (2.5%) = **$ 369,824**

Administrative and Legal (2.5%) = **$ 369,824**

Construction Management and Administration (7%) = **$ 1,035,506**

Land Acquisition Costs (345 ac @ $4,000 per ac) = **$ 1,380,000**

Total Estimated Project Cost = **$ 19,131,532**

11/22/2011

Total Area 1 and 2 **$ 44,390,946**

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

Table A-8. OPTIONS 4 & 5
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
WITH MAXIMUM HEADWATER ELEVATION AT MP 0 OF 2358.0
November 22, 2011

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	*LS*	$ 105,000.00		$ 105,000.00
2	Construction Surveying	1.0	*LS*	$ 40,000.00		$ 40,000.00
3	Erosion Control	1.0	*LS*	$ 85,000.00		$ 85,000.00
4	Water Control	1.0	*LS*	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	*AC*	$ 1,000.00		$ 1,100.00
6	Excavation, Haul Off-Site	32,718	*CY*	$ 3.00		$ 98,154.00
7	Excavation, Fill On-Site, Class A Compaction	8,071	*CY*	$ 4.00		$ 32,284.00
8	Salvaging and Spreading Topsoil	5,022	*SY*	$ 1.00		$ 5,022.00
9	Seeding and Mulching	1.1	*AC*	$ 1,100.00		$ 1,210.00
10	Rock Riprap Armoring, Class B	9,849	*CY*	$ 55.00		$ 541,695.00
11	Granular Filter Fabric	1,642	*CY*	$ 30.00		$ 49,260.00
12	Flume Modifications					$ 64,800.00
13	Reinforced Concrete	12	*CY*	$ 400.00	$ 4,800.00	---
14	Remove and Replace Beams	6	*EA*	$ 10,000.00	$ 60,000.00	---
15	Remove Parshall Flume	1	*EA*	$ 30,000.00		$ 30,000.00
16	New Parshall Flume	1	*EA*	$ 225,000.00		$ 225,000.00
17	12-Foot Corrugated Metal Pipe	300	*LF*	$ 400.00		$ 120,000.00
18	Plum Creek Siphon Inlet Modifications					$ 161,800.00
19	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
20	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
21	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
22	Reinforced Concrete	142	*CY*	$ 400.00	$ 56,800.00	---
23	Plum Creek Siphon Outlet Modifications					$ 105,000.00
24	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
25	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
26	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
25	Reinforced Concrete	226	*CY*	$ 400.00	$ 90,400.00	---
26	102'x16' Bridge Farm Access	1,632	*SF*	$ 75.00		$ 122,400.00

Subtotal =	**$ 1,887,725.00**
30% Construction Contingency =	**$ 566,317.50**
Probable Construction Costs =	**$ 2,454,042.50**
Design (8%) =	**$ 196,323**
Permitting (2.5%) =	**$ 61,351**
Administrative and Legal (2.5%) =	**$ 61,351**
Construction Management and Administration (7%) =	**$ 171,783**
Total Estimated Project Cost =	**$ 2,944,851.00**

11/22/2011

Assumptions:

1. Improvements consist of widening the canal upstream of the Parshall flume and siphon, replacing the Parshall flume, modifying the Plum Creek siphon and flume at Mile 3.15 and replacement of two bridges.
2. Land acquisition for additional right of way is not included.
3. Temporary construction easements not included.

APPENDIX B

Preliminary Results for Options1, 3, 4 and 5

Table B-1. Comparison of Reductions to Target Flow Shortages for Combined Reservoir Operations without Area 2 for Different Storage Scenarios

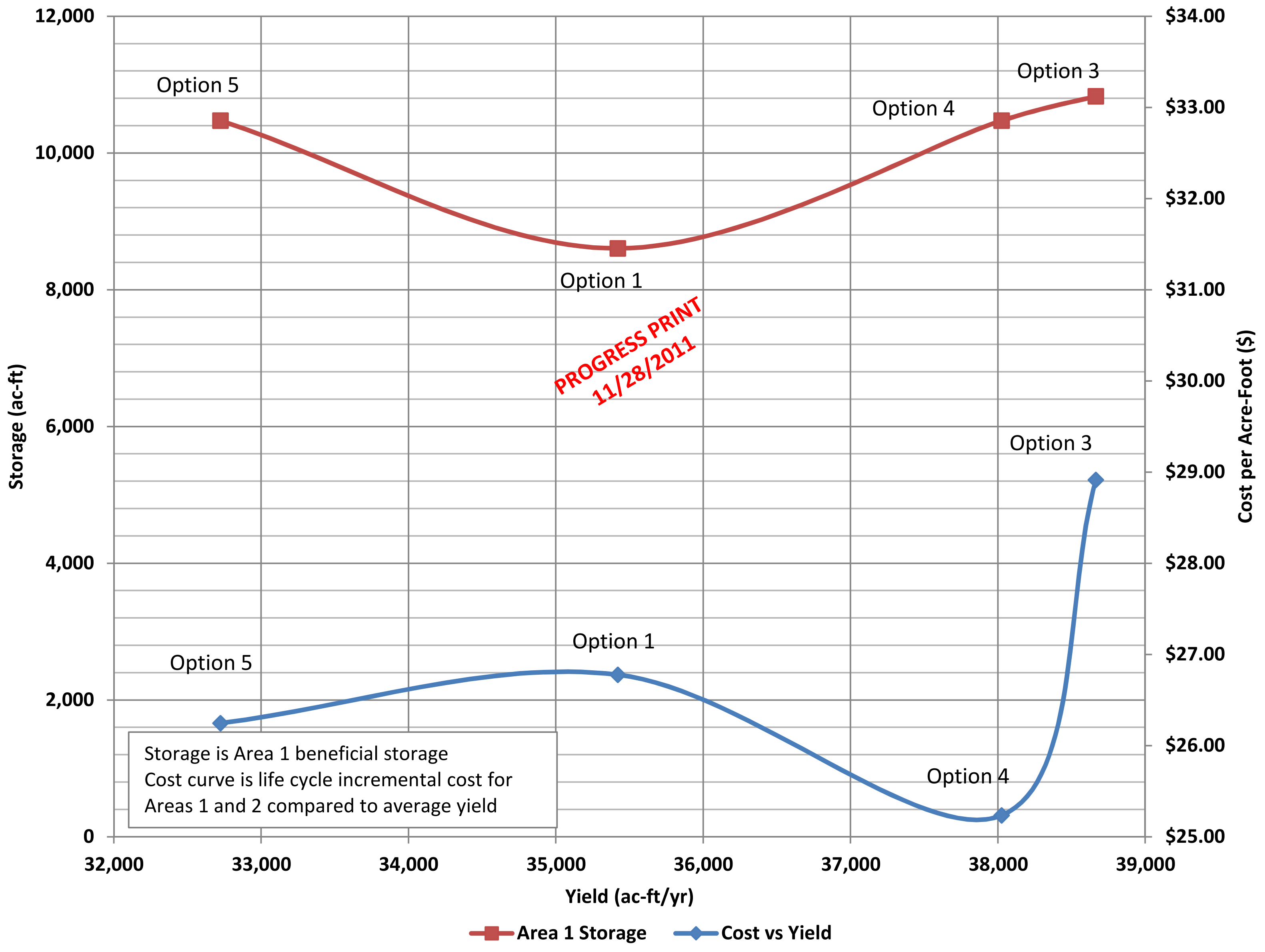
		OPTION 1[1] Area 2 Available Outside of June 15-August 31 Irrigation Season	OPTION 3[2] Area 2 Available Outside of June 15-August 31 Irrigation Season	OPTION 4[3] Area 2 Available Outside of June 15-August 31 Irrigation Season
Year	Year Type	Yield (ac-ft)	Yield (ac-ft)	Yield (ac-ft)
1997	Wet	49,017	53,191	52,467
1998	Wet	69,222	80,795	77,174
1999	Wet	44,021	49,405	48,803
2000	Wet	62,846	68,949	68,111
2001	Normal	56,529	61,004	60,237
2002	Dry	23,610	25,617	25,169
2003	Dry	13,138	13,138	13,155
2004	Dry	2,765	2,765	2,789
2005	Dry	15,101	15,101	15,074
2006	Dry	9,713	9,741	9,739
2007	Dry	42,325	46,280	45,825
2008	Normal	36,768	37,995	38,030
	Average All:	35,421	38,665	38,048
	Average Wet:	56,277	63,085	61,639
	Average Normal:	46,648	49,499	49,133
	Average Dry:	17,775	18,774	18,625
Beneficial Storage for Area 1, acre-feet		8,604	10,829	10,473
Beneficial Storage for Area 2, acre-feet		5,033	4,810	4,810
Beneficial Storage for Areas 1 and 2, acre-feet		13,637	15,639	15,283

Notes:

1. Option 1 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 40 feet, Option 1 stage-storage relationship, Area 2 outlet gate width = 30 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Stage-discharge relationship was based on 40' and 30' gate widths.
2. Option 3 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 3 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.
3. Option 4 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 4 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.

5. Option 1 included a vegetative cover over a clay liner. Options 3, 4, and 5 storage areas included a dead pool of water over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage volume.

Figure B-1. Incremental Cost Analysis Summary
J-2 Area 1 Alternatives without Phelps Canal



Storage is Area 1 beneficial storage
Cost curve is life cycle incremental cost for
Areas 1 and 2 compared to average yield

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Table B-2. J-2 Alternatives Operation and Maintenance Costs without Phelps Canal

Alternative	Beneficial Storage, acre-feet	Capital Costs ($000)	Operation Cost Rate	Pumped acre-feet	Pumping Costs @ $1.60/ac-ft ($000)	Pump Replacement ($000)	Annual Operating Cost ($000)	Equivalent Annual Cost ($000)	SDHF Augmentation, cfs	SDHF Augmentation, ac-ft/yr	Reductions to Shortages to Target Flows, Average Year ac-ft/yr	Delivered total ac-ft/yr	Life Cycle Cost per ac-ft
J -2 Option 1	13,637	$44,974	0.75%	5,300	8.48	10	$367.45	$1,267.14	2,000	11,901	35,421	47,322	$26.78
J -2 Option 3	15,640	$52,063	0.75%	5,300	8.48	10	$420.61	$1,462.07	2,000	11,901	38,665	50,566	$28.91
J -2 Option 4	15,283	$44,708	0.75%	5,300	8.48	10	$365.46	$1,259.83	2,000	11,901	38,025	49,926	$25.23
J -2 Option 5	13,959	$42,220	0.75%	0	0	10	$326.65	$1,171.26	2,000	11,901	32,725	44,626	$26.25

Assumptions

1. Option 1 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 40 feet, Option 1 stage-storage relationship, Area 2 outlet gate width = 30 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Stage-discharge relationship was based on 40' and 30' gate widths.
2. Option 3 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 3 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.
3. Option 4 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 4 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.
4. Option 5 included the same Area 1 as Option 4, with a reduced Area 2 and no pumping into Area 1. Yield was not modeled with continuous simulation modeling. It was estimated by subtracting the average pumped acre-feet of water from the Option 4 yield.
5. Option 1 included a vegetative cover over a clay liner. Options 3, 4, and 5 storage areas included a dead pool of water over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage volume.
6. Life Cycle is 50 years.
7. Interest is not included in cost calculation.
8. Annual operations and maintenance cost of reservoirs is 0.75% of initial construction cost plus an additional 0.5% for the pump station.
9. Pumps will need to be replaced every 25 years.
10. Cost of pumping is $1.60 per acre-foot.
11. SDHF Augmentation is based on 3 days at 2000 cfs. Though the units are ac-ft per year, the values presented are the total volume of SDHF aufmentation flows provided by the alernative over three days.
12. Water to reduce shortages to target flows is excess flows in CNPPID's system that could be stored during times of excess, and released during periods of shortage.

Table B-3. Option 1 without Phelps Canal Upgrade

Option 1

J-2 - Alternative 2, Area 1 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount	
1	Mobilization / Demobilization	1	LS	$	339,187.50	$	339,187.50
2	Clearing and Grubbing	10	AC	$	1,000.00	$	10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$	5.00	$	246,000.00
4	Core Trench	127,100	CY	$	3.00	$	381,300.00
5	Earth Fill, Class A Compaction	1,160,000	CY	$	4.00	$	4,640,000.00
6	Toe Drains	17,235	CY	$	20.00	$	344,700.00
7	Salvaging and Spreading Topsoil, 12" Thick	690,000	CY	$	4.00	$	2,760,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$	603,000.00	$	1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$	1,168,000.00	$	2,336,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$	340,000.00	$	340,000.00
11	90' Long x 36' Wide County Bridge, Road A	3,240	SF	$	75.00	$	243,000.00
12	Gravel Surfacing	4,700	CY	$	15.00	$	70,500.00
13	Seeding and Mulching	430	AC	$	900.00	$	387,000.00
14	Road Improvements	0.5	MI	$	45,000.00	$	22,500.00
15	Drain Tile	770	LF	$	10.00	$	7,700.00
16	Drain Tile Sand and Gravel	422	CY	$	3.00	$	1,266.00
17	Ditch Grading	13000	CY	$	5.00	$	65,000.00
18	18" CMP, Galvanized 14 gauge	75	LF	$	21.00	$	1,575.00

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Subtotal =	**$**	**14,004,729**
30% Construction Contingency =	**$**	**4,201,419**
Probable Construction Costs =	**$**	**18,206,147**
Design (8%) =	**$**	**1,456,492**
Permitting (2.5%) =	**$**	**455,154**
Administrative and Legal (2.5%) =	**$**	**455,154**
Construction Management and Administration (7%) =	**$**	**1,274,430**
Land Acquisition Costs (458 ac @ $4,000 per ac) =	**$**	**1,832,000**
Total Estimated Project Cost =	**$**	**23,679,376**

Option 1

J-2 - Alternative 2, Area 2 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount	
1	Mobilization / Demobilization	1	LS	$	274,407.00	$	274,407.00
2	Clearing and Grubbing	10	AC	$	1,000.00	$	10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$	5.00	$	125,000.00
4	Core Trench	110,500	CY	$	3.00	$	331,500.00
5	Earth Fill, Class A Compaction	573,000	CY	$	4.00	$	2,292,000.00
6	Toe Drains	15,129	CY	$	20.00	$	302,580.00
7	Salvaging and Spreading Topsoil, 12" Thick	520,000	CY	$	4.00	$	2,080,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$	544,000.00	$	1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$	672,000.00	$	1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$	2,333,000.00	$	2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$	1,500.00	$	150,000.00
12	Gravel Surfacing	5,640	CY	$	15.00	$	84,600.00
13	Seeding and Mulching	324	AC	$	900.00	$	291,600.00
14	Road Improvements	4.20	MI	$	45,000.00	$	189,000.00
15	Synthetic Liner	598,900	SF	$	2.00	$	1,197,800.00
16	Drain Tile	4,450	LF	$	10.00	$	44,500.00
17	Drain Tile Sand and Gravel	2,430	CY	$	3.00	$	7,290.00
18	18" CMP, Galvanized 14 gauge	50	LF	$	21.00	$	1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$	75,600.00	$	75,600.00

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Subtotal =	**$**	**12,765,927**
30% Construction Contingency =	**$**	**3,829,778**
Probable Construction Costs =	**$**	**16,595,705**
Design (8%) =	**$**	**1,327,656**
Permitting (2.5%) =	**$**	**414,893**
Administrative and Legal (2.5%) =	**$**	**414,893**
Construction Management and Administration (7%) =	**$**	**1,161,699**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	**$**	**1,380,000**
Total Estimated Project Cost =	**$**	**21,294,846**
Total Area 1 and 2	**$**	**44,974,223**

Table B-4. Option 3 without Phelps Canal Upgrade

Option 3

J-2 - Alternative 2, Area 1 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 439,025.00	$ 439,025.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	2,900,000	CY	$ 4.00	$ 11,600,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 603,000.00	$ 1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,168,000.00	$ 2,336,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 340,000.00	$ 340,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal =	$	**18,161,066**
30% Construction Contingency =	$	**5,448,320**
Probable Construction Costs =	$	**23,609,386**
Design (8%) =	$	**1,888,751**
Permitting (2.5%) =	$	**590,235**
Administrative and Legal (2.5%) =	$	**590,235**
Construction Management and Administration (7%) =	$	**1,652,657**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) =	$	**3,472,000**
Total Estimated Project Cost =	$	**31,803,263**

Option 3

J-2 - Alternative 2, Area 2 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 258,217.00	$ 258,217.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	963,000	CY	$ 4.00	$ 3,852,000.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 544,000.00	$ 1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 672,000.00	$ 1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
15	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
16	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
17	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
18	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00

Subtotal =	$	**12,102,137**
30% Construction Contingency =	$	**3,630,641**
Probable Construction Costs =	$	**15,732,778**
Design (8%) =	$	**1,258,622**
Permitting (2.5%) =	$	**393,319**
Administrative and Legal (2.5%) =	$	**393,319**
Construction Management and Administration (7%) =	$	**1,101,294**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	$	**1,380,000**
Total Estimated Project Cost =	$	**20,259,334**
Total Area 1 and 2	$	**52,062,597**

Table B-5. Option 4 without Phelps Canal Upgrade

Option 4

J-2 - Alternative 2, Area 1 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 325,600.00	$ 325,600.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 603,000.00	$ 1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,168,000.00	$ 2,336,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 340,000.00	$ 340,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal =	**$ 13,447,641**
30% Construction Contingency =	**$ 4,034,292**
Probable Construction Costs =	**$ 17,481,933**
Design (8%) =	**$ 1,398,555**
Permitting (2.5%) =	**$ 437,048**
Administrative and Legal (2.5%) =	**$ 437,048**
Construction Management and Administration (7%) =	**$ 1,223,735**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) =	**$ 3,472,000**
Total Estimated Project Cost =	**$ 24,450,320**

Option 4

J-2 - Alternative 2, Area 2 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 258,197.20	$ 258,197.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 544,000.00	$ 1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 672,000.00	$ 1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
15	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
16	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
17	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
18	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00

Subtotal =	**$ 12,101,325**
30% Construction Contingency =	**$ 3,630,398**
Probable Construction Costs =	**$ 15,731,723**
Design (8%) =	**$ 1,258,538**
Permitting (2.5%) =	**$ 393,293**
Administrative and Legal (2.5%) =	**$ 393,293**
Construction Management and Administration (7%) =	**$ 1,101,221**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	**$ 1,380,000**
Total Estimated Project Cost =	**$ 20,258,067**
Total Area 1 and 2	**$ 44,708,387**

Table B-6. Option 5 without Phelps Canal Upgrade

Option 5

J-2 - Alternative 2, Area 1 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18" CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal =	**$ 13,966,291**
30% Construction Contingency =	**$ 4,189,887**
Probable Construction Costs =	**$ 18,156,178**
Design (8%) =	**$ 1,452,494**
Permitting (2.5%) =	**$ 453,904**
Administrative and Legal (2.5%) =	**$ 453,904**
Construction Management and Administration (7%) =	**$ 1,270,932**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) =	**$ 3,472,000**
Total Estimated Project Cost =	**$ 25,259,414**

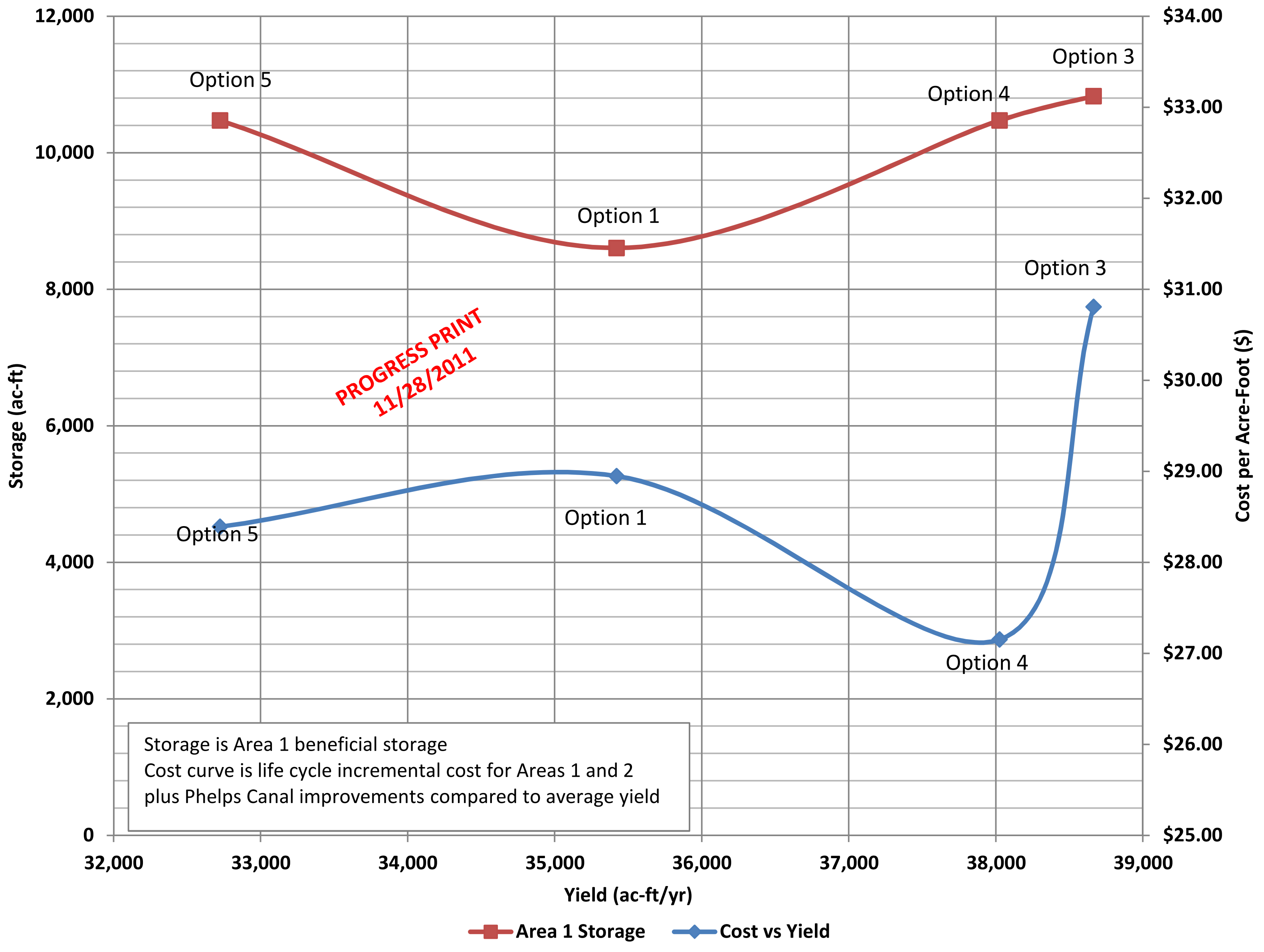
Option 5

J-2 - Alternative 2, Area 2 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 206,647.20	$ 206,647.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 740,000.00	$ 1,480,000.00
10	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
11	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
12	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
13	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
14	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
15	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
16	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
17	18" CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
18	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00

Subtotal =	**$ 9,987,775**
30% Construction Contingency =	**$ 2,996,333**
Probable Construction Costs =	**$ 12,984,108**
Design (8%) =	**$ 1,038,729**
Permitting (2.5%) =	**$ 324,603**
Administrative and Legal (2.5%) =	**$ 324,603**
Construction Management and Administration (7%) =	**$ 908,888**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	**$ 1,380,000**
Total Estimated Project Cost =	**$ 16,960,929**
Total Area 1 and 2	**$ 42,220,343**

Figure B-2. Incremental Cost Analysis Summary
J-2 Area 1 Alternatives with Phelps Canal



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Storage is Area 1 beneficial storage
Cost curve is life cycle incremental cost for Areas 1 and 2
plus Phelps Canal improvements compared to average yield

Table B-7. J-2 Alternatives Operation and Maintenance Costs with Phelps Canal

Alternative	Beneficial Storage, acre-feet	Capital Costs ($000)	Operation Cost Rate	Pumped acre-feet	Pumping Costs @ $1.60/ac-ft ($000)	Pump Replacement ($000)	Annual Operating Cost ($000)	Equivalent Annual Cost ($000)	SDHF Augmentation, cfs	SDHF Augmentation, ac-ft/yr	Reductions to Shortages to Target Flows, Average Year ac-ft/yr	Delivered total ac-ft/yr	Life Cycle Cost per ac-ft
J -2 Option 1 with Phelps Canal	13,637	$48,134	0.75%	5,300	8.48	10	$391.15	$1,369.84	2,000	11,901	35,421	47,322	$28.95
			1.25%										
J -2 Option 3 with Phelps Canal	15,640	$55,007	0.75%	5,300	8.48	10	$442.70	$1,557.77	2,000	11,901	38,665	50,566	$30.81
			1.25%										
J -2 Option 4 with Phelps Canal	15,283	$47,653	0.75%	5,300	8.48	10	$387.54	$1,355.53	2,000	11,901	38,025	49,926	$27.15
			1.25%										
J -2 Option 5 with Phelps Canal	13,959	$45,165	0.75%	0	0	0	$338.74	$1,266.97	2,000	11,901	32,725	44,626	$28.39
			1.25%										

Assumptions

1. Option 1 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 40 feet, Option 1 stage-storage relationship, Area 2 outlet gate width = 30 feet, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Stage-discharge relationship was based on 40' and 30' gate widths.
2. Option 3 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 3 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.
3. Option 4 includes hydrocycle mitigation, Area 2 pump capacity = 300 cfs, Area 1 outlet gate width = 36 feet, Area 2 outlet gate width = 40 feet, Option 4 stage-storage relationship, Area 2 available outside of irrigation season of June 15-August 31, Phelps Canal capacity = 1,675 cfs. Gate width settings in continuous simulation modeling were 40' (Area 1) and 30' (Area 2) but stage-discharge relationship was based on actual gate width information.
4. Option 5 included the same Area 1 as Option 4, with a reduced Area 2 and no pumping into Area 1. Yield was not modeled with continuous simulation modeling. It was estimated by subtracting the average pumped acre-feet of water from the Option
5. Option 1 included a vegetative cover over a clay liner. Options 3, 4, and 5 storage areas included a dead pool of water over a clay liner. The dead pool volume was subtracted from the overall storage volume to determine the beneficial storage
6. Life Cycle is 50 years.
7. Interest is not included in cost calculation.
8. Annual operations and maintenance cost of reservoirs is 0.75% of initial construction cost plus an additional 0.5% for the pump station.
9. Annual operations 7. Annual operation 7. Annual ope 7. Annual ope 7. Annual op 7. Annual oper 7. Annual opera 7. Annual op 7. Annual operations 7. Annual operati 7. Annual operatio 7. Annual operations and ma 7. Annual opera 7. Annual operat
10. Pumps will need to be replaced every 25 years.
11. Cost of pumping is $1.60 per acre-foot.
12. SDHF Augmentation is based on 3 days at 2000 cfs. Though the units are ac-ft per year, the values presented are the total volume of SDHF aufmentation flows provided by the alernative over three days.
13. Water to reduce shortages to target flows is excess flows in CNPPID's system that could be stored during times of excess, and released during periods of shortage.

Table B-8. Option 1 with Phelps Canal Upgrade

Option 1

J-2 - Alternative 2, Area 1 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 339,187.50	$ 339,187.50
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	127,100	CY	$ 3.00	$ 381,300.00
5	Earth Fill, Class A Compaction	1,160,000	CY	$ 4.00	$ 4,640,000.00
6	Toe Drains	17,235	CY	$ 20.00	$ 344,700.00
7	Salvaging and Spreading Topsoil, 12" Thick	690,000	CY	$ 4.00	$ 2,760,000.00
8	36' w x 10' h Sluice Gate Inlet (3@12'w x 10'h) with Controls, Elec. & Assoc. Work	3	EA	$ 603,000.00	$ 1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,168,000.00	$ 2,336,000.00
10	30' w x 18' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 340,000.00	$ 340,000.00
11	90' Long x 36' Wide County Bridge, Road A	3,240	SF	$ 75.00	$ 243,000.00
12	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
13	Seeding and Mulching	430	AC	$ 900.00	$ 387,000.00
14	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
15	Drain Tile	770	LF	$ 10.00	$ 7,700.00
16	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
17	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
18	18" CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal =	**$ 14,004,729**
30% Construction Contingency =	**$ 4,201,419**
Probable Construction Costs =	**$ 18,206,147**
Design (8%) =	**$ 1,456,492**
Permitting (2.5%) =	**$ 455,154**
Administrative and Legal (2.5%) =	**$ 455,154**
Construction Management and Administration (7%) =	**$ 1,274,430**
Land Acquisition Costs (458 ac @ $4,000 per ac) =	**$ 1,832,000**
Total Estimated Project Cost =	**$ 23,679,376**

Option 1

J-2 - Alternative 2, Area 2 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 274,407.00	$ 274,407.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
5	Earth Fill, Class A Compaction	573,000	CY	$ 4.00	$ 2,292,000.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging and Spreading Topsoil, 12" Thick	520,000	CY	$ 4.00	$ 2,080,000.00
8	36' w x 7' h Sluice Gate Inlet (3@12'w x 7'h) with Controls, Elec. & Assoc. Work	3	EA	$ 544,000.00	$ 1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 672,000.00	$ 1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	324	AC	$ 900.00	$ 291,600.00
14	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
15	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
16	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
17	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
18	18" CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
20	Phelps Canal	1	LS	$ 2,025,725.00	$ 2,025,725.00

Subtotal =	**$ 14,791,652**
30% Construction Contingency =	**$ 4,437,496**
Probable Construction Costs =	**$ 19,229,148**
Design (8%) =	**$ 1,538,332**
Permitting (2.5%) =	**$ 480,729**
Administrative and Legal (2.5%) =	**$ 480,729**
Construction Management and Administration (7%) =	**$ 1,346,040**
Land Acquisition Costs (345 ac @ $4,000 per ac) =	**$ 1,380,000**
Total Estimated Project Cost =	**$ 24,454,977**
Total Areas 1 and 2	**$ 48,134,354**

Table B-9. Option 3 with Phelps Canal Upgrade

Option 3

J-2 - Alternative 2, Area 1 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 439,025.00	$ 439,025.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	2,900,000	CY	$ 4.00	$ 11,600,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	36' w x 10' h Sluice Gate Inlet (3@12'w x 10'h) with Controls, Elec. & Assoc. Work	3	EA	$ 603,000.00	$ 1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,168,000.00	$ 2,336,000.00
10	30' w x 18' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 340,000.00	$ 340,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal = $ **18,161,066**
30% Construction Contingency = $ **5,448,320**
Probable Construction Costs = $ **23,609,386**
Design (8%) = $ **1,888,751**
Permitting (2.5%) = $ **590,235**
Administrative and Legal (2.5%) = $ **590,235**
Construction Management and Administration (7%) = $ **1,652,657**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) = $ **3,472,000**
Total Estimated Project Cost = $ **31,803,263**

Option 3

J-2 - Alternative 2, Area 2 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 258,217.00	$ 258,217.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	963,000	CY	$ 4.00	$ 3,852,000.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	36' w x 7' h Sluice Gate Inlet (3@12'w x 7'h) with Controls, Elec. & Assoc. Work	3	EA	$ 544,000.00	$ 1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 672,000.00	$ 1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
15	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
16	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
17	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
18	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
20	Phelps Canal	1	LS	$ 1,887,725.00	$ 1,887,725.00

Subtotal = $ **13,989,862**
30% Construction Contingency = $ **4,196,959**
Probable Construction Costs = $ **18,186,821**
Design (8%) = $ **1,454,946**
Permitting (2.5%) = $ **454,671**
Administrative and Legal (2.5%) = $ **454,671**
Construction Management and Administration (7%) = $ **1,273,077**
Land Acquisition Costs (345 ac @ $4,000 per ac) = $ **1,380,000**
Total Estimated Project Cost = $ **23,204,185**

Total Areas 1 and 2 $ **55,007,448**

Table B-10. Option 4 with Phelps Canal Upgrade

Option 4

J-2 - Alternative 2, Area 1 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 325,600.00	$ 325,600.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	36' w x 10' h Sluice Gate Inlet (3@12'w x 10'h) with Controls, Elec. & Assoc. Work	3	EA	$ 603,000.00	$ 1,809,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,168,000.00	$ 2,336,000.00
10	30' w x 18' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 340,000.00	$ 340,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal = **$ 13,447,641**
30% Construction Contingency = **$ 4,034,292**
Probable Construction Costs = **$ 17,481,933**
Design (8%) = **$ 1,398,555**
Permitting (2.5%) = **$ 437,048**
Administrative and Legal (2.5%) = **$ 437,048**
Construction Management and Administration (7%) = **$ 1,223,735**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) = **$ 3,472,000**
Total Estimated Project Cost = **$ 24,450,320**

Option 4

J-2 - Alternative 2, Area 2 Updated 11-7-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 258,197.20	$ 258,197.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	36' w x 7' h Sluice Gate Inlet (3@12'w x 7'h) with Controls, Elec. & Assoc. Work	3	EA	$ 544,000.00	$ 1,632,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 672,000.00	$ 1,344,000.00
10	Pump Station - 4 pumps <150 hp, with Controls, Structure and Elec.	1	EA	$ 2,333,000.00	$ 2,333,000.00
11	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
12	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
13	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
14	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
15	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
16	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
17	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
18	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
19	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
20	Phelps Canal	1	LS	$ 1,887,725.00	$ 1,887,725.00

Subtotal = **$ 13,989,050**
30% Construction Contingency = **$ 4,196,715**
Probable Construction Costs = **$ 18,185,765**
Design (8%) = **$ 1,454,861**
Permitting (2.5%) = **$ 454,644**
Administrative and Legal (2.5%) = **$ 454,644**
Construction Management and Administration (7%) = **$ 1,273,004**
Land Acquisition Costs (345 ac @ $4,000 per ac) = **$ 1,380,000**
Total Estimated Project Cost = **$ 23,202,918**

Total Areas 1 and 2 **$ 47,653,238**

Table B-11. Option 5 with Phelps Canal Upgrade

Option 5

J-2 - Alternative 2, Area 1 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 338,250.00	$ 338,250.00
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	49,200	CY	$ 5.00	$ 246,000.00
4	Core Trench	140,500	CY	$ 3.00	$ 421,500.00
5	Earth Fill, Class A Compaction	1,750,000	CY	$ 4.00	$ 7,000,000.00
6	Toe Drains	25,200	CY	$ 20.00	$ 504,000.00
7	Salvaging Topsoil, 6" Thick	56,000	CY	$ 4.00	$ 224,000.00
8	30' w x 12' h Sluice Gate Inlet (3@10'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 648,000.00	$ 1,944,000.00
9	36' w x 28' h Radial Gate Outlet (2@18'w x 28'h) with Controls, Elec. & Assoc. Work	2	EA	$ 1,236,000.00	$ 2,472,000.00
10	18' w x 30' h Radial Phelps County Gate with Controls, Elec. & Assoc. Work	1	EA	$ 575,000.00	$ 575,000.00
11	Gravel Surfacing	4,700	CY	$ 15.00	$ 70,500.00
12	Seeding and Mulching	70	AC	$ 900.00	$ 63,000.00
13	Road Improvements	0.5	MI	$ 45,000.00	$ 22,500.00
14	Drain Tile	770	LF	$ 10.00	$ 7,700.00
15	Drain Tile Sand and Gravel	422	CY	$ 3.00	$ 1,266.00
16	Ditch Grading	13000	CY	$ 5.00	$ 65,000.00
17	18” CMP, Galvanized 14 gauge	75	LF	$ 21.00	$ 1,575.00

Subtotal = **$ 13,966,291**
30% Construction Contingency = **$ 4,189,887**
Probable Construction Costs = **$ 18,156,178**
Design (8%) = **$ 1,452,494**
Permitting (2.5%) = **$ 453,904**
Administrative and Legal (2.5%) = **$ 453,904**
Construction Management and Administration (7%) = **$ 1,270,932**
Land Acquisition Costs (718 ac @ $4,000 per ac plus structures) = **$ 3,472,000**
Total Estimated Project Cost = **$ 25,259,414**

Option 5

J-2 - Alternative 2, Area 2 Updated 11-28-11

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization / Demobilization	1	LS	$ 206,647.20	$ 206,647.20
2	Clearing and Grubbing	10	AC	$ 1,000.00	$ 10,000.00
3	Remediation of Collapsible Soils	25,000	CY	$ 5.00	$ 125,000.00
4	Earth Fill, Class A Compaction	962,802	CY	$ 4.00	$ 3,851,208.00
5	Core Trench	110,500	CY	$ 3.00	$ 331,500.00
6	Toe Drains	15,129	CY	$ 20.00	$ 302,580.00
7	Salvaging Topsoil, 6" Thick	32,000	CY	$ 4.00	$ 128,000.00
8	21' w x 12' h Sluice Gate Inlet (3@7'w x 12'h) with Controls, Elec. & Assoc. Work	3	EA	$ 589,000.00	$ 1,767,000.00
9	40' w x 24' h Radial Gate Outlet (2@20'w x 24'h) with Controls, Elec. & Assoc. Work	2	EA	$ 740,000.00	$ 1,480,000.00
10	Box Culvert under 748 road, 30' wide by 10' high	100	LF	$ 1,500.00	$ 150,000.00
11	Gravel Surfacing	5,640	CY	$ 15.00	$ 84,600.00
12	Seeding and Mulching	40	AC	$ 900.00	$ 36,000.00
13	Synthetic Liner	598,900	SF	$ 2.00	$ 1,197,800.00
14	Drain Tile	4,450	LF	$ 10.00	$ 44,500.00
15	Drain Tile Sand and Gravel	2,430	CY	$ 3.00	$ 7,290.00
16	Road Improvements	4.20	MI	$ 45,000.00	$ 189,000.00
17	18” CMP, Galvanized 14 gauge	50	LF	$ 21.00	$ 1,050.00
18	Double 12' x 7' Box Culvert	1	LS	$ 75,600.00	$ 75,600.00
19	Phelps Canal	1	LS	$ 1,887,725.00	$ 1,887,725.00

Subtotal = **$ 11,875,500**
30% Construction Contingency = **$ 3,562,650**
Probable Construction Costs = **$ 15,438,150**
Design (8%) = **$ 1,235,052**
Permitting (2.5%) = **$ 385,954**
Administrative and Legal (2.5%) = **$ 385,954**
Construction Management and Administration (7%) = **$ 1,080,671**
Land Acquisition Costs (345 ac @ $4,000 per ac) = **$ 1,380,000**
Total Estimated Project Cost = **$ 19,905,780**

Total Area 1 and 2 **$ 45,165,194**

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

Table B-12. OPTION 1
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
WITH MAXIMUM HEADWATER ELEVATION AT MP 0 OF 2358.0
November 7, 2011

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	LS	$ 105,000.00		$ 105,000.00
2	Construction Surveying	1.0	LS	$ 40,000.00		$ 40,000.00
3	Erosion Control	1.0	LS	$ 85,000.00		$ 85,000.00
4	Water Control	1.0	LS	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	AC	$ 1,000.00		$ 1,100.00
6	Excavation, Haul Off-Site	32,718	CY	$ 3.00		$ 98,154.00
7	Excavation, Fill On-Site, Class A Compaction	8,071	CY	$ 4.00		$ 32,284.00
8	Salvaging and Spreading Topsoil	5,022	SY	$ 1.00		$ 5,022.00
9	Seeding and Mulching	1.1	AC	$ 1,100.00		$ 1,210.00
10	Rock Riprap Armoring, Class B	9,849	CY	$ 55.00		$ 541,695.00
11	Granular Filter Fabric	1,642	CY	$ 30.00		$ 49,260.00
12	Flume Modifications					$ 64,800.00
13	Reinforced Concrete	12	CY	$ 400.00	$ 4,800.00	---
14	Remove and Replace Beams	6	EA	$ 10,000.00	$ 60,000.00	---
15	Remove Parshall Flume	1	EA	$ 30,000.00		$ 30,000.00
16	New Parshall Flume	1	EA	$ 225,000.00		$ 225,000.00
17	12-Foot Corrugated Metal Pipe	300	LF	$ 400.00		$ 120,000.00
18	Plum Creek Siphon Inlet Modifications					$ 161,800.00
19	Concrete Demo	1	LS	$ 25,000.00	$ 25,000.00	---
20	Beams	1	LS	$ 50,000.00	$ 50,000.00	---
21	Buttresses	1	LS	$ 30,000.00	$ 30,000.00	---
22	Reinforced Concrete	142	CY	$ 400.00	$ 56,800.00	---
23	Plum Creek Siphon Outlet Modifications					$ 105,000.00
24	Concrete Demo	1	LS	$ 25,000.00	$ 25,000.00	---
25	Beams	1	LS	$ 50,000.00	$ 50,000.00	---
26	Buttresses	1	LS	$ 30,000.00	$ 30,000.00	---
25	Reinforced Concrete	226	CY	$ 400.00	$ 90,400.00	---
26	115'x16' Bridge 749 Road	1,840	SF	$ 75.00		$ 138,000.00
27	102'x16' Bridge Farm Access	1,632	SF	$ 75.00		$ 122,400.00

Subtotal = **$ 2,025,725.00**
30% Construction Contingency = **$ 607,717.50**
Probable Construction Costs = **$ 2,633,442.50**
Design (8%) = **$ 210,675**
Permitting (2.5%) = **$ 65,836**
Administrative and Legal (2.5%) = **$ 65,836**
Construction Management and Administration (7%) = **$ 184,341**
Total Estimated Project Cost = **$ 3,160,131.00**

Assumptions:

1. Improvements consist of widening the canal upstream of the Parshall flume and siphon, replacing the Parshall flume, modifying the Plum Creek siphon and flume at Mile 3.15 and replacement of two bridges.
2. Land acquisition for additional right of way is not included.
3. Temporary construction easements not included.

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

Table B-13. OPTIONS 3 & 4 & 5
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
WITH MAXIMUM HEADWATER ELEVATION AT MP 0 OF 2358.0

November 7, 2011

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	*LS*	$ 105,000.00		$ 105,000.00
2	Construction Surveying	1.0	*LS*	$ 40,000.00		$ 40,000.00
3	Erosion Control	1.0	*LS*	$ 85,000.00		$ 85,000.00
4	Water Control	1.0	*LS*	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	*AC*	$ 1,000.00		$ 1,100.00
6	Excavation, Haul Off-Site	32,718	*CY*	$ 3.00		$ 98,154.00
7	Excavation, Fill On-Site, Class A Compaction	8,071	*CY*	$ 4.00		$ 32,284.00
8	Salvaging and Spreading Topsoil	5,022	*SY*	$ 1.00		$ 5,022.00
9	Seeding and Mulching	1.1	*AC*	$ 1,100.00		$ 1,210.00
10	Rock Riprap Armoring, Class B	9,849	*CY*	$ 55.00		$ 541,695.00
11	Granular Filter Fabric	1,642	*CY*	$ 30.00		$ 49,260.00
12	Flume Modifications					$ 64,800.00
13	Reinforced Concrete	12	*CY*	$ 400.00	$ 4,800.00	---
14	Remove and Replace Beams	6	*EA*	$ 10,000.00	$ 60,000.00	---
15	Remove Parshall Flume	1	*EA*	$ 30,000.00		$ 30,000.00
16	New Parshall Flume	1	*EA*	$ 225,000.00		$ 225,000.00
17	12-Foot Corrugated Metal Pipe	300	*LF*	$ 400.00		$ 120,000.00
18	Plum Creek Siphon Inlet Modifications					$ 161,800.00
19	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
20	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
21	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
22	Reinforced Concrete	142	*CY*	$ 400.00	$ 56,800.00	---
23	Plum Creek Siphon Outlet Modifications					$ 105,000.00
24	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
25	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
26	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
25	Reinforced Concrete	226	*CY*	$ 400.00	$ 90,400.00	---
26	102'x16' Bridge Farm Access	1,632	*SF*	$ 75.00		$ 122,400.00

Subtotal = **$ 1,887,725.00**
30% Construction Contingency = **$ 566,317.50**
Probable Construction Costs = **$ 2,454,042.50**
Design (8%) = **$ 196,323**
Permitting (2.5%) = **$ 61,351**
Administrative and Legal (2.5%) = **$ 61,351**
Construction Management and Administration (7%) = **$ 171,783**
Total Estimated Project Cost = **$ 2,944,851.00**

Assumptions:

1. Improvements consist of widening the canal upstream of the Parshall flume and siphon, replacing the Parshall flume, modifying the Plum Creek siphon and flume at Mile 3.15 and replacement of two bridges.
2. Land acquisition for additional right of way is not included.
3. Temporary construction easements not included.

APPENDIX E

PHELPS CANAL EVALUATION MEMORANDA

MEMO

☐	Overnight
☐	Regular Mail
☐	Hand Delivery
☒	Other: e-mail_____

TO:	Beorn Courtney
PHONE:	720-524-6115
FROM:	Deb Ohlinger
RE:	Phelps Canal Evaluation Modifications (Update)
DATE:	January 26, 2012
PROJECT #:	009-1466
PHASE:	110, 110004

Introduction

Olsson Associates (Olsson) completed an analysis of alternative Phelps Canal improvements and documented the results in a memo, dated December 14, 2010. Several modifications were made to the Phelps Canal improvements to convey 1,675 cubic feet per second (cfs) so that the maximum headwater elevation at MP 0, the upstream end of Phelps Canal, was 2358.0.

Modifications to December 14, 2010 Phelps Canal Improvements to Convey 1,675 cfs

All of the necessary modifications are shown in Figure 1 of this memorandum.

Excavation, Haul Off-Site

To limit the headwater elevation at MP 0, it is necessary to widen a portion of the canal, as opposed to the original design of only adding freeboard berms. Cross sections 22800 through 29574 were modified to reflect a trapezoidal section with a 60-foot (ft) bottom and 2 horizontal feet to 1 vertical foot (2:1) side slopes. The quantity of excavation, haul off-site increased from 0 cubic yards (cy) to 30,196 cy.

Excavation, Fill On-Site, Class A Compaction

Widening the canal resulted in additional fill needed to maintain a minimum 16-ft wide berm top width. In addition, to maintain two feet of freeboard from Area 1, portions of the berm between cross sections 10802 through 13000 required raising. The quantity of excavation, fill on-site increased from 1,294 cubic yards (cy) to 10,593 cy.

New Parshall Flume

The size of the new Parshall flume increased from having a throat width of 40 ft to 50 ft.

12-Foot Corrugated Metal Pipe
The size of the additional siphon pipe increased from an 8-ft pipe, to a 12-ft pipe.

102'x16' Bridge Farm Access
A 102-ft by 16-ft Farm Access bridge was added to the design improvements, which resulted in an approximate cost increase of $122,400.

Unit Cost Modifications
Mobilization, construction surveying, and erosion control unit costs were updated to maintain approximately the same percentage of the overall cost, which increased. The unit cost of structural concrete was increased to $700 per cubic yard. The construction contingency was reduced from 30% to 25% due to the refinements made to date.

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

OPTION 1
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
WITH MAXIMUM HEADWATER ELEVATION AT MP 0 OF 2358.0
January 26, 2012

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	*LS*	$ 105,000.00		$ 105,000.00
2	Construction Surveying	1.0	*LS*	$ 40,000.00		$ 40,000.00
3	Erosion Control	1.0	*LS*	$ 85,000.00		$ 85,000.00
4	Water Control	1.0	*LS*	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	*AC*	$ 1,000.00		$ 1,100.00
6	Excavation, Haul Off-Site	30,196	*CY*	$ 3.00		$ 90,588.00
7	Excavation, Fill On-Site, Class A Compaction	10,593	*CY*	$ 4.00		$ 42,372.00
8	Salvaging and Spreading Topsoil	5,022	*SY*	$ 1.00		$ 5,022.00
9	Seeding and Mulching	1.1	*AC*	$ 1,100.00		$ 1,210.00
10	Rock Riprap Armoring, Class B	9,849	*CY*	$ 55.00		$ 541,695.00
11	Granular Filter Fabric	1,642	*CY*	$ 30.00		$ 49,260.00
12	Flume Modifications					$ 68,400.00
13	Reinforced Concrete	12	*CY*	$ 700.00	$ 8,400.00	---
14	Remove and Replace Beams	6	*EA*	$ 10,000.00	$ 60,000.00	---
15	Remove Parshall Flume	1	*EA*	$ 30,000.00		$ 30,000.00
16	New Parshall Flume	1	*EA*	$ 360,000.00		$ 360,000.00
17	12-Foot Corrugated Metal Pipe	300	*LF*	$ 400.00		$ 120,000.00
18	Plum Creek Siphon Inlet Modifications					$ 204,400.00
19	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
20	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
21	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
22	Reinforced Concrete	142	*CY*	$ 700.00	$ 99,400.00	---
23	Plum Creek Siphon Outlet Modifications					$ 105,000.00
24	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
25	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
26	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
25	Reinforced Concrete	226	*CY*	$ 700.00	$ 158,200.00	---
26	115'x16' Bridge 749 Road	1,840	*SF*	$ 75.00		$ 138,000.00
27	102'x16' Bridge Farm Access	1,632	*SF*	$ 75.00		$ 122,400.00

Subtotal = **$ 2,209,447.00**

25% Construction Contingency = **$ 552,361.75**

Probable Construction Costs = **$ 2,761,808.75**

Design (8%) = **$ 220,945**

Permitting (2.5%) = **$ 69,045**

Administrative and Legal (2.5%) = **$ 69,045**

Construction Management and Administration (7%) = **$ 193,327**

Total Estimated Project Cost = **$ 3,314,170.50**

1/26/2012

Assumptions:

1. Improvements consist of widening the canal upstream of the Parshall flume and siphon, replacing the Parshall flume, modifying the Plum Creek siphon and flume at Mile 3.15 and replacement of two bridges.
2. Land acquisition for additional right of way is not included.
3. Temporary construction easements not included.

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

OPTIONS 3, 4, & 5
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
WITH MAXIMUM HEADWATER ELEVATION AT MP 0 OF 2358.0
January 26, 2012

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	LS	$ 105,000.00		$ 105,000.00
2	Construction Surveying	1.0	LS	$ 40,000.00		$ 40,000.00
3	Erosion Control	1.0	LS	$ 85,000.00		$ 85,000.00
4	Water Control	1.0	LS	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	AC	$ 1,000.00		$ 1,100.00
6	Excavation, Haul Off-Site	30,196	CY	$ 3.00		$ 90,588.00
7	Excavation, Fill On-Site, Class A Compaction	10,593	CY	$ 4.00		$ 42,372.00
8	Salvaging and Spreading Topsoil	5,022	SY	$ 1.00		$ 5,022.00
9	Seeding and Mulching	1.1	AC	$ 1,100.00		$ 1,210.00
10	Rock Riprap Armoring, Class B	9,849	CY	$ 55.00		$ 541,695.00
11	Granular Filter Fabric	1,642	CY	$ 30.00		$ 49,260.00
12	Flume Modifications					$ 68,400.00
13	Reinforced Concrete	12	CY	$ 700.00	$ 8,400.00	---
14	Remove and Replace Beams	6	EA	$ 10,000.00	$ 60,000.00	---
15	Remove Parshall Flume	1	EA	$ 30,000.00		$ 30,000.00
16	New Parshall Flume	1	EA	$ 360,000.00		$ 360,000.00
17	12-Foot Corrugated Metal Pipe	300	LF	$ 400.00		$ 120,000.00
18	Plum Creek Siphon Inlet Modifications					$ 204,400.00
19	Concrete Demo	1	LS	$ 25,000.00	$ 25,000.00	---
20	Beams	1	LS	$ 50,000.00	$ 50,000.00	---
21	Buttresses	1	LS	$ 30,000.00	$ 30,000.00	---
22	Reinforced Concrete	142	CY	$ 700.00	$ 99,400.00	---
23	Plum Creek Siphon Outlet Modifications					$ 105,000.00
24	Concrete Demo	1	LS	$ 25,000.00	$ 25,000.00	---
25	Beams	1	LS	$ 50,000.00	$ 50,000.00	---
26	Buttresses	1	LS	$ 30,000.00	$ 30,000.00	---
25	Reinforced Concrete	226	CY	$ 700.00	$ 158,200.00	---
26	102'x16' Bridge Farm Access	1,632	SF	$ 75.00		$ 122,400.00

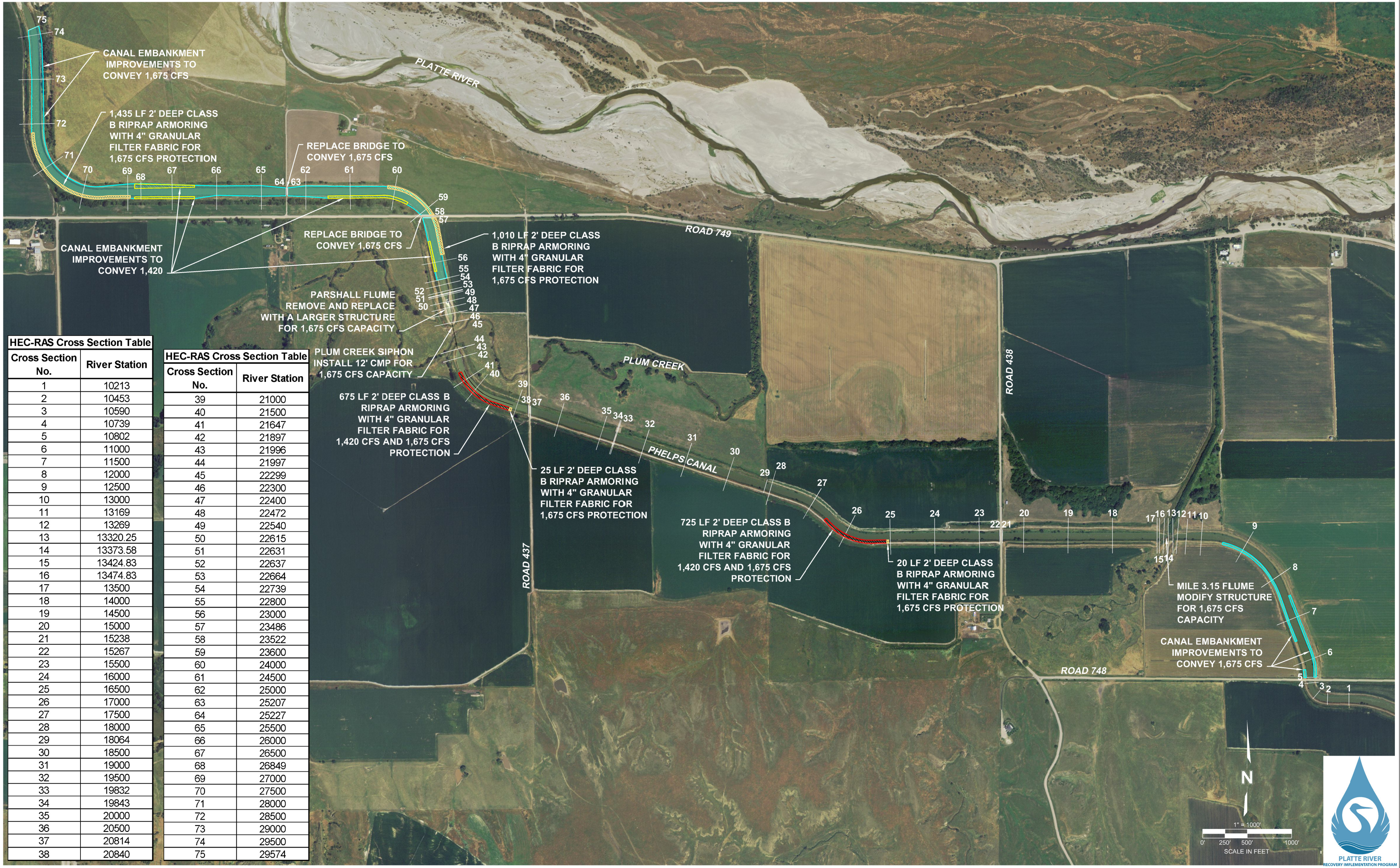
Subtotal = **$ 2,071,447.00**
25% Construction Contingency = **$ 517,861.75**
Probable Construction Costs = **$ 2,589,308.75**
Design (8%) = **$ 207,145**
Permitting (2.5%) = **$ 64,733**
Administrative and Legal (2.5%) = **$ 64,733**
Construction Management and Administration (7%) = **$ 181,252**
Total Estimated Project Cost = **$ 3,107,170.50**

1/26/2012

Assumptions:

1. Improvements consist of widening the canal upstream of the Parshall flume and siphon, replacing the Parshall flume, modifying the Plum Creek siphon and flume at Mile 3.15 and replacement of one bridge.
2. Land acquisition for additional right of way is not included.
3. Temporary construction easements not included.

DWG: C:\Users\agabor\Desktop\Projects\Work at Home\009-1466\Phelps Canal_WTRS\91466_EXB1_REV.dwg USER: agabor
DATE: Jan 27, 2012 11:00am XREFS: 09_1466_LowResolutionAerials



HEC-RAS Cross Section Table

Cross Section No.	River Station
1	10213
2	10453
3	10590
4	10739
5	10802
6	11000
7	11500
8	12000
9	12500
10	13000
11	13169
12	13269
13	13320.25
14	13373.58
15	13424.83
16	13474.83
17	13500
18	14000
19	14500
20	15000
21	15238
22	15267
23	15500
24	16000
25	16500
26	17000
27	17500
28	18000
29	18064
30	18500
31	19000
32	19500
33	19832
34	19843
35	20000
36	20500
37	20814
38	20840

HEC-RAS Cross Section Table

Cross Section No.	River Station
39	21000
40	21500
41	21647
42	21897
43	21996
44	21997
45	22299
46	22300
47	22400
48	22472
49	22540
50	22615
51	22631
52	22637
53	22664
54	22739
55	22800
56	23000
57	23486
58	23522
59	23600
60	24000
61	24500
62	25000
63	25207
64	25227
65	25500
66	26000
67	26500
68	26849
69	27000
70	27500
71	28000
72	28500
73	29000
74	29500
75	29574

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

PROJECT: 009-1466
DRAWN BY: AG
DATE: 1.30.12

CNPPID J-2 REREGULATING RESERVOIR
PHELPS CANAL IMPROVEMENTS (UPDATE)

OLSSON ASSOCIATES
BLACK & VEATCH LLP

FIGURE
1

MEMO

☐	Overnight
☐	Regular Mail
☐	Hand Delivery
☒	Other: e-mail_____

TO:	Beorn Courtney
PHONE:	720-524-6115
FROM:	Deb Ohlinger
RE:	Phelps Canal Evaluation
DATE:	December 14, 2010
PROJECT #:	009-1466
PHASE:	110, 110004

Objectives of Evaluation

The Phelps Canal from the gates at the J-2 Return to Mile 3.63 was evaluated to determine the existing capacity of the canal. The canal was also evaluated to determine the improvements needed to increase its capacity. Olsson's scope of work was to "perform…what if scenarios in an effort to determine how to improve the capacity up to 1,400 cfs without major improvements."

Development of Existing Conditions Model

A HEC-RAS model was created to evaluate the existing capacity and identify needed improvements to convey higher flows. LiDAR data was available for the segment of the Phelps Canal between the gates at the J-2 Return and Mile 3.63. Cross sections were developed from the LiDAR data at a maximum interval of 500 feet. Additional cross sections were added as needed, such as at flumes, the Plum Creek siphon, and their transitions. Olsson Associates conducted a limited field survey to obtain cross sections at five bridges along the reach along with flowline elevations in additional locations. Cross sections were developed from the survey data and input into the HEC-RAS model.

The LiDAR data showed up to 1.2 feet of variability along the bottom of the canal, likely a result of vegetation, water, or snow being present at the time of the mapping. Because the area was flown in March, however, water should not have been present at the time of the mapping. The LiDAR data generally shows the invert elevations of the canal to be higher than the surveyed cross sections, which could also be a result of variability in the bottom due to LiDAR methodology. It is also possible that scour exists at the surveyed bridge cross sections, which could account for some of the lower invert elevations. Both the survey data and LiDAR data were left unadjusted.

As-built drawings, listed in Table 1, were provided by the Central Nebraska Public Power and Irrigation District (CNPPID) for the Plum Creek siphon, the Parshall flume immediately upstream of the siphon, and the flume downstream of Road 438, at Mile 3.15. The elevations shown on the as-built drawings were based on the NGVD 29 vertical datum. The LiDAR and field survey were based on the NAVD 88 vertical datum. The conversion from the NGVD 29 to the NAVD 88 datum in this area was +0.91 foot, as calculated by the National Geodetic Survey's VERTCON online program.

Table 1. List of As-built Drawings Used for Study

	Structure	**Plans**
1.	Parshall flume between Mile 1.36 and 1.41, Station 127+36 to 125+40 in HEC-RAS model	Phelps Canal Rehabilitation, Drawing Nos. G80-21-20 through G80-21-23 and G80-21-30. October 1980. Lloyd Benjamin & Associates.
2.	Plum Creek siphon between Mile 1.42 and 1.52, Station 124+00 to 118+97 in HEC-RAS model	Phelps County Canal Siphon at Station 137+90, Drawings Nos. G11-11A-1 through G11-11A-5. November 18, 1936.
3.	Flume between Mile 3.12 and 3.15, Station 34+25 and 32+69 in the HEC-RAS model	Phelps County Canal Flume at Sta. 225+87.92, Drawing Nos. G11-17-1 through G11-17-4. May 4, 1936.
4.	Flume between Mile 3.12 and 3.15, Station 34+25 and 32+69 in the HEC-RAS model	Canal Lining Repair Adjoining Flume and Underdrain Structure A-fx-3.1 Phelps County Canal, Drawing G-11-17-1 AR. January 30, 1973.
5.	Master Plan	Master Plan – Phelps Canal, Sheets 1-6. CH2M Hill Project No. R 3081.20. No date. Aerial photography date March 30, 1974.

The Parshall flume plans show a design flow of 1,420 cubic feet per second (cfs). The Phelps Canal Master Plan shows design flows to be 1,420 cfs upstream of the Plum Creek siphon, 1,410 cfs between the siphon and the flume at Mile 3.15, and 1,400 cfs downstream of the flume. The HEC-RAS cross sections and key structures are shown in Figure 1.

Comparison of Existing Conditions Model to Previous Information

Known water surface elevations (WSE) and anecdotal evidence were used to truth check and calibrate the model. Water surface elevations were obtained from available as-built drawings, primarily at the locations of structures. Calibration was achieved primarily by adjusting the Manning's n values of the canal and side slope within an appropriate range. Since the canal is quite uniform in roughness, the same Mannings n values were used at all cross sections unless a concrete structure was present at the location. The Mannings n values at all of the non-concrete cross sections were adjusted during calibration and the comparisons were made at the structure locations shown in Tables 2 and 3, since design information was available. The final Manning's n values were 0.027 for the canal bottom and 0.028 for the upper slopes that have vegetation. A Manning's n of 0.015 was used for concrete structures and transitions.

The 1936 siphon plans show that the upstream and downstream canal geometry is a trapezoidal section with a 36-feet wide bottom width and 1.5 horizontal to 1 vertical side slopes. The depth of water was shown to be 11 feet. Observation of the surveyed and LiDAR cross sections indicates that the side slopes generally tend to be flatter than 1.5:1. At the top of the canal, often above the water surface elevation, the side slopes are close to 1.5:1 at some cross sections. The main portion of the cross section shows side slopes closer to 2:1. With the LiDAR cross sections, it is difficult to discern the exact points of the toe of slope due to the variability in the bottom. The field survey showed that the bottom of the canal was not flat across its width. Survey shots should have been taken at the toe of slope, however, the shape of the canal is not as trapezoidal as one might have anticipated. The bottom width generally appears to be greater than 36 feet, potentially closer to 40 feet. With a larger cross sectional area, the water depth should be lower than shown on the plans and the overall canal capacity greater than expected. The average water depth at the design flow of 1,420 cfs is slightly less than the 11 feet shown in the plans.

The Plum Creek siphon, a 165-inch diameter corrugated metal pipe (CMP), was modeled as a culvert. Table 2 compares the design information and model results at the Plum Creek siphon. All elevations have been converted to NAVD 88.

Table 2. Comparison of Plum Creek Siphon Design and Master Plan Information to HEC-RAS Model

As-built information		**HEC-RAS Model**		**WSE Difference Model – As-built**
Design flow	1,535 cfs	Model flow	1,535 cfs	
Inlet WSE	2356.46	Inlet WSE	2358.17	+1.71 ft
Outlet WSE	2353.84	Outlet WSE	2354.77	+0.93 ft
Difference in inlet vs outlet WSE	2.62 ft	Difference in inlet vs outlet WSE	3.40 ft	
Calculated inlet and outlet difference using equations for head losses = 3.55 ft				
Master Plan Information		**HEC-RAS Model**		**WSE Difference Model – Master Plan**
Design flow	1,420 cfs	Model flow	1,420 cfs	
Inlet WSE	2357.61	Inlet WSE	2357.20	-0.41 ft
Outlet WSE	2355.11	Outlet WSE	2354.77	-0.34 ft
Difference in inlet vs outlet WSE	2.50 ft	Difference in inlet vs outlet WSE	2.43 ft	
Calculated inlet and outlet difference using equations for head losses = 3.02 ft				

The water surface elevations were higher in the HEC-RAS model than shown on the design drawings (item 1 in Table 1) for the listed design flow of 1,535 cfs. The water surface elevations compared more favorably to the master plan at the listed master plan flow of 1,420 cfs (see item 5 in Table 1). The master plan showed a flow of 1,410 downstream of the siphon, however, the model used a flow of 1,420 throughout the reach.

The outlet water surface elevation is a function of the conditions downstream of the siphon. It is not surprising that it is different than the as-built drawings or master plan due to the difference in evaluation, development of a backwater profile in a HEC-RAS model versus simpler channel calculations. The siphon was analyzed using the U.S. Bureau of Reclamation's (USBR) design method for siphons to determine whether an appropriate headwater difference exists between the upstream and downstream water surface elevations. The calculations are shown for both 1,535 cfs and 1,420 cfs in Exhibit 1. For 1,535 cfs, the difference in the water surface elevations was calculated to be 3.55 feet, greater than the 2.62-feet difference shown on the as-built drawings. Differences from the original design could have resulted from using a different Manning's n for the pipe, resulting in a different head loss in the pipe, or different coefficients for determining head losses for the inlet and outlet transitions. The inlet and outlet water surface elevation difference in the master plan at 1,420 cfs was 2.50 feet, close to the difference in the HEC-RAS model of 2.43

feet. The head loss calculated by the USBR method was 3.02 feet, higher than the difference shown on the master plan or in the HEC-RAS model.

Table 3 show the design and modeled water surfaces at the Parshall flume upstream of the Plum Creek siphon and at the flume at Mile 3.15. The design and modeled water surface elevations compare very favorably and are different by less than 0.1 foot.

Table 3. Comparison of Flume Design and HEC-RAS Model

<table>
<tr><th colspan="4">Parshall Flume</th></tr>
<tr><th colspan="2">Flume Plan Information</th><th colspan="2">HEC-RAS Model</th></tr>
<tr><td>Design flow</td><td>1,420 cfs</td><td>Model flow</td><td>1,420 cfs</td></tr>
<tr><td>Design WSE</td><td>2356.85</td><td>Flume Crest WSE</td><td>2356.83</td></tr>
<tr><td colspan="4"></td></tr>
<tr><th colspan="4">Flume at Mile 3.15</th></tr>
<tr><th colspan="2">Flume Plan Information</th><th colspan="2">HEC-RAS Model</th></tr>
<tr><td>Design flow</td><td>1,420 cfs</td><td>Model flow</td><td>1,420 cfs</td></tr>
<tr><td>Inlet WSE</td><td>2353.06</td><td>Inlet WSE</td><td>2353.01</td></tr>
<tr><td>Flume WSE</td><td>2352.55</td><td>Flume WSE</td><td>2352.46</td></tr>
</table>

Cory Steinke reported that a patrolman was very concerned that the system was maxed out when it was being run at approximately 1,300 cfs. At 1,300 cfs, the HEC-RAS model shows that the canal can adequately convey water with a reasonable amount of freeboard. Upstream of the Parshall flume, the freeboard ranges from 1.7 to 3.8 feet, with most cross sections showing over 2.0 feet. The only other locations with less than 3 feet of freeboard were at the flume at Mile 3.15, which had a design freeboard of 1.0 foot, and the bridge at Road 437. The freeboard at that location was 2.8 feet. Further discussions with Mr. Steinke indicated that the main problems observed by the patrolman could have been downstream of the reach modeled as part of this study.

Table 4 shows a comparison of modeled water surface elevations to the bridge low chord elevations. For the design flow of 1,420 cfs, nearly 2 feet or more clearance exists for all of the bridges except Road 749, where the low chord is submerged by the water. During the lower flow observed by the patrolman, the water surface would have been right at the bottom of Bridge 749, a potential cause for concern.

Table 4. Comparison of Modeled Water Surface Elevations to Bridge Low Chord Elevations

Bridge Structure and Location, Mile	Clear Span Width, ft	Bridge Structure HEC-RAS Station	Bridge Low Chord (LC) elevation, ft	Upstream Cross Section	Q = 1,420 cfs		Q = 1,300 cfs	
					WSE	Bridge LC - WSE	WSE	Bridge LC - WSE
Driveway, 0.89	82	15220	2360.50	15227	2358.81	1.69	2358.41	2.09
Road 749, 1.21	102	13500	2358.62	13522	2358.69	-0.07	2358.29	0.33
Road 437, 1.72	80	10825	2356.25	10840	2353.90	2.35	2353.42	2.83
Foot Bridge, 1.91	71	9835	2356.44	9843	2353.73	2.71	2353.25	3.19
Road 438, 2.78	108	5250	2359.77	5267	2353.22	6.55	2352.73	7.04

Based on comparisons of the modeled results to the available information, the model has been calibrated to produce results that are representative of the existing canal conditions. If any alternatives to increase canal capacity advance to final design, additional field survey and calibration of the HEC-RAS model should be completed.

Figure 2 shows a profile of the HEC-RAS model results for the existing conditions for both 1,000 cfs and 1,420 cfs. The magenta "levees" represent the bank elevation of the canal and demonstrate the available freeboard is available at each cross section.

Flow Line Comparison

In order to evaluate whether the flowline of the canal has changed outside of the structures, the existing canal flowlines obtained from the LiDAR and field survey were compared to the flowlines shown in the Master Plan. Table 5 shows the results of the comparison. In many locations, the canal bottom is lower than shown in the master plan. Maintenance has occurred in the canal over the years, which would explain the canal being lower in elevation. Where the bottom is lower, the capacity of the canal should be better than anticipated. The upstream portion of the canal does show higher elevations, likely due to sedimentation. The master plan showed over three feet of drop in the canal near master plan station 2000. As mentioned previously, the LiDAR canal bottom elevations are higher than the surveyed elevations.

Table 5. Comparison of Canal Flowlines

	HEC-RAS[1]		Master Plan			
		Elevation		Elevation		HEC-RAS –
Structure Location	Station	NAVD 88	Station	NGVD 29	NAVD 88	Master Plan[1]
	19574	2347.07	330	2346.80	2347.71	-0.64
	18904	2348.39	1000	2347.20	2348.11	0.28
	17904	2348.31	2000	2343.40	2344.31	4.00
	16904	2347.46	3000	2344.20	2345.11	2.35
	16849	2346.73	3055	2344.60	2345.51	1.22
	15904	2348.08	4000	2345.20	2346.11	1.97
Driveway @MI 0.89	15217	2345.58	5029	2346.20	2347.11	-1.53
	15136	2346.48	4768	2346.60	2347.51	-1.03
	14904	2348.20	5000	2347.20	2348.11	0.09
	13904	2348.44	6000	2347.50	2348.41	0.03
Bridge 749 @MI 1.21	13504	2345.89	6400	2349.60	2350.51	-4.62
	12904	2348.37	7000	2347.80	2348.71	-0.34
	11773	2342.83	8131	2344.20	2345.11	-2.28
	11404	2344.08	8500	2344.00	2344.91	-0.83
	10904	2343.40	9000	2344.60	2345.51	-2.11
Bridge 437 @MI 1.72	10827	2343.07	9077	2344.60	2345.51	-2.44
	9904	2343.52	10000	2343.80	2344.71	-1.19
Wooden Bridge @MI 1.91	9837.5	2343.38	10066.5	2344.00	2344.91	-1.53
	8904	2343.98	11000	2342.00	2342.91	1.07
	8064	2343.57	11840	2342.40	2343.31	0.26
	7904	2343.93	12000	2341.60	2342.51	1.42
	6904	2342.80	13000	2341.40	2342.31	0.49
	5904	2343.94	14000	2343.40	2344.31	-0.37
Bridge 438 @MI 2.78	5252.5	2342.87	14651.5	2344.40	2345.31	-2.44
	4904	2343.39	15000	2343.80	2344.71	-1.32
	3904	2342.85	16000	2342.60	2343.51	-0.66

	2904	2340.65	17000	2340.20	2341.11	-0.46
	1904	2342.20	18000	2341.60	2342.51	-0.31
	1000	2341.75	18904	2341.60	2342.51	-0.76

[1] Shaded cells indicate HEC-RAS data was from field survey. Remaining data was from LiDAR.

Improvements to the Phelps Canal

The Olsson scope of work stated that the objective was to determine how to improve the capacity up to 1,400 cfs without major improvements. Because that target flow was so close to the canal design flow of 1,420 cfs, the latter flow was evaluated. It was suggested that the capacity be increased to 1,675 cfs to match the desired capacity of the hydropower unit or 2,000 cfs to match the peak output of the hydropower units. Cory Steinke stated that it would be desirable to evaluate improvements needed for 1,675 cfs. Critical to determining the capacity is the freeboard criteria on which the capacity is based. Different as-built drawings showed different freeboard heights, ranging from one foot within structures to four feet. Consultation with Mr. Steinke led to a minimum freeboard height criteria of two feet.

Alternative 1 - Canal Improvements to Convey 1,420 cfs

The majority of the canal contains a flow of 1,420 cfs with 2 feet of freeboard, with the exception of only a few areas upstream of the Plum Creek siphon. The Parshall flume has a minimum freeboard of 0.5 foot; however, the Parshall flume is affected by the downstream Plum Creek siphon. Improvements to the Parshall flume would be ineffective without improvements to the Plum Creek siphon. The water surface elevation at the inlet of the siphon is 1.3 feet below the top of the headwall. To limit the improvements, it is recommended that the Parshall flume and Plum Creek siphon remain as is for this alternative. The downstream flume crossing at Mile 3.15 has a minimum freeboard of 1.1 foot, which is adequate when compared to the design freeboard of approximately one foot below the concrete bracing beams.

To provide additional freeboard upstream of the Plum Creek siphon, the berms adjacent to the canal will need to be raised in three areas, for a total of approximately 2,000 linear feet of the canal. Because of the backwater effects of the siphon, widening the canal does not significantly lower the water surface elevation. The entrance of the siphon is similar to the entrance of a culvert in that the pipe is usually smaller than the open channel or ditch and water backs up upstream of the pipe. The water surface elevation at 1,420 cfs will be higher than the top of the siphon opening, and that elevation will extend upstream for a certain distance. The water surface elevation at the siphon entrance will control the water surface elevation upstream. Raising the berm, therefore, is the best option to obtain 2 feet of freeboard. The additional height is less than 1 foot in all areas and should not require a large area of disturbance. The top width of the proposed berm varies from 17 feet to 20 feet. A top width of 20 feet is preferred, but 17 feet is adequate, and often more than the existing width, to limit disturbance and prevent the need for land acquisition. The side slopes of the proposed berm would be 2 horizontal feet to 1 vertical foot (2:1) on each side. At this slope, the sides of the proposed berm would catch the sides of the existing berm above the base of the embankment, eliminating the need for land acquisition.

No bridges were recommended to be widened since widening of the canal was not recommended. Most of the bridges have 2 feet of clearance between the water surface elevation and the bridge low chord. Although the water is in contact with the low chord at Road 749, 2 feet of freeboard is still maintained between the water surface and the top of the berm. Over 2feet is available between the water surface and the top of the road.

Increasing the flow raises the concern of increased velocity and water depth that could increase the shear stress of the water in the channel and result in erosion. Between 1,000 cfs, at which the canal typically is operated, and 1,420 cfs, the maximum increase in velocity outside of the concrete-lined flumes and siphon transitions would be 0.34 feet per second (ft/s). The average velocity outside of the concrete areas was 1.8 ft/s for 1,000 cfs and 2.1 ft/s for 1,420 cfs. The maximum increase in depth would be 1.8 feet.

Shear stresses were calculated using the method detailed in *Design of Roadside Channels with Flexible Linings*, Hydraulic Engineering Circular No. 15 (HEC-15). Based on soil borings conducted for the J-2 Return feasibility analysis, the soils in the area, and most likely used to construct the Phelps Canal, were lean clays and sandy clays. The permissible shear stress for these soil types is 0.09 pounds per square foot (psf). Outer bends of curves experience higher shear stresses and are more susceptible to erosion. The additional shear stress in bends can be calculated by applying a coefficient to the shear stress calculated at the bottom of the channel that is based on the canal and bend geometry. Shear stresses for 1,000 cfs were calculated to be 0.01 to 0.09 psf at the maximum depth of the canal, which would represent the shear stress at the toe of the side slopes.

For 1,420 cfs, the shear stresses ranged from 0.01 to 0.10 psf. The average increase in shear stress between 1,000 cfs and 1,420 cfs was 0.01 psf. At two bend locations, the shear stresses increased to 0.09 psf and riprap lining is recommended. The locations are shown in Figure 1. The riprap would be toed in below the canal bottom and would extend above the water surface elevation by two feet. Because the added shear stress does not attenuate immediately at the end of the bend, the protection would be extended downstream. The riprap would be NDOR Class B riprap at a thickness of 24 inches underlain by 4 inches of granular filter material.

The shear stress at the wooden bridge east of Road 437 and between HEC-RAS river stations 9832 and 9843 is 0.09 psf for 1,000 cfs. The shear stress is predicted to increase to 0.10 and 0.11 psf for the 1,420 and 1,675 cfs flows, respectively. Photos indicate that riprap has been placed on the side slopes at the bridge. If increased flows move forward, this location should be monitored for erosion. Widening of the canal or slightly flattening the side slopes and replacing the bridge might be warranted.

Alternative 1 would provide canal conveyance of 1,420 cfs with 2 feet of freeboard and minimal disturbance. Riprap bank protection is recommended at two bend locations. The total estimated project cost for this alternative is $354,000. The majority of the costs are the riprap armoring, as shown in a breakdown of costs included as Exhibit 2. If the armoring were not installed, the project cost would be significantly less. Locations of proposed improvements are shown in Figure 1.

Alternative 2 - Canal Improvements to Convey 1,675 cfs

To convey 1,675 cfs with 2 feet of freeboard the Plum Creek siphon and the Parshall flume located immediately upstream of the siphon must be improved. Though the HEC-RAS model shows that the siphon could potentially convey 1,675 cfs without overtopping, the water surface is at the top of the headwall and the backwater effect causes capacity problems upstream of the siphon. Minimal canal improvements would be necessary after these improvements are made. The downstream flume crossing at Mile 3.15 would also need modifications.

According to the U.S. Natural Resources Conservation Services (NRCS) Parshall flume dimensions table, replicated in the USBR Water Measurement Manual, the Parshall flume is currently sized for a maximum of 1,500 cfs. To convey 1,675 cfs, the next standard size of Parshall flume would have a maximum capacity of 2,000 cfs. The overall length would be increased by 3 feet and the throat width would be increased from 30 feet to 40 feet. It is assumed that the entire existing structure would require removal and replacement.

The Plum Creek siphon would remain in place and an 8-foot diameter CMP, same as the existing pipe material, would be installed with 5 feet of clearance between the existing pipe and the new pipe. The east side of the inlet and outlet transitions would need to be modified to allow for the additional pipe. It is assumed that the existing west side and canal bottom would remain in place. The east side of the canal would be removed, the bottom would be widened and a new east side would be constructed. The conceptual level opinion of cost reflects an open trench construction. It is assumed that Plum Creek can be diverted around the construction site, which would most likely require excavating a diversion channel and restoring the area when complete. The cost of diversion should be covered by the water control cost item, but the cost of potential easement for a diversion if it goes outside of the right of way was not included.

All of the improvements for the flume and the siphon would be constructed within the footprint of the existing berms. It was assumed that no land acquisition was necessary. According to Cory Steinke, at this location, 150 feet of deeded right of way exists from the canal centerline to the east side and 160 feet exists from the canal centerline to the west. The improvements will fit within the existing right of way.

With these improvements, the water surface elevation at the inlet of the siphon is 0.7 foot below the top of the headwall. The top of the headwall is the same elevation as the crown elevation of the dike between the siphon entrance and Plum Creek. If it is desired to increase the crown elevation, the entire length of Dike No. 1, as shown on Sheet G11-11A-2 of the as-built drawings could require modification. The existing crown is 12 feet wide. Simply increasing the height could leave a top width that is undesirable for maintenance vehicles. Modification of the crown was not included in the improvements.

To provide additional freeboard upstream of the Plum Creek siphon, the berms will need to be raised in three areas, for a total of approximately 1,200 linear feet of the canal. The additional height is less than 1 foot in all areas and should not require a large area of disturbance. The top width of the proposed berm varies from 16 feet to 20 feet. A top width of 20 feet is preferred, but 16 feet is adequate and often more than the existing width, to limit disturbance and prevent needed land acquisition. The minimum width of 16 feet is slightly less than the minimum 17-feet width used for Alternative 1, since the freeboard was shown to be inadequate at a different cross section that had a slightly narrower top width. The side slopes of the proposed berm would be 2:1 on each side. As in Alternative 1, the side slopes will catch the berm before its base. Similar to Alternative 1, no bridge widening is recommended.

The downstream flume crossing at Mile 3.15 would have only 0.2 foot of freeboard with the above improvements in place; therefore, it is recommended to raise the elevation of the middle section by 1 foot to obtain a minimum of 1 foot of freeboard, as shown in the original design. Modification of the structure will require removing the beams across the top of the structure, prepping the existing concrete and installing dowels, forming, placing new concrete on top of the existing walls, and replacing the concrete beams. It is assumed that 2 feet of the existing concrete walls will be removed when the beams are removed, resulting in a total of 3 additional vertical feet of concrete to be installed. The conceptual level opinion of costs assumes that the existing box culvert and flume will remain in place and can support the additional weight of concrete and water proposed in this alternative. This assumption will need to be verified during the design phase if this alternative is pursued.

An increase in flow to 1,675 cfs would increase the depth of water in the canal a maximum of 2.84 feet. The maximum increase in velocity of the water would be 0.74 ft/s outside of the concrete-lined flumes and siphon transitions. The average velocity outside of the concrete areas was 1.8 ft/s for 1,000 cfs as compared to 2.3 ft/s for 1,675 cfs. The shear stresses for 1,675 cfs ranged from 0.01 to 0.11 psf. The average increase in shear stress between 1,000 cfs and 1,675 cfs was 0.02 psf. At three bend locations, the shear stresses increased to 0.10 psf and riprap lining is recommended. At a fourth location, near HEC-RAS river stations 18000 to 17000, the shear stress increased from 0.04 to 0.08 psf. Because the increase is significant and the result is close to 0.09, riprap lining is included as a recommendation. The locations are shown in Figure 1. The riprap would be toed in below the canal bottom, would extend above the water surface elevation by two feet, and would be extended downstream. The riprap would be NDOR Class B riprap at a thickness of 24 inches underlain by 4 inches of granular filter material.

Alternative 2 would provide canal conveyance of 1,675 cfs with 2 feet of freeboard. The total estimated project cost for this alternative is $2,123,000. A breakdown of costs is included as Exhibit 3. Locations of proposed improvements are shown in Figure 1.

The analysis did not address the issue of turning on the canal and immediately conveying 1,420 or 1,675 cfs. Additional armoring of the canal might be needed for this type of operation. With the significant cost of armoring, this issue warrants further investigation if increasing conveyance in Phelps Canal is desired.

The accompanying electronic HEC-RAS and Excel files detail the existing and proposed modeling, results, comparisons of water surface elevations to the low bank elevations, and highlight the cross sections modified to provide additional freeboard.

References

U.S. Army Corps of Engineers. January 2010. *HEC-RAS River Analysis System, Version 4.1.0*.

U.S. Bureau of Reclamation. 2001. *Water Measurement Manual*.

U.S. Bureau of Reclamation. 1978. *Design of Small Canals*.

U.S. Department of Transportation, Federal Highway Administration. September 2005. *Design of Roadside Channels with Flexible Linings*, Hydraulic Engineering Circular No. 15.

EXHIBIT 1

Calculation of Plum Creek Siphon Head Losses based on Procedure in *Design of Small Canals* by the U.S. Bureau of Reclamation, 1978

Existing Siphon, Q=1,535 cfs				**Existing Siphon, Q=1,420 cfs**			
Basic pipe data				**Basic pipe data**			
Flow	Q=	**1535**	cfs	Flow	Q=	**1420**	cfs
Diameter	d=	13.75	feet	Diameter	d=	13.75	feet
Area	A=	148.5	ft^2	Area	A=	148.5	ft^2
Veocity (Q/A)	V=	10.34	fps	Veocity (Q/A)	V=	9.56	fps
Acceleration of gravity	g=	32.2	ft/s^2	Acceleration of gravity	g=	32.2	ft/s^2
Velocity head in pipe ($V^2/2g$)	h_{vp}=	1.66	ft	Velocity head in pipe ($V^2/2g$)	h_{vp}=	1.42	ft
Wetted perimeter (πd)	wp=	43.2	ft	Wetted perimeter (πd)	wp=	43.2	ft
Hydraulic radius (A/wp)	r=	3.44	ft	Hydraulic radius (A/wp)	r=	3.44	ft
Mannings n	n=	0.024		Mannings n	n=	0.024	
Friction slope of pipe ($1/2.2r^{4/3})n^2V^2$	s_f=	0.005393	ft/ft	Friction slope of pipe ($1/2.2r^{4/3})n^2V^2$	s_f=	0.004615	ft/ft
Length of pipe	L=	301.2	ft	Length of pipe	L=	301.2	ft
Friction loss in pipe (s_fL)	h_p=	1.624	ft	Friction loss in pipe (s_fL)	h_p=	1.390	ft
Pipe Bend Losses				**Pipe Bend Losses**			
Bend angle (avg of inlet/outlet)		5.7	degrees	Bend angle (avg of inlet/outlet)		5.7	degrees
Bend loss coefficient, Figure 8-1	zeta=	0.06		Bend loss coefficient, Figure 8-1	zeta=	0.06	
Bend loss, each bend	h_b=	0.100	ft	Bend loss, each bend	h_b=	0.085	ft
Bend loss, two bends	h_b=	0.199	ft	Bend loss, two bends	h_b=	0.170	ft
Inlet and Outlet Transition Losses				**Inlet and Outlet Transition Losses**			
Channel upstream and downstream, use Q=1420 cfs for lower V				Channel upstream and downstream, use Q=1420 cfs			
Veocity in canal, from HEC-RAS	V=	2.42	fps	Veocity in canal, from HEC-RAS	V=	2.42	fps
Velocity head in canal	h_{vc}=	0.09	ft	Velocity head in canal	h_{vc}=	0.09	ft
Inlet transition = 0.4*change in h_v	h_i=	0.63	ft	Inlet transition = 0.4*change in h_v	h_i=	0.53	ft
Outet transition = 0.7*change in h_v	h_o=	1.10	ft	Outet transition = 0.7*change in h_v	h_o=	0.93	ft
Total loss	H=	3.549	ft	**Total loss**	H=	3.023	ft
Total loss increased by 10%	H=	3.904	ft	Total loss increased by 10%	H=	3.325	ft
Recommended during design				Recommended during design			

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

EXHIBIT 2
ALTERNATIVE 1
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,420 CFS WITH 2 FEET OF FREEBOARD IN MOST LOCATIONS
December 14, 2010

Item Number	Description	Appr. Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	1.0	*LS*	$ 15,000.00	$ 15,000.00
2	Construction Surveying	1.0	*LS*	$ 5,000.00	$ 5,000.00
3	Erosion Control	1.0	*LS*	$ 10,000.00	$ 10,000.00
4	Clearing and Grubbing	1.5	*AC*	$ 1,000.00	$ 1,500.00
5	Earth Fill, Class A Compaction	1,499	*CY*	$ 10.00	$ 14,990.00
6	Rock Riprap Armoring, Class B	3,630	*CY*	$ 55.00	$ 199,650.00
7	Granular Filter Fabric	605	*CY*	$ 30.00	$ 18,150.00
8	Salvaging and Spreading Topsoil	7,174	*SY*	$ 1.00	$ 7,174.00
9	Seeding and Mulching	1.5	*AC*	$ 1,100.00	$ 1,650.00
				Subtotal =	**$ 273,114.00**
				20% Construction Contingency =	**$ 54,622.80**
				Probable Construction Costs =	**$ 327,736.80**
				Permitting and Design (8%) =	**$ 26,218.94**
				Total Estimated Project Cost =	**$ 353,955.74**

Assumptions:

1. Improvements consist of raising the berms at select locations. No bridge widening is included.
2. Flumes and Plum Creek siphon have less than 2 feet of freeboard
3. Land acquisition is not needed since berm increases are within the footprints of existing berms.
4. Temporary construction easements not included.

Upgrade Phelps Canal

Gosper County, Nebraka

OLSSON PROJECT NO. 009-1466

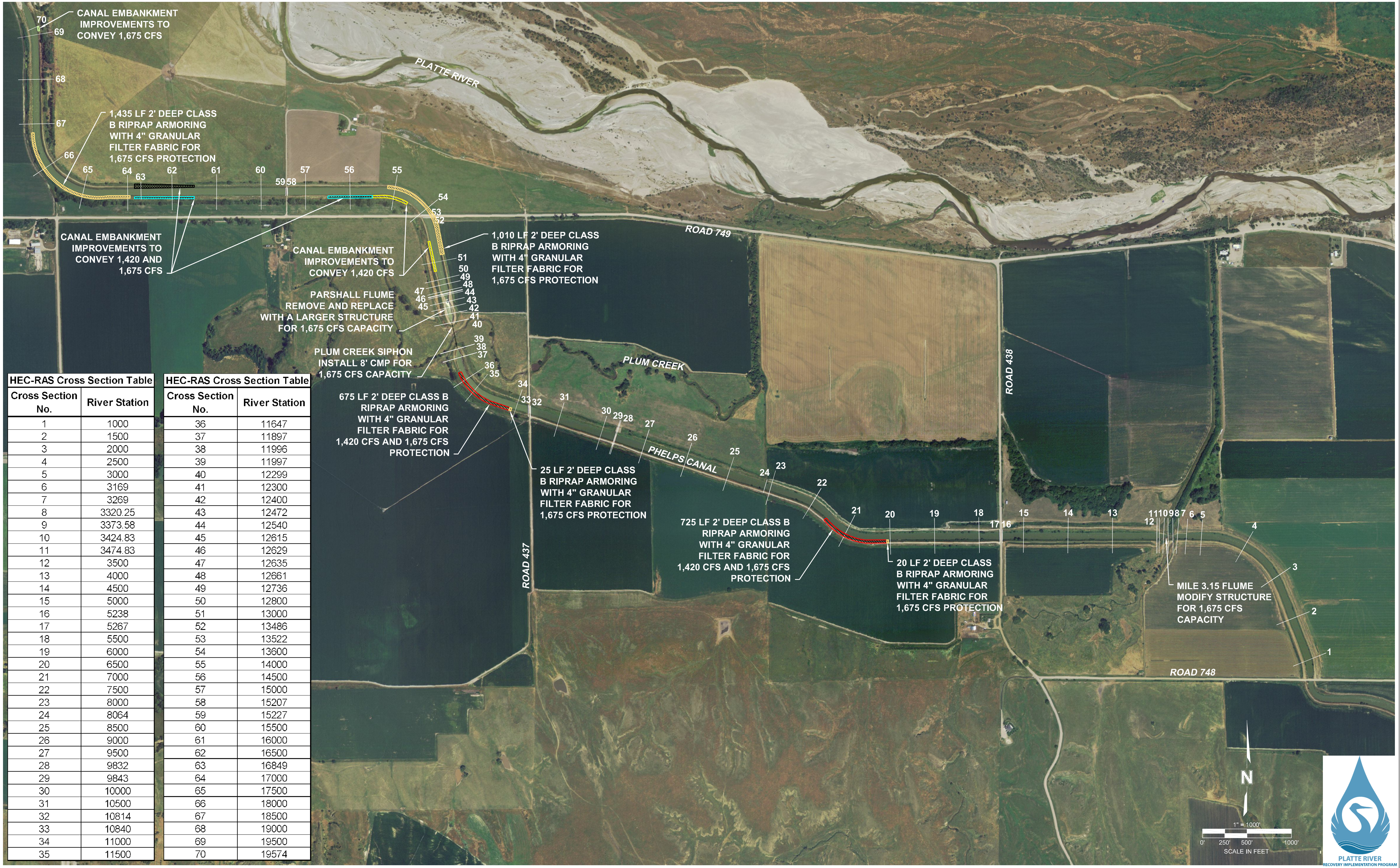
EXHIBIT 3
ALTERNATIVE 2
PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COSTS
IMPROVEMENTS TO CONVEY 1,675 CFS WITH 2 FEET OF FREEBOARD
December 14, 2010

Item Number	Description	Appr. Quantity	Unit	Unit Price		Amount
1	Mobilization/Demobilization	1.0	*LS*	$ 80,000.00		$ 80,000.00
2	Construction Surveying	1.0	*LS*	$ 30,000.00		$ 30,000.00
3	Erosion Control	1.0	*LS*	$ 60,000.00		$ 60,000.00
4	Water Control	1.0	*LS*	$ 100,000.00		$ 100,000.00
5	Clearing and Grubbing	1.1	*AC*	$ 1,000.00		$ 1,100.00
6	Earth Fill, Class A Compaction	1,294	*CY*	$ 10.00		$ 12,940.00
7	Salvaging and Spreading Topsoil	5,022	*SY*	$ 1.00		$ 5,022.00
8	Seeding and Mulching	1.1	*AC*	$ 1,100.00		$ 1,210.00
9	Rock Riprap Armoring, Class B	9,849	*CY*	$ 55.00		$ 541,695.00
10	Granular Filter Fabric	1,642	*CY*	$ 30.00		$ 49,260.00
11	Flume Modifications					$ 64,800.00
	Reinforced Concrete	12	*CY*	$ 400.00	$ 4,800.00	---
	Remove and Replace Beams	6	*EA*	$ 10,000.00	$ 60,000.00	---
12	Remove Parshall Flume	1	*EA*	$ 30,000.00		$ 30,000.00
13	New Parshall Flume	1	*EA*	$ 200,000.00		$ 200,000.00
14	8-Foot Corrugated Metal Pipe	300	*LF*	$ 350.00		$ 105,000.00
15	Plum Creek Siphon Inlet Modifications					$ 161,800.00
	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
	Reinforced Concrete	142	*CY*	$ 400.00	$ 56,800.00	---
16	Plum Creek Siphon Outlet Modifications					$ 195,400.00
	Concrete Demo	1	*LS*	$ 25,000.00	$ 25,000.00	---
	Beams	1	*LS*	$ 50,000.00	$ 50,000.00	---
	Buttresses	1	*LS*	$ 30,000.00	$ 30,000.00	---
	Reinforced Concrete	226	*CY*	$ 400.00	$ 90,400.00	---

Subtotal = **$ 1,638,227.00**
20% Construction Contingency = **$ 327,645.40**
Probable Construction Costs = **$ 1,965,872.40**
Permitting and Design (8%) = **$ 157,269.79**
Total Estimated Project Cost = **$ 2,123,142.19**

Assumptions:

1. Improvements consist of raising the berms at select locations, replacing the Parshall flume, and modifying the Plum Creek siphon and flume at Mile 3.15. No bridge widening is included.
2. Flumes and Plum Creek siphon have less than 2 feet of freeboard
3. Land acquisition is not needed since improvements are within the footprints of existing berms or right of way.
4. Temporary construction easements not included.



HEC-RAS Cross Section Table	
Cross Section No.	River Station
1	1000
2	1500
3	2000
4	2500
5	3000
6	3169
7	3269
8	3320.25
9	3373.58
10	3424.83
11	3474.83
12	3500
13	4000
14	4500
15	5000
16	5238
17	5267
18	5500
19	6000
20	6500
21	7000
22	7500
23	8000
24	8064
25	8500
26	9000
27	9500
28	9832
29	9843
30	10000
31	10500
32	10814
33	10840
34	11000
35	11500

HEC-RAS Cross Section Table	
Cross Section No.	River Station
36	11647
37	11897
38	11996
39	11997
40	12299
41	12300
42	12400
43	12472
44	12540
45	12615
46	12629
47	12635
48	12661
49	12736
50	12800
51	13000
52	13486
53	13522
54	13600
55	14000
56	14500
57	15000
58	15207
59	15227
60	15500
61	16000
62	16500
63	16849
64	17000
65	17500
66	18000
67	18500
68	19000
69	19500
70	19574

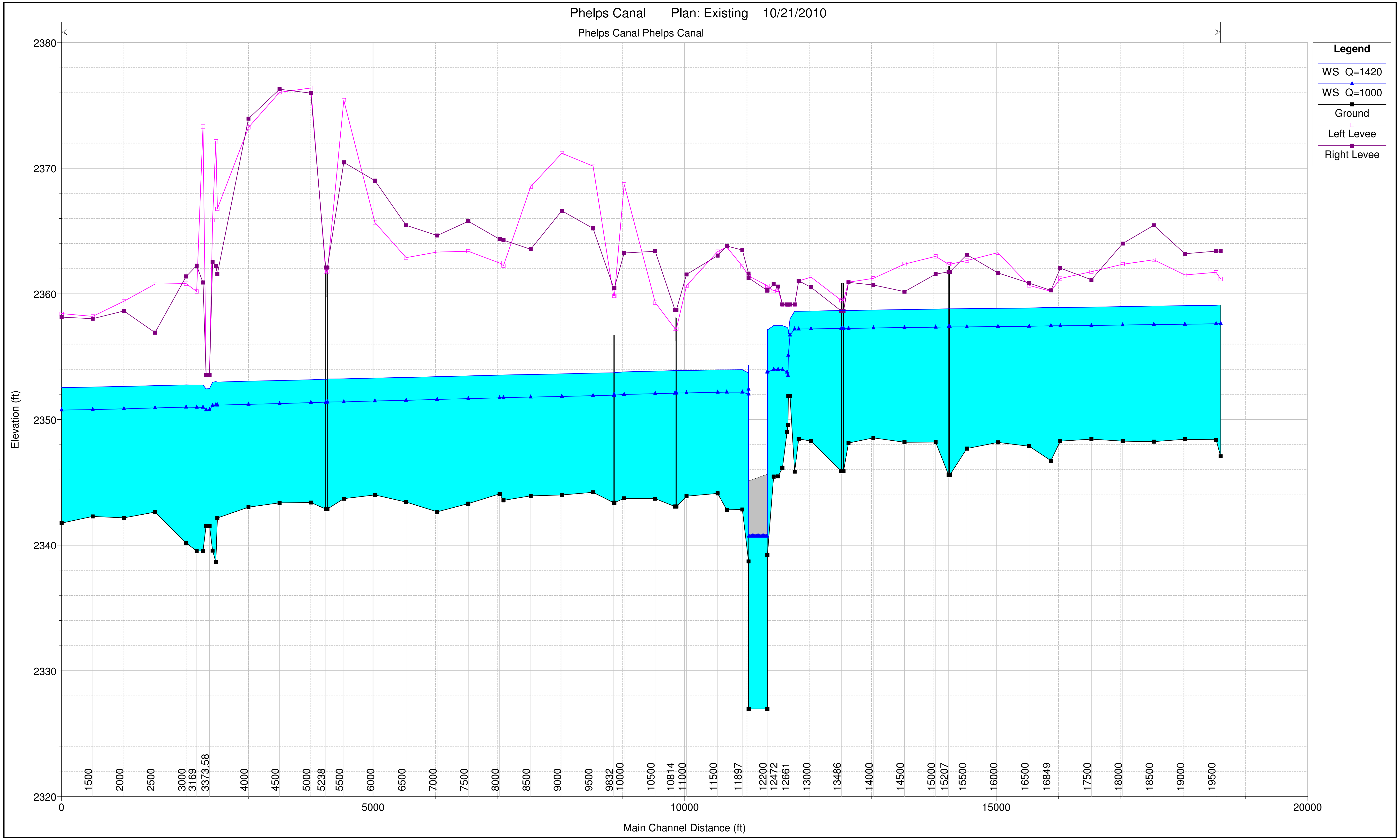
PROJECT: 009-1466
DRAWN BY: AG
DATE: 10/2010

CNPPID J-2 REREGULATING RESERVOIR
PHELPS CANAL IMPROVEMENTS

OLSSON ASSOCIATES
BLACK & VEATCH LLP

FIGURE
1

DWG: C:\Users\agabor\Desktop\Projects\Work at Home\009-1466\Phelps Canal_WIRS\91466_EXB1.dwg USER: agabor
DATE: Jan 27, 2012 11:17am XREFS: 09_1466_LowResolutionAerials


Phelps Canal Plan: Existing 10/21/2010
Phelps Canal Phelps Canal
Legend
WS Q=1420
WS Q=1000
Ground
Left Levee
Right Levee
Elevation (ft)
2380
2370
2360
2350
2340
2330
2320
Main Channel Distance (ft)
0
5000
10000
15000
20000
1500
2000
2500
3000
3169
3373.58
4000
4500
5000
5238
5500
6000
6500
7000
7500
8000
8500
9000
9500
9832
10000
10500
10814
11000
11500
11897
12200
12472
12661
13000
13486
14000
14500
15000
15207
15500
16000
16500
16849
17500
18000
18500
19000
19500

APPENDIX F

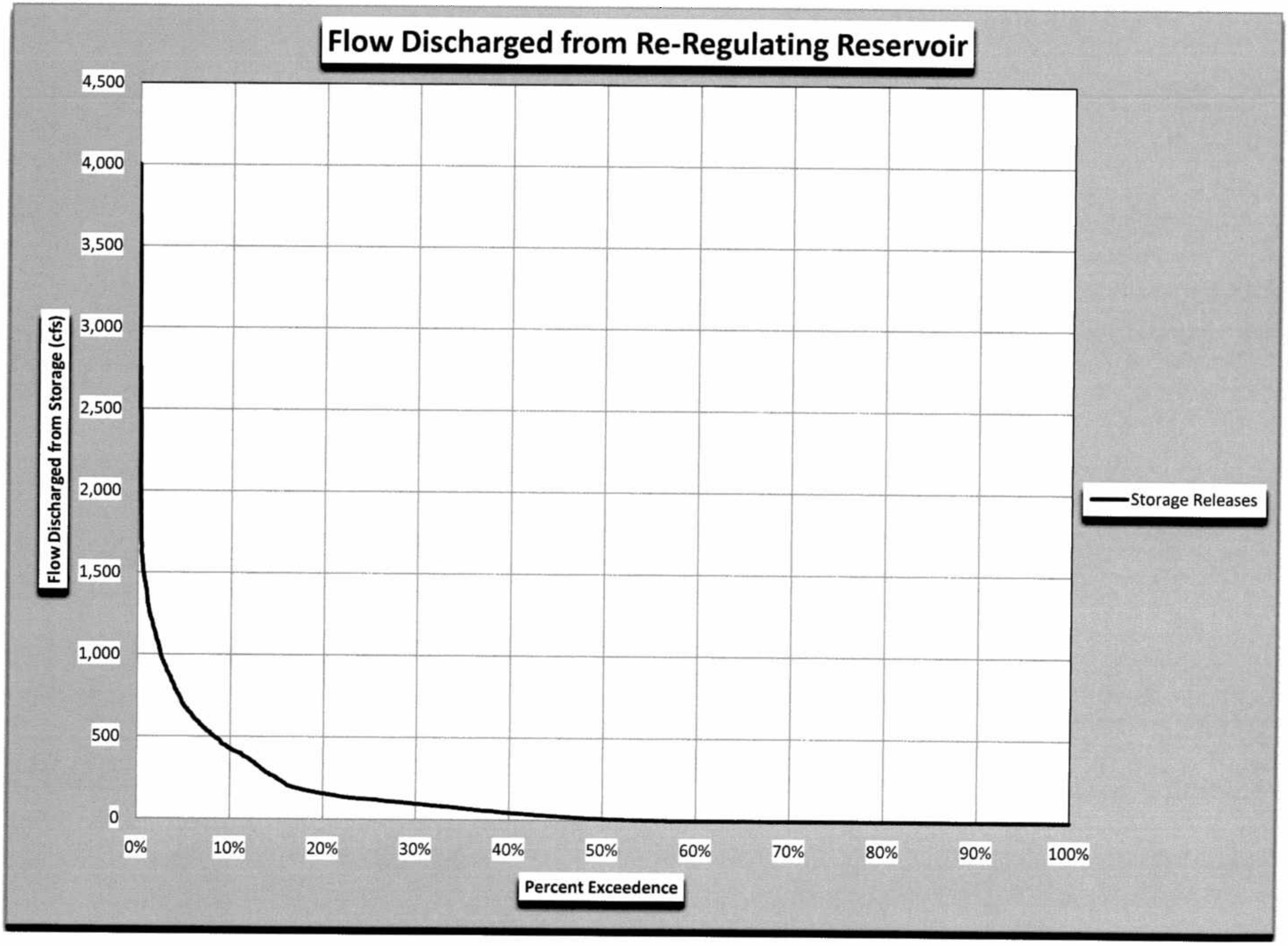
GATE ANALYSIS AND MEMORANDA

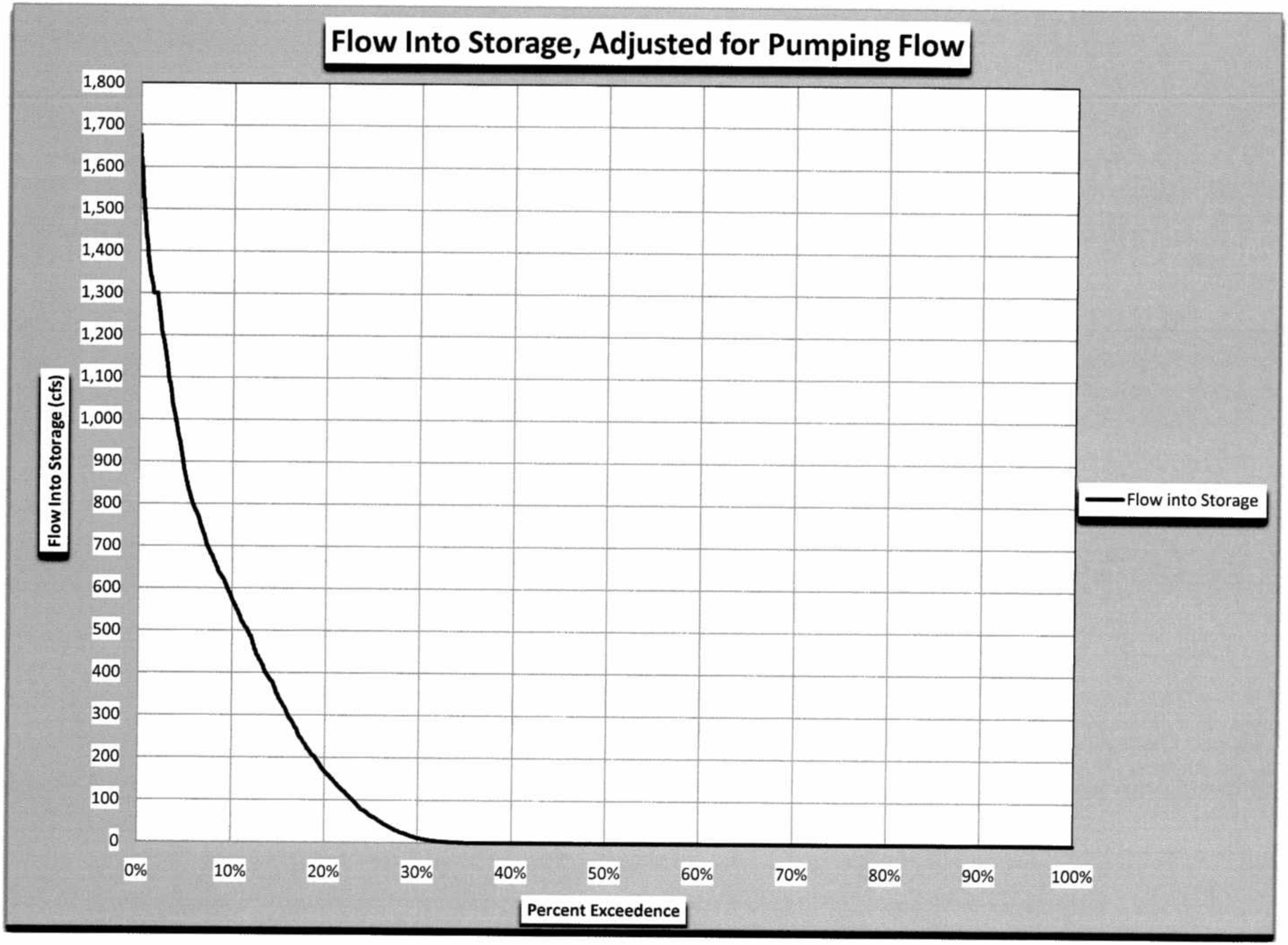
GATE ANALYSIS

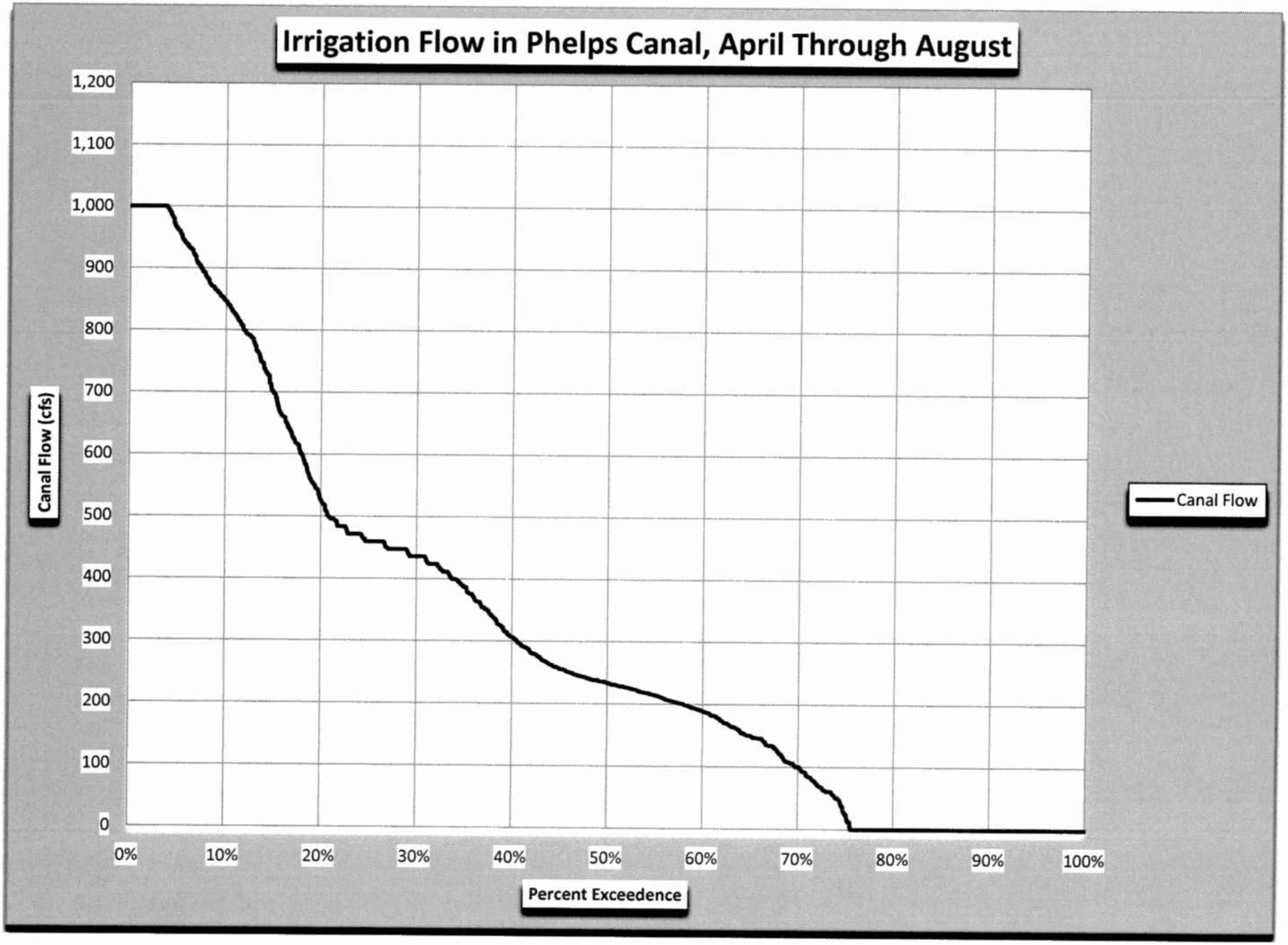
FINAL DATA

FLOW DURATION CURVES

OUTLET GATES RATING CURVE DATA (100% OPEN)


Flow Discharged from Re-Regulating Reservoir
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow Discharged from Storage (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence
Storage Releases


Flow Into Storage, Adjusted for Pumping Flow
Flow Into Storage (cfs)
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence
Flow into Storage



Irrigation Flow in Phelps Canal, April Through August

BLACK & VEATCH

Author A. W. Lemke

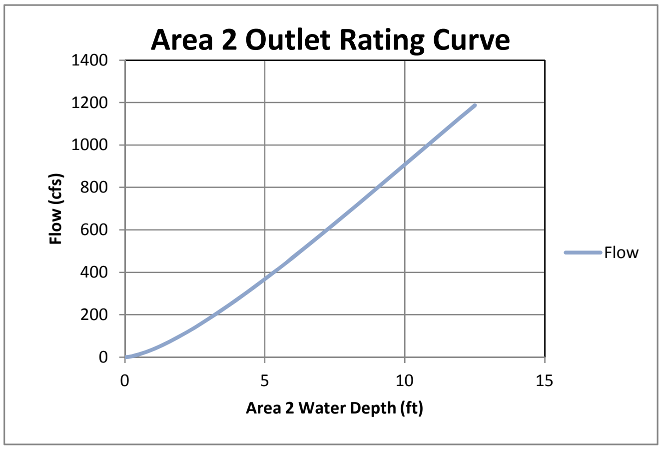
Project Name Platte River Restoration Project
Date 11/14/2011

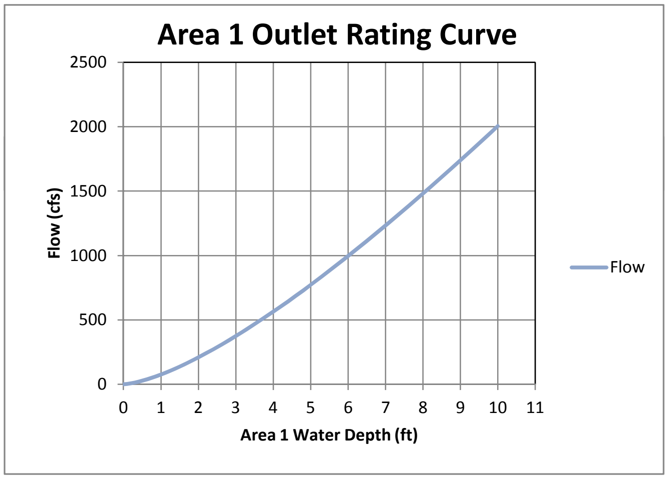
Project No. 168977
Verifier

Calculation No.
Date

Title Rating Curve for Area 1 & Area 2 Outlets

Outlet Area 2		Outlet Area 1		
Number of gates	1	Number of gates	1	
Gate width (ft)	10	Gate width (ft)	20	ft
Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)	
0	0	0	0	
0.25	5	0.2	7	
0.5	13	0.4	19	
0.75	24	0.6	35	
1	37	0.8	54	
1.25	52	1	76	
1.5	68	1.2	99	
1.75	84	1.4	124	
2	102	1.6	151	
2.25	121	1.8	179	
2.5	141	2	208	
2.75	161	2.2	239	
3	182	2.4	271	
3.25	203	2.6	304	
3.5	226	2.8	339	
3.75	248	3	374	
4	271	3.2	410	
4.25	295	3.4	447	
4.5	319	3.6	485	
4.75	343	3.8	524	
5	368	4	563	
5.25	393	4.2	604	
5.5	419	4.4	645	
5.75	444	4.6	686	
6	470	4.8	729	
6.25	496	5	772	
6.5	523	5.2	815	
6.75	550	5.4	859	
7	576	5.6	904	
7.25	603	5.8	950	
7.5	631	6	996	
7.75	658	6.2	1042	
8	685	6.4	1089	
8.25	713	6.6	1136	
8.5	740	6.8	1184	
8.75	768	7	1233	
9	796	7.2	1282	
9.25	824	7.4	1331	
9.5	852	7.6	1381	
9.75	880	7.8	1431	
10	908	8	1481	
10.25	936	8.2	1532	
10.5	964	8.4	1583	
10.75	992	8.6	1635	
11	1020	8.8	1687	
11.25	1047	9	1739	
11.5	1075	9.2	1792	
11.75	1103	9.4	1845	
12	1131	9.6	1898	
12.25	1159	9.8	1952	
12.5	1186	10	2006	





GATE COSTS

BLACK & VEATCH
Corporation

1755 Telstar Drive, Suite 305, Colorado Springs, Colorado 80920, (719) 260-0983

B&V Project 168977

FEASIBILITY DESIGN SUBMITTAL

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures

Feasibility Design

OPINION OF
PROBABLE PROJECT COST
January 18, 2012

SUMMARY

General Requirements, 15%		$1,056,000
Area 1 Inlet		$1,683,000
Area 2 Inlet		$1,653,000
Area 1 Outlet		$1,084,000
Area 2 Outlet		$1,002,000
Phelps Canal Control Gate 1		$315,000
Electrical and I&C		$1,300,000
Contingencies:		
Construction	30%	2,428,000
TOTAL PROBABLE CONSTRUCTION COST		**$10,521,000**
Land/Easements:		
Land/Easement		0
SUBTOTAL PROBABLE PROJECT COST		**$10,521,000**
Engineering (Applied Before Construction Contingency)*	25%	2,023,000
TOTAL PROBABLE PROJECT COST		**$12,544,000**

* Engineering includes:
- 8% Design Engineering
- 5% Permitting and Project Approvals
- 5% Administrative and Legal
- 7% Construction Management and Administration

BLACK & VEATCH

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures
Probable Construction Cost
January 18, 2012

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
GENERAL REQUIREMENTS				
Mobilization, Bonds, Ins, Supervision, Temporary facilities				
Temporary utilities, Equipment rental & misc.		Lump Sum		1,055,600
Total - General Requirements (15%)				$1,056,000
Area 1 Inlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	3,450	cu yd	10.00	34,500
Interlocking sheetpile	8,750	sq ft	25.00	218,750
Compacted fill	900	cu yd	30.00	27,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade	785	cu yd	500.00	392,500
Conc lining for canal	24,600	sq ft	10.00	246,000
Walls	485	cu yd	800.00	388,000
Suspended	45	cu yd	1,000.00	45,000
Embedded accessories		Lump Sum		15,900
Stop logs		Lump Sum		15,000
Manual crank to lift stop logs	3	each	7,500.00	22,500
Metal				
Structural steel	2	ton	4,300.00	8,600
Removable grating	160	sq ft	25.00	4,000
Guardrail	400	lin ft	50.00	20,000
Inlet Gate				
Sluice Gate, 10 ft x 12 ft	3	each	60,000.00	180,000
Miscellaneous		Lump Sum		5,000
Total (Area 1 Inlet) -				$1,683,000
Phelps Canal Control Gate 1				
Canal Control Gate				
Radial Gate, 18 ft x 30 ft	1	each	310,000.00	310,000
Miscellaneous		Lump Sum		5,000
Total (Phelps Canal Control Gate 1) -				$315,000

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures
Probable Construction Cost
January 18, 2012

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Area 1 Outlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	705	cu yd	10.00	7,050
Interlocking sheetpile	7,000	sq ft	25.00	175,000
Compacted fill	325	cu yd	30.00	9,750
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade (includes stilling basin)	400	cu yd	500.00	200,000
Walls	245	cu yd	800.00	196,000
Suspended	30	cu yd	1,000.00	30,000
Embedded accessories		Lump Sum		8,300
Stop logs		Lump Sum		35,000
Manual crank to lift stop logs	1	each	7,500.00	7,500
Metal				
Structural steel	3	ton	4,300.00	12,900
Removable grating	120	sq ft	25.00	3,000
Guardrail	100	lin ft	50.00	5,000
Riprap downstream of stilling basin	1,065	cu yd	65.00	69,200
Outlet Gate				
Radial Gate, 20 ft x 28 ft	1	each	255,000.00	255,000
Miscellaneous		Lump Sum		10,000
Total (Area 1 Outlet) -				$1,084,000
Area 2 Inlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	4,240	cu yd	10.00	42,400
Interlocking sheetpile	10,000	sq ft	25.00	250,000
Compacted fill	900	cu yd	30.00	27,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade	785	cu yd	500.00	392,500
Conc lining for canal	31,850	sq ft	10.00	318,500
Walls	314	cu yd	800.00	251,333
Suspended	45	cu yd	1,000.00	45,000
Embedded accessories		Lump Sum		10,800
Stop logs		Lump Sum		15,000
Manual crank to lift stop logs	3	each	7,500.00	22,500
Metal				
Structural steel	2	ton	4,300.00	8,600
Removable grating	160	sq ft	25.00	4,000
Guardrail	400	lin ft	50.00	20,000
Inlet Gate				
Sluice Gate, 12 ft x 12 ft	3	each	60,000.00	180,000
Miscellaneous		Lump Sum		5,000
Total (Area 2 Inlet) -				$1,653,000

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Area 2 Outlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	435	cu yd	10.00	4,350
Interlocking sheetpile	6,000	sq ft	25.00	150,000
Compacted fill	165	cu yd	30.00	4,950
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade (includes stilling basin)	260	cu yd	500.00	130,000
Walls	415	cu yd	800.00	332,000
Suspended	20	cu yd	1,000.00	20,000
Embedded accessories		Lump Sum		13,100
Stop logs		Lump Sum		50,000
Manual crank to lift stop logs	1	each	7,500.00	7,500
Metal				
Structural steel	2	ton	4,300.00	8,600
Removable grating	200	sq ft	25.00	5,000
Guardrail	100	lin ft	50.00	5,000
Riprap downstream of stilling basin	715	cu yd	65.00	46,500
Outlet Gate				
Radial Gate, 10 ft x 24 ft	1	each	155,000.00	155,000
Miscellaneous		Lump Sum		10,000
Total (Area 2 Outlet) -				$1,002,000
Electrical and I&C				
I&C - Area 1, Area 2, and Control Gates		Lump Sum		100,000
Electrical - Area 1		Lump Sum		200,000
Electrical - Area 2		Lump Sum		200,000
Electrical - 5 kV Line				
5 kV line, direct buried	2.0	miles	400,000.00	800,000
Total (Electrical and I&C) -				$1,300,000

GATE ANALYSIS

DECEMBER 14, 2011 SUPPLEMENTAL MEMORANDUM – REV 1

BLACK & VEATCH
Building a world of difference.

TECHNICAL MEMORANDUM NO. 1A (Task 2.2.4)

Platte River Recovery Implementation Program B&V Project 168977
Reservoir Hydraulic Structures – Descriptions and Cost Opinions December 14, 2011
Supplemental Memorandum – Rev 1

The purpose of this supplemental memorandum is to provide updated cost opinions of the hydraulic structures associated with the Program regulating reservoirs based on the following changes that were discussed on the October 27, 2011 conference call:

- Delete the Area 2 Phelps Canal Control Gate
- Delete the Area 2 Reservoir Pumping Station
- Reduce the width of the reservoir outlet gates

In addition, the following changes are incorporated in this revision 1 memorandum:

- Lower the Area 2 inlet invert elevation 5 feet from El 2348 to El 2343.
- Increase the Area 2 inlet gate heights by 5 feet. The top elevation of the inlet gates will not be changed, but the bottom of the gate will be lowered 5 feet to correspond to the inlet being lowered 5 feet.
- Delete the Area 2 inlet vertical concrete wall on the south bank of the Phelps Canal and replace with concrete canal lining.
- Use the beneficial storage volumes for Area 1 and Area 2.

Based upon feedback from the stakeholders in the Platte River Recovery Implementation Program, a single Phelps Canal control gate downstream of Area 1 is desired. Therefore, the cost opinion has been updated to reflect a single canal control gate for both reservoirs.

Once the Area 2 pumping station is deleted, the upper 4 feet in Area 2 will not be available for storage and consideration should be given to reducing the height of the embankment correspondingly (to be addressed by OA).

In B&V's first technical memorandum, each reservoir outlet structure was sized to discharge 1,000 cfs at the minimum reservoir operating elevation (3 feet of head) in order to pass the SDHF of 2,000 cfs. In the first supplemental memorandum, B&V was directed to change the design criteria to size each outlet structure to pass 1,000 cfs at the reservoirs' minimum stage at the end of the 3 day SDHF. As further explained in this revised memorandum, the Area 1 outlet structure is sized to release 1,500 cfs at the reservoir's minimum stage at the end of the 3 day SDHF and Area 2 is still sized for 1,000 cfs.

A 2,000 cfs SDHF constant release over 3 days equals 11,901 acre-ft. The beneficial storage volume in Area 1 at an elevation of 2353 is 10,473 acre-ft. The beneficial storage volume in Area 2 at an elevation of 2357 (no pump station) is 3,486 acre-ft. The total storage volume for both areas equals 13,959 acre-ft. After 11,901 acre-ft is released for the SDHF, 2,058 acre-ft will remain.

Because Area 1 is approximately 3 times larger than Area 2, the average constant release rate from Area 1 during the SDHF will be 3 times larger than Area 2 (1,500 cfs from Area 1 and 500 cfs from Area 2). Therefore, the Area 1 outlet structure is sized to release 1,500 cfs at the reservoirs' minimum stage at the end of the 3 day SDHF. However, the Area 2 outlet structure release rate will remain unchanged at 1,000 cfs.

Increasing the Area 1 minimum operating surface elevation from 2331 to 2337.5 results in a beneficial storage volume of 1,072 acre-ft. Increasing the minimum head at the outlet gate for Area 1 from 3 feet to 9.5 feet reduces the total gate width by 34 feet (two 27 foot wide gates to one 20 foot wide gate).

Increasing the Area 2 minimum operating surface elevation from 2341 to 2349.5 results in a total storage volume of 1,096 acre-ft. Increasing the minimum head at the outlet gate for Area 2 from 3 feet to 11.5 feet reduces the total gate width by 44 feet (two 27 foot wide gates to one 10 foot wide gate).

Thus, for sizing the outlet gates, the total storage remaining in both reservoirs is 2,172 acre-ft.

Costs

The following table illustrates the change to the cost opinion based on:

- Deleting the Area 2 Phelps Canal Control Gate
- Deleting the Area 2 Reservoir Pumping Station
- Area 1 Reservoir Outlet Structure - providing a single 20 foot wide gate rather than two 27 foot wide gates.
- Area 2 Reservoir Outlet Structure - providing a single 10 foot wide gate rather than two 27 foot wide gates.
- Lower the Area 2 inlet invert elevation 5 feet from El 2348 to El 2343.
- Increase the Area 2 inlet gate heights by 5 feet.
- Delete the Area 2 inlet vertical concrete wall on the south bank of the Phelps Canal and replace with concrete canal lining.

Table 1. Opinion of Probable Project Costs

Item	**Total Probable Project Cost ***
Total Probable Project Cost in Original Tech Memo	$ 21,336,000
Revised Total Probable Project Cost	$ 12,542,000
Difference in Cost	$ 8,794,000

* Includes 15% general requirements, 30% contingency, and 25% engineering, permitting, and approvals.

GATE ANALYSIS

SUPPLEMENT TO OCTOBER 26, 2011 MEMORANDUM

TECHNICAL MEMORANDUM NO. 1A (Task 2.2.4)

Platte River Recovery Implementation Program	B&V Project 168977
Reservoir Hydraulic Structures – Descriptions and Cost Opinions	November 7, 2011
Supplemental Memorandum

The purpose of this supplemental memorandum is to provide updated cost opinions of the hydraulic structures associated with the Program regulating reservoirs based on the following changes that were discussed on the October 27, 2011 conference call:

- Delete the Area 2 Phelps Canal Control Gate
- Delete the Area 2 Reservoir Pumping Station
- Reduce the width of the reservoir outlet gates

Based upon feedback from the stakeholders in the Platte River Recovery Implementation Program, a single Phelps Canal control gate downstream of Area 1 is desired. Therefore, the cost opinion has been updated to reflect a single canal control gate for both reservoirs.

Once the Area 2 pumping station is deleted, the upper 4 feet in Area 2 will not be available for storage and consideration should be given to reducing the height of the embankment correspondingly (to be addressed by OA).

In B&V's first technical memorandum, each reservoir outlet structure was sized to discharge 1,000 cfs at the minimum reservoir operating elevation (3 feet of head) in order to pass the SDHF of 2,000 cfs. B&V has now been directed to change the design criteria to size each outlet structure to pass 1,000 cfs at the reservoirs' minimum stage at the end of the 3 day SDHF.

A 2,000 cfs SDHF constant release over 3 days equals 11,901 acre-ft. The storage volume in Area 1 at an elevation of 2353 is 8,605 acre-ft. The storage volume in Area 2 at an elevation of 2357 (no pump station) is 3,797 acre-ft. The total storage volume for both areas equals 12,402 acre-ft. After 11,901 acre-ft is released for the SDHF, 501 acre-ft will remain.

Increasing the Area 1 minimum operating surface elevation from 2331 to 2332 results in a total storage volume of 287 acre-ft. Increasing the minimum head at the outlet gate for Area 1 from 3 feet to 4 feet reduces the gate width by 9 feet.

Increasing the Area 2 minimum operating surface elevation from 2341 to 2344 results in a total storage volume of 173 acre-ft. Increasing the minimum head at the outlet gate for Area 2 from 3 feet to 6 feet allows eliminating one gate, and reducing the remaining gate width by 7 feet.

Thus, for sizing the outlet gates, the total storage remaining in both reservoirs is 460 acre-ft.

Costs

The following table illustrates the change to the cost opinion based on:

- Deleting the Area 2 Phelps Canal Control Gate
- Deleting the Area 2 Reservoir Pumping Station
- Reducing the width of the Area 1 reservoir outlet gates from 27 feet to 18 feet.
- Reducing the width of the Area 2 reservoir outlet gate from 27 feet to 20 feet.
- Eliminating one gate of the Area 2 reservoir outlet.

Table 1. Opinion of Probable Project Costs

Item	**Total Probable Project Cost ***
Total Probable Project Cost in Original Tech Memo	$ 21,336,000
Revised Total Probable Project Cost	$ 14,678,000
Difference in Cost	$ 6,658,000

* Includes 15% general requirements, 30% contingency, and 25% engineering, permitting, and approvals.

BLACK & VEATCH

Author A. W. Lemke

Project Name Platte River Restoration Project

Date 11/14/2011

Project No. 168977

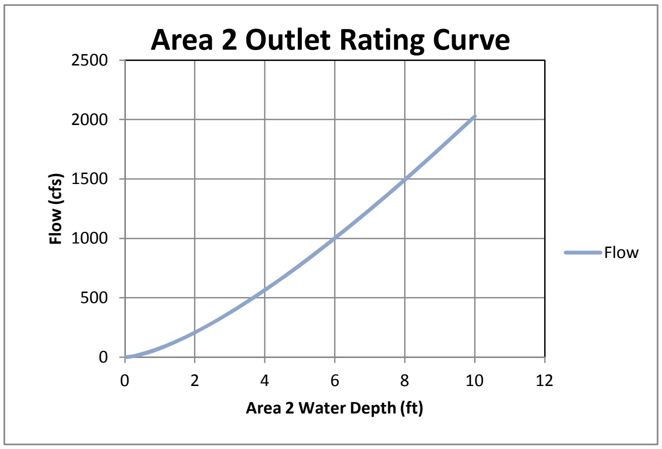
Verifier

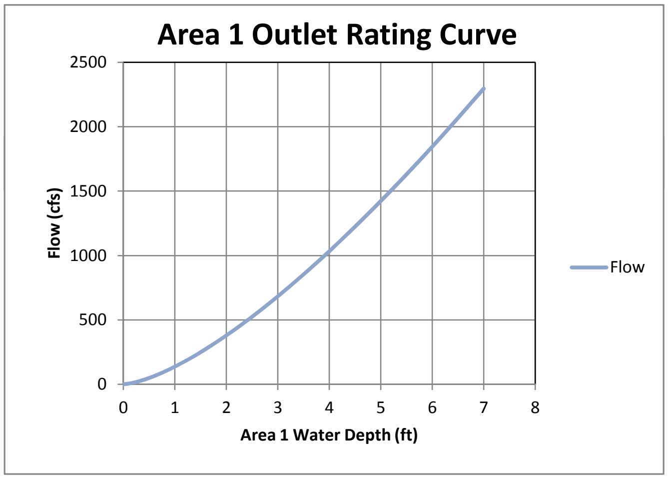
Calculation No.

Date

Title Rating Curve for Area 1 & Area 2 Outlets

Outlet Area 2		Outlet Area 1		
Number of gates	1	Number of gates	2	
Gate width (ft)	20	Gate width (ft)	18	ft
Head	Flow	Head	Flow	
(ft)	(cfs)	(ft)	(cfs)	
0	0	0	0	
0.2	7	0.2	12	
0.4	19	0.4	35	
0.6	35	0.6	64	
0.8	54	0.8	98	
1	76	1	137	
1.2	99	1.2	179	
1.4	124	1.4	224	
1.6	151	1.6	273	
1.8	179	1.8	325	
2	209	2	379	
2.2	240	2.2	435	
2.4	272	2.4	494	
2.6	305	2.6	555	
2.8	340	2.8	618	
3	375	3	683	
3.2	411	3.2	750	
3.4	449	3.4	818	
3.6	487	3.6	889	
3.8	526	3.8	961	
4	566	4	1034	
4.2	606	4.2	1109	
4.4	647	4.4	1186	
4.6	689	4.6	1263	
4.8	732	4.8	1343	
5	776	5	1423	
5.2	820	5.2	1505	
5.4	864	5.4	1589	
5.6	909	5.6	1673	
5.8	955	5.8	1759	
6	1002	6	1846	
6.2	1049	6.1	1890	
6.4	1096	6.2	1934	
6.6	1144	6.3	1978	
6.8	1193	6.4	2023	
7	1242	6.5	2068	
7.2	1291	6.6	2113	
7.4	1341	6.7	2159	
7.6	1391	6.8	2205	
7.8	1442	6.9	2251	
8	1493	7	2297	
8.2	1545	7.1	2344	
8.4	1597	7.2	2391	
8.6	1650	7.3	2438	
8.8	1702	7.4	2485	
9	1756	7.5	2533	
9.2	1809	7.6	2581	
9.4	1863	7.7	2629	
9.6	1917	7.8	2677	
9.8	1972	7.9	2726	
10	2027	8	2774	





OPINION OF
PROBABLE PROJECT COST
October 26, 2011

SUMMARY

			Total Cost with all contingencies
General Requirements, 15%		$1,235,200	
Area 1 Inlet		$1,682,750	3,000,000
Area 2 Inlet		$1,506,200	2,685,000
Area 1 Outlet		$2,211,350	3,942,000
Area 2 Outlet		$1,219,150	2,173,000
Phelps Canal Control Gate 1		$315,000	561,000
Electrical and I&C		$1,300,000	2,317,000
Contingencies:			
Construction	30%	2,840,900	
TOTAL PROBABLE CONSTRUCTION COST		**$12,310,550**	
Land/Easements:			
Land/Easement		0	
SUBTOTAL PROBABLE PROJECT COST		**$12,310,550**	
Engineering (Applied Before Construction Contingency)*	25%	2,367,400	
TOTAL PROBABLE PROJECT COST		**$14,677,950**	14,678,000

* Engineering includes:
- 8% Design Engineering
- 5% Permitting and Project Approvals
- 5% Administrative and Legal
- 7% Construction Management and Administration

DRAFT

GATE ANALYSIS

OCTOBER 26, 2011 MEMORANDUM

TECHNICAL MEMORANDUM NO. 1 (Task 2.2.4)

Platte River Recovery Implementation Program — B&V Project 168977
Reservoir Hydraulic Structures – Descriptions and Cost Opinions — October 26, 2011

The purpose of this memorandum is to provide preliminary descriptions and cost opinions of the following hydraulic structures associated with the Program regulating reservoirs:

- Areas 1 and 2 Reservoir Outlet Structures
- Area 1 and 2 Reservoir Inlet Structures
- Area 2 Reservoir Pumping Station
- Phelps Canal Control Gates

Information used to develop this memorandum included the "Final CNPPID J-2 Regulation Reservoir, Task 1 of Feasibility Study – Investigation of Reservoir Combined Operations," by Olsson Associates, June 24, 2011 and recent email correspondence between Olsson Associates and Black & Veatch.

Reservoir and Gate Hydraulic Data

Information in the referenced report and recent email correspondence was reviewed to determine basic hydraulic data and operational characteristics for the various hydraulic structures. A summary of this information is included as Table 1. The data provided in the table was used as basis for the preliminary descriptions and cost opinions for the hydraulic structures.

Descriptions of Hydraulic Structures

Descriptions of the hydraulic structures under consideration are as follows.

Areas 1 and 2 Reservoir Outlet Structures

The outlet structures for Areas 1 and 2 Reservoirs are considered to be similarly arranged. Each outlet structure will release water from storage for the mitigation of hydropower cycling, Platte River flow augmentation and annual Short Duration High Flow (SDHF) discharges. Based on the modeling information provided by Olsson Associates (OA), the maximum discharge from each reservoir is 2,000 cfs which occurs infrequently. A maximum flow of 2,000 cfs is used to size the outlet works energy dissipation and downstream erosion protection. The maximum total SDHF discharge is 2,000 cfs which is to remain constant over a 3-day period each year while reservoir storage is depleted. One or both reservoirs will be used to achieve the 2,000 cfs SDHF. The flow duration of releases over the 10-year modeling period is provided in the Appendix. From the flow duration relationship, it is noted that total discharge is less than about 200 cfs for 80 percent of the time and there is no discharge expected for approximately 50 percent of the time.

Table 1. Reservoir and Gate Hydraulic Data

Item	**Value**	**Comments**
Area 1 Reservoir		
Embankment Crest Elevation	2356.0 ft	
Max. Operating WS Elevation	2353.0 ft	
Min. Operating WS Elevation	**2331.0 ft**	Revised from **2328.0** ft* to provide minimum 3 ft of head at outlet gate, which will reduce storage capacity by approx. 62 acre-ft.
Maximum Reservoir Bottom Elevation	2330.0 ft	
Storage Capacity	8,605 acre-ft	
Inlet Gate Structure		
Flow Range	0 – 1,675 cfs	
Gate Sill Elevation	2342.0 ft	
Function	Flow Regulation	
Outlet Gate Structure		
Flow Range, Typical	0 – 1,000 cfs	
Minimum Flow to Size Gate	1,000 cfs with 3 ft head	
Flow, Maximum	2,000 cfs	4.75 ft of head required to achieve 2,000 cfs with 100% open gate.
Gate Sill Elevation	2328.0 ft	
Function	Flow Regulation, SDHF	
Area 2 Reservoir		
Embankment Crest Elevation	2364.0 ft	
Max. Operating WS Elevation	2361.0 ft	
Min. Operating WS Elevation	**2341.0 ft**	Revised from **2339.0** ft* to provide minimum 3 ft of head at outlet gate, which will reduce storage capacity by approx. 32 acre-ft.
Maximum Reservoir Bottom Elevation	2340.0 ft	
Storage Capacity	5,033 acre-ft	
Inlet Gate Structure		
Flow Range	0 – 1,675 cfs	
Gate Sill Elevation	2348.0 ft	
Function	Flow Regulation	
Outlet Gate Structure		
Flow Range, Typical	0 – 1,000 cfs	
Minimum Flow to Size Gate	1,000 cfs with 3 ft head	
Flow, Maximum	2,000 cfs	4.75 ft of head required to achieve 2,000 cfs with 100% open gate.
Gate Sill Elevation	2338.0 ft	
Function	Flow Regulation, SDHF	

Table 1. Reservoir and Gate Hydraulic Data

Item	Value	Comments
Phelps Canal		
Flow Range to Inlets	0 – 1,675 cfs	Combined flows
Flow Range Past Area 1	0 – 1,000 cfs	Irrigation flows past gate
At Area 1 Inlet		
Invert El.	2342.0 ft	
Max WS El. @ no flow	**2357.0** ft	Revised from **2353.0 ft*** based on data provided by CNPPID
Max WS El. @ 1675 cfs	2353.0 ft	
At Area 2 Inlet		Located just downstream of Area 1 Inlet
Invert El.	2348.0 ft	
Max WS El. @ no flow	2357.0 ft	
Max WS El. @ 1675 cfs	2355.0 ft	
Canal Control Gate 1 (Downstream of Area 1)		
Water Surface Elevation	2342 – 2357 ft	
Flow Range	0 – 1,000 cfs	
Function	Flow Regulation	
Canal Control Gate 2 (Downstream of Area 2)		
Water Surface Elevation	2348 – 2357 ft	
Flow Range	0 – 1,675 cfs	
Function	Flow Regulation	
Platte River		
WS Elevation Near Area 1 Outlet		
0 cfs	2315.2 ft	
5,000 cfs	2323.1 ft	Design discharge during SDHF
69,660 cfs	2331.9 ft	100-year discharge
WS Elevation Near Area 2 Outlet		
0 cfs	2324.6 ft	
5,000 cfs	2331.8 ft	Design discharge during SDHF
69,660 cfs	2342.2 ft	100-year discharge

Table 1. Reservoir and Gate Hydraulic Data

Item	Value	Comments
Area 2 Pumping Station		
Discharge Capacity	300 cfs	
Area 2 Pumping WS El. Range	2357 – 2361 ft	
Static Head	Minimum 4 ft	Based on Max Phelps WS El. 2357 ft
Total Head Range	4 to 8 feet	Depends on the type of pump selected, the final layout of the pumps, and the WS El. in the Phelps Canal

*Revision to data provided in "Investigation of Reservoir Combined Operations," Olsson Associates, June 24, 2011.

The normal operating water surface elevation varies 22 feet, from El. 2331.0 ft to 2353.0 ft, in the Area 1 Reservoir and 20 feet, from El. 2341.0 ft to 2361.0 ft, in the Area 2 Reservoir. Because of the range of flow regulation required for the outlet gates, and the maximum water depth, radial gates are considered for each outlet structure. It is anticipated that each outlet structure will have the ability to discharge a maximum of 1,000 cfs at the minimum reservoir operating elevation, in order to pass the SDHF of 2,000 cfs. Two radial gates approximately 25 feet in length are considered for each outlet structure. Two gates were considered more favorable than one gate at each structure to improve flow regulation capabilities and to result in a more manageable gate size. Due to the low discharges that are periodically required, future consideration should be given to including a smaller service gate at each outlet structure. The preliminary configurations of the outlet structures are shown on Figures 2 and 4.

Areas 1 and 2 Reservoir Inlet Structures

Each reservoir inlet structure was considered to have a maximum hydraulic capacity of 1,675 cfs, corresponding to the maximum discharge capacity being considered for the Phelps Canal and the maximum rate of flow being considered from Phelps Canal into storage. The flow duration relationship of discharges into storage over the 10-year modeling period is provided in the Appendix. From the flow duration relationship, it is noted that total discharge into storage is less than about 200 cfs for 80 percent of the time and there is no discharge expected for approximately 65 percent of the time.

The preliminary configurations considered for the inlet structures are based on the installation of a control gate within the Phelps Canal just downstream from each Reservoir inlet structure to control canal water surface elevation as necessary to provide sufficient head at the inlet structures, and to regulate downstream irrigation flows. A Phelps Canal maximum water surface elevation of 2355.0 feet was used upstream of the canal control gate 2. A Phelps Canal maximum water surface elevation of 2353.0 feet was used upstream of the canal control gate 1. Both elevations correspond to a Phelps Canal flow of 1,675 cfs.

Area 1 inlet structure is designed for flow into the reservoir for storage, with no requirement to discharge water back into the Phelps Canal. Area 2 inlet structure is designed to allow flow into the reservoir for storage, and discharge back into the Phelps Canal to maintain a constant flow rate when the Hydropower facility is used for peaking.

A sluice gate inlet structure with downward closing sluice gates was considered for each inlet structure. Regulation of flows into the reservoirs would be made by controlling the Phelps Canal water surface elevation at the control gate and by modulating the sluice gates to achieve the desired discharge. For the Area 1 Inlet Structure, the sill elevation would be at El. 2342.0 ft, corresponding to the Phelps Canal invert elevation. For a maximum Phelps Canal water elevation of 2355.0 feet and an inlet capacity of 1,675 cfs, a total of three 10 foot tall by 12 foot wide sluice gates would be required. The sluice gates would be closed when the Area 1 reservoir reached maximum operating level to prevent additional inflow from Phelps Canal, or if it is desired to convey water from Phelps Canal into Area 2 with no discharge into Area 1.

For the Area 2 Inlet Structure, the sluice gate sill would be at El. 2348.0 ft, to match the Phelps Canal invert. For a maximum Phelps Canal water elevation of 2357.0 feet and an inlet capacity of 1,675 cfs, a total of three 7 foot tall by 12 foot wide sluice gates would be required. The sluice gates would be closed as the reservoir water level approached 2357.0 feet, to prevent backflow from the reservoir to the canal as the reservoir water surface elevation increased up to maximum operating level of 2361.0 ft through pumping, or if it is desired to convey water from Phelps Canal into Area 1 with no discharge into Area 2. The preliminary configuration of the reservoir inlet structures is shown on Figures 1 and 3.

Area 2 Reservoir Pumping Station

The maximum water surface in Area 2 is Elevation 2361. The maximum water surface in the Phelps Canal adjacent to Area 2 is Elevation 2357. It is planned to fill Area 2 by gravity from the Phelps Canal until the water surface elevation in Area 2 approaches the maximum water level in the Phelps Canal. A pumping station is required to fill the reservoir from Elevation 2357 to 2361. It is anticipated the pumps will typically operate once per year for approximately 2 weeks to fill the reservoir above Elevation 2357 in preparation for the 2,000 cfs short duration flushing flow.

The pumping station will have a total capacity of 300 cfs (135,000 gpm). It has yet to be determined if the pumping station should provide firm or total capacity. For the purposes of this study, the pump station will provide firm capacity using 3 pumps at 1/3 the total capacity (approximately 45,000 gpm per pump). A fourth pump will be provided as a backup. The total dynamic head will range from 4 to 8 feet, depending on the type of pump selected, the final layout of the pumps, and the water surface elevation in the Phelps Canal.

Two constant speed pumps were selected: a submersible propeller pump and a vertical axial flow pump. The primary difference between the two types of pumps is that the motor is integral with the submersible pump and would be located below the water surface while the motor for the vertical axial flow pump would be located above the pump column and above the maximum water surface. Both pumps are high flow, low head pumps and can pass large diameter solids. Each pump would be powered by a 460 volt motor. It is assumed that existing overhead power lines are located near the site as there are several houses nearby.

The pumping station has been laid out as an outdoor installation. There would be no superstructure. The pumps, motors, and electrical equipment would be designed for outdoor use. The pumping station concrete diversion and inlet channel would be located next to the inlet structure for Area 2. Each pump would pump directly from the open water surface within the forebay into Area 2. The pumps would discharge either to a plunge pool in Area 2 or to a reinforced slope (concrete, riprap, baffles, etc.) into Area 2. The pumping flow rate could be determined from the number of pumps in operation and the water level in the Phelps Canal. The configuration of the pumping station adjacent to the Area 2 inlet structure is shown on Figure 3.

Phelps Canal Control Gates

Control gates are needed in the Phelps Canal downstream of Areas 1 and 2 to maintain a sufficient water surface elevation in the canal for storage operations and to regulate downstream irrigation flows in the canal. The flow duration relationship of irrigation flows within the Phelps Canal over the 10-year modeling period for the April through August irrigation season is provided in the Appendix. From the flow duration relationship, it is noted that maximum irrigation flow is 1,000 cfs, and no irrigation flow is expected for approximately 25 percent of time. Canal flow is currently zero during the non-irrigation season (September through March). However, under future operations, the canal will have flow year round. It is anticipated that water will flow under the ice during winter flows. The Phelps Canal control gates must be able to modulate from fully closed to fully open maintaining the required downstream irrigation flow and anupstream water elevation based on the desired flow rate from the canal into storage. The gates must also be able to accommodate bottom releases during winter flows. A radial type gate was considered for each of the Phelps Canal control gates.

The Phelps canal would be transitioned from its current trapezoidal cross-section to a concrete lined rectangular cross-section to accommodate the control gates. The height and width of the control gate would be selected to maintain an equivalent flow capacity as the canal.

Inlet Gates, Canal Gate, and Pumps Operation Summary
The following table summarizes the operation of the inlet gates and Phelps canal gate.

Table 2. Operation Summary

Condition	**Component**	**Position/Function**	**Comments**
1 – Initial Condition with Empty Reservoirs	Phelps Canal Gate	Fully Open	
	Reservoir Inlet Gates	Raised position	
2 – Fill Reservoirs by Gravity	Phelps Canal Gate	Regulation	Gate will modulate to control downstream irrigation flow in Phelps Canal and upstream canal water level and flow rate into storage
	Reservoir Inlet Gates	Raised position	
3 – Fill Area 2 Reservoir by Pumping	Phelps Canal Gate	Regulation	Gate will modulate to control downstream irrigation flow in Phelps Canal and upstream canal water level and flow rate into storage
	Area 2 Reservoir Inlet Gates	Lowered Position	
4 – Pump Operation	All firm capacity pumps	Manual start by remote control. Pumps would start one by one. All pumps would stop once Area 2 reservoir is full. Pumps would stop one by one if water surface in canal begins to drop. Pumps would re-start one by one as elevation in canal increases.	Pumps will stop on either a minimum canal water surface elevation (approx. El 2354) or a maximum reservoir water surface El 2361
Note, in all scenarios, the Phelps Canal control gate will modulate so that the upstream water elevation does not exceed El 2357.			

Costs

An opinion of probable project cost was developed for each structure. These costs were derived from conceptual level design drawings and should be considered preliminary and used for preliminary budgeting purposes only. Estimates of total capital costs are included in Appendix C. Further details regarding the capital cost estimates are presented below and summarized in Table 3.

Estimates of capital costs were developed from unit and lump sum prices for the various components of each structure. Pricing was based primarily on material quotes from vendors and manufacturers, past experience, and information from similar projects. Additional amounts for general requirements; permitting, contingencies; and engineering, legal, and administrative costs were combined to obtain a total estimated capital cost.

Fifteen percent of the construction cost was added to all components as an allowance for mobilization(s), bonds, insurance, supervision, temporary facilities, temporary utilities, equipment rental, and miscellaneous. Thirty percent of the construction cost was added to each component as a contingency, which is customary for projects at this level of development. Twenty five percent of the construction cost was allocated for engineering, permitting and project approvals, legal, and administrative costs associated with each facility.

Permitting costs are extremely difficult to estimate and can vary significantly. Of the twenty five percent allocated for engineering, five percent was allocated for permitting and project approvals and five percent was allocated for administrative and legal services. These allowances will need to be updated as the project develops.

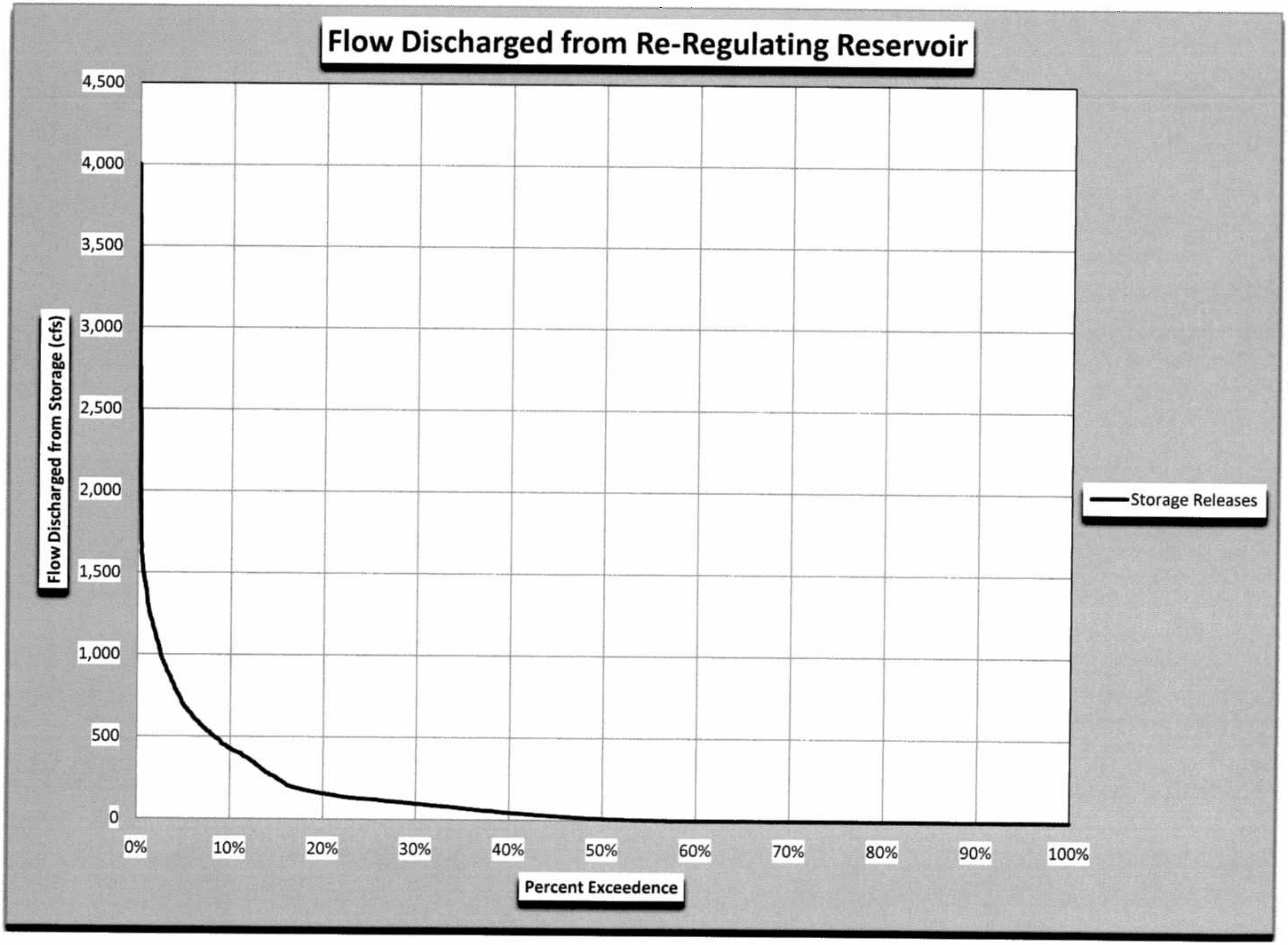
Table 3. Opinion of Probable Project Costs

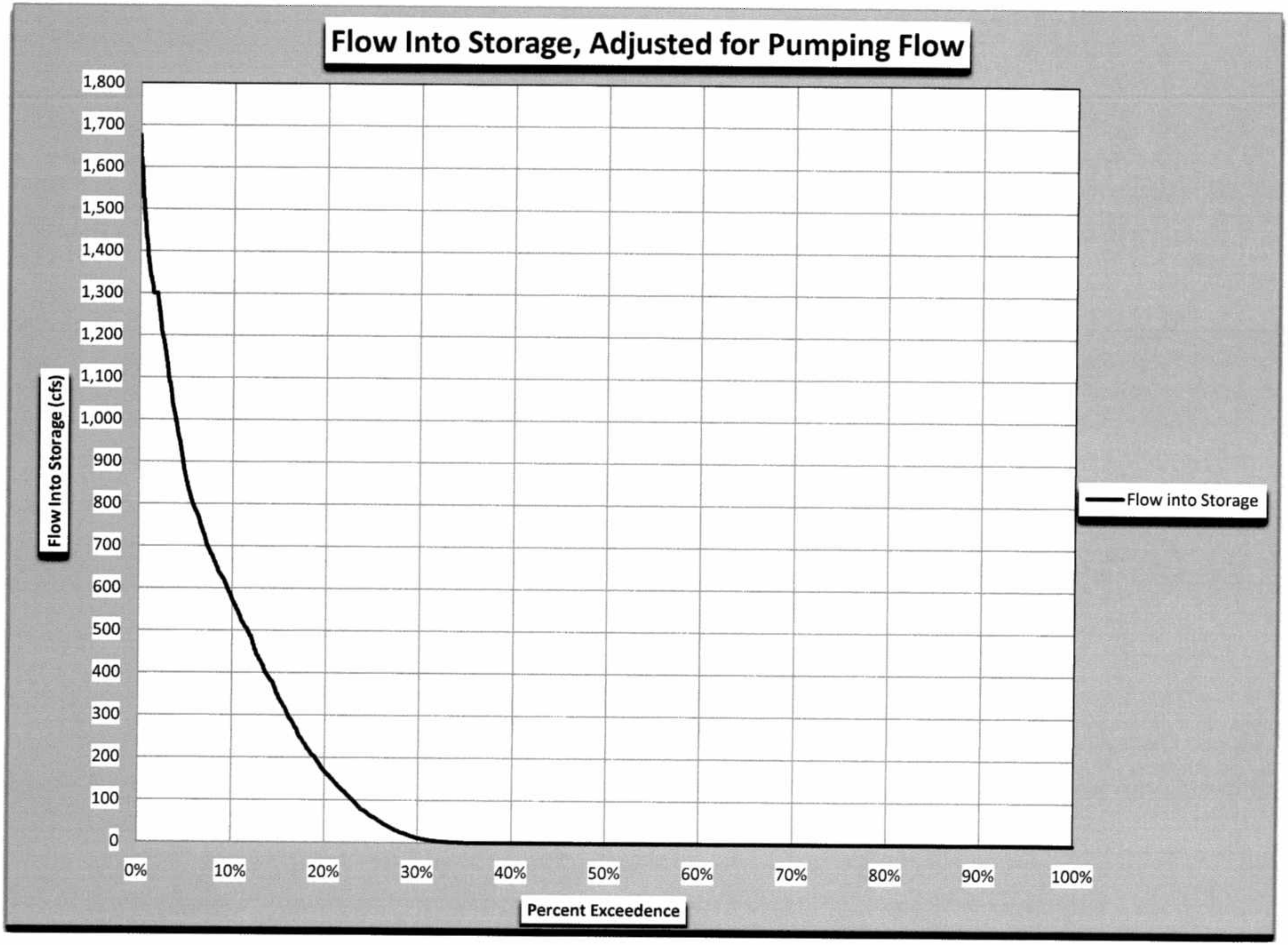
Structure	**Total Probable Project Cost ***
Area 1 Inlet	$ 3,000,000
Area 2 Inlet	$ 2,840,000
Area 1 Outlet	$ 4,810,000
Area 2 Outlet	$ 4,613,000
Phelps Canal Control Gate 1	$ 561,000
Phelps Canal Control Gate 2	$ 374,000
Area 2 Pump Station	$ 2,175,000
Electrical and I&C	$ 2,963,000
Total	$ 21,336,000

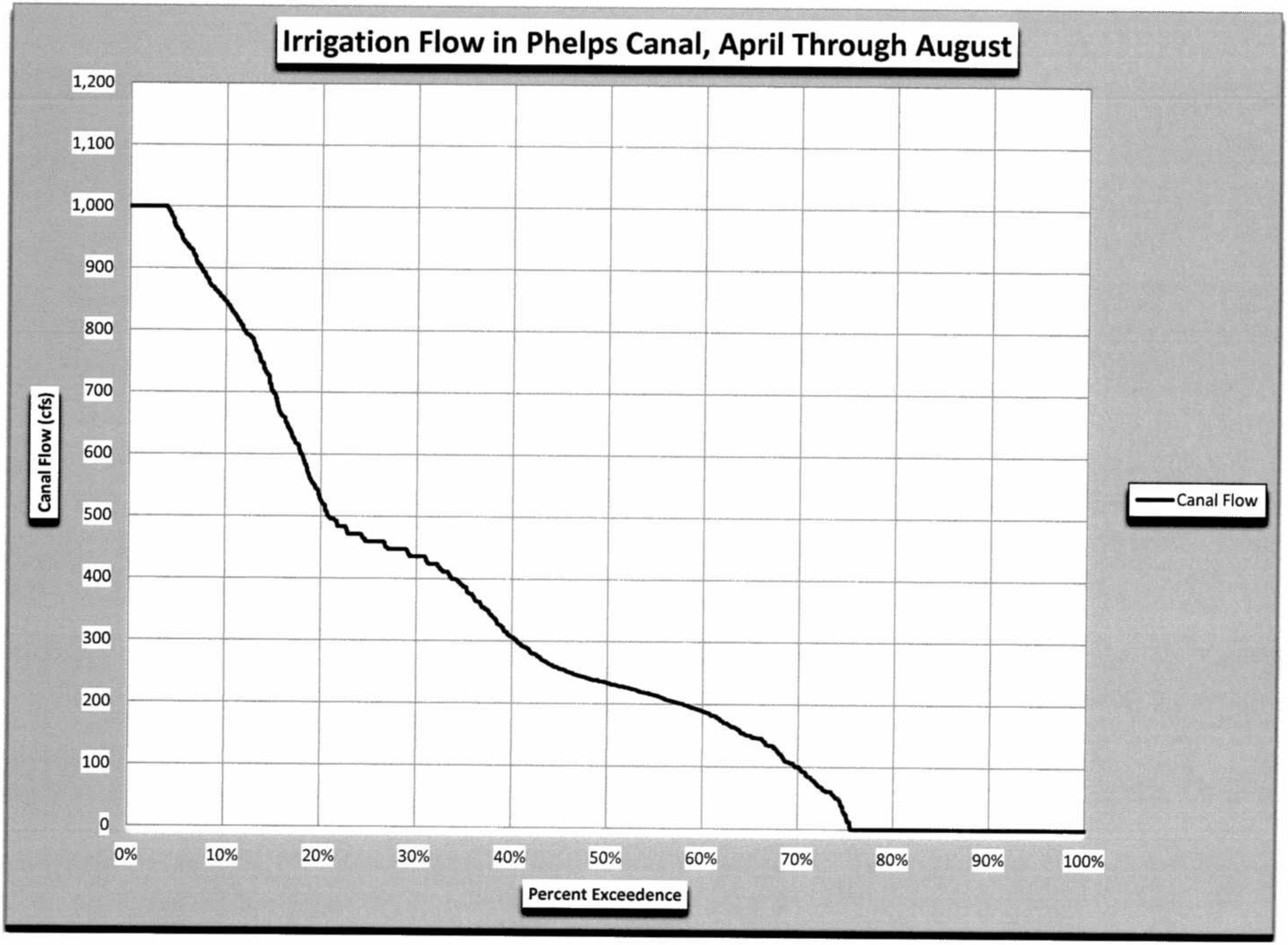
* Includes 15% general requirements, 30% contingency, and 25% engineering, permitting, and approvals.

Appendix A

Flow Duration Curves
Outlet Gate Rating Curve Data (100% Open)


Flow Discharged from Re-Regulating Reservoir
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow Discharged from Storage (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence
Storage Releases


Flow Into Storage, Adjusted for Pumping Flow
Flow Into Storage (cfs)
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent Exceedence
Flow into Storage



Irrigation Flow in Phelps Canal, April Through August

BLACK & VEATCH

Author *A. W. Lemke*

Project Name Platte River Restoration Project

Date 10/14/2011

Project No. 1E+05

Verifier

Calculation No.

Date

Title Rating Curve for Area 1 & Area 2 Outlets

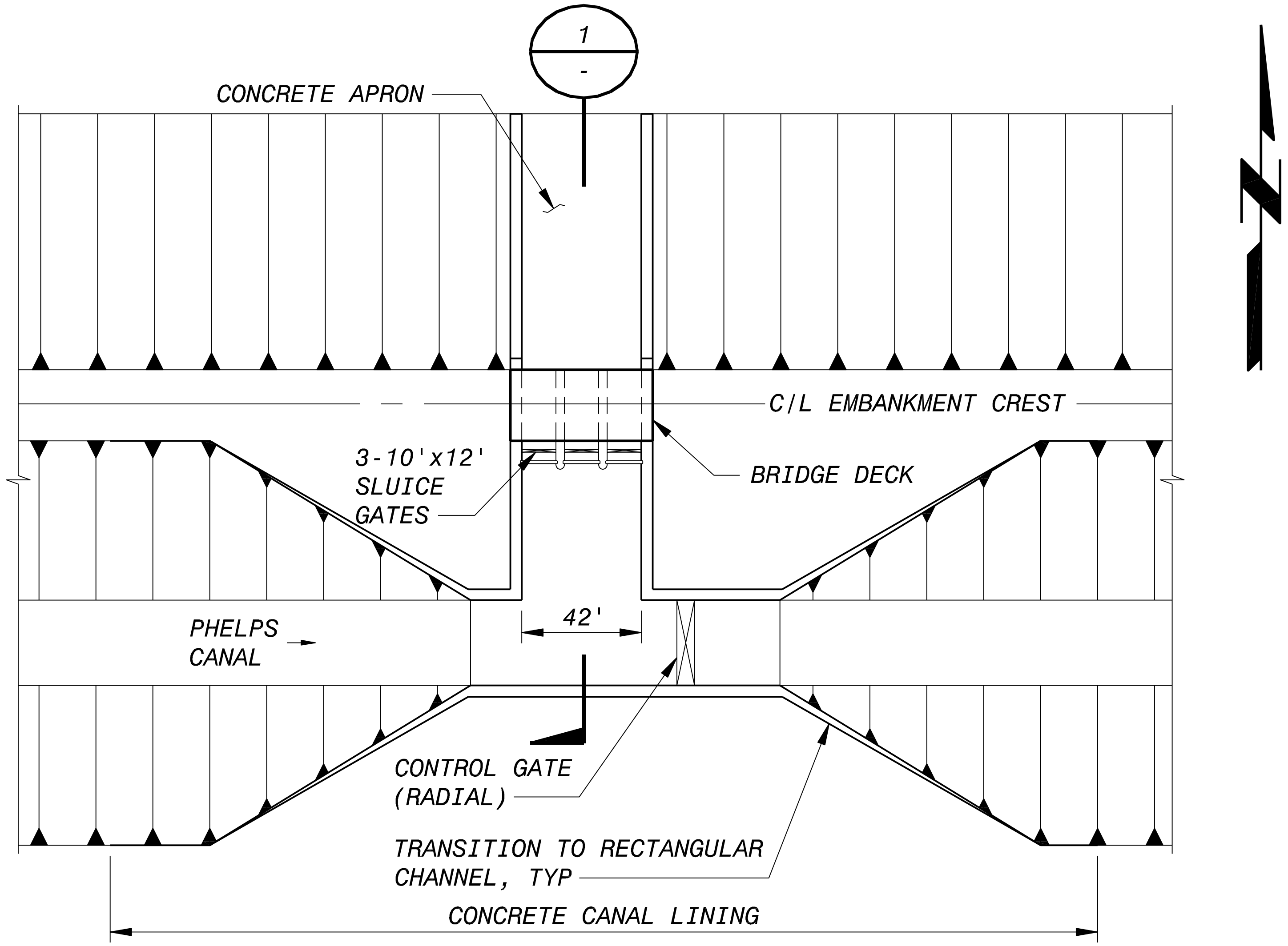
Outlet Area 2		Outlet Area 1	
Head (ft)	Flow (cfs)	Head (ft)	Flow (cfs)
0	0	0	0
0.2	19	0.2	19
0.4	52	0.4	52
0.6	96	0.6	96
0.8	147	0.8	147
1	205	1	205
1.2	269	1.2	269
1.4	338	1.4	338
1.6	411	1.6	411
1.8	489	1.8	489
2	570	2	570
2.2	656	2.2	656
2.4	745	2.4	745
2.6	837	2.6	837
2.8	932	2.8	932
3	1031	3	1031
3.2	1132	3.2	1132
3.4	1236	3.4	1236
3.6	1343	3.6	1343
3.8	1452	3.8	1452
4	1564	4	1564
4.2	1678	4.2	1678
4.4	1794	4.4	1794
4.6	1913	4.6	1913
4.8	2034	4.8	2034
5	2157	5	2157
5.2	2282	5.2	2282
5.4	2409	5.4	2409
5.6	2538	5.6	2538
5.8	2669	5.8	2669
6	2802	6	2802

Appendix B

Structure Drawings

NOTES

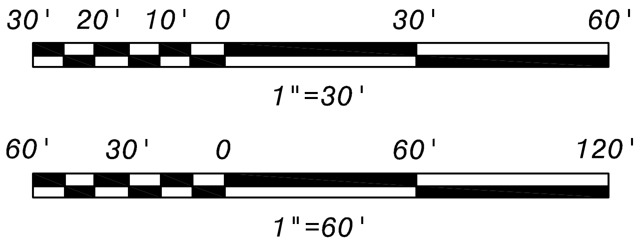
1. ALL DIMENSIONS ARE APPROXIMATE, AND ARE BASED ON CONCEPTUAL LEVEL DESIGN.

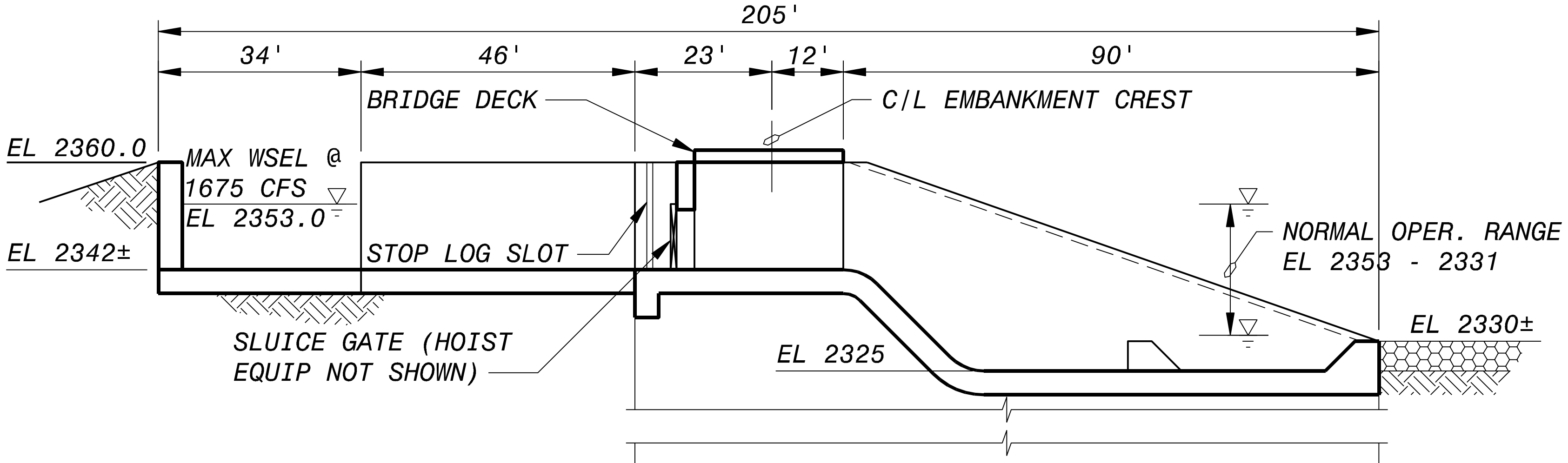


PLAN - AREA 1 INLET STRUCTURE

1" = 60'-0"

PRELIMINARY





SECTION 1

1" = 30'-0"

DATE	REVISION OR ISSUE	NO.	BY	CK	APP
10/20/11	INITIAL ISSUE	A			
DATE	REVISION OR ISSUE	NO.	BY	CK	APP

Black & Veatch

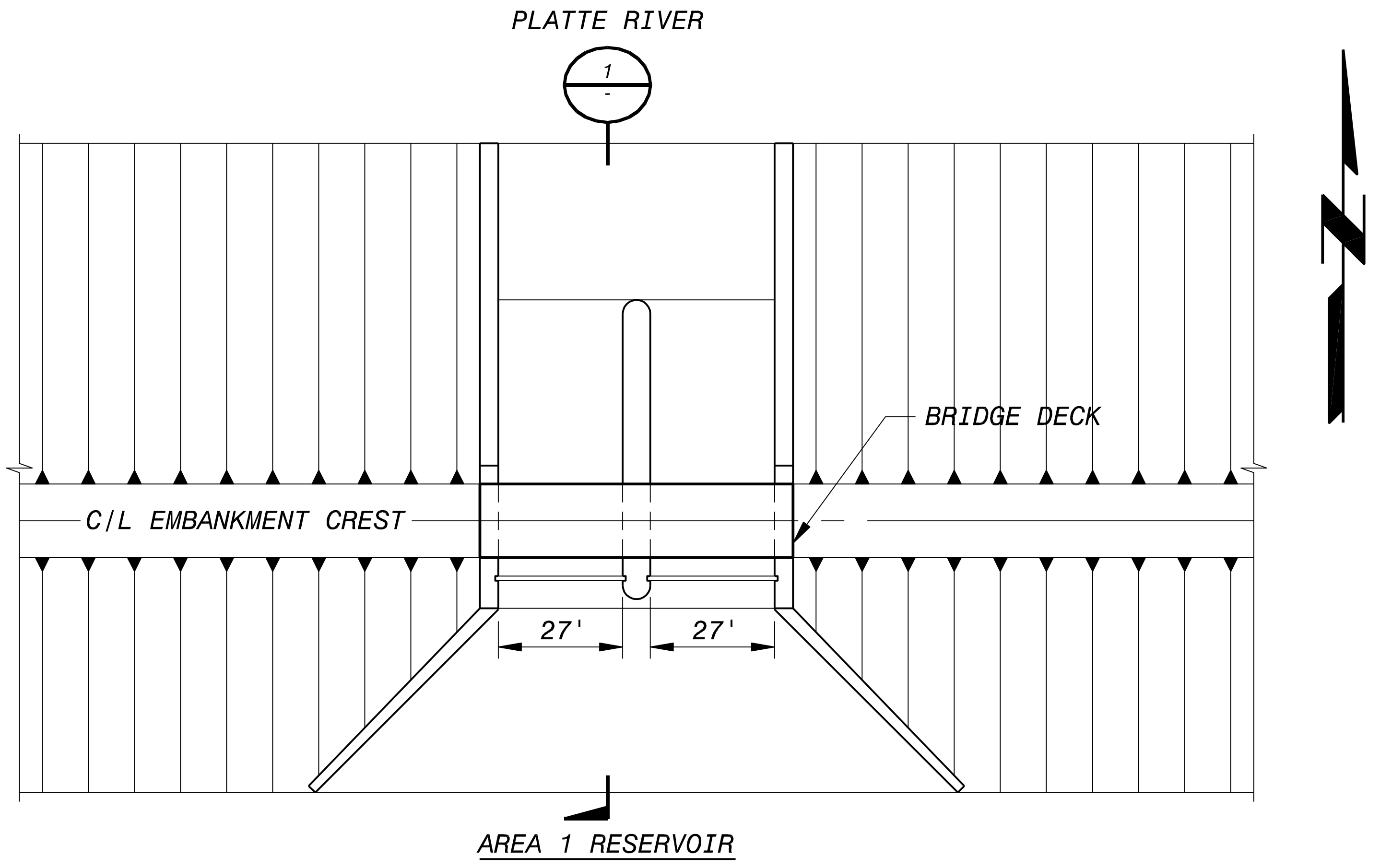
PROJECT
168977

PLATTE RIVER RECOVERY
IMPLEMENTATION PROGRAM

AREA 1 INLET STRUCTURE

FIG. 1

B00000

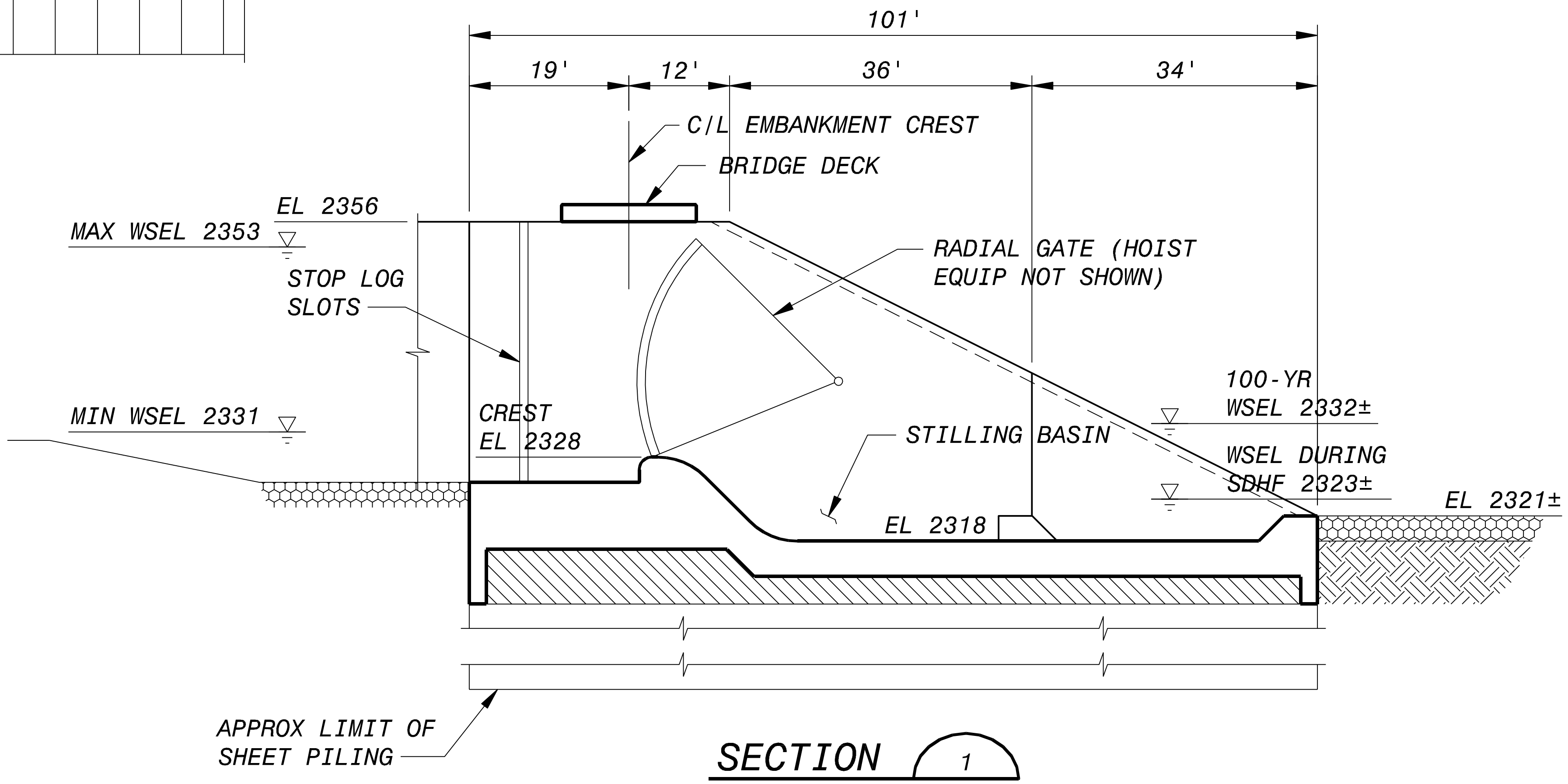


AREA 1 OUTLET STRUCTURE

1" = 40'-0"

NOTES

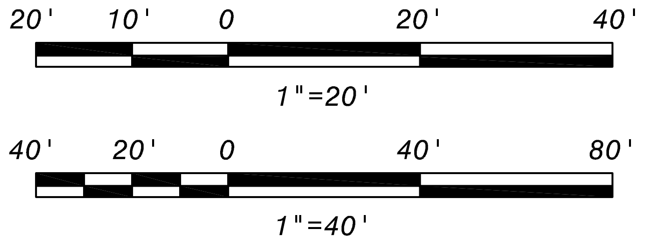
1. ALL DIMENSIONS ARE APPROXIMATE, AND ARE BASED ON CONCEPTUAL LEVEL DESIGN.



SECTION 1

1" = 20'-0"

PRELIMINARY



DATE	REVISION OR ISSUE	NO.	BY	CK	APP	DATE	REVISION OR ISSUE	NO.	BY	CK	APP
						10/20/11	INITIAL ISSUE	A			

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PROJECT
168977

PLATTE RIVER RECOVERY
IMPLEMENTATION PROGRAM

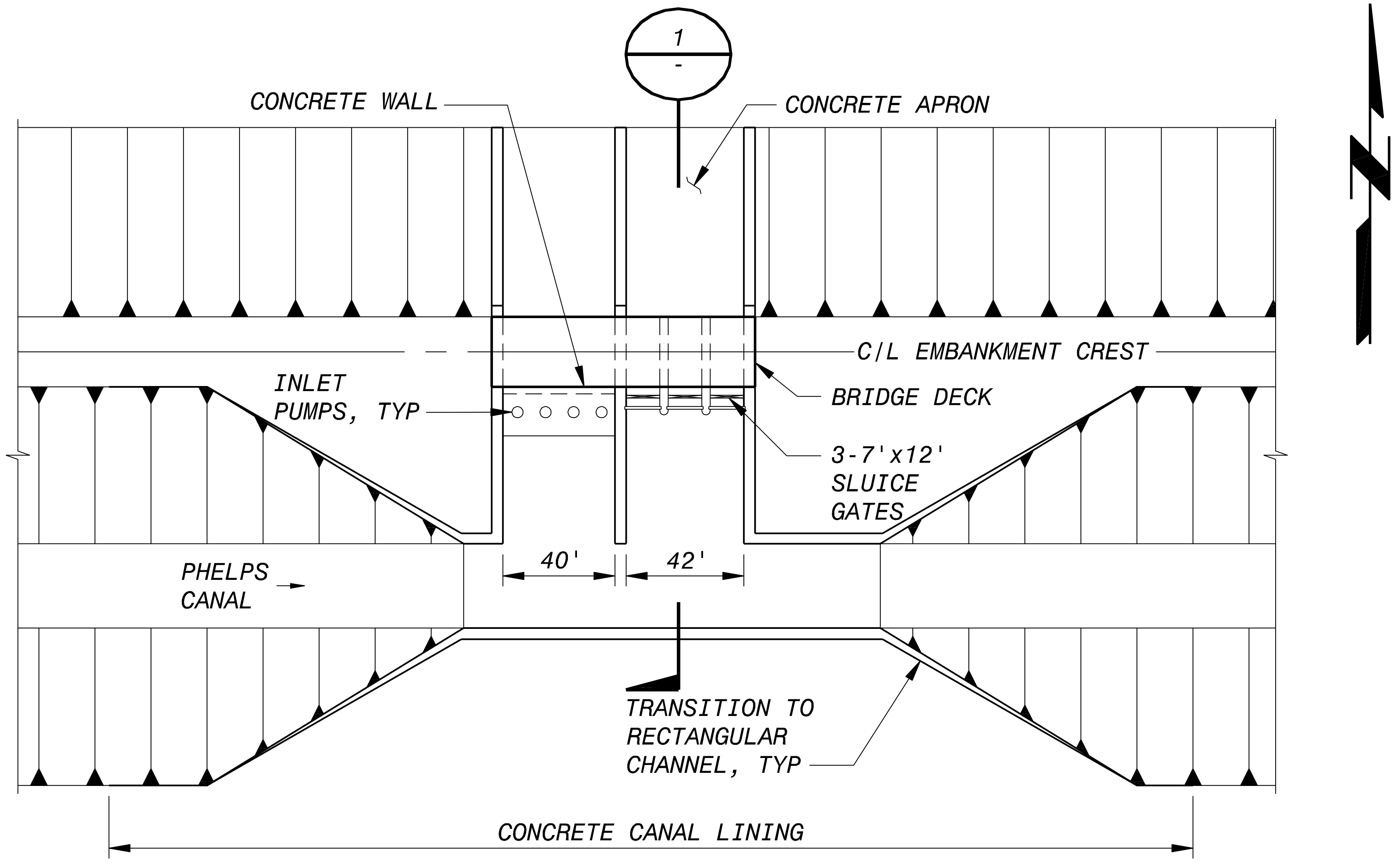
AREA 1 OUTLET STRUCTURE

FIG. 2

B00000

NOTES

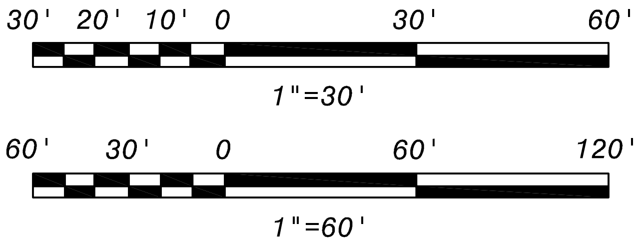
1. ALL DIMENSIONS ARE APPROXIMATE, AND ARE BASED ON CONCEPTUAL LEVEL DESIGN.

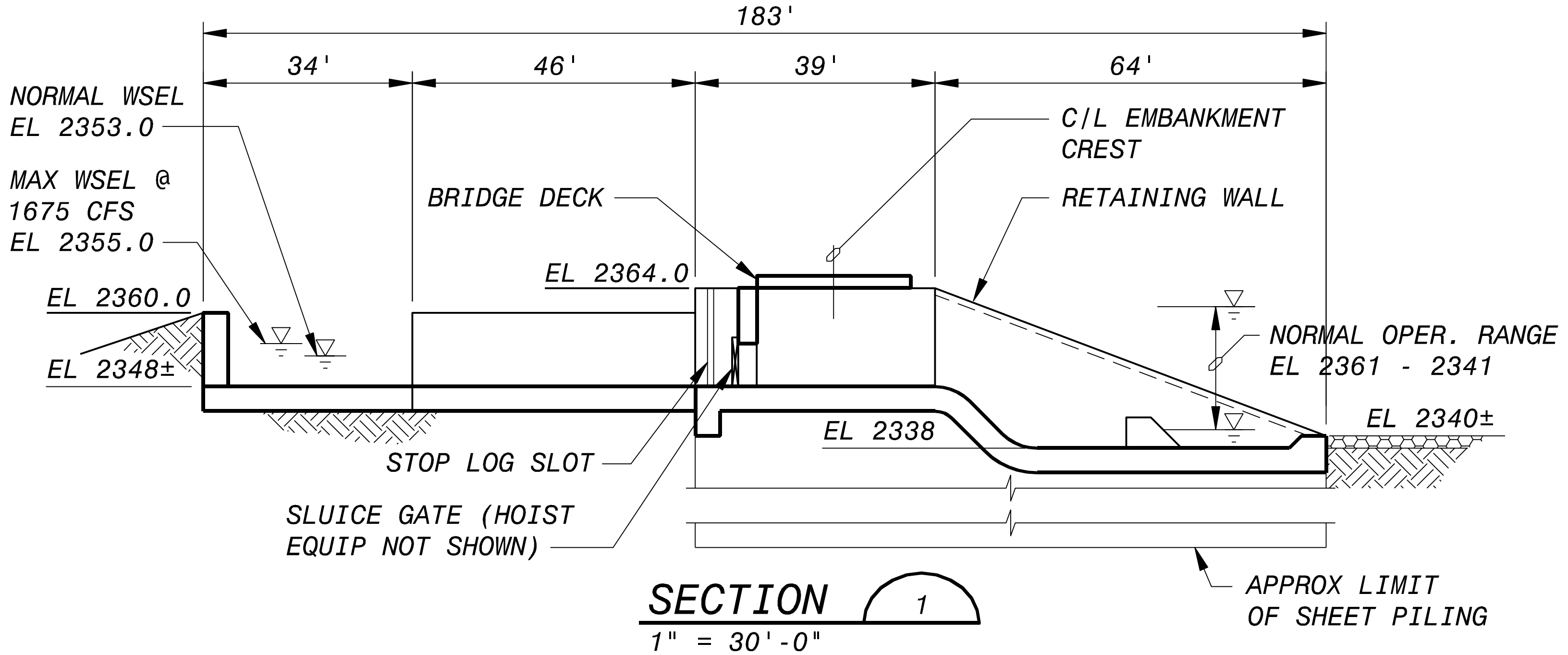


PLAN - AREA 2 INLET STRUCTURE

1" = 60'-0"

PRELIMINARY





SECTION 1

1" = 30'-0"

DATE	REVISION OR ISSUE	NO.	BY	CK	APP	DATE	REVISION OR ISSUE	NO.	BY	CK	APP
						10/20/11	INITIAL ISSUE	A			

Black & Veatch

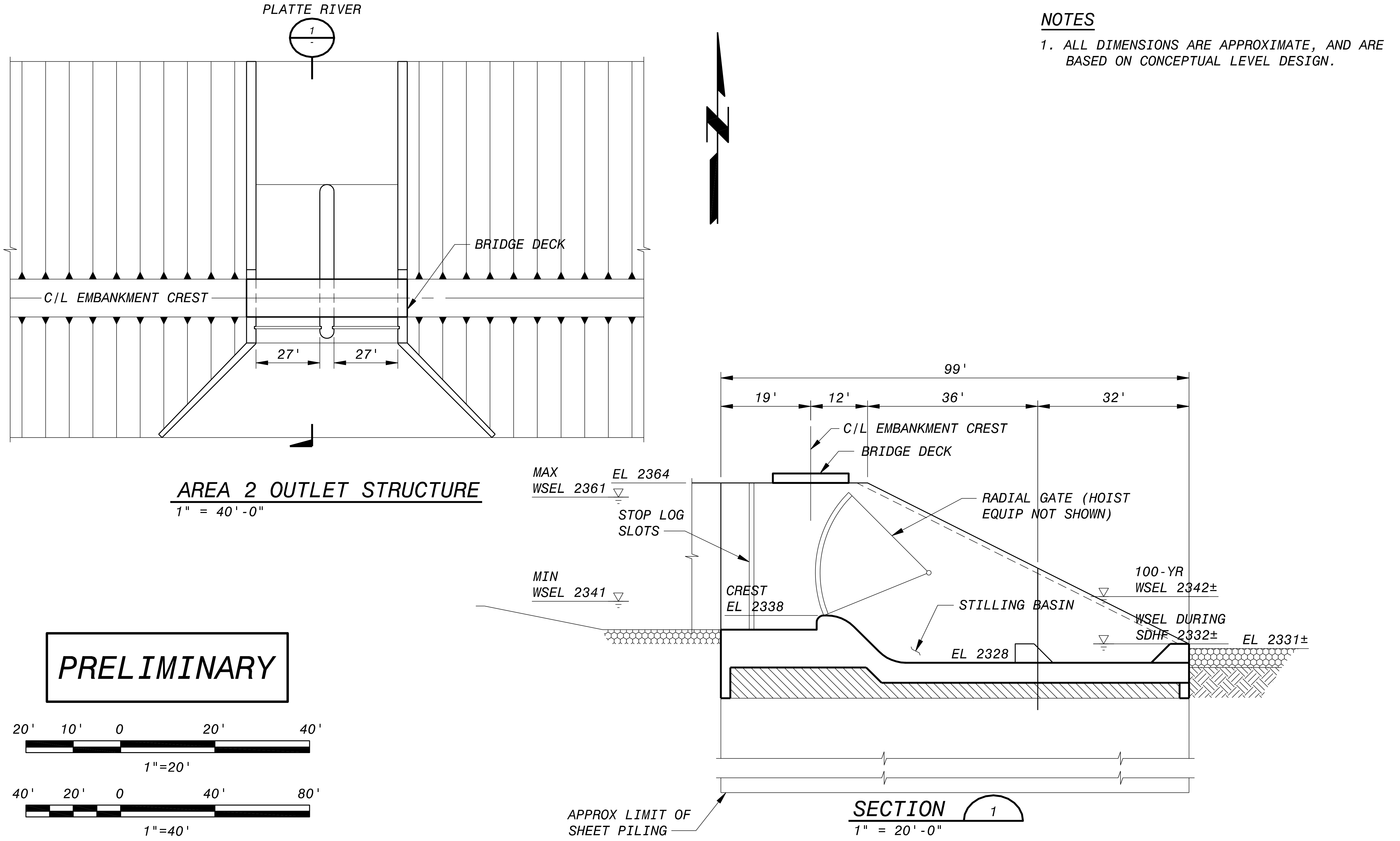
PROJECT
168977

PLATTE RIVER RECOVERY
IMPLEMENTATION PROGRAM

AREA 2 INLET STRUCTURE

FIG. 3

B00000



NOTES

1. ALL DIMENSIONS ARE APPROXIMATE, AND ARE BASED ON CONCEPTUAL LEVEL DESIGN.

DATE	REVISION OR ISSUE	NO.	BY	CK	APP

DATE	REVISION OR ISSUE	NO.	BY	CK	APP
10/20/11	INITIAL ISSUE	A			

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PROJECT
168977

PLATTE RIVER RECOVERY
IMPLEMENTATION PROGRAM

AREA 2 OUTLET STRUCTURE

FIG. 4

B00000

Appendix C

Opinion of Probable Project Cost

BLACK & VEATCH
Corporation

1755 Telstar Drive, Suite 305, Colorado Springs, Colorado 80920, (719) 260-0983

B&V Project 168977

CONCEPTUAL DESIGN SUBMITTAL

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures

OPINION OF PROBABLE PROJECT COST
October 26, 2011

SUMMARY

General Requirements, 15%		$1,795,400
Area 1 Inlet		$1,682,750
Area 2 Inlet		$1,593,000
Area 1 Outlet		$2,698,300
Area 2 Outlet		$2,587,900
Phelps Canal Control Gate 1		$315,000
Phelps Canal Control Gate 2		$210,000
Area 2 Pump Station		$1,220,319
Electrical and I&C		$1,662,200
Contingencies:		
Construction	30%	4,129,500
TOTAL PROBABLE CONSTRUCTION COST		**$17,894,369**
Land/Easements:		
Land/Easement		0
SUBTOTAL PROBABLE PROJECT COST		**$17,894,369**
Engineering (Applied Before Construction Contingency)*	25%	3,441,200
TOTAL PROBABLE PROJECT COST		**$21,335,569**

* Engineering includes:
- 8% Design Engineering
- 5% Permitting and Project Approvals
- 5% Administrative and Legal
- 7% Construction Management and Administration

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
GENERAL REQUIREMENTS				
Mobilization, Bonds, Ins, Supervision, Temporary facilities				
Temporary utilities, Equipment rental & misc.		Lump Sum		1,795,400
Total - General Requirements (15%)				$1,795,400
Area 1 Inlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	3,450	cu yd	10.00	34,500
Interlocking sheetpile	8,750	sq ft	25.00	218,750
Compacted fill	900	cu yd	30.00	27,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade	785	cu yd	500.00	392,500
Conc lining for canal	24,600	sq ft	10.00	246,000
Walls	485	cu yd	800.00	388,000
Suspended	45	cu yd	1,000.00	45,000
Embedded accessories		Lump Sum		15,900
Stop logs		Lump Sum		15,000
Manual crank to lift stop logs	3	each	7,500.00	22,500
Metal				
Structural steel	2	ton	4,300.00	8,600
Removable grating	160	sq ft	25.00	4,000
Guardrail	400	lin ft	50.00	20,000
Inlet Gate				
Sluice Gate, 10 ft x 12 ft	3	each	60,000.00	180,000
Miscellaneous		Lump Sum		5,000
Total (Area 1 Inlet) -				$1,682,750
Phelps Canal Control Gate 1				
Canal Control Gate				
Radial Gate, 18 ft x 30 ft	1	each	310,000.00	310,000
Miscellaneous		Lump Sum		5,000
Total (Phelps Canal Control Gate 1) -				$315,000

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures
Probable Construction Cost
October 26, 2011

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Area 1 Outlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	2,400	cu yd	10.00	24,000
Interlocking sheetpile	8,000	sq ft	25.00	200,000
Compacted fill	600	cu yd	30.00	18,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade (includes stilling basin)	1,000	cu yd	500.00	500,000
Walls	1,040	cu yd	800.00	832,000
Suspended	80	cu yd	1,000.00	80,000
Embedded accessories		Lump Sum		33,600
Stop logs		Lump Sum		50,000
Manual crank to lift stop logs	2	each	7,500.00	15,000
Metal				
Structural steel	4	ton	4,300.00	17,200
Removable grating	240	sq ft	25.00	6,000
Guardrail	140	lin ft	50.00	7,000
Riprap downstream of stilling basin	1,500	cu yd	65.00	97,500
Outlet Gate				
Radial Gate, 27 ft x 28 ft	2	each	374,000.00	748,000
Miscellaneous		Lump Sum		10,000
Total (Area 1 Outlet) -				$2,698,300
Area 2 Inlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	3,450	cu yd	10.00	34,500
Interlocking sheetpile	10,000	sq ft	25.00	250,000
Compacted fill	900	cu yd	30.00	27,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade	845	cu yd	500.00	422,500
Conc lining for canal	24,600	sq ft	10.00	246,000
Walls	350	cu yd	800.00	280,000
Suspended	80	cu yd	1,000.00	80,000
Embedded accessories		Lump Sum		12,900
Stop logs		Lump Sum		15,000
Manual crank to lift stop logs	3	each	7,500.00	22,500
Metal				
Structural steel	2	ton	4,300.00	8,600
Removable grating	160	sq ft	25.00	4,000
Guardrail	400	lin ft	50.00	20,000
Inlet Gate				
Sluice Gate, 7 ft x 12 ft	3	each	35,000.00	105,000
Miscellaneous		Lump Sum		5,000
Total (Area 2 Inlet) -				$1,593,000

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures
Probable Construction Cost
October 26, 2011

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Phelps Canal Control Gate 2				
Canal Control Gate				
Radial Gate, 12 ft x 30 ft	1	each	205,000.00	205,000
Miscellaneous		Lump Sum		5,000
Total (Phelps Canal Control Gate 2) -				$210,000
Area 2 Pump Station				
Earthwork				
Clear and grub		Lump Sum		5,000
Structural excavation	5,870	cu yd	10.00	58,700
Compacted fill	0	cu yd	30.00	0
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade	111	cu yd	500.00	55,600
Walls	388	cu yd	800.00	310,519
Suspended slab	9	cu yd	1,000.00	8,900
Embedded accessories		Lump Sum		11,900
Metal				
Structural steel	4	ton	4,300.00	17,200
Removable grating	400	sq ft	25.00	10,000
Handrail	100	lin ft	25.00	2,500
Equipment				
New Pumps				
Submersible or Vertical Turbine, <150 hp	4	each	150,000.00	600,000
Pump Installatoin	4	each	20,000.00	80,000
Mechanical				
Process piping				
Discharge Pipe, 42" (5 ft per pump)	20	lin ft	500.00	10,000
Total (Area 2 Pump Station) -				$1,220,319

Platte River Recovery Implementation Program
Reservoir Inlet and Outlet Structures
Probable Construction Cost
October 26, 2011

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
Area 2 Outlet				
Earthwork				
Clear and grub		Lump Sum		10,000
Structural excavation	2,300	cu yd	10.00	23,000
Interlocking sheetpile	8,000	sq ft	25.00	200,000
Compacted fill	600	cu yd	30.00	18,000
Dewatering		Lump Sum		50,000
Concrete, cast in place				
Slab on grade (includes stilling basin)	1,000	cu yd	500.00	500,000
Walls	925	cu yd	800.00	740,000
Suspended	80	cu yd	1,000.00	80,000
Embedded accessories		Lump Sum		30,200
Stop logs		Lump Sum		50,000
Manual crank to lift stop logs	2	each	7,500.00	15,000
Metal				
Structural steel	4	ton	4,300.00	17,200
Removable grating	240	sq ft	25.00	6,000
Guardrail	140	lin ft	50.00	7,000
Riprap downstream of stilling basin	1,500	cu yd	65.00	97,500
Outlet Gate				
Radial Gate, 27 ft x 28 ft	2	each	367,000.00	734,000
Miscellaneous		Lump Sum		10,000
Total (Area 2 Outlet) -				$2,587,900
Electrical and I&C				
I&C - Area 1, Area 2, PS, and Control Gates		Lump Sum		150,000
Electrical - Pump Station				
Motor Connections	4	each	9,989.56	40,000
5kV-480V Transformer	1	each	20,000.00	20,000
480 V MCC	4	each	50,000.00	200,000
Grounding	5	clf	464.00	2,200
Miscellaneous		Lump Sum		50,000
Electrical - Area 1		Lump Sum		200,000
Electrical - Area 2		Lump Sum		200,000
Electrical - 5 kV Line				
5 kV line, direct buried	2.0	miles	400,000.00	800,000
Total (Electrical and I&C) -				$1,662,200

APPENDIX G

GEOTECHNICAL INVESTIGATION MEMORANDUM

OLSSON
ASSOCIATES

MEMO

☐ Overnight
☐ Regular Mail
☐ Hand Delivery
☐ Other: ___________

TO: Eric Dove, Olsson Associates
FROM: Andrew Phillips, Olsson Associates
RE: J-2 Areas 1 and 2 Analysis
DATE: February 25, 2011
PROJECT #: B09-1466

This memorandum is provided to address the geotechnical considerations for the J-2 Return project Areas 1 and 2 located along the Platte River near Jeffreys Island. A preliminary embankment stability assessment, seepage conditions, and settlement calculations were completed for Areas 1 and 2 based on laboratory tested soil parameters. This is a preliminary memorandum of findings that will be used by the design team to refine the overall design. A more detailed summary of findings will be furnished with the feasibility report. The impacts to the reservoir operations and yield as a result of the below recommendations will be investigated during the future Task 4 work. The results of the soil testing borings and laboratory analysis can be found in Appendix A CNPPID Reregulating Reservoir Feasibility Study.

SETTLEMENT

For the purposes of analyzing embankment settlement due to collapse of the foundation soils, four collapse tests were performed on samples of the alluvial soils. The laboratory tests indicate that the foundation soils have the potential to collapse approximately 0.3 to 2.1 percent, which indicates a moderate risk of collapse. Based upon the depth of clay noted in the soil test borings and laboratory testing, the embankment could settle as much as 2 inches and 6 inches if the foundation soils were to collapse in Area 1 and Area 2, respectively.

Based on the Atterberg limits and the gradation of the anticipated embankment materials, an allowable differential settlement limit of 0.5 percent was established. In isolated areas the collapse test results indicate that the embankment could undergo differential settlement that could exceed the limit of 0.5 percent if the clay layer thicknesses dramatically changes over a short horizontal length of the embankment. At these locations and only if a drastic change exists, there is a potential for the formation of cracks. Based upon the wide spacing of the soil test borings, the extents of the potential differential cracking could not be accurately determined. A preliminary estimate for areas that could undergo unacceptable amounts of differential settlement would be approximately 0 to 5 percent of the total embankment area. Additional soil test borings should be completed at a later date to better delineate the thickness of the collapsible material and the change in the thickness along the embankment.

If an isolated area where differential cracking could be present exists, it could be addressed through one of three options. The collapsible soils could be saturated during embankment construction allowing the soils to pre-collapse, the cracks that develop after the construction of the embankment could be filled with a gravity grouting process, or the collapsible soils could be overexcavated.

Option 1: In order to saturate the collapsible soils during construction a permanent 12 to 18 inch thick sand blanket would be placed under half of the base width of the berm. Water would be continuously added to the blanket during construction of the embankment, saturating the underlying soils and resulting in the pre-collapse. The pre-collapse would occur during construction of the embankment. On-site sands could be used to construct the blanket. A construction method similar to this was used on a highly instrumented NRCS embankment near McCook, Nebraska.

Option 2: After the embankment has been constructed and the pool has filled, the severity of the transverse cracks within the embankment could be observed to determine the necessity of the gravity grouting process. The exposed slope surface should be inspected to determine the extents of the cracking and to determine whether gravity grouting is warranted. The observed cracks should be tested for their ability to take water. If the cracks are observed to take water, then gravity grouting will be necessary to seal the open cracks. If the cracks do not demonstrate the ability to pipe water through the embankment, then only the exposed crack surfaces will need to be sealed by excavating the top 2 feet of the crack and recompacting the surface materials.

Option 3: The collapsible material could be overexcavated and recompacted to remove the collapse potential of the soils. The collapse potential of the natural soils is related to the relatively low density of the undisturbed material. When the soil is recompacted at a higher density for use as structural fill, the collapse potential of the soil is removed. Excavations necessary to remove the collapsible soils above the ground water table would involve excavations ranging in depth from 5 to 10 feet below the existing ground surface in Area 1 and 5 to 15 feet in Area 2.

SEEPAGE

For analysis of seepage, vertical soil permeability of 2.7 x 10^{-3} cm/sec and 2.0 x 10^{-5}cm/sec were utilized to calculate seepage rates for the cohesionless and cohesive soils, respectively. Our analysis includes a horizontal to vertical permeability ratio of 10 for the cohesionless and cohesive soils. The permeability results are based on the average values obtained from the laboratory testing.

In order to manage the total potential seepage out of the bottom of the storage areas, a 12-inch liner is recommended. The liner will need to be protected to prevent damage that could occur due to frost heave and desiccation cracking. One of the following three options should be implemented to protect the liner in Areas 1 and 2. Due to uplift concerns for the storage Area 1 liner related to flooding from the Platte River, the water level or bottom of the storage area within storage Area 1 should be maintained at a minimum elevation of 2331.5 at all times in addition to and regardless of the option selected for the protection of the liner.

Option 1: Place the clay liner 3 feet below the finished grade. Water would not need to be maintained within the storage area 2 if Option 1 is selected. Embankment material placed within four feet of the inner slope should consist of silty clay soils.

Option 2: Place the clay liner 12 inches below the finished grade. Cover the clay liner with at least 12 inches of water at all times. Embankment material placed within four feet of the inner slope should consist of silty clay soils.

Option 3: Install a synthetic liner 12 inches below the finished grade. Water would not need to be maintained within the storage area 2 if Option 3 is selected. Consideration should be given to protecting the synthetic liner with a 12-inch ballast layer (granular or silty clay).

Due to uplift concerns related to the Phelps County Canal when Storage Areas 2 is empty, the Phelps County Canal within 600 feet of Area 2 should be lined with at least 12 inches of compacted clay or a synthetic liner. The soil test borings indicate that the base of the canal near Area 2 is likely sandy material, resulting in the need for the liner. The liner will need to be protected in a manner similar to those presented above. Based upon the soil test borings, the base of the canal near Area 1 is anticipated to be alluvial clay material; therefore a liner is not needed at the base of the canal near Area 1.

When the storage areas are full and the canal is empty, uplift pressures could generate at the base of the liner within the canal that could exceed excitable levels. Therefore, it is recommended that the water level in the canal be near the same elevation as the water level in the storage areas.

We anticipate that the northern one-third of Areas 1 and 2 will need to be lined with clay because sand was encountered at the existing ground surface or is anticipated to be encountered during excavation operations. Grading operations will also likely encounter sand in the southwest corner of Area 1, which will need to be lined with clay as well. It is anticipated that suitable clay will be encountered throughout the remainder of the storage areas.

To protect the cemetery that is located near the southeast corner of Area 1, a trench drain should be installed along the entire perimeter of the cemetery. The drain should extend at least 6 feet below the existing ground surface and be approximately 2.5 feet wide. The perimeter trench drain was designed to keep the phreatic line approximately 1.5 feet below the existing ground surface. If the phreatic line would need to be maintained at a depth greater than 1.5 feet to allow for future excavations within the cemetery, additional trench drains and deep pressure relief wells would need to be installed.

A seepage berm or excavation of the alluvial clay soils is recommended in the northeast corner of Area 1 due to uplift concerns outside of the storage area resulting from the full water level within the storage area. The combination of the high water level and shallow thickness of alluvial clay soils results in uplift pressures exceeding acceptable limits. One of the following two options should be implemented.

Option 1: Construct a seepage berm along approximately 2,100 lineal feet of the river side toe. The seepage berm should be approximately 2 feet tall and extend from the toe a perpendicular distance of 120 feet. The intent of the seepage berm is to provide additional weight at the toe of the embankment to counteract the uplift forces and to provide a filter layer should preferential flow paths develop in the underlying soils. Please see Figure 1 for a drawing of the seepage berm.

Option 2: Excavate the alluvial clay soils along approximately 2,100 lineal feet of the river side toe. The excavation should extend a perpendicular distance of 60 feet from the river side toe of the embankment and then be backfilled with sand. Based upon the soil test borings, excavations to remove the alluvial clay soils will likely extend approximately 1.5 to 3.5 feet below the existing ground surface.

<u>SLOPE STABILITY</u>

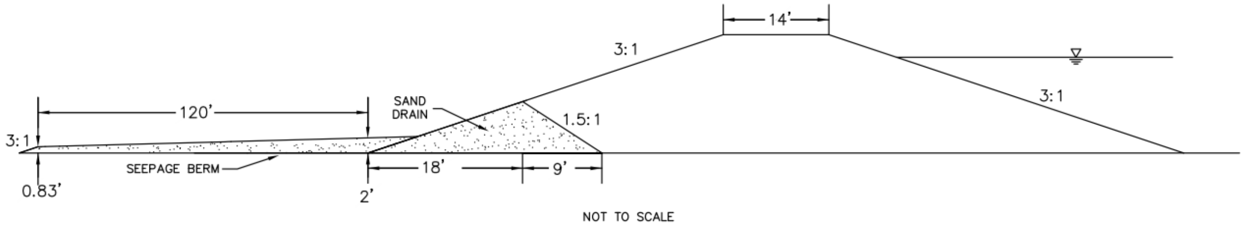
Shear strength parameters utilized in the slope stability analyses for the J-2 Return project were determined based on our engineering judgment and laboratory test results. The soil properties with the shear strength parameters are summarized in Table 1.

TABLE 1
SOIL PROPERTIES FOR ANALYSIS

		Effective Stresses		**Total Stresses**	
Material	**Wet Density, pcf**	**φ', degrees**	**c', psf**	**φ, degrees**	**c, psf**
Foundation-Alluvium clay	112.0	32.3	0	20.9	113.1
Foundation-Alluvium sand	120.0	28	0	28	0
Embankment	113.1	28.7	45.9	15.9	192.2

Based upon the tested soil properties, the embankments were stable under the analyzed conditions of steady seepage and rapid drawdown. The maximum water height for both conditions was set at 3 feet below the top of the embankment.

FIGURE 1: Embankment Profile



A toe sand drain will be needed for both areas. The sand toe drain should be located at the river side edge of the embankment. The sand drain should extend a minimum lateral distance of 27 feet into the embankment. Based upon the results of the soil test borings and laboratory testing, it is anticipated that enough sand material will be encountered during grading operations for Area 1 for construction of the sand drain. We do not anticipate encountering a significant amount of sand material during grading operations for Area 2. Additional excavation operations will be needed to obtain the material in order to construct the sand drain for Area 2.

Should you have any questions regarding the recommendations provided in this memorandum, please feel free to call me at (402) 458-5625.

Appendix A: CNPPID Reregulating Reservoir Feasibility Study

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APPENDIX A:

CNPPID REREGULATING RESERVOIR
FEASIBIILITY STUDY
J-2 RETURN ALTERNATIVES

REPORT OF GEOTECHNICAL EXPLORATION

CNPPID REREGULATING RESERVOIR
FEASIBILITY STUDY
J-2 RETURN ALTERNATIVES

GOSPER AND PHELPS COUNTY, NEBRASKA

PREPARED FOR
THE PLATTER RIVER RECOVERY IMPLEMENTATION PROGRAM

PREPARED BY
OLSSON ASSOCIATES

PROFESSIONAL CIVIL ENGINEER
ANDREW M.
PHILLIPS
E-12242
8-19-10
STATE OF NEBRASKA

AUGUST 19, 2010

OLSSON PROJECT NO. A09-1466

1111 Lincoln Mall • Lincoln, Nebraska • (402) 474-6311 • FAX (402) 474-5160

TABLE OF CONTENTS

INTRODUCTION

This preliminary report presents the results of the geotechnical subsurface exploration performed for the proposed J-2 Return CNPPID Re-regulating Reservoirs. The proposed Area 1 and Area 2 reservoirs are located approximately 5 to 7 miles southwest of Lexington, Nebraska. Area 1 is located in the northwest corner of Phelps County and is bordered by County Road 748 on the south side and the Platte River on the north side. County Road A and County Road B form the western and eastern boundaries of Area 1. Area 2 is located on both the west and east sides of the border between Gosper County and Phelps County and is bordered by County Road 749 on the north side and an existing canal on the south side. County Road 437 and County Road 438 form the western and eastern boundaries of Area 2.

The purpose of this exploration was to evaluate the subsurface conditions and to provide preliminary soil properties and characteristics for the on-site alluvial soils. We have completed the following scope of services for this project:

- Performed a site reconnaissance and reviewed geologic subsurface conditions.
- Drilled 29 soil test borings to depths ranging from 10 to 50 feet in the proposed reservoir areas and soil probed 38 locations at the approximate embankment center lines and toe locations and at locations inaccessible by the drilling rig.
- Performed laboratory tests on soil samples obtained during the drilling operations.
- Prepared a report presenting soil test borings, laboratory test results, and geologic profiles.

The scope of this exploration did not include any environmental assessment for the presence of wetlands and/or hazardous or toxic materials in the soil or groundwater on or near this site. Any statements in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client.

This report was prepared by an engineer intern and reviewed by a professional engineer registered in the State of Nebraska with the firm of ***Olsson Associates (Olsson)***. The conclusions and recommendations contained herein are based on generally accepted, professional, geotechnical engineering practices at the time of this preliminary report, within this geographic area. No other warranty is expressed or implied. This preliminary report has been prepared for the exclusive use of ***The Platter River Recovery Implementation Program*** with specific application to the proposed project.

PROJECT INFORMATION

Site Location and Description

The project site is located south of the Platte River approximately 5 to 7 miles southwest of Lexington, Nebraska between County Road 748 and County Road 749. Area 1 is located in the northwest corner of Phelps County and is bordered by County Road 748 on the south side and the Platte River on the north side. County Road A and County Road B form the western and eastern boundaries of Area 1. The site location for the proposed Area 1 reservoir is depicted on the Site Location Plan provided in Appendix A. Area 2 is located on both the west and east sides of the border between Gosper County and Phelps County and is bordered by County Road 749 on the north side and an existing canal on the south side. County Road 437 and County Road 438 form the western and eastern boundaries of Area 2. The site location for the proposed Area 2 reservoir is depicted on the Site Location Plan provided in Appendix D.

Project Description

This preliminary report includes the laboratory test data on the collected soils samples from the proposed J-2 Return reservoir areas. At the time of this report, the locations and the geometry of the levee embankments had not been selected.

EXPLORATORY AND TEST PROCEDURES

Field Exploration

The field exploration program consisted of drilling 29 soil test borings and 38 soil probe borings at the locations shown on the Boring Location Maps provided in (Appendix A). The boring locations were established in the field using existing reference points. Ground surface elevations of the soil test borings were surveyed by ***Olsson*** and were rounded to the nearest 0.1-foot increment. Ground surface elevation of the soil probes were approximated from a topographic map prepared by Olsson and were rounded to the nearest foot increment.

The soil test borings were drilled to depths ranging between 10 and 50 feet below the existing ground surface with a truck-mounted drill rig using continuous-flight auger and hollow-stem auger. The soil probe borings were drilled to depths ranging between 0.5 and 10.5 feet below the existing ground surface with a hand-operated soil probe. Soil samples were obtained at selected intervals in the soil test borings. Soil samples designated as "U" samples on the boring logs (Appendix B) were obtained in general accordance with ASTM D-1587 (Thin-Walled Tube Sampling of Soils). Soil samples designated as “SS” samples were obtained in general accordance with ASTM D-1586 (Penetration Test and Split-Barrel Sampling of Soils). Recovered samples were extruded in the field, sealed in plastic containers, labeled, and protected for transportation to the laboratory for testing.

The soil test borings and soil probes labeled with an A, B, or C demonstrate the location of the drilling operations relative to the proposed reservoir embankments. A letter “A” denotes the approximate toe location of the proposed embankments on the pool side. A letter “B” denotes the approximate centerline of the proposed embankments, and a letter “C” denotes the approximate embankment toe location on the riverside. The toe locations were determined with preliminary embankment heights ranging from 20 to 30 feet and an assumed top of embankment width of 14 feet.

Laboratory Testing

Descriptions of the soils encountered in the soil test borings were prepared in general accordance with ASTM D-2488 (Visual-Manual Procedure for Description and Identification of Soils). Soil stratification, as shown on the Boring Logs, represents soil conditions at the boring locations;

however, variations may occur between or around the boring locations. The lines of demarcation represent the approximate boundary between soil types, but the transition may be more gradual.

Laboratory tests were also performed to evaluate the engineering properties of the recovered soil samples. Twenty one unconfined compression tests (Q_U) were performed on thin-walled tube samples to evaluate the stress-strain characteristics and related shear strength of the cohesive soils. Four collapse/consolidation tests were performed on thin-walled tube samples of foundation material to evaluate consolidation characteristics and collapse potential. Sixty-one Atterberg limits test were conducted to aid in the classification of the soils under the Unified Soils Classification System and to evaluate the shrink/swell/collapse characteristics of the soils. Seventy-one mechanical sieve analysis and 220 particle-size distributions utilizing a No. 200 sieve were conducted to aid in the classification of the soils under the Unified Soils Classification System. Nine hydrometers were performed to determine the clay and silt fractions of the cohesive alluvium. Eleven standard Proctor tests were performed on the bulk samples of alluvium and topsoil to determine the maximum dry densities and optimum moisture contents. Eight flex-wall permeability tests and five falling head permeability tests were performed on in-situ and remolded samples of cohesive and non-cohesive alluvium to determine the vertical permeabilities. Four Consolidated-Undrained triax tests were performed on in-situ and remolded samples of cohesive alluvium to determine the shear strength properties of foundation and embankment fill soils. Eleven crumb test and two pinhole dispersion tests were performed to evaluate the dispersive nature of the cohesive alluvium. Seven organics content tests were performed by ***Harris Laboratories***.

All tests were conducted in general accordance with current ASTM or other state-of-the-art test procedures. A summary of the laboratory test results is presented in Appendix C and Appendix F.

SUBSURFACE CONDITIONS

Area Geology

The project site is located on the lowland and upland regions south of the Platte River. Most of the soil associations consist of Cozad silt loam, Gosper silt Loam, Lex loam, Platte-Wann complex, Wann fine sandy loam, and Hobbs silt loam. Most of these associations are well drained with a moderately low to moderately high permeability. The majority of the area is known to be linear at 0 to 6 percent slopes.

Test Borings and Laboratory Summary

Subsurface conditions at the soil test boring locations typically consisted of, in descending order, firm to stiff water deposited cohesive alluvium, loose to dense cohesionless alluvial deposits overlying Ogallala formation. Clayey sand fill soil was encountered in soil test boring B-5 of Area 1 at depths ranging from 0.5 to 1.5 feet below the existing ground surface. A developed zone of varying thickness was encountered at the surface of some of the soil test borings. Refer to the boring logs, included in Appendix B (Area 1) and Appendix E (Area 2), for specific soil profile descriptions and details. The soil conditions encountered in Area 1 and Area 2 during this preliminary investigation are summarized in Table 1 and Table 2.

TABLE 1

AREA 1 GENERALIZED SOIL PROPERTIES

Alluvium (Cohesive) – Firm to stiff, dark yellowish brown to grayish brown, dry to wet, mostly lean clay, little silt, few fine sand

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
CL, CL/ML, CL/CH, CH	78.3 – 106.2	7.4 – 36.4	52 - 96	0.2-7.5	28 - 55	10 - 32	9 – 12

Hydrometer, Sieve, and Permeability Test Results

Sample	% Gravel	% Sand	% Silt	% Clay	Liquid Limit (%)	Plasticity Index (%)	Permeability (cm/sec)
B-6C U-2 (3.5-5')	0.0	14.0	48.5	37.5	36	18	1.64 x 10^{-4}
B-7C U-1 (1-2.5')	0.0	5.3	59.7	35.0	33	11	---
B-16 U-2 (3.5-5')	3.3	34.5	39.7	22.5	26	11	8.54 x 10^{-5}
B-18 U-2 (3.5-5')	0.0	5.7	50.8	43.5	42	26	8.96 x 10^{-7}
Remold B-10 (0-4') and B-11 (0-1.5')	0.0	5.7	50.8	43.5	35	17	2.61 x 10^{-7}

Alluvium (Non-Cohesive) – Loose to dense, yellowish brown to grayish brown, dry to wet, mostly fine to coarse sand, trace to little silt, trace to some lean clay, trace to few fine sand

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
SP, SC, SC/SM, SM	101.0 -111.9	1.8 – 22.6	0 - 49	---	23	8	7 – 32

Sieve and Permeability Test Results

Sample	% Gravel	% Sand	% Silt	% Clay	Liquid Limit (%)	Plasticity Index (%)	Permeability (cm/sec)
B-6C U-3 (8.5-10')	0.9	83.6	15.4		---	---	3.53 x 10^{-5}
Remold B-8B SS-3 (8.5-10')	16.1	77.7	6.1		---	---	6.98 x 10^{-4}
Remold B-13 G-3 (6.5-8.5')	11.7	86.2	2.1		---	---	1.34 x 10^{-3}

Ogalla Formation* – Very stiff, yellowish brown, wet, mostly lean clay, some fine sand, trace calcium and iron.

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
CL	---	28.2	51.6	---	---	---	30

*Only encountered in Area 1 soil test boring B-3 at 28.5 feet below the existing ground surface

TABLE 2

AREA 2 GENERALIZED SOIL PROPERTIES

Alluvium (Cohesive) – Soft to stiff, dark yellowish brown to grayish brown, dry to wet, mostly lean clay, little to some silt, trace to some fine sand

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
CL, CL/ML, CH	78.8 – 107.0	15.6 – 37.0	53 – 99	0.2-0.7	23 - 50	5 - 30	3 – 18

Hydrometer, Sieve, and Permeability Test Results

Sample	% Gravel	% Sand	% Silt	% Clay	Liquid Limit (%)	Plasticity Index (%)	Permeability (cm/sec)
B-6C U-3 (8.5-10’)	0.0	11.7	62.3	26.0	25	6	2.81 x 10^{-5}
B-8B U-1 (1-2.5’)	0.0	4.1	72.9	23.0	28	---	2.33 x 10^{-5}
B-11 U-1 (1-2.5’)	0.0	4.1	71.7	23.0	---	---	2.44 x 10^{-3}
B-12 U-2 (3.5-5’)	0.0	25.2	37.8	37.0	37	21	1.98 x 10^{-5}
Remold B-15 (2-4’) and B-17 (2-4’)	0.0	3.7	57.3	39.0	43	23	2.97 x 10^{-8}

Alluvium (Non-Cohesive) – Loose to medium dense, yellowish brown to grayish brown, dry to wet, mostly fine to coarse sand, trace to little silt, trace to some lean clay, trace to few fine sand

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
SP, SM, SW/SC, SC/SM, SP/SC	95.0 - 98.2	1.5 – 18.7	1 – 48	---	---	---	3 - 28

Sieve and Permeability Test Results

Sample	% Gravel	% Sand	% Silt	% Clay	Liquid Limit (%)	Plasticity Index (%)	Permeability (cm/sec)
Remold B-4B SS-6 (23.5-25’)	7.1	92.1	0.8		---	---	4.36 x 10^{-3}

Ogalla Formation** – Very stiff, olive brown, wet, mostly fine sand, some lean clay

USCS Classification	Dry Density (pcf)	Moisture Content (%)	P200 Sieve (%)	Q_U (tsf)	Liquid Limit (%)	Plasticity Index (%)	Standard Penetration Blow Counts (N)
SC	---	23.8	29.0	---	---	---	36

**Only encountered in Area 2 soil test boring B-3 at 44.5 feet below the existing ground surface

Shear strength parameters for the in-situ cohesive alluvium and for possible remolded cohesive borrow material for the slope stability analyses of the future embankments were determined based on our engineering judgment and Consolidated-Undrained (CU) triax tests performed by ***Olsson***. The soil properties obtained from the CU triax testing on in-situ and remolded samples from Area 1 and Area 2 are provided in Table 3.

TABLE 3
SOIL PROPERTIES FOR ANALYSIS

Material	Wet Density (pcf)	CU Total Stress		CU Effective Stress	
		Φ (Degrees)	c, psf	φ' (Degrees)	c' (psf)
Area 1 Embankment Fill (Remolded Cohesive Alluvium)	112.5	18.6	14.4	31.3	0
Area 2 Embankment Fill (Remolded Cohesive Alluvium)	113.6	17.9	0	29.6	0
Area 1 Foundation (Cohesive Alluvium)	117.1	23.8	535.4	32.6	157.4
Area 2 Foundation (Cohesive Alluvium)	112.0	20.9	113.1	32.3	0

Groundwater Summary

Groundwater was encountered in Area 1 and Area 2 in the soil test borings summarized in Table 4 and Table 5. The dates, conditions and depths of the groundwater table are noted in more detail on the Soil Test Boring Logs in Appendix B and Appendix E. Groundwater levels will fluctuate depending on seasonal variations of precipitation and other factors and may occur at higher elevations at some time in the future.

TABLE 4

AREA 1 SUMMARY OF GROUNDWATER OBSERVATIONS

Boring	Groundwater Depth While Drilling (Feet)	Groundwater Elevation While Drilling (Feet)	Groundwater Depth Immediately After Drilling (Feet)	Groundwater Elevation Immediately After Drilling (Feet)
B-1C	11.5	2327.7	10.9	2328.3
B-2C	9.0	2326.9	9.4	2326.5
B-3B	7.0	2323.5	6.3	2324.2
B-4C	3.5	2324.4	4.0	2323.9
B-5C	7.5	2330.7	7.5	2330.7
SP-5	7.0	2331.2	---	---
B-6C	6.5	2333.5	9.0	2331.0
B-7C	6.5	2336.65	11.2	2332.0
B-8B	7.0	2327.2	6.0	2328.2
B-10C	5.0	2327.5	4.0	2328.5
B-11C	5.0	2325.9	5.7	2325.2
B-13	4.0	2328.2	5.1	2327.1
B-15	6.0	2326.3	5.7	2326.6
B-16	5.5	2328.4	5.9	2328.0
B-17	6.5	2326.1	3.5	2329.1
B-18	5.0	2326.0	3.8	2327.2

TABLE 5

AREA 2 SUMMARY OF GROUNDWATER OBSERVATIONS

Boring	Groundwater Depth While Drilling (Feet)	Groundwater Elevation While Drilling (Feet)	Groundwater Depth Immediately After Drilling (Feet)	Groundwater Elevation Immediately After Drilling (Feet)
B-3C	13.0	2329.9	11.6	2331.3
B-4B	11.0	2329.2	9.7	2330.5
B-7C	21.5	2336.9	23.0	2335.4
B-8B	7.5	2334.9	8.8	2333.6
B-14	7.5	2341.8	---	---

****

We trust that this preliminary report will assist you in the design and construction of the proposed project. ***Olsson*** appreciates the opportunity to provide our services on this project and look forward to working with you during construction and on future projects. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,
Olsson Associates

Prepared by:

Caleb Strate

Caleb Strate, E.I.
Assistant Engineer

Reviewed by:

PROFESSIONAL CIVIL ENGINEER
ANDREW M.
PHILLIPS
E-12242
8-19-10
STATE OF NEBRASKA

Andrew M. Phillips, P.E.
Geotechnical Engineer

APPENDIX A

AREA 1

Site Location Plan

Boring Location Map

SITE LOCATION PLAN

CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY , NEBRASKA
OA PROJECT NO. A09-1466

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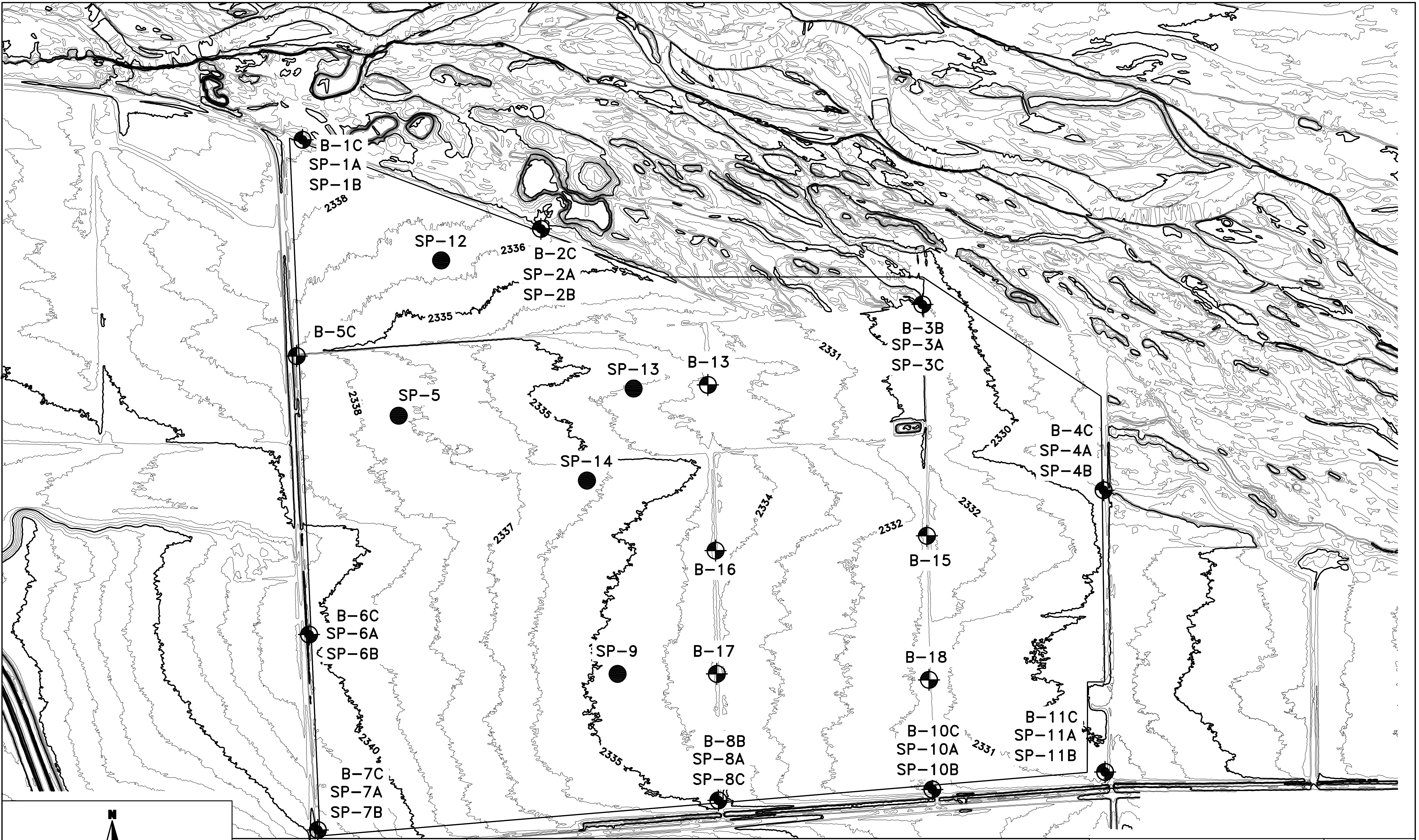


LEGEND

- ⊕ SOIL TEST BORING
- ● SOIL TEST PROBE
- ⊕ BORING & SOIL PROBE

BORING LOCATION MAP
CNPPID REREGULATING RESERVOIR
FEASIBILITY STUDY
AREA 1

J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA

DATE: 6/15/10 | DRAWN BY: SVJ

JOB NUMBER: A09-1466

OLSSON
ASSOCIATES

APPENDIX B

AREA 1

Symbols & Nomenclature

Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample
U:	Thin-walled Tube Sample
% Rec:	Percentage of Thin-walled Tube sample recovered
SPT Blow Counts:	Standard Penetration Test blows per 6" penetration
HSA:	Hollow Stem Auger
CFA:	Continuous Flight Auger
N.E.:	Not Encountered
N.A.:	Not Available

DRILLING PROCEDURES

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance (SPT) 'N' value is the number of blows of a 140 pound hammer falling 30 inches to drive a 2 inch O.D., 1.4 inch I.D. split-spoon sampler one foot. The thin-walled tube sampling procedure is described by ASTM specification D 1587.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM Designations D-2487 and D-2488. The USCS group symbol shown on the boring logs correspond to the group names listed below.

Group Symbol	***Group Name***	***Group Symbol***	***Group Name***
GW	Well Graded Gravel	CL	Lean Clay
GP	Poorly Graded Gravel	ML	Silt
GM	Silty Gravel	OL	Organic Clay or Silt
GC	Clayey Gravel	CH	Fat Clay
SW	Well Graded Sand	MH	Elastic Silt
SP	Poorly Graded Sand	OH	Organic Clay or Silt
SM	Silty Sand	PT	Peat
SC	Clayey Sand		

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	**Unconfined Compressive Strength (Qu) (psf)**
Very Soft	<500
Soft	500 - 1000
Firm	1001 - 2000
Stiff	2001 - 4000
Very Stiff	4001 - 8000
Hard	> 8000

COHESIONLESS SOILS

Relative Density	**Angle Value**
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	≥ 50

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2	**BORING NO. B- 1C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

11.5'	WHILE DRILLING	
10.9'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2339.19									
	DEVELOPED ZONE 1.0"									
2338.2	*ALLUVIUM* Clayey sand (SC)	1								
2337.2	Loose, dark brown, moist, mostly fine sand, some lean clay, few silt	2	SS-1	SC	3 2 3	--	17.6	--	--	41.4
2336.2	Clayey sand (SC)	3								
2335.2	Medium dense, yellowish brown, moist, mostly fine sand, some lean clay, little silt 4.0'	4	SS-2	SP	4 5 9	--	--	--	--	--
2334.2	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine sand, iron	5								
2333.2		6								
2332.2		7								
2331.2		8								
2330.2	Poorly graded sand (SP)	9	SS-3	SP	7 6 8	--	1.8	--	--	2.9
2329.2	Medium dense, yellowish brown, dry, mostly fine to coarse sand	10								
2328.2	∇	11								
2327.2		12								
2326.2	13.5'	13								
2325.2	Sandy silty lean clay (CL/ML)	14	SS-4	CL/ML	6 7 5	--	11.0	--	--	70.5
2324.2	Stiff, yellowish brown, wet, mostly silty lean clay, some fine to coarse sand 15.0'	15								
2323.2		16								
2322.2		17								
2321.2		18								
2320.2	Poorly graded sand (SP)	19	SS-5	SP	8 13 18	--	11.8	--	--	1.0
2319.2	Dense, yellowish brown, wet, mostly fine to medium sand	20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 1C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B- 1C**

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

11.5'	WHILE DRILLING	
10.9'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2339.19*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2318.2		21								
2317.2		22								
2316.2		23								
2315.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	24	SS-6	SP	9 13 13	--	10.2	--	--	0.2
2314.2		25								
2313.2		26								
2312.2		27								
2311.2		28								
2310.2	Poorly graded sand (SP) Dense, yellowish brown, wet, mostly fine to coarse sand	29	SS-7	SP	12 15 16	--	9.9	--	--	0.8
2309.2		30								
	BASE OF BORING @ 30.0 FEET									
2308.2		31								
2307.2		32								
2306.2		33								
2305.2		34								
2304.2		35								
2303.2		36								
2302.2		37								
2301.2		38								
2300.2		39								
2299.2		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B- 1C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-1A**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 1.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2339.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2338.0	***ALLUVIUM*** Clayey sand (SC) Medium dense, dark yellowish brown, moist, mostly fine sand, some lean clay, few silt	1								
	BASE OF SOIL PROBE @ 1.0 FEET									
2337.0		2								
	Driller's Note: 1-inch developed zone encountered at the surface									
2336.0		3								
2335.0		4								
2334.0		5								
2333.0		6								
2332.0		7								
2331.0		8								
2330.0		9								
2329.0		10								
2328.0		11								
2327.0		12								
2326.0		13								
2325.0		14								
2324.0		15								
2323.0		16								
2322.0		17								
2321.0		18								
2320.0		19								
2319.0		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

SOIL PROBE NO. SP-1A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO.**	**SP-1B**
LOCATION:	AREA 1	
LAT/LONG:	N--°--'--", W--°--'--"	
JOB NO.:	A09-1466	
DATE START:	3/30/2010	
DATE FINISH:	3/30/2010	
DRILL COMPANY:	OLSSON ASSOCIATES	
EQUIPMENT USED:	SOIL PROBE	
DRILLED BY:	A. SNOOK	
PREPARED BY:	S. JENSEN	

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 0.5 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2339.00									
	ALLUVIUM Clayey sand (SC) Medium dense, dark yellowish brown, moist, mostly fine sand, some lean clay									
2338.0	***BASE OF SOIL PROBE @ 0.5 FEET***	1								
2337.0		2								
	Driller's Note: 1-inch developed zone encountered at the surface									
2336.0		3								
2335.0		4								
2334.0		5								
2333.0		6								
2332.0		7								
2331.0		8								
2330.0		9								
2329.0		10								
2328.0		11								
2327.0		12								
2326.0		13								
2325.0		14								
2324.0		15								
2323.0		16								
2322.0		17								
2321.0		18								
2320.0		19								
2319.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-1B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2 **BORING NO. B- 2C**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

9.0'	WHILE DRILLING	
9.4'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING AT 30.0 FEET

ELEV (ft)	SOIL PROFILE		DEPTH (ft)	TEST DATA							
				SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2335.86										
	DEVELOPED ZONE	**1.0"**									
2334.9	***ALLUVIUM***		1								
2333.9	Clayey sand (SC) Loose, yellowish brown, dry to moist, mostly fine sand, little lean clay		2	**SS-1**	SC	3 2 3	--	10.2	--	--	17.4
2332.9			3								
2331.9		**4.0'**	4	**U-2**	SC CL SP	--	--	21.1	106.2	0.5	--
	Lean clay (CL) Soft, grayish brown, moist	**4.5'**									
2330.9	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to medium sand		5								
2329.9			6								
2328.9			7								
2327.9			8								
2326.9	∇ Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand, iron	**9.0'**	9	**SS-3**	SP	3 6 8	--	11.7	--	--	3.1
2325.9			10								
2324.9			11								
2323.9			12								
2322.9			13								
2321.9	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, few lean clay, trace coarse sand		14	**SS-4**	SP/SC	7 10 11	--	14.7	--	--	10.3
2320.9			15								
2319.9			16								
2318.9			17								
2317.9			18								
2316.9	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand		19	**SS-5**	SP	5 7 9	--	10.6	--	--	2.8
2315.9			20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 2C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 2 OF 2	**BORING NO. B- 2C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

9.0'	WHILE DRILLING	
9.4'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2335.86*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2314.9		21								
2313.9		22								
2312.9		23								
2311.9	Poorly graded sand (SP) Dense, yellowish brown, wet, mostly fine to coarse sand	24	SS-6	SP	10 12 20	--	9.5	--	--	1.0
2310.9		25								
2309.9		26								
2308.9		27								
2307.9		28								
2306.9	Poorly graded sand (SP) Dense, yellowish brown, wet, mostly fine to coarse sand	29	SS-7	SP	9 14 16	--	--	--	--	--
2305.9		30								
	BASE OF BORING @ 30.0 FEET									
2304.9		31								
2303.9		32								
2302.9		33								
2301.9		34								
2300.9		35								
2299.9		36								
2298.9		37								
2297.9		38								
2296.9		39								
2295.9		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B- 2C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1 **SOIL PROBE NO. SP-2A**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.0 FEET

TEST DATA

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2336.00									
2335.0	***DEVELOPED ZONE*** **1.0"** ***ALLUVIUM*** Lean clay with sand (CL) Firm, yellowish brown, moist, mostly lean clay, some fine sand	1	G-1	CL	--	--	22.0	--	--	70.0
2334.0	Lean clay (CL)	2	G-2	CL	--	--	24.8	--	--	80.0
2333.0	Firm, yellowish brown, moist, mostly lean clay, little fine sand **3.0'**	3	G-3	CL	--	--	24.5	--	--	84.9
2332.0	Clayey sand (SC) Medium dense, yellowish brown, dry to moist, mostly fine sand, some clay **4.0'**	4	G-4	SC	--	--	13.2	--	--	43.0
2331.0	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine to medium sand	5								
	BASE OF SOIL PROBE @ 5.0 FEET									
2330.0		6								
2329.0		7								
2328.0		8								
2327.0		9								
2326.0		10								
2325.0		11								
2324.0		12								
2323.0		13								
2322.0		14								
2321.0		15								
2320.0		16								
2319.0		17								
2318.0		18								
2317.0		19								
2316.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-2A

OLSSON
ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-2B
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	APPROX. SURFACE ELEV. (ft): 2336.00									
	DEVELOPED ZONE **1.0"**									
2335.0	***ALLUVIUM***	1								
2334.0	Lean clay with sand (CL) Firm, dark yellowish brown, moist, mostly lean clay, little fine sand	2								
2333.0		3								
2332.0	**4.5'**	4								
2331.0	Poorly graded sand (SP) Medium dense, yellowish brown	5								
	BASE OF SOIL PROBE @ 5.0 FEET									
2330.0		6								
2329.0		7								
2328.0		8								
2327.0		9								
2326.0		10								
2325.0		11								
2324.0		12								
2323.0		13								
2322.0		14								
2321.0		15								
2320.0		16								
2319.0		17								
2318.0		18								
2317.0		19								
2316.0		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-2B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2	**BORING NO. B- 3B**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2010
DATE FINISH:	3/26/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

7.0'	WHILE DRILLING	
6.3'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2330.52									
	DEVELOPED ZONE 1.0"									
2329.5	***ALLUVIUM***	1								
2328.5	Clayey sand (SC) Medium dense, dark brown, dry to moist, mostly fine sand, some lean clay 2.5'	2	SS-1	SC	3 4 6	--	11.8	--	--	34.5
2327.5		3								
2326.5	Poorly graded sand (SP) Medium dense, yellowish brown, dry, mostly fine to medium sand, some coarse sand, iron	4	SS-2	SP	6 6 7	--	4.6	--	--	4.7
2325.5		5								
2324.5	∇	6								
2323.5		7								
2322.5		8								
2321.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand, iron	9	SS-3	SP	4 5 5	--	13.1	--	--	1.1
2320.5		10								
2319.5		11								
2318.5		12								
2317.5		13								
2316.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	14	SS-4	SP	7 8 11	--	15.8	--	--	4.4
2315.5		15								
2314.5		16								
2313.5		17								
2312.5		18								
2311.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand, iron	19	SS-5	SP	10 11 11	--	12.8	--	--	0.8
2310.5		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B- 3B**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B- 3B**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2010
DATE FINISH:	3/26/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

7.0'	WHILE DRILLING	
6.3'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

			TEST DATA							
ELEV (ft)	SOIL PROFILE ***APPROX. SURFACE ELEV. (ft): 2330.52***	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2309.5		21								
2308.5		22								
2307.5		23								
2306.5	Poorly graded sand (SP) Dense, yellowish brown, wet, mostly fine to coarse sand, iron	24	SS-6	SP	10 12 20	--	11.8	--	--	0.8
2305.5		25								
2304.5		26								
2303.5		27								
2302.5	28.5'	28								
2301.5	***WEATHERED OGALLALA FORMATION*** Sandy lean clay (CL) Very stiff, yellowish brown, wet, mostly lean clay, some fine sand, calcium and iron	29	SS-7	CL	9 14 16	--	28.2	--	--	51.6
2300.5	***BASE OF BORING @ 30.0 FEET***	30								
2299.5		31								
2298.5		32								
2297.5		33								
2296.5		34								
2295.5		35								
2294.5		36								
2293.5		37								
2292.5		38								
2291.5		39								
2290.5		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 3B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-3A**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING

NE 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE AT 1.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2330.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)
	ALLUVIUM Sandy lean clay (CL) Stiff, very dark gray brown, very moist, mostly lean clay, some fine sand **1.0'**	
2329.0	Poorly graded sand (SP) **1.5'** Medium dense, yellowish brown, moist, mostly fine to medium sand	1
2328.0		2
2327.0	***BASE OF SOIL PROBE @ 1.5 FEET***	3
2326.0	Driller's Note: 1-inch developed zone encountered at the surface	4
2325.0		5
2324.0		6
2323.0		7
2322.0		8
2321.0		9
2320.0		10
2319.0		11
2318.0		12
2317.0		13
2316.0		14
2315.0		15
2314.0		16
2313.0		17
2312.0		18
2311.0		19
2310.0		20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	29.2	--	--	52.8
G-2	SP	--	--	19.2	--	--	0.3

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**SOIL PROBE NO. SP-3A**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-3C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 1.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2330.00

ELEV (ft)	SOIL PROFILE		DEPTH (ft)
	DEVELOPED ZONE	**1.0"**	
2329.0	***ALLUVIUM*** Sandy lean clay (CL)	**1.0'**	1
	BASE OF SOIL PROBE @ 1.0 FEET		
2328.0			2
2327.0			3
2326.0			4
2325.0			5
2324.0			6
2323.0			7
2322.0			8
2321.0			9
2320.0			10
2319.0			11
2318.0			12
2317.0			13
2316.0			14
2315.0			15
2314.0			16
2313.0			17
2312.0			18
2311.0			19
2310.0			20

Driller's Note: Medium dense, yellowish brown, moist, mostly fine to medium sand encountered at base of boring

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	27.3	--	--	61.3

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-3C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2	**BORING NO. B- 4C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2010
DATE FINISH:	3/26/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

3.5'	WHILE DRILLING	
4.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2327.91

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"		Surface	CL/ML	--	32/20	23.7	101.8	1.7	--
2326.9	***ALLUVIUM***	1								
2325.9	Silty lean clay (CL/ML) Stiff, light gray, moist, mostly silty lean clay, trace fine sand, iron	2	U-1	CL/ML	--	32/22	21.2	102.1	--	--
2324.9		3								
	3.5' ∇									
2323.9	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	4	SS-2	SP	4 6 8	--	--	--	--	--
2322.9		5								
2321.9		6								
2320.9		7								
2319.9		8								
	9.0'									
2318.9	Sandy lean clay (CL) Stiff, dark brown, wet, mostly lean lean clay, some fine sand	9	SS-3	CL	3 4 7	--	21.4	--	--	52.6
	10.0'									
2317.9		10								
2316.9		11								
2315.9		12								
2314.9		13								
2313.9	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay	14	SS-4	SP/SC	4 5 6	--	15.1	--	--	5.7
2312.9		15								
2311.9		16								
2310.9		17								
2309.9		18								
2308.9	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay, iron	19	SS-5	SP/SC	8 9 11	--	11.7	--	--	6.9
2307.9		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B- 4C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B- 4C**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2010
DATE FINISH:	3/26/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
3.5' WHILE DRILLING
4.0' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

	SOIL PROFILE		**TEST DATA**							
ELEV (ft)	***APPROX. SURFACE ELEV. (ft): 2327.91***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	ALLUVIUM									
2306.9		21								
2305.9		22								
2304.9		23								
2303.9	Poorly graded sand (SP) Dense, yellowish brown, wet, mostly fine to medium sand, iron	24	**SS-6**	SP	11 15 17	--	13.2	--	--	1.7
2302.9		25								
2301.9		26								
2300.9		27								
2299.9		28								
2298.9	**29.0'**	29	**SS-7**	SP	4 4 6	--	7.2	--	--	0.9
2297.9	***OGALLALA FORMATION*** Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly sand, trace clay ***BASE OF BORING @ 30.0 FEET***	30								
2296.9		31								
2295.9		32								
2294.9		33								
2293.9		34								
2292.9		35								
2291.9		36								
2290.9		37								
2289.9		38								
2288.9		39								
2287.9		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 4C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-4A**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 4.1 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
	APPROX. SURFACE ELEV. (ft): 2330.00		SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2329.0	***ALLUVIUM*** Lean clay with sand (CL)	1	G-1	CL	--	--	22.7	--	--	64.8
2328.0	Stiff, yellowish brown, moist, mostly lean clay, few fine sand	2	G-2	CL	--	--	23.1	--	--	88.7
2327.0	3.5'	3								
2326.0	Clayey sand (SC) Medium dense, very dark brown	4								
	BASE OF SOIL PROBE @ 4.1FEET									
2325.0		5								
2324.0		6								
2323.0		7								
2322.0		8								
2321.0		9								
2320.0		10								
2319.0		11								
2318.0		12								
2317.0		13								
2316.0		14								
2315.0		15								
2314.0		16								
2313.0		17								
2312.0		18								
2311.0		19								
2310.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-4A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-4B**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2329.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)
	DEVELOPED ZONE **6.0"**	
2328.0	***ALLUVIUM***	1
2327.0	Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, few silt, trace fine sand, iron	2
2326.0		3
2325.0	**4.0'**	4
2324.0	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to medium sand	5
	BASE OF SOIL PROBE @ 5.0 FEET	
2323.0		6
2322.0		7
2321.0		8
2320.0		9
2319.0		10
2318.0		11
2317.0		12
2316.0		13
2315.0		14
2314.0		15
2313.0		16
2312.0		17
2311.0		18
2310.0		19
2309.0		20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	25.8	--	--	86.3
G-2	CL	--	--	22.3	--	--	77.7
G-3	CL	--	--	24.4	--	--	89.1
G-4	CL	--	--	26.5	--	--	83.3

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-4B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-5C

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

7.5' WHILE DRILLING
7.5' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 20.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2338.18									
	DEVELOPED ZONE **6.0"**									
2337.2	***FILL*** Clayey sand (SC) Medium dense, dark brown, moist, mostly fine sand, some lean clay, little silt **1.5'**	1								
2336.2	***ALLUVIUM*** Lean clay (CL) Firm, grayish brown, moist, mostly lean clay, trace fine sand	2	SS-1	CL	3 4 5	--	23.2	--	--	89.3
2335.2		3								
2334.2	Sandy lean clay (CL) Firm, grayish brown, moist, mostly lean clay, some fine sand **5.0'**	4	U-2	CL	--	47/24	21.7	101.1	1.7	58.6
2333.2	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to medium sand	5								
2332.2		6								
2331.2	∇ **7.5'**	7								
2330.2		8								
2329.2	Poorly graded sand (SP) Loose, yellowish brown, wet, mostly fine to coarse sand,	9	SS-3	SP	3 4 3	--	6.3	--	--	3.2
2328.2		10								
2327.2		11								
2326.2		12								
2325.2		13								
2324.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	14	SS-4	SP	1 3 8	--	7.4	--	--	0.4
2323.2		15								
2322.2		16								
2321.2		17								
2320.2		18								
2319.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	19	SS-5	SP	6 11 13	--	8.2	--	--	1.0
2318.2		20								
	BASE OF BORING @ 20.0 FEET									

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-5C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-5**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

7.0' WHILE DRILLING

NP 0 HOURS AFTER COMP.

NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.0 FEET

			TEST DATA							
ELEV (ft)	**SOIL PROFILE** ***APPROX. SURFACE ELEV. (ft): 2337.00***	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2336.0	***FILL*** Clayey sand (SC) Medium dense, yellowish brown 1.0'	1	G-1	CL	--	--	29.5	--	--	95.3
2335.0	***ALLUVIUM*** Lean clay (CL) Firm, dark brown, very moist, mostly lean clay, trace fine sand 2.0'	2								
2334.0		3	G-2	CL	--	--	24.4	--	--	87.4
2333.0	Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, few silt, trace fine sand	4								
2332.0		5	G-3	CL	--	--	25.1	--	--	86.9
2331.0		6								
2330.0	∇	7	G-4	CL	--	--	26.6	--	--	77.6
2329.0	8.0'	8								
2328.0	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	9								
2327.0		10								
	BASE OF SOIL PROBE @ 10.0 FEET									
2326.0		11								
2325.0		12								
2324.0		13								
2323.0		14								
2322.0		15								
2321.0		16								
2320.0		17								
2319.0		18								
2318.0		19								
2317.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-5

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2	**BORING NO. B- 6C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

6.5'	WHILE DRILLING	
9.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2339.98*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2339.0	*ALLUVIUM*	1								
2338.0	Lean clay (CL) Firm, yellowish brown to dark yellowish brown, very moist, mostly lean clay, few fine sand, calcium	2	U-1	CL	--	33/20	26.0	94.5	--	91.2
2337.0		3								
2336.0	Lean clay (CL) Firm, yellowish brown to dark yellowish brown, moist, mostly lean clay, little fine sand, calcium	4	U-2	CL	--	36/18	22.2	94.1	--	81.5
2335.0		5								
2334.0	6.5'	6								
2333.0		7								
2332.0	Lean clay (CL) Firm, light brown, moist, mostly lean clay, few fine sand	8								
2331.0	∇ 9.0'	9	U-3	SC	--	--	12.7	--	--	15.4
2330.0	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, little lean clay	10								
2329.0		11								
2328.0		12								
2327.0		13								
2326.0	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, some lean clay	14	SS-4	SC	5 7 11	--	15.1	--	--	32.5
2325.0		15								
2324.0		16								
2323.0		17								
2322.0		18								
2321.0	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand	19	SS-5	SP	6 9 14	--	12.5	--	--	3.6
2320.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B- 6C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2

BORING NO. B- 6C

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

6.5'	WHILE DRILLING	
9.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2339.98

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	ALLUVIUM									
2319.0		21								
2318.0		22								
2317.0		23								
2316.0	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay	24	SS-6	SP/SC	7 11 11	--	6.1	--	--	5.2
2315.0		25								
2314.0		26								
2313.0		27								
2312.0		28								
2311.0	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	29	SS-7	SP	8 10 15	--	9.0	--	--	0.5
2310.0		30								
	BASE OF BORING @ 30.0 FEET									
2309.0		31								
2308.0		32								
2307.0		33								
2306.0		34								
2305.0		35								
2304.0		36								
2303.0		37								
2302.0		38								
2301.0		39								
2300.0		40								

BLOWS/FT	**DENSITY**
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	**CONSISTENCY**
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B- 6C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1 **SOIL PROBE NO. SP-6A**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 8.5 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2340.00									
	DEVELOPED ZONE **6.0"**									
2339.0	***ALLUVIUM*** Lean clay with sand (CL) Firm, very dark brown, moist, mostly lean clay, little fine sand **1.5'**	1								
2338.0		2	G-1	CL	--	36/19	24.3	--	--	84.3
2337.0	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, little fine sand	3								
2336.0		4								
2335.0		5								
2334.0		6	G-2	CL	--	38/19	22.5	--	--	88.3
2333.0	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, little fine sand	7								
2332.0		8								
2331.0	***BASE OF SOIL PROBE @ 8.5 FEET***	9								
2330.0		10								
2329.0		11								
2328.0		12								
2327.0		13								
2326.0		14								
2325.0		15								
2324.0		16								
2323.0		17								
2322.0		18								
2321.0		19								
2320.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-6A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-6B
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 9.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2340.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2339.0	***ALLUVIUM***	1								
2338.0	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, few fine sand	2	G-1	CL	--	37/17	23.5	--	--	92.3
2337.0		3								
2336.0	4.0'	4								
	Lean clay with sand (CL) Stiff, very dark brown, moist, mostly lean clay, few fine sand 4.5'		G-2	CL	--	--	22.7	--	--	84.1
2335.0		5								
2334.0		6								
2333.0	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, little fine sand	7	G-3	CL	--	39/18	23.2	--	--	87.0
2332.0		8								
	8.5'									
2331.0	Silty, clayey sand (SC/SM) Medium dense, yellowish brown	9								
	BASE OF SOIL PROBE @ 9.0 FEET									
2330.0		10								
2329.0		11								
2328.0		12								
2327.0		13								
2326.0		14								
2325.0		15								
2324.0		16								
2323.0		17								
2322.0		18								
2321.0		19								
2320.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-6B

SOIL TEST BORING REPORT

OLSSON ASSOCIATES

PAGE 1 OF 2

BORING NO. B- 7C

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

6.5' WHILE DRILLING
11.2' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2343.15*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE									
2342.2	1.5'	1								
2341.2	***ALLUVIUM*** Lean clay (CL) Stiff, dark yellowish brown mottled with very dark grayish brown, very moist, mostly lean clay, trace fine sand	2	**U-1**	CL	--	33/22	28.1	78.3	--	94.7
2340.2		3								
2339.2	Lean to fat clay (CL/CH) Stiff, dark yellowish brown mottled with very dark grayish brown, very moist, mostly lean to fat clay, trace fine sand	4	**U-2**	CL/CH	--	49/19	29.9	90.1	--	--
2338.2		5								
2337.2		6								
2336.2		7								
2335.2		8								
2334.2	Lean clay (CL) Stiff, dark yellowish brown mottled with very dark grayish brown, moist, mostly lean clay, trace fine sand	9	**SS-3**	CL	3 4 6	--	--	--	--	--
2333.2		10								
2332.2	∇ 11.5'	11								
2331.2		12								
2330.2		13								
2329.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	14	**SS-4**	SP	5 5 6	--	7.8	--	--	2.2
2328.2		15								
2327.2		16								
2326.2		17								
2325.2		18								
2324.2	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, little lean clay	19	**SS-5**	SC	7 7 9	--	10.5	--	--	13.9
2323.2		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 7C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 2 OF 2

BORING NO. B- 7C

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

6.5' WHILE DRILLING

11.2' 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2343.15

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2322.2		21								
2321.2		22								
2320.2		23								
2319.2	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay	24	**SS-6**	SP/SC	5 10 16	--	9.7	--	--	8.5
2318.2		25								
2317.2		26								
2316.2		27								
2315.2		28								
2314.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	29	**SS-7**	SP	7 10 12	--	13.1	--	--	1.6
2313.2		30								
	BASE OF BORING @ 30.0 FEET									
2312.2		31								
2311.2		32								
2310.2		33								
2309.2		34								
2308.2		35								
2307.2		36								
2306.2		37								
2305.2		38								
2304.2		39								
2303.2		40								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered

NP - Not Performed

BORING NO. B- 7C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-7A**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2343.00

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
2342.0	***DEVELOPED ZONE*** 1.5'	1	G-1	CL	--	--	22.8	--	--	82.7
2341.0	***ALLUVIUM*** Lean clay with sand (CL) Firm, yellowish brown, moist, mostly lean clay, little fine sand 2.5'	2								
2340.0		3	G-2	CL	--	--	28.2	--	--	86.1
2339.0	Lean clay with sand (CL) Stiff, very dark grayish brown, very moist, mostly lean clay, little fine sand	4								
2338.0		5	G-3	CL	--	45/21	26.8	--	--	87.3
2337.0		6								
2336.0		7	G-4	CL	--	--	27.0	--	--	87.1
2335.0	Lean clay (CL) Stiff, yellowish brown, very moist, mostly lean clay, little fine sand	8								
2334.0	9.5'	9								
2333.0	Clayey sand (SC) Medium dense, yellowish brown, moist, mostly fine sand, some lean clay	10								
2332.0	***BASE OF SOIL PROBE @ 10.5 FEET***	11								
2331.0		12								
2330.0		13								
2329.0		14								
2328.0		15								
2327.0		16								
2326.0		17								
2325.0		18								
2324.0		19								
2323.0		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-7A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1 **SOIL PROBE NO. SP-7B**
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/29/2010
DATE FINISH: 3/29/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.5 FEET

			TEST DATA							
ELEV (ft)	**SOIL PROFILE** ***APPROX. SURFACE ELEV. (ft): 2343.00***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
2342.0	***DEVELOPED ZONE*** 1.5'	1	G-1	CL	--	--	25.6	--	--	85.2
2341.0	***ALLUVIUM*** Lean clay (CL) Stiff, yellowish brown, very moist, mostly lean clay, little fine sand 2.0'	2								
2340.0	Lean clay (CL) Stiff, dark yellowish brown, very moist, mostly lean clay, few fine sand	3								
2339.0		4	G-2	CL	--	36/18	25.8	--	--	91.7
2338.0		5								
2337.0		6	G-3	CL	--	38/19	25.2	--	--	90.6
2336.0		7								
2335.0		8	G-4	CL	--	--	27.2	--	--	85.3
2334.0	Lean clay (CL) Stiff, yellowish brown, very moist, mostly lean clay, little fine sand	9								
2333.0		10								
2332.0	***BASE OF SOIL PROBE @ 10.5 FEET***	11								
2331.0		12								
2330.0		13								
2329.0		14								
2328.0		15								
2327.0		16								
2326.0		17								
2325.0		18								
2324.0		19								
2323.0		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-7B

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2 **BORING NO. B- 8B**
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/22/2010
DATE FINISH: 3/22/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
7.0' WHILE DRILLING
6.0' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2334.22

TEST DATA

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2333.2	***DEVELOPED ZONE*** 1.0'	1								
2332.2	***ALLUVIUM*** Lean clay (CL) Stiff, very dark brown, very moist, mostly lean clay, little fine sand	2	**U-1**	CL	--	--	27.1	92.5	0.5	85.9
2331.2		3								
2330.2	Sandy lean clay (CL) Firm, very dark brown, moist, mostly lean clay, some fine sand	4	**U-2**	CL	--	--	21.8	101.1	--	57.3
2329.2		5								
2328.2	∇	6								
2327.2	7.0'	7								
2326.2		8								
2325.2	Well graded sand with clay and gravel (SW/SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand, few clay	9	**SS-3**	SW/SC	2 3 6	--	8.8	--	--	6.1
2324.2		10								
2323.2		11								
2322.2		12								
2321.2		13								
2320.2	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, some lean clay, trace coarse sand	14	**SS-4**	SC	5 8 10	--	16.9	--	--	33.6
2319.2		15								
2318.2		16								
2317.2		17								
2316.2		18								
2315.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand and lean clay	19	**SS-5**	SP	7 9 12	--	5.6	--	--	2.3
2314.2		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 8B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2

BORING NO. B- 8B

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/22/2010
DATE FINISH:	3/22/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

7.0'	WHILE DRILLING	
6.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2334.22*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2313.2		21								
2312.2		22								
2311.2		23								
2310.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	24	SS-6	SP	7 11 11	--	11.7	--	--	2.2
2309.2		25								
2308.2		26								
2307.2		27								
2306.2		28								
2305.2	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, little lean clay	29	SS-7	SC	7 7 9	--	13.8	--	--	19.2
2304.2	***BASE OF BORING @ 30.0 FEET***	30								
2303.2		31								
2302.2		32								
2301.2		33								
2300.2		34								
2299.2		35								
2298.2		36								
2297.2		37								
2296.2		38								
2295.2		39								
2294.2		40								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B- 8B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-8A
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/29/2010
DATE FINISH: 3/29/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2334.00*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2333.0	***DEVELOPED ZONE*** 1.0'	1	G-1	CL	--	--	22.2	--	--	74.2
2332.0	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown to dark brown, very moist, mostly lean clay, little fine sand	2	G-2	CL	--	--	27.4	--	--	85.4
2331.0		3	G-3	CL	--	--	27.8	--	--	88.3
2330.0		4	G-4	CL	--	--	29.4	--	--	74.4
2329.0		5								
2328.0	5.5' Sandy lean clay (CL) Firm, grayish brown, very moist, mostly lean clay, some fine sand	6	G-5	CL	--	--	27.8	--	--	63.8
	BASE OF SOIL PROBE @ 6.0 FEET									
2327.0		7								
2326.0		8								
2325.0		9								
2324.0		10								
2323.0		11								
2322.0		12								
2321.0		13								
2320.0		14								
2319.0		15								
2318.0		16								
2317.0		17								
2316.0		18								
2315.0		19								
2314.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-8A

OLSSON
ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-8C
LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/29/2010
DATE FINISH: 3/29/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2335.00

DEVELOPED ZONE

1.0'

ALLUVIUM Lean clay (CL)
Firm, yellowish brown, moist, mostly lean clay, little fine sand

Lean clay with sand (CL)
Firm, yellowish brown, very moist, mostly lean clay, some fine sand

BASE OF SOIL PROBE @ 6.0 FEET

ELEV (ft)	DEPTH (ft)
2334.0	1
2333.0	2
2332.0	3
2331.0	4
2330.0	5
2329.0	6
2328.0	7
2327.0	8
2326.0	9
2325.0	10
2324.0	11
2323.0	12
2322.0	13
2321.0	14
2320.0	15
2319.0	16
2318.0	17
2317.0	18
2316.0	19
2315.0	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	20.9	--	--	75.1
G-2	CL	--	--	24.0	--	--	88.7
G-3	CL	--	--	28.5	--	--	72.7

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-8C

OLSSON
ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1 **SOIL PROBE NO. SP-9**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2335.00									
	DEVELOPED ZONE 6.0"									
2334.0	***ALLUVIUM*** Lean clay with sand (CL)	1	G-1	CL	--	--	18.6	--	--	72.3
2333.0	Firm, very dark grayish brown, moist, mostly lean clay, some fine sand	2								
2332.0	3.0'	3								
2331.0	Lean clay with sand (CL)	4	G-2	CL	--	--	26.3	--	--	71.5
2330.0	Stiff, yellowish brown, very moist, mostly lean clay, some fine sand 5.5'	5	G-3	CL	--	--	31.5	--	--	58.5
2329.0	Clayey sand (SC) Medium dense, dark brown, very moist, mostly fine sand, some lean clay, few silt 6.5'	6								
2328.0		7								
2327.0	Poorly graded sand (SP) Medium dense, yellowish brown, very moist, mostly fine to medium sand	8								
2326.0		9								
2325.0		10								
	BASE OF SOIL PROBE @ 10.0 FEET									
2324.0		11								
2323.0		12								
2322.0		13								
2321.0		14								
2320.0		15								
2319.0		16								
2318.0		17								
2317.0		18								
2316.0		19								
2315.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-9

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 2

BORING NO. B- 10C

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/27/2010
DATE FINISH: 3/27/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

5.0' WHILE DRILLING
4.0' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

			TEST DATA							
ELEV (ft)	SOIL PROFILE ***APPROX. SURFACE ELEV. (ft): 2332.45***	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2331.5	***DEVELOPED ZONE*** 1.0'	1								
2330.5	***ALLUVIUM*** Lean clay with sand (CL) Firm, very dark grayish brown, very moist, mostly lean clay, little fine sand	2	**U-1**	CL	--	43/20	26.5	93.7	1.0	78.1
2329.5		3								
2328.5	4.0'	4								
2327.5	∇ Lean clay with sand (CL) Firm, yellowish brown, wet, mostly lean clay, little fine sand, iron	5	**U-2**	CL	--	46/19	26.9	94.2	0.7	80.8
2326.5		6								
2325.5		7								
2324.5	8.0'	8								
2323.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	9	**SS-3**	SP	3 4 8	--	14.2	--	--	1.9
2322.5		10								
2321.5		11								
2320.5		12								
2319.5		13								
2318.5	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, some lean clay	14	**SS-4**	SC	8 11 12	--	22.6	--	--	36.4
2317.5		15								
2316.5		16								
2315.5		17								
2314.5		18								
2313.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	19	**SS-5**	SP	5 9 10	--	10.3	--	--	3.4
2312.5		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-10C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 2 OF 2	**BORING NO. B- 10C**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

5.0'	WHILE DRILLING	
4.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2332.45*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM									
2311.5		21								
2310.5		22								
2309.5		23								
2308.5	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay	24	SS-6	SP/SC	6 9 9	--	9.8	--	--	5.7
2307.5		25								
2306.5		26								
2305.5		27								
2304.5		28								
2303.5	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	29	SS-7	SP	5 7 7	--	--	--	--	--
2302.5		30								
	BASE OF BORING @ 30.0 FEET									
2301.5		31								
2300.5		32								
2299.5		33								
2298.5		34								
2297.5		35								
2296.5		36								
2295.5		37								
2294.5		38								
2293.5		39								
2292.5		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-10C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

SOIL PROBE NO. SP-10A

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/29/2010
DATE FINISH: 3/29/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.25 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2331.00									
	DEVELOPED ZONE 1.0'									
2330.0	***ALLUVIUM*** Lean clay (CL) Firm, very dark brown, very moist, mostly lean clay, few silt, trace fine sand 1.5'	1	G-1	CL	--	44/20	26.9	--	--	83.7
2329.0		2								
2328.0	Lean clay with sand (CL) Firm, dark yellowish brown, very moist, mostly lean clay, little fine sand, iron	3								
2327.0	4.5'	4	G-2	CL	--	--	26.1	--	--	78.0
2326.0	Lean clay with sand (CL) Soft, light grayish brown, very moist, mostly lean clay, little fine sand	5								
2325.0		6								
	BASE OF SOIL PROBE @ 6.25 FEET									
2324.0		7								
2323.0		8								
2322.0		9								
2321.0		10								
2320.0		11								
2319.0		12								
2318.0		13								
2317.0		14								
2316.0		15								
2315.0		16								
2314.0		17								
2313.0		18								
2312.0		19								
2311.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-10A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-10B**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE AT 8.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2331.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)
	DEVELOPED ZONE	
2330.0	**1.0'**	1
	ALLUVIUM Lean clay (CL)	
2329.0	Firm, very dark grayish brown, very moist, mostly lean clay, little fine sand	2
2328.0		3
2327.0	Lean clay with sand (CL)	4
2326.0	Firm, light grayish brown, very moist, mostly lean clay, some fine sand	5
2325.0	**6.0'**	6
2324.0	Clayey sand (SC) Medium dense, gray, wet, mostly fine to medium sand, some lean clay **7.0'**	7
2323.0	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	8
	BASE OF SOIL PROBE @ 8.0 FEET	
2322.0		9
2321.0		10
2320.0		11
2319.0		12
2318.0		13
2317.0		14
2316.0		15
2315.0		16
2314.0		17
2313.0		18
2312.0		19
2311.0		20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	41/17	29.2	--	--	91.3
G-2	CL	--	--	32.6	--	--	82.1
G-3	CL	--	--	32.1	--	--	71.2

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-10B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2 **BORING NO. B- 11C**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

5.0' WHILE DRILLING
5.7' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2330.94									
	DEVELOPED ZONE 1.0'									
2329.9	***ALLUVIUM*** Lean clay (CL) Stiff, dark brown, moist, mostly lean clay, trace fine sand 1.5'	1								
2328.9	Sandy lean clay (CL) Stiff, brown, very moist, mostly lean clay, some fine sand, calcium	2	U-1	CL	--	--	26.0	90.6	0.2	53.0
2327.9		3								
2326.9	Sandy lean clay (CL) Stiff, brown mottled with light gray, very moist, mostly lean clay, some fine sand, calcium	4	U-2	CL	--	--	27.6	89.0	0.5	--
2325.9	∇	5								
2324.9		6								
2323.9	7.5'	7								
2322.9		8								
2321.9	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, some lean clay, iron	9	SS-3	SC	2 4 6	--	21.3	--	--	47.2
2320.9		10								
2319.9		11								
2318.9		12								
2317.9	13.5'	13								
2316.9	Silty lean clay with sand (CL/ML) Stiff, yellowish brown, wet, mostly silty lean clay, little fine to coarse sand 15.0'	14	SS-4	CL/ML	5 10 12	--	36.4	--	--	82.3
2315.9		15								
2314.9		16								
2313.9		17								
2312.9		18								
2311.9	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, few lean clay and fine gravel	19	SS-5	SP/SC	8 7 3	--	7.4	--	--	6.3
2310.9		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-11C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B- 11C**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

5.0'	WHILE DRILLING	
5.7'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 30.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2330.94									
	ALLUVIUM									
2309.9		21								
2308.9		22								
2307.9		23								
2306.9	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, few lean clay	24	SS-6	SP/SC	6 12 10	--	12.5	--	--	10.2
2305.9		25								
2304.9		26								
2303.9		27								
2302.9		28								
2301.9	Clayey sand (SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, little lean clay	29	SS-7	SC	3 6 8	--	18.4	--	--	12.4
2300.9		30								
	BASE OF BORING @ 30.0 FEET									
2299.9		31								
2298.9		32								
2297.9		33								
2296.9		34								
2295.9		35								
2294.9		36								
2293.9		37								
2292.9		38								
2291.9		39								
2290.9		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-11C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1 **SOIL PROBE NO. SP-11A**

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 10.0 FEET

APPROX. SURFACE ELEV. (ft): 2331.00

			TEST DATA							
ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2330.0	***DEVELOPED ZONE*** 1.0'	1	G-1	CL	--	--	22.1	--	--	88.6
2329.0	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, few silt, few fine sand 2.5'	2	G-2	CL	--	--	25.9	--	--	96.1
2328.0		3	G-3	CL	--	--	25.2	--	--	90.9
2327.0	Lean clay with sand (CL) Firm, dark brown, moist, mostly lean clay, little fine sand, few silt	4	G-4	CL	--	--	25.0	--	--	84.2
2326.0	5.0'	5	G-5	CL	--	--	23.8	--	--	78.2
2325.0	Lean clay (CL) Firm, light brown mottled with gray, wet, mostly lean clay, few fine sand	6								
2324.0	7.5'	7								
2323.0	Sandy Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, some fine sand, few silt, iron	8	G-6	CL	--	--	24.0	--	--	63.7
2322.0	9.0'	9								
2321.0	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine sand ***BASE OF SOIL PROBE @ 10.0 FEET***	10								
2320.0		11								
2319.0		12								
2318.0		13								
2317.0		14								
2316.0		15								
2315.0		16								
2314.0		17								
2313.0		18								
2312.0		19								
2311.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-11A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-11B**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 10.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2331.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2330.0	***DEVELOPED ZONE*** 1.0'	1								
2329.0	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, little fine sand	2	G-1	CL	--	--	25.1	--	--	87.5
2328.0	3.0'	3								
2327.0	Lean clay (CL) Stiff, dark brown, very moist, mostly lean clay, few fine sand	4	G-2	CL	--	--	25.9	--	--	89.7
2326.0		5								
2325.0	5.5'	6								
2324.0	Lean clay with sand (CL) Firm, light brown mottled with gray, dry, mostly lean clay, little fine sand	7	G-3	CL	--	--	7.4	--	--	82.9
2323.0		8								
2322.0	8.5' Poorly graded sand (SP) Medium dense, yellowish brown, dry, mostly fine sand	9								
2321.0		10								
2320.0	***BASE OF SOIL PROBE @ 10.0 FEET***	11								
2319.0		12								
2318.0		13								
2317.0		14								
2316.0		15								
2315.0		16								
2314.0		17								
2313.0		18								
2312.0		19								
2311.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-11B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-12**
LOCATION:	AREA 1
LAT/LONG:	N--˚--'--", W--˚--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2336.00

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
2335.0	***ALLUVIUM*** Sandy lean clay (CL) Firm, dark brown, moist, mostly lean clay, some fine sand **1.0'**	1								
2334.0	Lean clay with sand (CL) Stiff, very dark grayish brown, very moist, mostly lean clay, little fine sand **4.0'**	2	G-1	CL	--	39/19	30.2	--	--	67.2
2333.0		3								
2332.0		4								
2331.0	Clayey sand (SC) Medium dense, brown, moist, mostly fine sand, some lean clay, iron **5.0'**	5	G-2	SC	--	--	20.9	--	--	33.4
2330.0	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to medium sand, trace coarse sand	6								
2329.0	***BASE OF SOIL PROBE @ 6.0 FEET***	7								
2328.0	Driller's Note: 6-inch developed zone encountered at the surface	8								
2327.0		9								
2326.0		10								
2325.0		11								
2324.0		12								
2323.0		13								
2322.0		14								
2321.0		15								
2320.0		16								
2319.0		17								
2318.0		18								
2317.0		19								
2316.0		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-12

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1 **BORING NO. B-13**

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/26/2010
DATE FINISH: 3/26/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
4.0' WHILE DRILLING
5.1' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 15.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2332.20									
	DEVELOPED ZONE **6.0"**									
2331.2	***ALLUVIUM***	1								
2330.2	Lean clay with sand (CL) Firm, yellowish brown, very moist, mostly lean clay, little fine sand	2	**U-1**	CL	3 4 5	28/18	27.0	88.7	--	78.8
2329.2		3								
2328.2	**4.0'**	4								
2327.2	∇ Clayey sand (SC) Medium dense, dark yellowish brown, dry to moist, mostly fine sand, some lean clay **5.0'**	5	**U-2**	SC	--	--	12.8	--	--	27.0
2326.2		6								
2325.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	7								
2324.2		8	**G-3**	SP	--	--	9.4	--	--	2.1
2323.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	9								
2322.2		10	**SS-3**	SP	3 5 7	--	11.1	--	--	1.3
2321.2		11								
2320.2		12								
2319.2		13								
2318.2	Poorly graded sand with clay (SP/SC) Loose, yellowish brown, wet, mostly fine to coarse sand, few lean clay	14								
2317.2		15	**SS-4**	SP/SC	3 5 2	--	14.1	--	--	10.4
	BASE OF BORING @ 15.0 FEET									
2316.2		16								
2315.2		17								
2314.2		18								
2313.2		19								
2312.2		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-13

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-13**
LOCATION:	AREA 1
LAT/LONG:	N--˚--'--", W--˚--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 3.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2334.00									
2333.0	***ALLUVIUM*** Lean clay with sand (CL) Stiff, very dark brown, moist, mostly lean clay, some fine sand **1.0'**	1	G-1	CL	--	--	23.5	--	--	72.5
2332.0	Lean clay with sand (CL) Stiff, yellowish brown, moist, mostly lean clay, little fine sand	2	G-2	CL	--	--	24.8	--	--	82.5
2331.0		3								
	BASE OF SOIL PROBE @ 3.0 FEET									
2330.0		4								
	Driller's Note: 6-inch developed zone encountered at the surface									
2329.0		5								
2328.0		6								
2327.0		7								
2326.0		8								
2325.0		9								
2324.0		10								
2323.0		11								
2322.0		12								
2321.0		13								
2320.0		14								
2319.0		15								
2318.0		16								
2317.0		17								
2316.0		18								
2315.0		19								
2314.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**SOIL PROBE NO. SP-13**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-14**
LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/29/2010
DATE FINISH:	3/29/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 6.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2336.00

DEVELOPED ZONE **6.0"**

ALLUVIUM Lean clay with sand (CL)
Firm, very dark grayish brown, moist, mostly lean clay, little fine sand
2.5'

Lean clay with sand (CL)
Firm, yellowish brown, moist, mostly lean clay, little fine sand
5.0'

Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine sand

BASE OF SOIL PROBE @ 6.0 FEET

ELEV (ft)	DEPTH (ft)
2335.0	1
2334.0	2
2333.0	3
2332.0	4
2331.0	5
2330.0	6
2329.0	7
2328.0	8
2327.0	9
2326.0	10
2325.0	11
2324.0	12
2323.0	13
2322.0	14
2321.0	15
2320.0	16
2319.0	17
2318.0	18
2317.0	19
2316.0	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	22.9	--	--	69.3
G-2	CL	--	--	21.9	--	--	82.6
G-3	CL	--	--	20.3	--	--	78.7
G-4	CL	--	--	19.8	--	--	71.3

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

SOIL PROBE NO. SP-14

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-15

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

6.0'	WHILE DRILLING
5.7'	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2332.32

SOIL PROFILE	Depth
DEVELOPED ZONE	**6.0"**
ALLUVIUM Sandy lean clay (CL) Firm, yellowish brown, dry to moist, mostly lean clay, some fine sand	**1.5'**
Silty, clayey sand (SC/SM) Medium dense, dark brown, moist, mostly fine sand, some silty lean clay	**4.0'**
Clayey sand (SC) Medium dense, yellowish brown, moist, mostly fine to coarse sand, some lean clay ∇	**6.0'**
Poorly graded sand (SP) Loose, yellowish brown, wet, mostly fine to coarse sand	
BASE OF BORING @ 15.0 FEET	

ELEV (ft)	DEPTH (ft)
2331.3	1
2330.3	2
2329.3	3
2328.3	4
2327.3	5
2326.3	6
2325.3	7
2324.3	8
2323.3	9
2322.3	10
2321.3	11
2320.3	12
2319.3	13
2318.3	14
2317.3	15
2316.3	16
2315.3	17
2314.3	18
2313.3	19
2312.3	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
Surface	CL	--	--	14.1	105.3	--	54.4
U-1	SC/SM	--	23/15	15.4	101.0	--	48.5
SS-2	SC	5 7 8	--	18.1	--	--	34.6
SS-3	SP	2 3 5	--	8.1	--	--	1.1

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-15

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1 **BORING NO. B-16**

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/27/2010
DATE FINISH: 3/27/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
5.5' WHILE DRILLING
5.9' 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2333.94									
	DEVELOPED ZONE **6.0"**									
2332.9	***ALLUVIUM***	1								
2331.9	Lean clay with sand (CL) Firm, very dark gray, very moist, mostly silty lean clay, little fine sand	2	U-1	CL	--	41/23	26.9	88.5	1.1	80.1
2330.9	**3.0'**	3								
2329.9	Lean clay with sand (CL) Firm, light gray, very moist, mostly lean clay, little fine sand **4.0'**	4	U-2	CL	--	26/15	18.2	104.7	--	55.4
2328.9	▽ Sandy lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, some fine sand **5.5'**	5								
2327.9		6								
2326.9		7								
2325.9		8								
2324.9	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand	9	SS-3	SP	3 5 6	--	13.7	--	--	1.4
2323.9	***BASE OF BORING @ 10.0 FEET***	10								
2322.9		11								
2321.9		12								
2320.9		13								
2319.9		14								
2318.9		15								
2317.9		16								
2316.9		17								
2315.9		18								
2314.9		19								
2313.9		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-16

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-17

LOCATION: AREA 1
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/26/2010
DATE FINISH: 3/26/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
6.5' WHILE DRILLING
3.5' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 15.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2332.59									
	DEVELOPED ZONE 6.0"									
2331.6	***ALLUVIUM***	1								
2330.6	Lean clay with sand (CL) Firm, very dark gray, moist, mostly lean clay, little fine sand	2	**U-1**	CL	--	39/16	24.8	96.3	7.5	78.3
2329.6	∇	3								
2328.6	Lean clay (CL) Stiff, light gray, wet, mostly silty lean clay, little fine sand	4	**U-2**	CL	--	35/19	21.0	100.7	--	85.6
2327.6		5								
2326.6		6								
	6.5'									
2325.6		7								
2324.6		8								
2323.6	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	9	**SS-3**	SP	3 6 9	--	12.3	--	--	3.0
2322.6		10								
2321.6		11								
2320.6		12								
2319.6		13								
2318.6	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to medium sand, few lean clay	14	**SS-4**	SP/SC	3 6 9	--	10.8	--	--	5.0
2317.6		15								
	BASE OF BORING @ 15.0 FEET									
2316.6		16								
2315.6		17								
2314.6		18								
2313.6		19								
2312.6		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER
NE - Not Encountered
NP - Not Performed

BORING NO. B-17

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1

BORING NO. B-18

LOCATION:	AREA 1
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/27/2010
DATE FINISH:	3/27/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

5.0'	WHILE DRILLING	
3.8'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 10.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2330.97

TEST DATA

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2330.0	*ALLUVIUM*	1								
2329.0	Fat clay (CH) Firm, stiff, dark grayish brown, very moist, mostly fat clay, little fine sand	2	U-1	CH	--	55/23	25.6	91.6	1.0	86.5
2328.0	3.0'	3								
2327.0	∇ Sandy lean clay (CL)	4								
2326.0	Firm, light grayish brown, wet, mostly lean clay, some fine sand	5	U-2	CL	--	42/16	26.4	97.6	--	69.6
2325.0		6								
2324.0		7								
	7.5'									
2323.0		8								
2322.0	Poorly graded sand (SP)	9								
2321.0	Medium dense, yellowish brown, wet, mostly fine to medium sand, trace coarse sand	10	SS-3	SP	4 7 9	--	7.2	--	--	2.6
	BASE OF BORING @ 10.0 FEET									
2320.0		11								
2319.0		12								
2318.0		13								
2317.0		14								
2316.0		15								
2315.0		16								
2314.0		17								
2313.0		18								
2312.0		19								
2311.0		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B-18

APPENDIX C

AREA 1

Summary of Laboratory Test Results

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA
OA Project #: A09-1466

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
AREA 1													
B-1C	SS-1	1-2.5'	17.6										41.4
	SS-3	8.5-10'	1.8										2.9
	SS-4	13.5-15'	11.0										70.5
	SS-5	18.5-20'	11.8										1.0
	SS-6	23.5-25'	10.2										0.2
	SS-7	28.5-30'	9.9										0.8
B-2C	SS-1	1-2.5'	10.2										17.4
	U-2	3.5-5'	21.1	106.2	0.587	97.1	0.5	3.0					
	SS-3	8.5-10'	11.7										3.1
	SS-4	13.5-15'	14.7										10.3
	SS-5	18.5-20'	10.6										2.8
	SS-6	23.5-25'	9.5										1.0
SP-2A	G-1	0-1.0'	22.0										70.0
	G-2	1-2.0'	24.8										80.0
	G-3	2-3.0'	24.5										84.9
	G-4	3-4.0'	13.2										43.0
B-3B	SS-1	1-2.5'	11.8										34.5
	SS-2	3.5-5'	4.6										4.7
	SS-3	8.5-10'	13.1										1.1
	SS-4	13.5-15'	15.8										4.4
	SS-5	18.5-20'	12.8										0.8
	SS-6	23.5-25'	11.8										0.8
	SS-7	28.5-30'	28.2										51.6
SP-3A	G-1	0-1.0'	29.2										52.8
	G-2	1-1.5'	19.2										0.3
SP-3C	G-1	0-1.0'	27.3										61.3
B-4C	Surface	0-1.0'	23.7	101.8	0.656	97.4	1.7	2.4	32	20	12	CL/ML	
	U-1	1-2.5'	21.2	102.1	0.651	87.9			32	22	10	CL/ML	
	SS-3	8.5-10'	21.4										52.6
	SS-4	13.5-15'	15.1										5.7
	SS-5	18.5-20'	11.7										6.9

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA
OA Project #: A09-1466

BORING	SAMPLE	SAMPLE	MOISTURE	DRY	VOID	SAT.	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS	%Passing
No.	I.D.	DEPTH (ft.)	CONTENT (%)	DENSITY (pcf)	RATIO	(%)	STRENGTH (tsf)	STRAIN (%)	LL	PL	PI	CLASS.	#200 Sieve
B-4C	SS-6	23.5-25'	13.2										1.7
	SS-7	28.5-30'	7.2										0.9
SP-4A	G-1	0-1.0'	22.7										64.8
	G-2	1-2.0'	23.1										88.7
SP-4B	G-1	0-1.0'	25.8										86.3
	G-2	1-1.5'	22.3										77.7
	G-3	1.5-2.5'	24.4										89.1
	G-4	2.5-3.5'	26.5										83.3
B-5C	SS-1	1-2.5'	23.2										89.3
	U-2	3.5-5'	21.7	101.1	0.667	87.9	1.7	9.3	47	24	24	CL	58.6
	SS-3	8.5-10'	6.3										3.2
	SS-4	13.5-15'	7.4										0.4
	SS-5	18.5-20'	8.2										1.0
SP-5	G-1	0-2.0'	29.5										95.3
	G-2	2-4.0'	24.4										87.4
	G-3	4-6.0'	25.1										86.9
	G-4	6-8.0'	26.6										77.6
B-6C	U-1	1-2.5'	26.0	94.5	0.782	91.8			33	20	13	CL	91.2
	U-2	3.5-5'	22.2	94.1	0.790	76.0			36	18	18	CL	81.5
	U-3	8.5-10'	12.7										15.4
	SS-4	13.5-15'	15.1										32.5
	SS-5	18.5-20'	12.5										3.6
	SS-6	23.5-25'	6.1										5.2
	SS-7	28.5-30'	9.0										0.5
SP-6A	G-1	0-3.0'	24.3						36	19	17	CL	84.3
	G-2	3-8.0'	22.5						38	19	19	CL	88.3
SP-6B	G-1	0-4.0'	23.5						37	17	20	CL	92.3
	G-2	4-4.5'	22.7										84.1
	G-3	4.5-9.0'	23.2						39	18	21	CL	87.0
B-7C	U-1	1-2.5'	28.1	78.3	1.150	65.9			33	22	11	CL	94.7
	U-2	3.5-5'	29.9	90.1	0.869	92.9			49	19	30	CL/CH	
	SS-4	8.5-10'	7.8										2.2

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA
OA Project #: A09-1466

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
B-7C	SS-5	13.5-15'	10.5										13.9
	SS-6	18.5-20'	9.7										8.5
	SS-7	23.5-25'	13.1										1.6
SP-7A	G-1	0-2.0'	22.8										82.7
	G-2	2-4.0'	28.2										86.1
	G-3	4-6.0'	26.8						45	21	24	CL	87.3
	G-4	6-7.5'	27.0										87.1
SP-7B	G-1	1-2.0'	25.6										85.2
	G-2	2-5.0'	25.8						36	18	18	CL	91.7
	G-3	5-7.0'	25.2						38	19	20	CL	90.6
	G-4	7-9.0'	27.2										85.3
B-8B	U-1	1-2.5'	27.1	92.5	0.821	89.0	0.5	1.7					85.9
	U-2	3.5-5'	21.8	101.1	0.661	88.9							57.3
	SS-3	8.5-10'	8.8										6.1
	SS-4	13.5-15'	16.9										33.6
	SS-5	18.5-20'	5.6										2.3
	SS-6	23.5-25'	11.7										2.2
	SS-7	28.5-30'	13.8										19.2
SP-8A	G-1	0-1.0'	22.2										74.2
	G-2	1-2.0'	27.4										85.4
	G-3	2-3.0'	27.8										88.3
	G-4	3-5.0'	29.4										74.4
	G-5	5-6.0'	27.8										63.8
SP-8C	G-1	0-0.5'	20.9										75.1
	G-2	0.5-1.5'	24.0										88.7
	G-4	3.5-5'	28.5										72.7
SP-9	G-1	0-2.0'	18.6										72.3
	G-2	3-4.0'	26.3										71.5
	G-3	4.5-5.5'	31.5										58.5
B-10C	U-1	1-2.5'	26.5	93.7	0.798	89.8	1.0	4.0	43	20	23	CL	78.1
	U-2	3.5-5'	26.9	94.2	0.789	92.3	0.7	1.8	46	19	27	CL	80.8
	SS-3	8.5-10'	14.2										1.9

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA
OA Project #: A09-1466

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
B-10C	SS-4	13.5-15'	22.6										36.4
	SS-5	18.5-20'	10.3										3.4
	SS-6	23.5-25'	9.8										5.7
SP-10A	G-1	0-3.0'	26.9						44	20	25	CL	83.7
	G-2	3-5.0'	26.1										78.0
SP-10B	G-1	0-3.0'	29.2						41	17	24	CL	91.3
	G-2	3-4.0'	32.6										82.1
	G-3	4-5.0'	32.1										71.2
B-11C	U-1	1-2.5'	26.0	90.6	0.859	81.7	0.2	1.1					53.0
	U-2	3.5-5'	27.6	89.0	0.893	83.5	0.5	1.5					
	SS-3	8.5-10'	21.3										47.2
	SS-4	13.5-15'	36.4										82.3
	SS-5	18.5-20'	7.4										6.3
	SS-6	23.5-25'	12.5										10.2
	SS-7	28.5-30'	18.4										12.4
SP-11A	G-1	0-1.0'	22.1										88.6
	G-2	1-2.0'	25.9										96.1
	G-3	2-3.0'	25.2										90.9
	G-4	3-4.0'	25.0										84.2
	G-5	4-5.0'	23.8										78.2
	G-6	7.5-9'	24.0										63.7
SP-11B	G-1	1-3.0'	25.1										87.5
	G-2	3-5.0'	25.9										89.7
	G-3	5-8.0'	7.4										82.9
SP-12	G-1	1-4.0'	30.2						39	19	20	CL	67.2
	G-2	4-5.0'	20.9										33.4
B-13	U-1	1-2.5'	27.0	88.7	0.900	80.9			28	18	11	CL	78.8
	U-2	3.5-5'	12.8										27.0
	G-3	6.5-8.5'	9.4										2.1
	SS-3	8.5-10'	11.1										1.3
	SS-4	13.5-15'	14.1										10.4
SP-13	G-1	0-1.0'	23.5										72.5

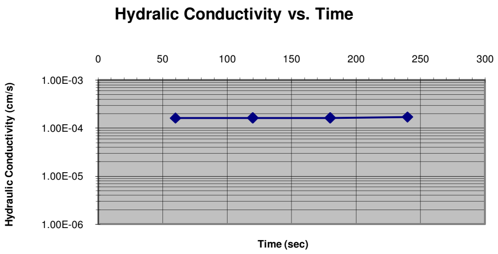
SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS COUNTY, NEBRASKA
OA Project #: A09-1466

BORING	SAMPLE	SAMPLE	MOISTURE	DRY	VOID	SAT.	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS	%Passing
No.	**I.D.**	**DEPTH (ft.)**	**CONTENT (%)**	**DENSITY (pcf)**	**RATIO**	**(%)**	**STRENGTH (tsf)**	**STRAIN (%)**	**LL**	**PL**	**PI**	**CLASS.**	**#200 Sieve**
SP-13	G-2	1-3.0'	24.8										82.5
SP-14	G-1	0-1.0'	22.9										69.3
	G-2	1-2.0'	21.9										82.6
	G-3	2-3.0'	20.3										78.7
	G-4	3-4.0'	19.8										71.3
B-15	Surface	0-1.0'	14.1	105.3	0.600	63.5							54.4
	U-1	1-2.5'	15.4	101.0	0.668	62.3			23	15	8	SC/SM	48.5
	SS-2	3.5-5'	18.1										34.6
	SS-3	8.5-10'	8.1										1.1
B-16	U-1	1-2.5'	26.9	88.5	0.903	80.4	1.1	0.8	41	23	18	CL	80.1
	U-2	3.5-5'	18.2	104.7	0.610	80.7			26	15	11	CL	55.4
	SS-3	8.5-10'	13.7										1.4
B-17	U-1	1-2.5'	24.8	96.3	0.750	89.3	7.5	1.4	39	16	24	CL	78.3
	U-2	3.5-5'	21.0	100.7	0.673	84.4			35	19	16	CL	85.6
	SS-3	8.5-10'	12.3										3.0
	SS-4	13.5-15'	10.8										5.0
B-18	U-1	1-2.5'	25.6	91.6	0.839	82.5	1.0	2.0	55	23	32	CH	86.5
	U-2	3.5-5'	26.4	97.6	0.726	98.0			42	16	26	CL	69.6
	SS-3	8.5-10'	7.2										2.6
Composite Bulk: B-10C (0-4.0'), B-11C (0-1.5')				**Max Dry Density = 97.3 pcf, Optimum Moisture Content = 21.7%**					35	18	17	CL	90.6
Composite Bulk: B-10C (4.5-7'), B-11C (2-7.0')				**Max Dry Density = 101.6 pcf, Optimum Moisture Content = 21.9%**					41	18	23	CL	83.6
Bulk: B-17 (2.5-6.5')				**Max Dry Density = 108.1 pcf, Optimum Moisture Content = 16.9%**					31	17	14	CL	74.7
Bulk: B-18 (2.5-7.5')				**Max Dry Density = 108.8 pcf, Optimum Moisture Content = 15.0%**					33	19	13	CL	81.7

Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 1
Date 6/1/2010
Project No. A09-1466
Boring No. B-6C
Sample No. U-2 (3.5-5')
Scale No.
Laboratory #



Sample Parameters

	Initial	Final
Height of Sample (cm)	10.201	10.284
Diameter of Sample (cm)	7.325	7.382
Wet density, lb/cu ft	114.565	118.710
Dry density, lb/cu ft	91.559	90.186
Water content	25.13%	31.63%
SG of solids	2.70	2.70
Saturation	80.75%	98.37%

	Test 1	Test 2	Test 3	Test 4
Cell Pressure (psi)	76.31	76.31	76.31	76.31
Upper Cap Pressure (psi)	69.79	69.79	69.79	69.79
Lower Cap Pressure (psi)	70.59	70.59	70.59	70.59
Differential Pressure (psi)	0.80	0.80	0.80	0.80
Hydraulic Gradient	6	6	6	6
Test time (sec)	60	60	60	60
Elapsed Time (sec)	60	120	180	240
Upper Cap Burette Initial Reading (mL)	9.8	8.6	7.5	6.5
Upper Cap Burette Final Reading (mL)	8.6	7.5	6.5	5.6
Lower Cap Burette Initial Reading (mL)	33	34.2	35.3	36.3
Lower Cap Burette Final Reading (mL)	34.2	35.3	36.3	37.3
Inflow/Outflow Ratio (0.75-1.25)	1.00	1.00	1.00	1.11
Permeability (cm/sec)	1.69E-04	1.70E-04	1.69E-04	1.77E-04
Temperature ©	21.8	21.8	21.8	21.9
Temperature Correction	0.96	0.96	0.96	0.96
Permeability, K @ 20 C (cm/sec)	1.61E-04	1.62E-04	1.62E-04	1.70E-04
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **1.64E-04**

Remarks:

Technician: DK
Computed By: AP
Checked By: AP

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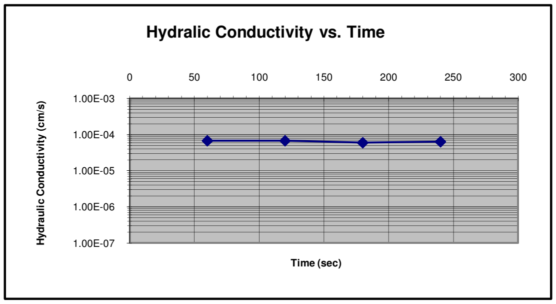
Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 1
Date 4/3/2010
Project No. A09-1466
Boring No. B-6C
Sample No. U-3
Scale No.
Laboratory #



Sample Parameters

	Initial	**Final**
Height of Sample (cm)	9.113	9.078
Diameter of Sample (cm)	7.311	7.270
Wet density, lb/cu ft	129.287	131.484
Dry density, lb/cu ft	111.873	111.876
Water content	15.57%	17.53%
SG of solids	2.70	2.70
Saturation	83.06%	93.53%

	Test 1	**Test 2**	**Test 3**	**Test 4**
Cell Pressure (psi)	80.21	80.21	80.21	80.21
Upper Cap Pressure (psi)	69.99	69.99	69.99	69.99
Lower Cap Pressure (psi)	70.60	70.60	70.60	70.60
Differential Pressure (psi)	0.61	0.61	0.61	0.61
Hydraulic Gradient	5	5	5	5
Test time (sec)	60	60	60	60
Elapsed Time (sec)	60	120	180	240
Upper Cap Burette Initial Reading (mL)	12.8	12	11.2	10.5
Upper Cap Burette Final Reading (mL)	12	11.2	10.5	9.7
Lower Cap Burette Initial Reading (mL)	36.7	37.5	38.3	39
Lower Cap Burette Final Reading (mL)	37.5	38.3	39	39.7
Inflow/Outflow Ratio (0.75-1.25)	1.00	1.00	1.00	0.88
Permeability (cm/sec)	6.89E-05	6.89E-05	6.01E-05	6.45E-05
Temperature ©	20.6	20.6	20.6	20.6
Temperature Correction	0.99	0.99	0.99	0.99
Permeability, K @ 20 C (cm/sec)	6.79E-05	6.79E-05	5.93E-05	6.36E-05
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **6.47E-05**

Remarks:

Technician: DK
Computed By: AP
Checked By: AP

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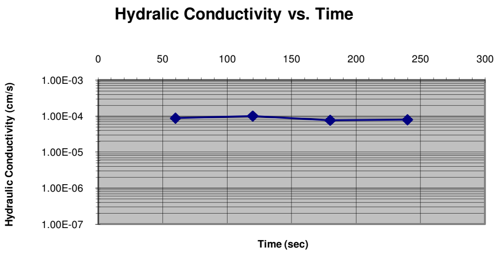
Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 1
Date 6/2/2010
Project No. A09-1466
Boring No. B-16
Sample No. U-2 (3.5-5')
Scale No.
Laboratory #



Sample Parameters

	Initial	**Final**
Height of Sample (cm)	11.968	11.932
Diameter of Sample (cm)	7.263	7.233
Wet density, lb/cu ft	124.917	127.361
Dry density, lb/cu ft	104.636	103.792
Water content	19.38%	22.71%
SG of solids	2.70	2.70
Saturation	85.77%	98.37%

	Test 1	**Test 2**	**Test 3**	**Test 4**
Cell Pressure (psi)	71.23	71.23	71.23	71.23
Upper Cap Pressure (psi)	64.75	64.75	64.75	64.75
Lower Cap Pressure (psi)	65.60	65.60	65.60	65.60
Differential Pressure (psi)	0.85	0.85	0.85	0.85
Hydraulic Gradient	5	5	5	5
Test time (sec)	60	60	60	60
Elapsed Time (sec)	60	120	180	240
Upper Cap Burette Initial Reading (mL)	10.7	10.2	9.7	9.3
Upper Cap Burette Final Reading (mL)	10.2	9.7	9.3	8.9
Lower Cap Burette Initial Reading (mL)	38.7	39.2	39.8	40.2
Lower Cap Burette Final Reading (mL)	39.2	39.8	40.2	40.6
Inflow/Outflow Ratio (0.75-1.25)	1.00	1.20	1.00	1.00
Permeability (cm/sec)	8.56E-05	9.83E-05	7.44E-05	7.71E-05
Temperature ©	19.2	19.2	19.3	19.4
Temperature Correction	1.02	1.02	1.02	1.02
Permeability, K @ 20 C (cm/sec)	8.73E-05	1.00E-04	7.58E-05	7.83E-05
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **8.54E-05**

Remarks:

Technician: DK
Computed By: AP
Checked By: AP

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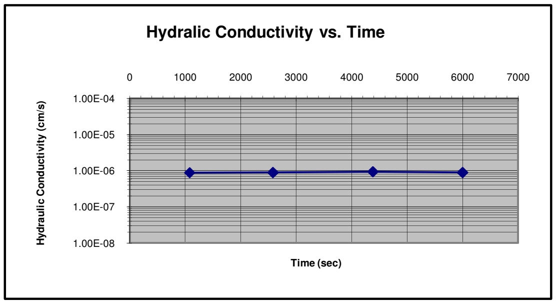
Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 1
Date 6/4/2010
Project No. A09-1466
Boring No. B-18
Sample No. U-2 (3.5-5')
Scale No.
Laboratory #



Sample Parameters

	Initial	Final
Height of Sample (cm)	10.304	10.330
Diameter of Sample (cm)	7.243	7.286
Wet density, lb/cu ft	123.866	122.960
Dry density, lb/cu ft	96.889	96.592
Water content	27.84%	27.30%
SG of solids	2.70	2.70
Saturation	100.00%	99.03%

	Test 1	Test 2	Test 3	Test 4
Cell Pressure (psi)	41.53	41.53	41.53	41.53
Upper Cap Pressure (psi)	34.95	34.95	34.95	34.95
Lower Cap Pressure (psi)	37.80	37.80	37.80	37.80
Differential Pressure (psi)	2.85	2.85	2.85	2.85
Hydraulic Gradient	19	19	19	19
Test time (sec)	1080	1500	1800	1620
Elapsed Time (sec)	1080	2580	4380	6000
Upper Cap Burette Initial Reading (mL)	22.7	22	21	19.6
Upper Cap Burette Final Reading (mL)	22	21	19.6	18.5
Lower Cap Burette Initial Reading (mL)	29.3	30.1	31.2	32.4
Lower Cap Burette Final Reading (mL)	30.1	31.2	32.4	33.5
Inflow/Outflow Ratio (0.75-1.25)	1.14	1.10	0.86	1.00
Permeability (cm/sec)	9.03E-07	9.20E-07	9.62E-07	9.18E-07
Temperature ©	21.3	21.5	21.4	21.4
Temperature Correction	0.97	0.96	0.97	0.97
Permeability, K @ 20 C (cm/sec)	8.76E-07	8.87E-07	9.31E-07	8.87E-07
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **8.96E-07**

Remarks:

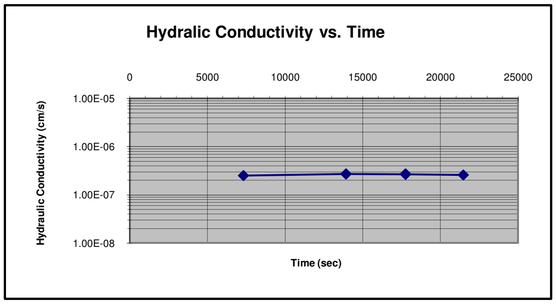
Technician: DK
Computed By: AP
Checked By: AP

OLSSON
ASSOCIATES

Revision No.	2
Revision Date	4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasilibility Study - Area 1
Date 7/7/2010
Project No. 009-1466
Boring No. Composite Bulk: B-10 (0-4'), B-11 (0-1.5')
Sample No.
Scale No.
Laboratory #



Sample Parameters

	Initial	Final
Height of Sample (cm)	7.582	7.507
Diameter of Sample (cm)	7.099	7.139
Wet density, lb/cu ft	115.767	120.946
Dry density, lb/cu ft	94.586	93.507
Water content	22.39%	29.34%
SG of solids	2.70	2.70
Saturation	77.39%	98.82%

	Test 1	Test 2	Test 3	Test 4
Cell Pressure (psi)	76.54	76.54	76.54	76.54
Lower Cap Pressure (psi)	72.17	72.17	72.17	72.17
Upper Cap Pressure (psi)	70.02	70.02	70.02	70.02
Differential Pressure (psi)	2.15	2.15	2.15	2.15
Hydraulic Gradient	20	20	20	20
Test time (sec)	7320.000001	6600	3840	3720
Elapsed Time (sec)	7320.000001	13920	17760	21480
Lower Cap Burette Initial Reading (mL)	37.1	38.3	39.4	40
Lower Cap Burette Final Reading (mL)	38.3	39.4	40	40.6
Upper Cap Burette Initial Reading (mL)	13.9	12.7	11.5	10.8
Upper Cap Burette Final Reading (mL)	12.7	11.5	10.8	10.2
Inflow/Outflow Ratio (0.75-1.25)	1.00	0.92	0.86	1.00
Permeability (cm/sec)	2.54E-07	2.75E-07	2.72E-07	2.62E-07
Temperature ©	20.6	20.8	20.7	20.7
Temperature Correction	0.99	0.98	0.98	0.98
Permeability, K @ 20 C (cm/sec)	2.50E-07	2.70E-07	2.67E-07	2.58E-07
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **2.61E-07**

Remarks:

Technician: DK
Computed By: AP
Checked By: AP

OLSSON ASSOCIATES

Falling Head Permeability Test

Date: 06/10/10

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Boring No. B-8B Sample No. SS-3 (8.5-10')

Specimen No.	Ring & Plate	Classification	
Specimen & Ring Wet	1419.40	Diameter of Specimen, sq cm	6.338
Tare Plus Wet	N/A	Area of specimen, sq cm	31.55
Tare Plus Dry	N/A	Initial Height of Specimen, cm	2.54
Tare	1282.80	Initial Volume of Spec., cc	80.137
Dry Soil	N/A	Initial Void Ratio	0.729
Ring	184.74	Constant	0.0531
Specific Gravity	2.7	Initial Dial Reading, in	0.0105
Volume of solids,cc	N/A	Height Constant, cm	45.00
Area of Standardpipe, sq cm	0.727		
Capillary rise, cm	0.00		

TEST NO.	1	2	3	4	5	6
Load Increment, T/sq ft.	0.5	0.5	0.5	0.5	0.5	0.5
Dial Reading at Start, in.	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
Change of Ht. of Spec., in.	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
Ht. of Spec., cm	2.5133	2.5133	2.5133	2.5133	2.5133	2.5133
Void Ratio	0.729	0.729	0.729	0.729	0.729	0.729
Date (1/01/97)	06/11/10	06/11/10	06/11/10	06/11/10	06/11/10	06/11/10
Initial Time (12:00 PM)	10:30 AM	10:30 AM	10:31 AM	10:31 AM	10:32 AM	10:32 AM
Date (1/01/97)	06/11/10	06/11/10	06/11/10	06/11/10	06/11/10	06/11/10
Final Time (12:00 PM)	10:30 AM	10:31 AM	10:31 AM	10:32 AM	10:32 AM	10:33 AM
Elapsed Time, sec	30.00	30.00	30.00	30.00	30.00	30.00
Total Elapsed Time, sec	30.00	60.00	90.00	120.00	150.00	180.00
Initial Height, cm	57.00	54.50	57.40	57.10	56.80	57.40
Final Height, cm	21.10	21.40	24.20	24.30	25.20	26.00
Viscosity Correction Factor	0.953	0.953	0.953	0.953	0.953	0.953
Coefficient of Permeability, cm/sec	7.98E-04	7.44E-04	7.21E-04	7.13E-04	6.84E-04	6.74E-04

AVERAGE PERMEABILITY (cm/s) 6.98E-04

Remarks:

Technician: Dan Kowalski Computed by: Caleb Strate

Falling Head Permeability Test

Date: 06/10/10

Project: CNPPID Reregulating Reservoir Feasibility Study

Boring No. B-13

Sample No. G-3 (6.5-8.5')

Specimen No.	Ring & Plate	Classification	
Specimen & Ring Wet	1430.70	Diameter of Specimen, sq cm	6.338
Tare Plus Wet	N/A	Area of specimen, sq cm	31.55
Tare Plus Dry	N/A	Initial Height of Specimen, cm	2.54
Tare	1287.40	Initial Volume of Spec., cc	80.137
Dry Soil	N/A	Initial Void Ratio	0.703
Ring	184.74	Constant	0.0531
Specific Gravity	2.7	Initial Dial Reading, in	0.0078
Volume of solids,cc	N/A	Height Constant, cm	45.00
Area of Standardpipe, sq cm	0.727		
Capillary rise, cm	0.00		

TEST NO.	1	2	3	4	5	6
Load Increment, T/sq ft.	0.5	0.5	0.5	0.5	0.5	0.5
Dial Reading at Start, in.	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
Change of Ht. of Spec., in.	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
Ht. of Spec., cm	2.5133	2.5133	2.5133	2.5133	2.5133	2.5133
Void Ratio	0.703	0.703	0.703	0.703	0.703	0.703
Date (1/01/97)	06/15/10	06/15/10	06/15/10	06/15/10	06/15/10	06/15/10
Initial Time (12:00 PM)	9:35 AM	9:36 AM	9:36 AM	9:37 AM	9:37 AM	9:38 AM
Date (1/01/97)	06/15/10	06/15/10	06/15/10	06/15/10	06/15/10	06/15/10
Final Time (12:00 PM)	9:36 AM	9:36 AM	9:37 AM	9:37 AM	9:38 AM	9:38 AM
Elapsed Time, sec	30.00	30.00	30.00	30.00	30.00	30.00
Total Elapsed Time, sec	180.00	210.00	240.00	270.00	300.00	330.00
Initial Height, cm	63.20	58.30	58.80	60.10	63.80	63.20
Final Height, cm	6.30	6.80	6.30	5.80	7.20	6.30
Viscosity Correction Factor	0.953	0.953	0.953	0.953	0.953	0.953
Coefficient of Permeability, cm/sec	1.37E-03	1.27E-03	1.30E-03	1.34E-03	1.35E-03	1.37E-03

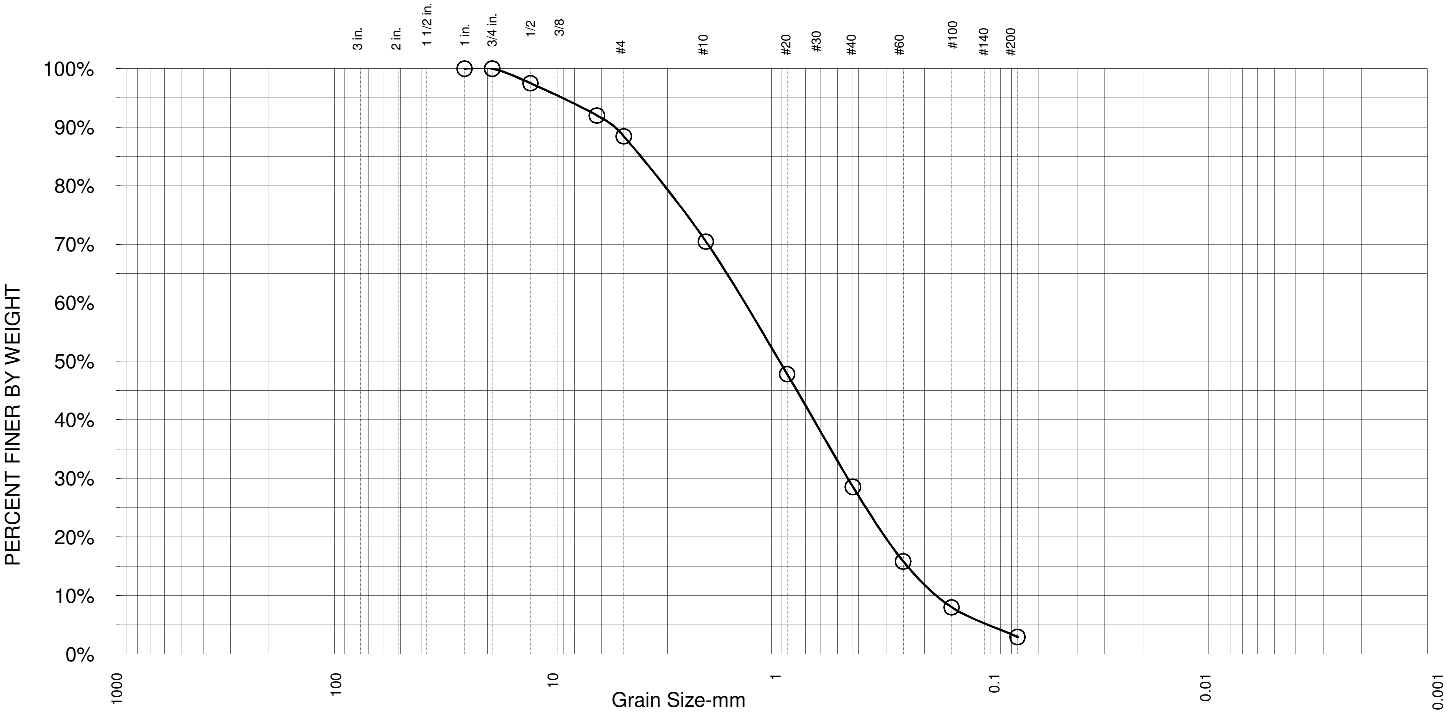
AVERAGE PERMEABILITY (cm/s) **1.34E-03**

Remarks:

Technician: Dan Kowalski

Computed by: Caleb Strate

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	11.6%	18.0%	41.9%	25.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	97.5%		
1/4	92.0%		
4	88.4%		
10	70.5%		
20	47.8%		
40	28.6%		
60	15.8%		
100	8.0%		
200	2.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 4.00 D_{60}= 1.40 D_{50}= 0.91

D_{30}= 0.44 D_{15}= 0.25 D_{10}= 0.18

C_U= 7.78 C_C= 0.77

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-1C, SS-3 (8.5-10')
Area 1

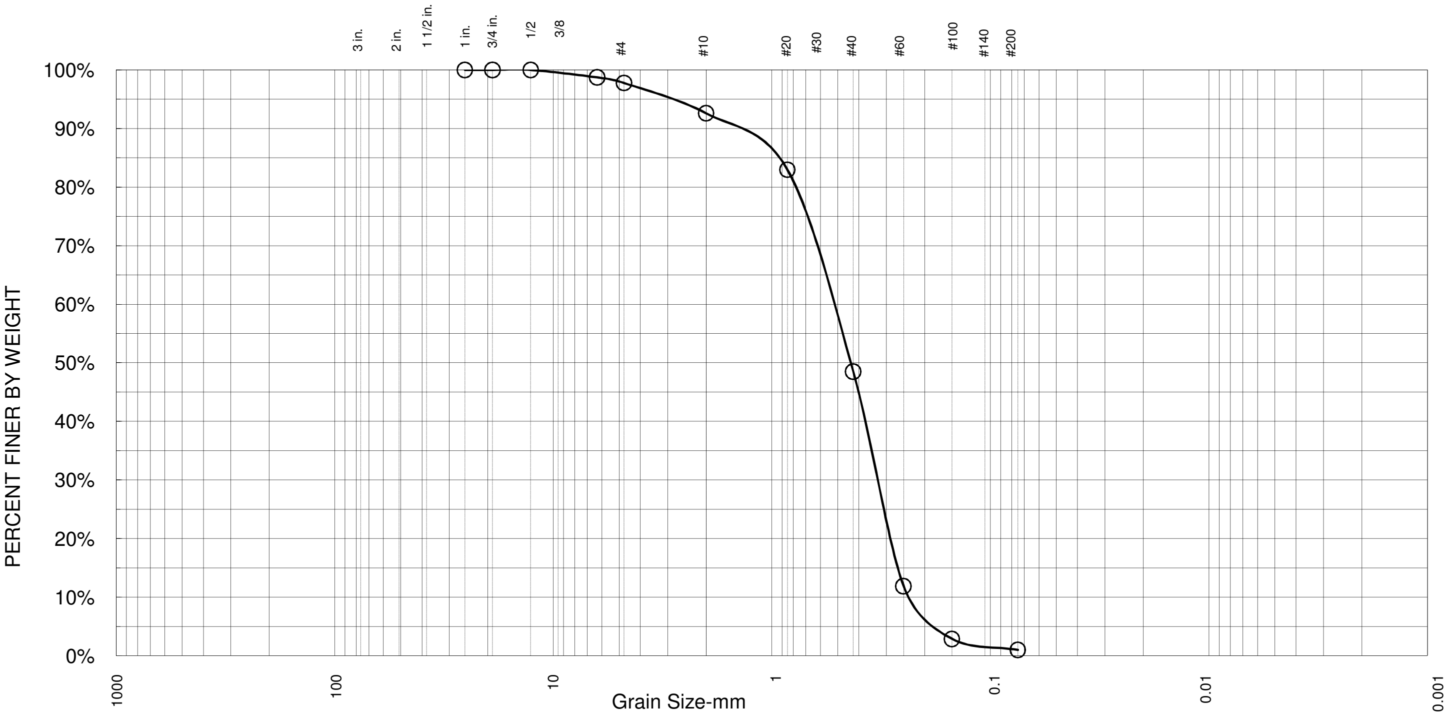
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	2.2%	5.2%	44.1%	47.5%	N/A	N/A

SIEVE	PERCENT	SPEC*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	98.7%		
4	97.8%		
10	92.6%		
20	83.0%		
40	48.5%		
60	11.9%		
100	2.9%		
200	1.0%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.92 D_{60}= 0.52 D_{50}= 0.44

D_{30}= 0.33 D_{15}= 0.27 D_{10}= 0.24

C_U= 2.17 C_C= 0.87

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-1C, SS-5 (18.5-20')
Area 1

Date: 5/11/2010

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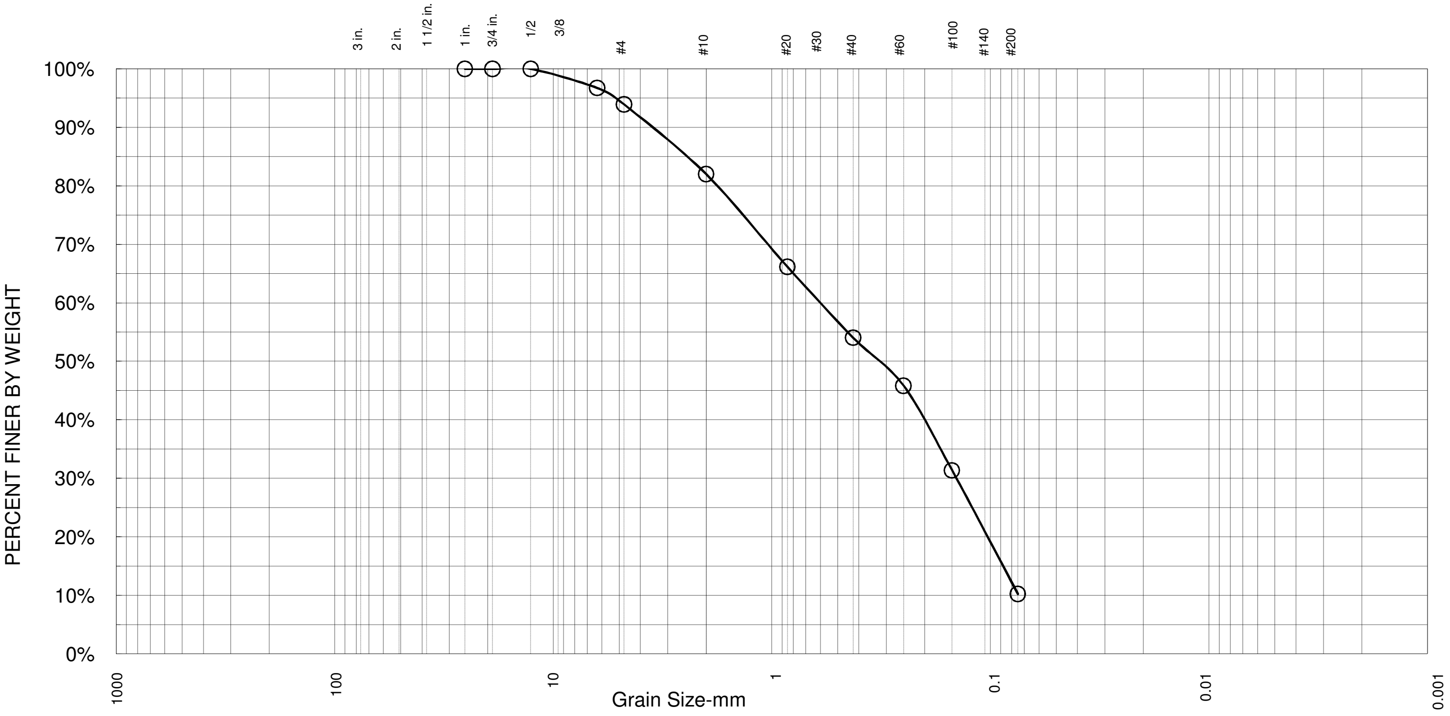
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	6.1%	11.9%	27.9%	43.8%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	96.7%		
4	93.9%		
10	82.0%		
20	66.2%		
40	54.1%		
60	45.8%		
100	31.4%		
200	10.3%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.50 D_{60}= 0.60 D_{50}= 0.32

D_{30}= 0.15 D_{15}= 0.09 D_{10}= 0.08

C_U= 7.50 C_C= 0.47

Classification

USCS= Poorly graded sand with clay (SP/SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-2C, SS-4 (13.5-15')
Area 1

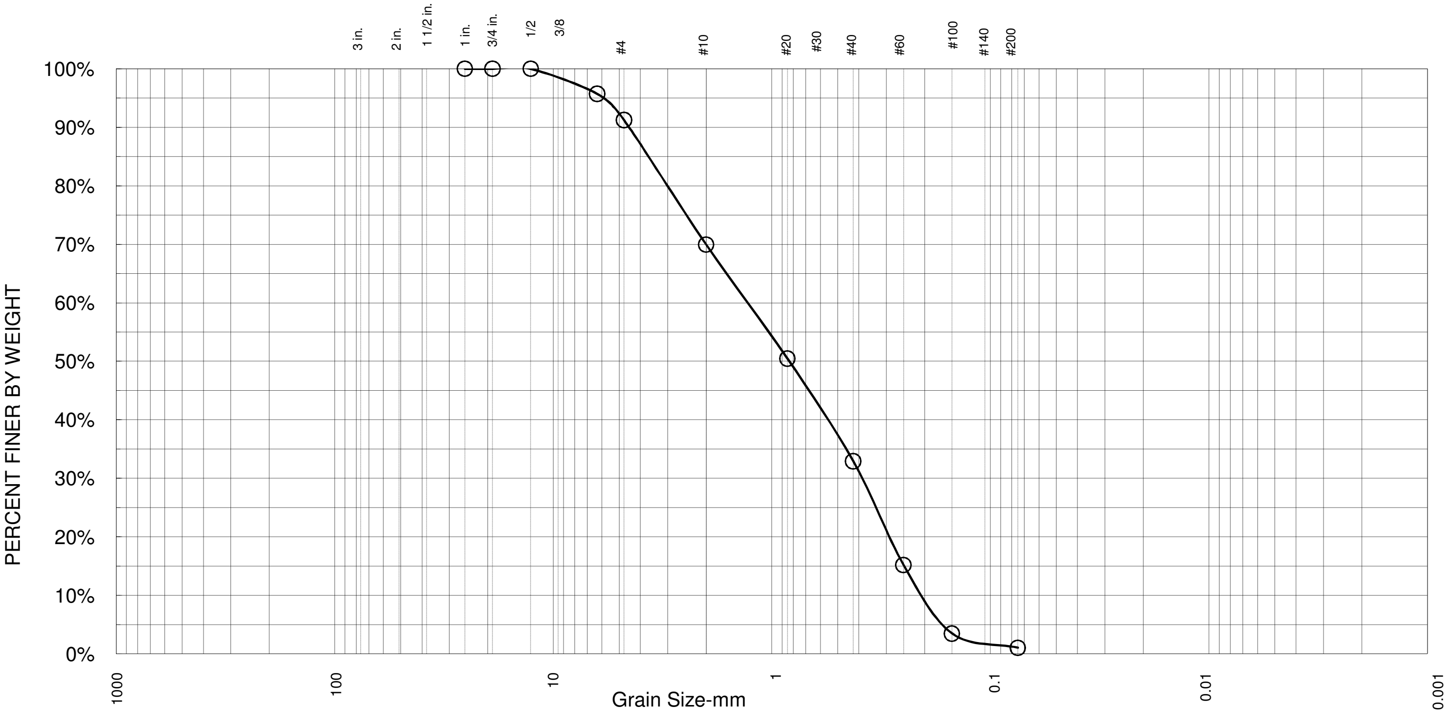
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	8.8%	21.3%	37.0%	31.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	95.7%		
4	91.2%		
10	69.9%		
20	50.5%		
40	32.9%		
60	15.2%		
100	3.5%		
200	1.0%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.70 D_{60}= 1.40 D_{50}= 0.55

D_{30}= 0.39 D_{15}= 0.25 D_{10}= 0.21

C_U= 6.67 C_C= 0.52

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-2C, SS-6 (23.5-25')
Area 1

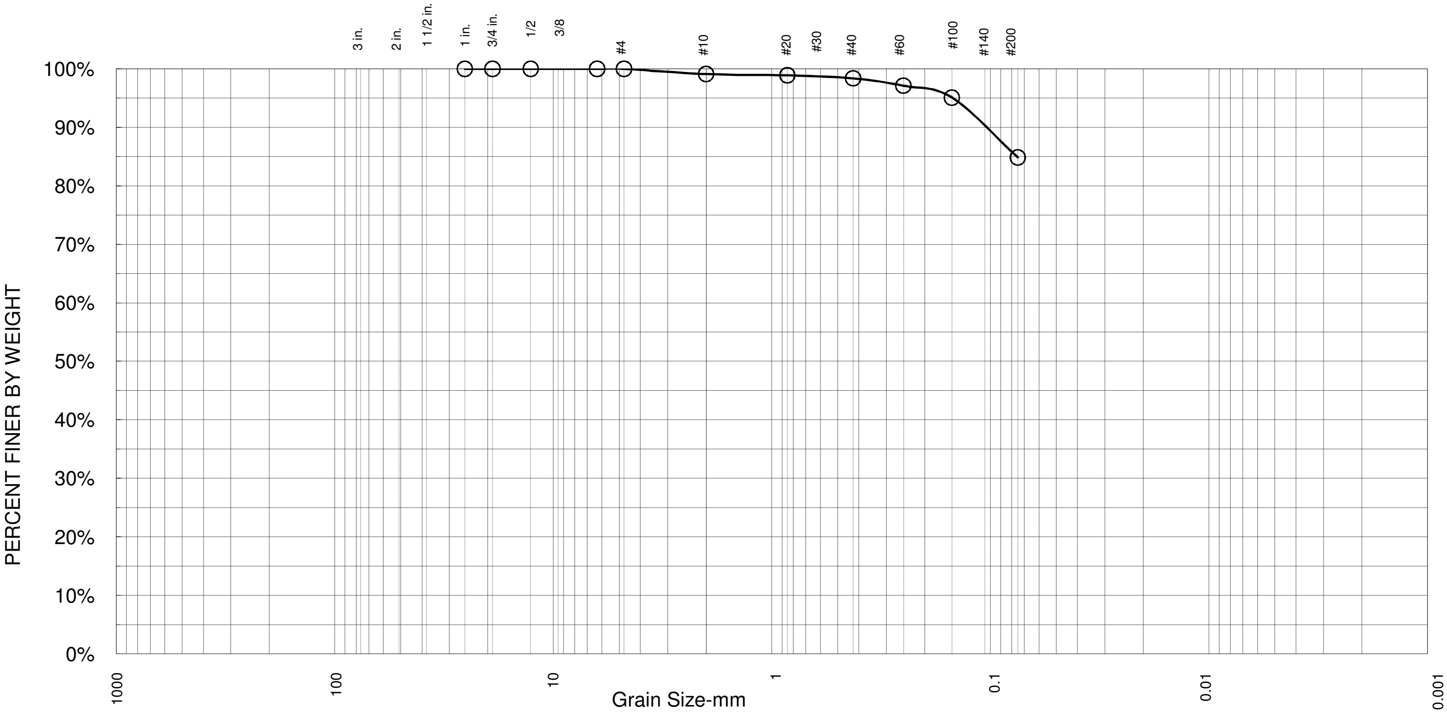
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.9%	0.7%	13.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.1%		
20	98.9%		
40	98.4%		
60	97.1%		
100	95.1%		
200	84.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.08 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay with sand (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-2A, G-3 (2-3.0')
Area 1

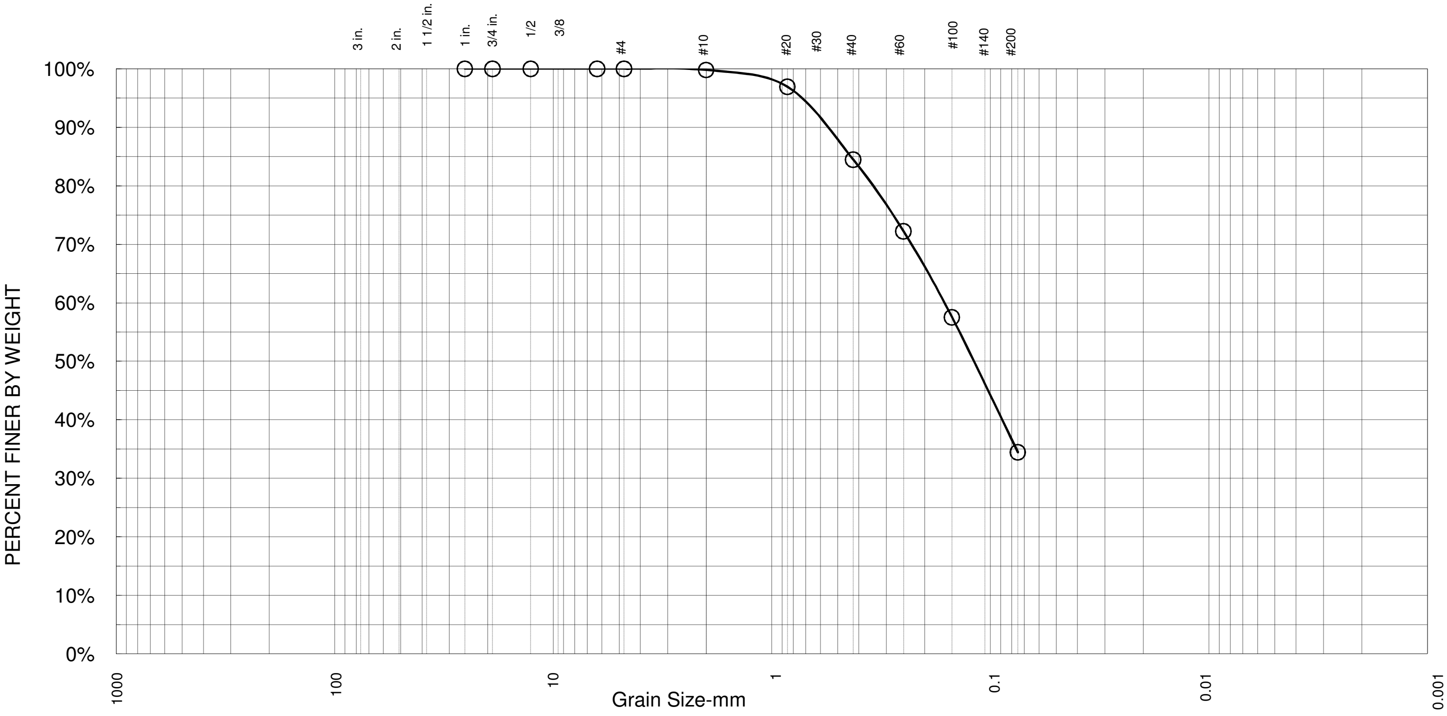
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.2%	15.3%	50.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.8%		
20	96.9%		
40	84.5%		
60	72.2%		
100	57.5%		
200	34.5%		

*-(no specification provided)

<ins>Soil Description</ins>

<ins>Atterberg Limits</ins>

PL=N/A LL=N/A PI=N/A

<ins>Coefficients</ins>

D_{85}= 0.42 D_{60}= 0.17 D_{50}= 0.13

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

<ins>Classification</ins>

USCS= Clayey sand (SC)

<ins>Remarks</ins>

N/A- Not Applicable

Sample ID.: B-3B, SS-1 (1-3.5')
Area 1

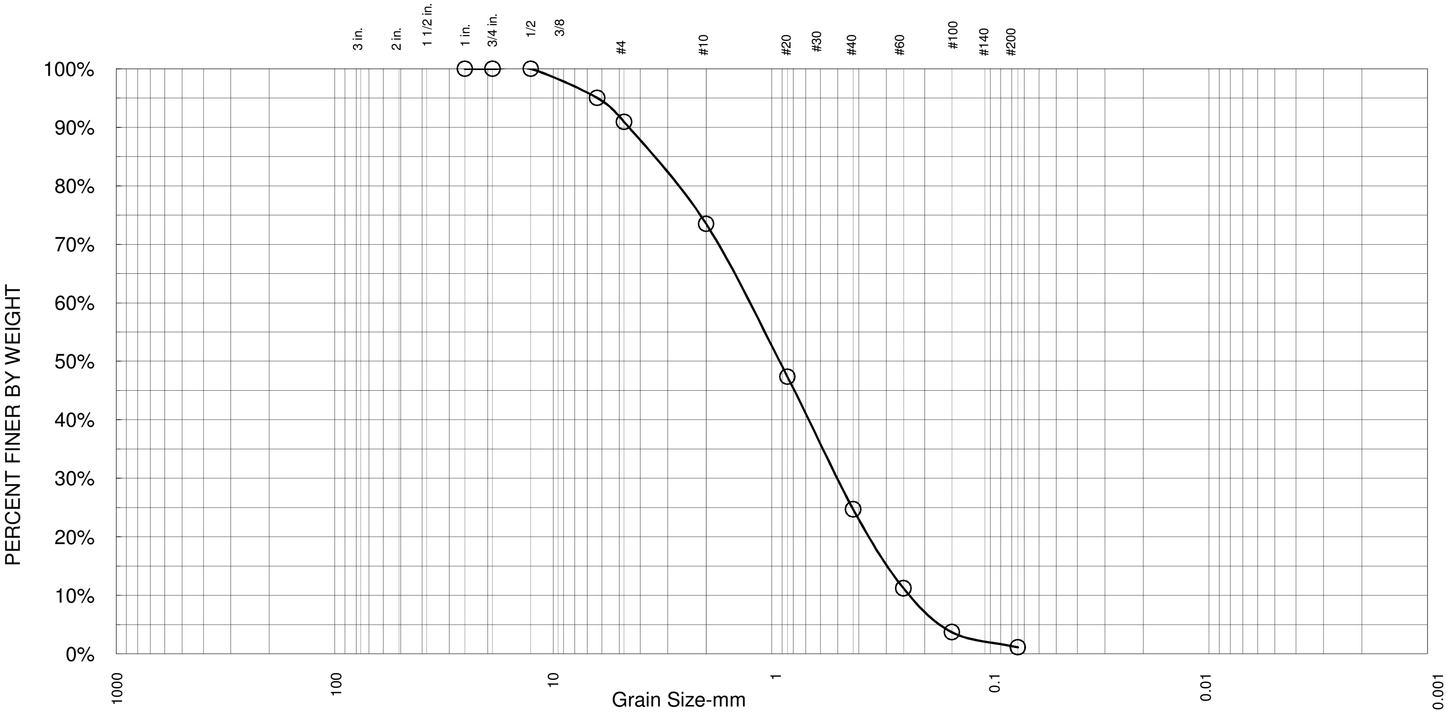
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	9.0%	17.4%	48.8%	23.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	95.0%		
4	91.0%		
10	73.5%		
20	47.4%		
40	24.7%		
60	11.2%		
100	3.7%		
200	1.1%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.50 D_{60}= 1.30 D_{50}= 0.91

D_{30}= 0.50 D_{15}= 0.30 D_{10}= 0.24

C_U= 5.42 C_C= 0.80

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-3B, SS-3 (8.5-10')
Area 1

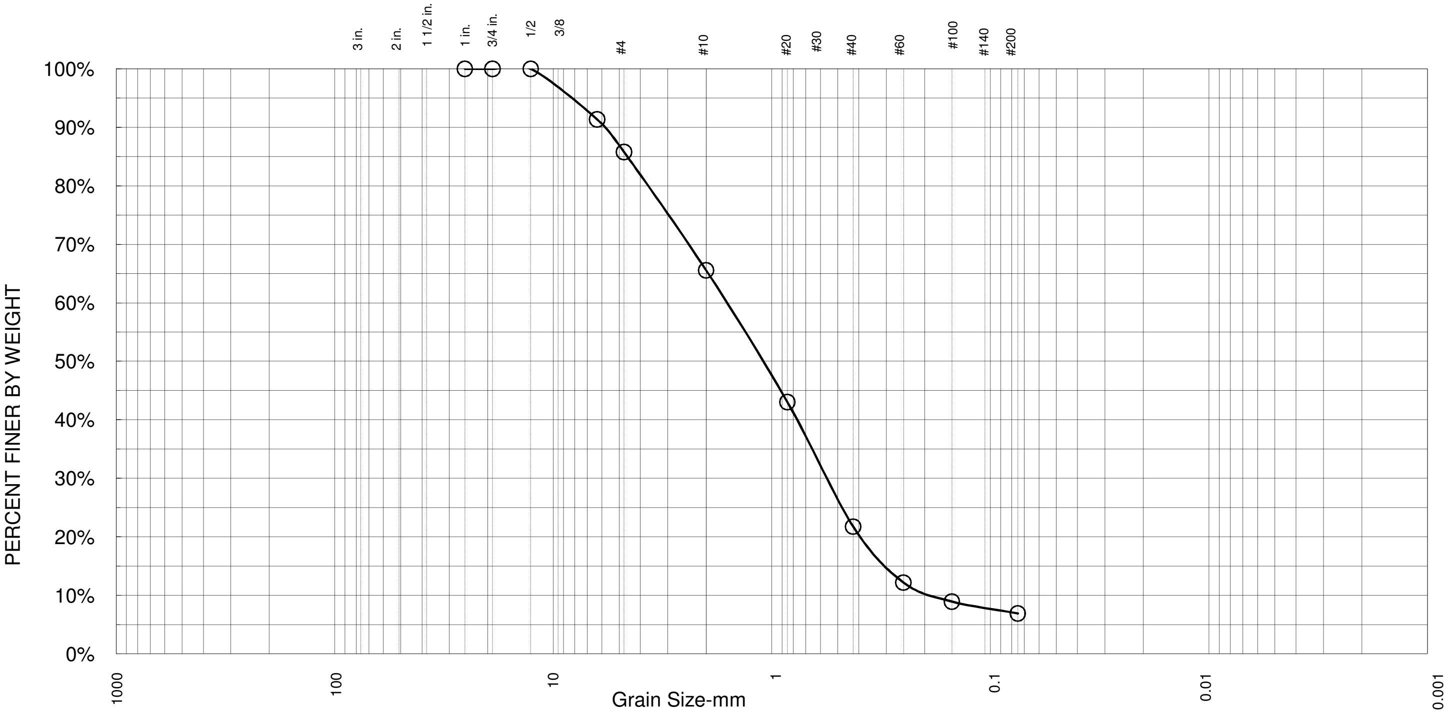
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	14.2%	20.2%	43.8%	14.8%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	91.3%		
4	85.8%		
10	65.5%		
20	43.0%		
40	21.7%		
60	12.2%		
100	8.9%		
200	6.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 4.60 D_{60}= 1.60 D_{50}= 1.20

D_{30}= 0.56 D_{15}= 0.30 D_{10}= 0.19

C_U= 8.42 C_C= 1.03

Classification

USCS= Well graded sand with clay (SW/SC)

Remarks

N/A- Not Applicable

Sample ID.: B-4C, SS-5 (18.5-20')
Area 1

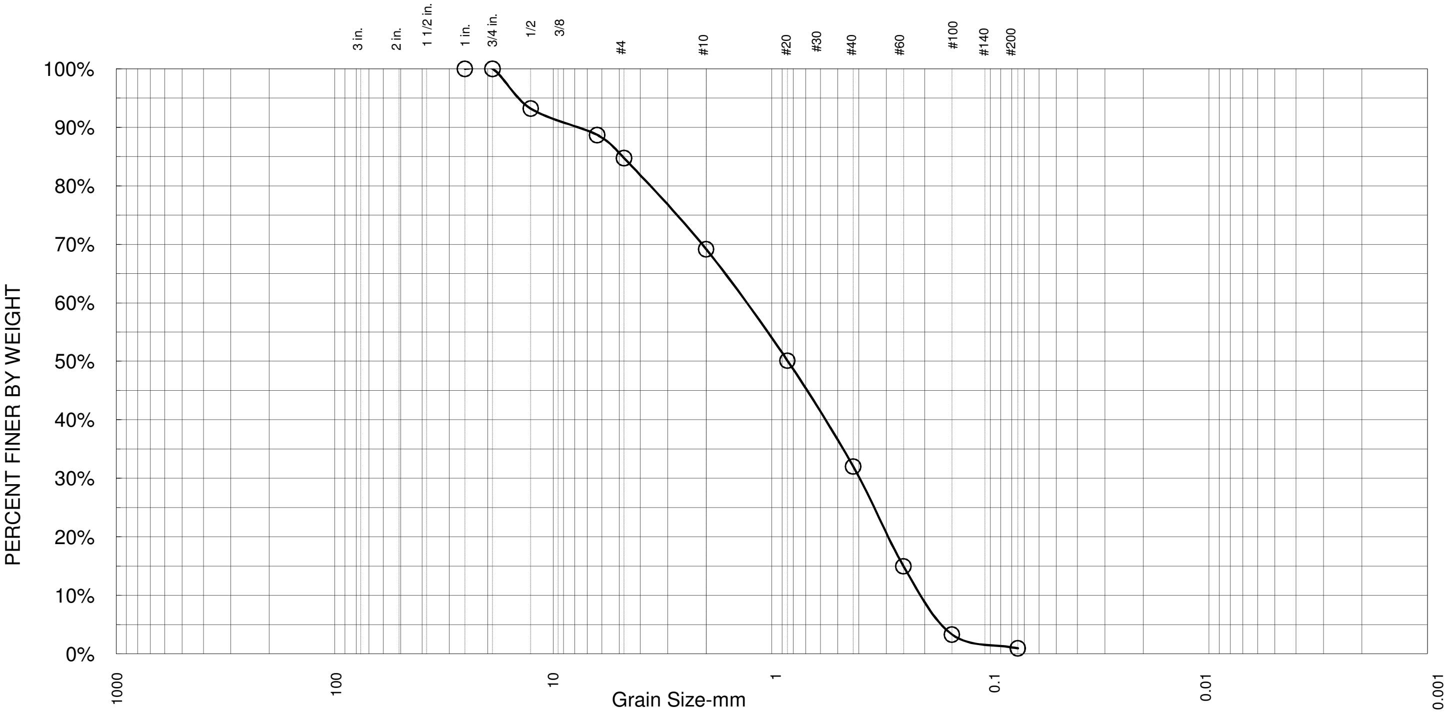
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	15.3%	15.6%	37.1%	31.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	93.2%		
1/4	88.7%		
4	84.7%		
10	69.2%		
20	50.1%		
40	32.0%		
60	15.0%		
100	3.3%		
200	0.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 4.90 D_{60}= 1.40 D_{50}= 0.85

D_{30}= 0.40 D_{15}= 0.25 D_{10}= 0.21

C_U= 6.67 C_C= 0.54

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-4C, SS-7 (28.5-30')
Area 1

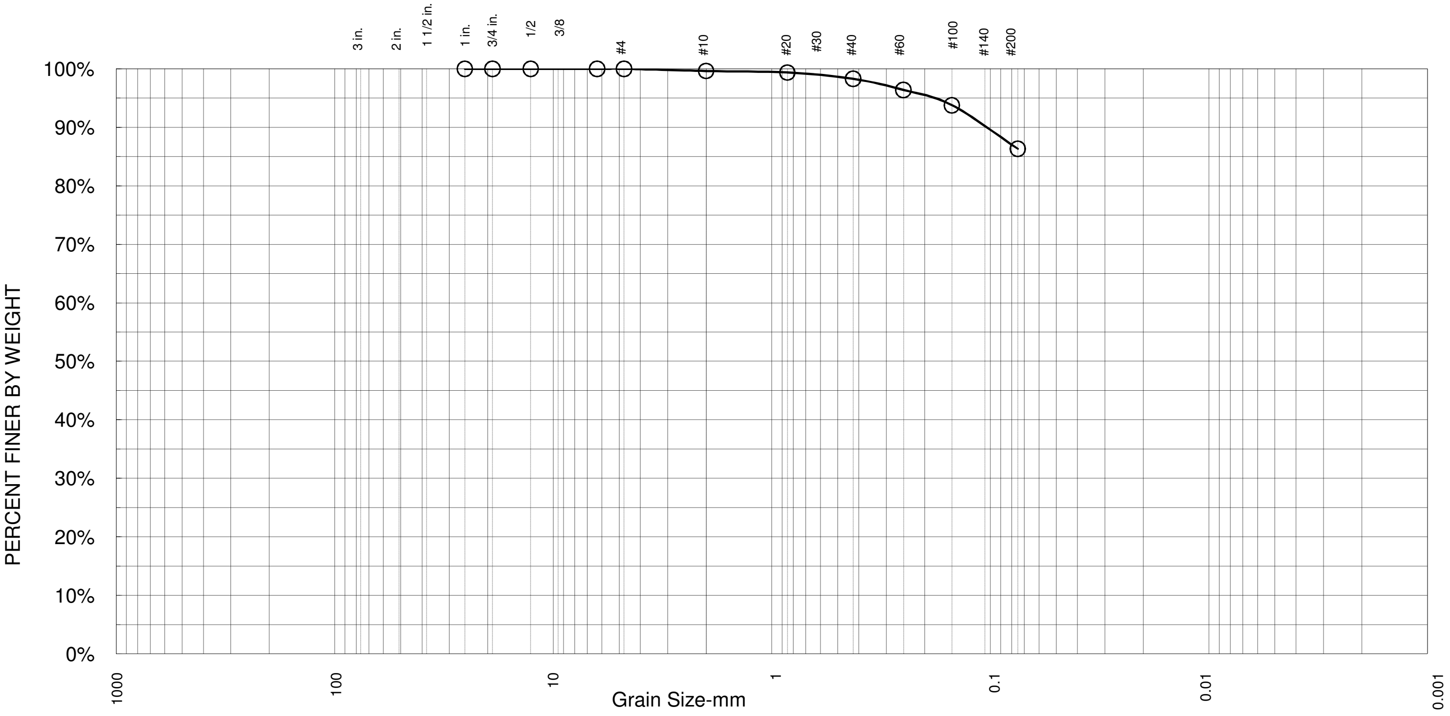
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.4%	1.3%	12.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.6%		
20	99.4%		
40	98.3%		
60	96.4%		
100	93.8%		
200	86.3%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-4B, G-1 (0-1.0')
Area 1

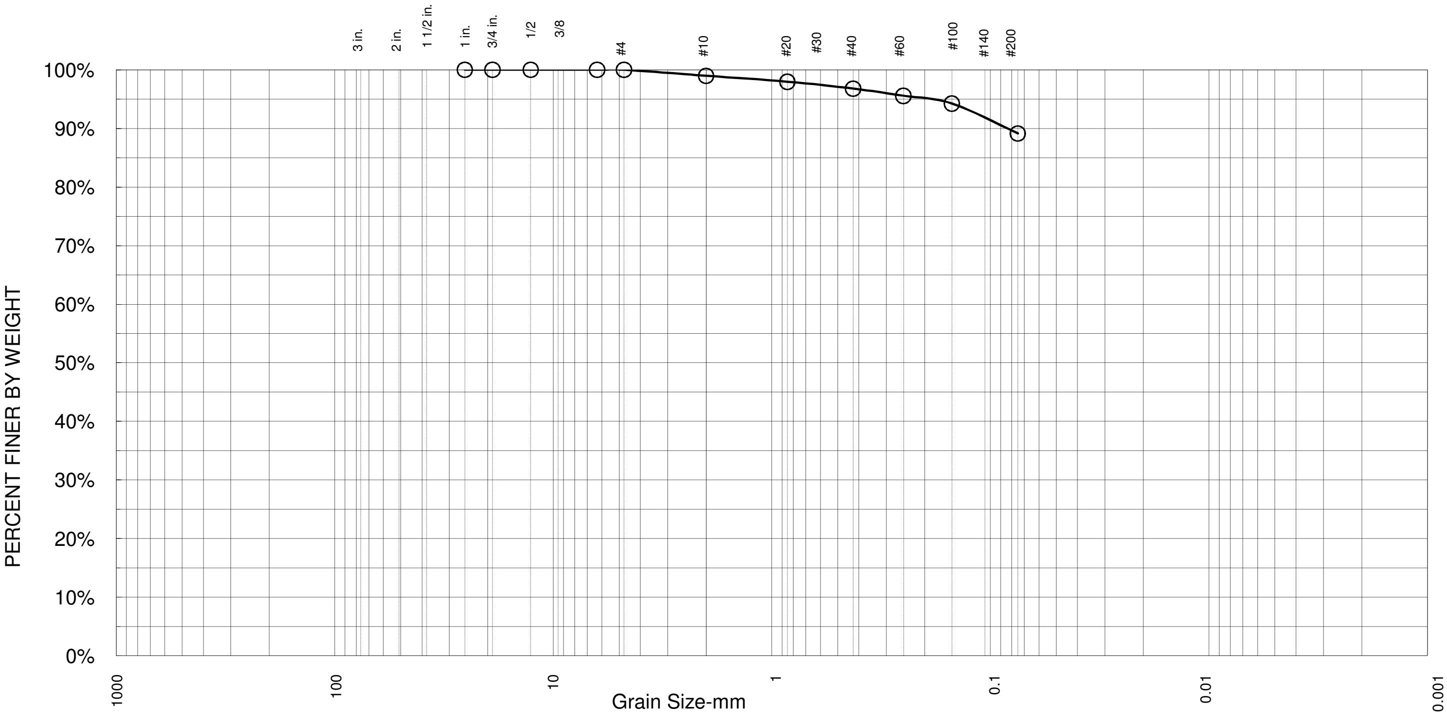
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	1.0%	2.2%	7.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.0%		
20	98.0%		
40	96.8%		
60	95.6%		
100	94.2%		
200	89.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-4B, G-2 (1.5-2.5')
Area 1

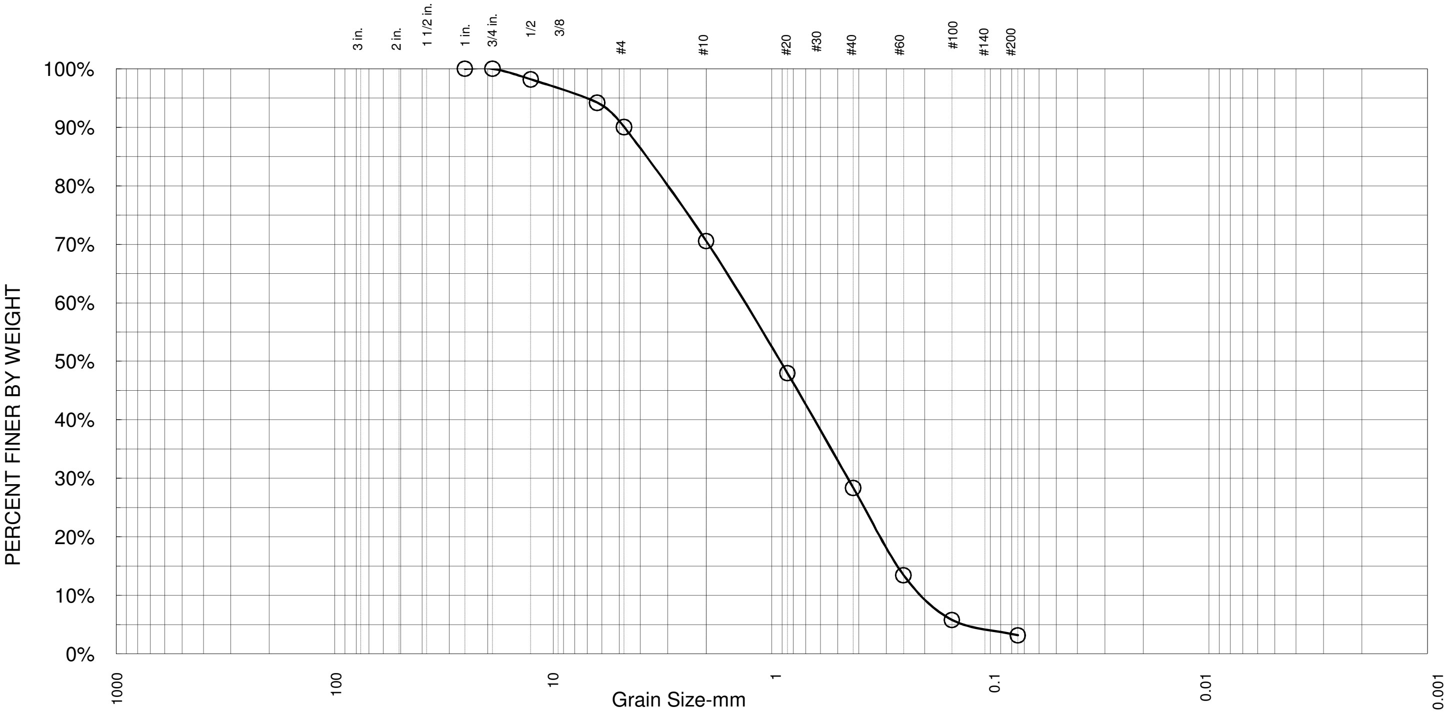
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	10.0%	19.5%	42.2%	25.2%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	98.2%		
1/4	94.2%		
4	90.0%		
10	70.6%		
20	48.0%		
40	28.4%		
60	13.4%		
100	5.8%		
200	3.2%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.80 D_{60}= 1.40 D_{50}= 0.90

D_{30}= 0.43 D_{15}= 0.27 D_{10}= 0.21

C_U= 6.67 C_C= 0.63

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-5C, SS-3 (8.5-10')
Area 1

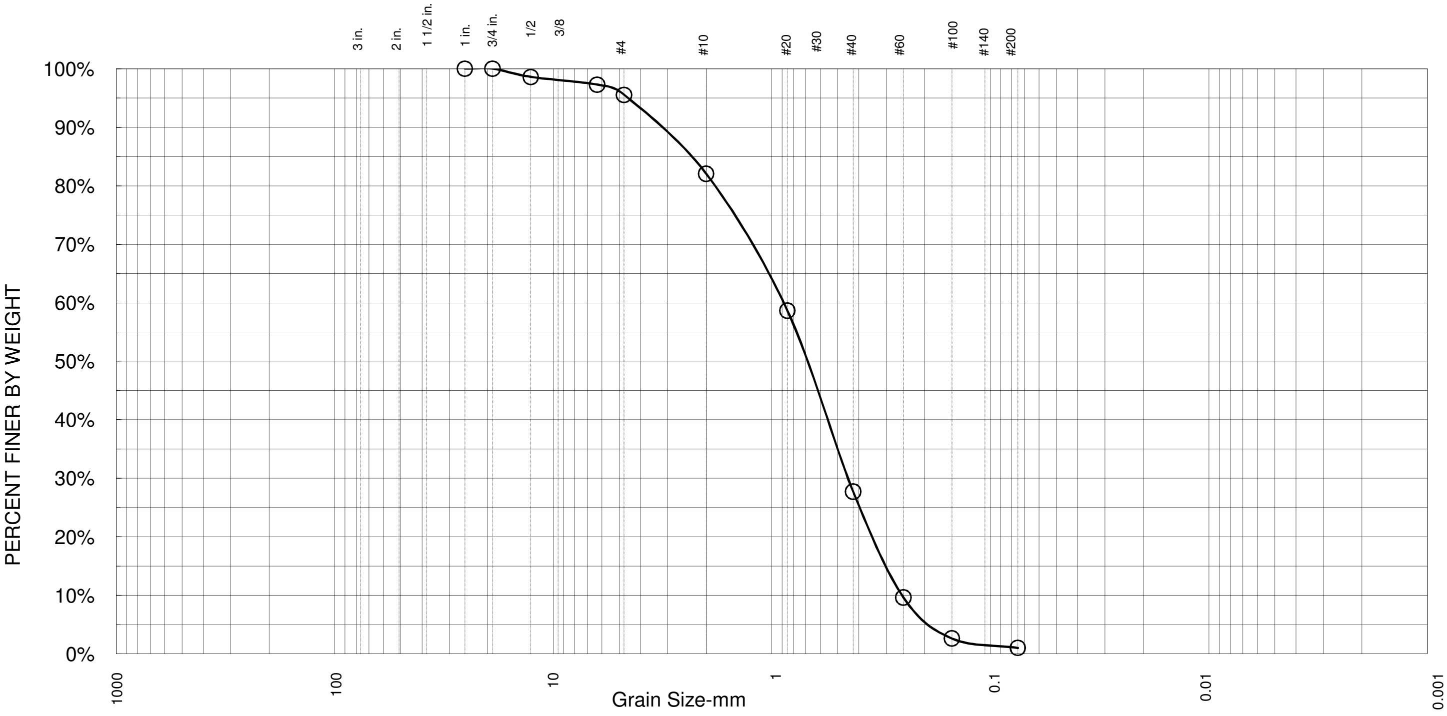
Date: 5/11/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	4.5%	13.5%	54.3%	26.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	98.6%		
1/4	97.3%		
4	95.5%		
10	82.0%		
20	58.7%		
40	27.7%		
60	9.6%		
100	2.6%		
200	1.0%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.30 D_{60}= 0.89 D_{50}= 0.69

D_{30}= 0.45 D_{15}= 0.30 D_{10}= 0.26

C_U= 3.42 C_C= 0.88

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-5C, SS-5 (18.5-20')
Area 1

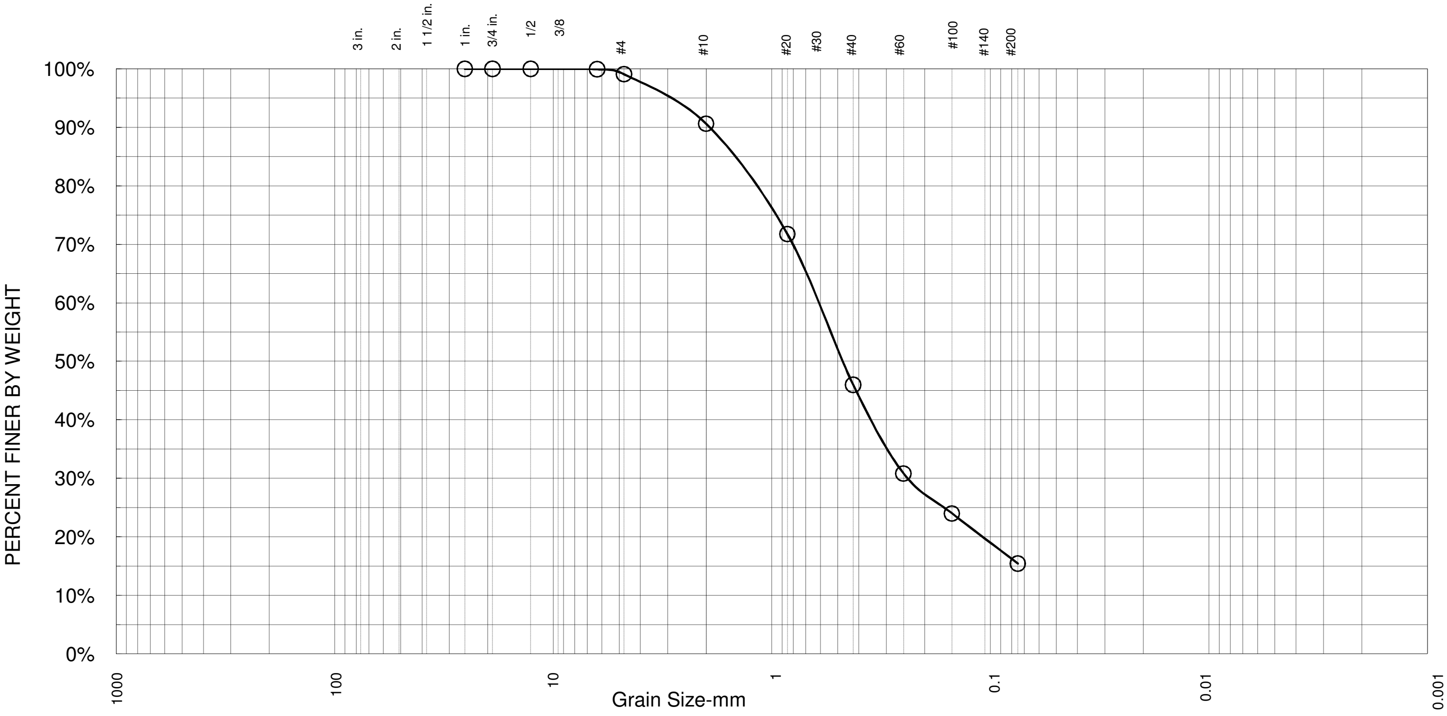
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.9%	8.4%	44.6%	30.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	99.9%		
4	99.1%		
10	90.6%		
20	71.8%		
40	46.0%		
60	30.8%		
100	24.0%		
200	15.4%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.60 D_{60}= 0.60 D_{50}= 0.48

D_{30}= 0.25 D_{15}= 0.08 D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

Sample ID.: B-6C, U-3 (8.5-10')
Area 1

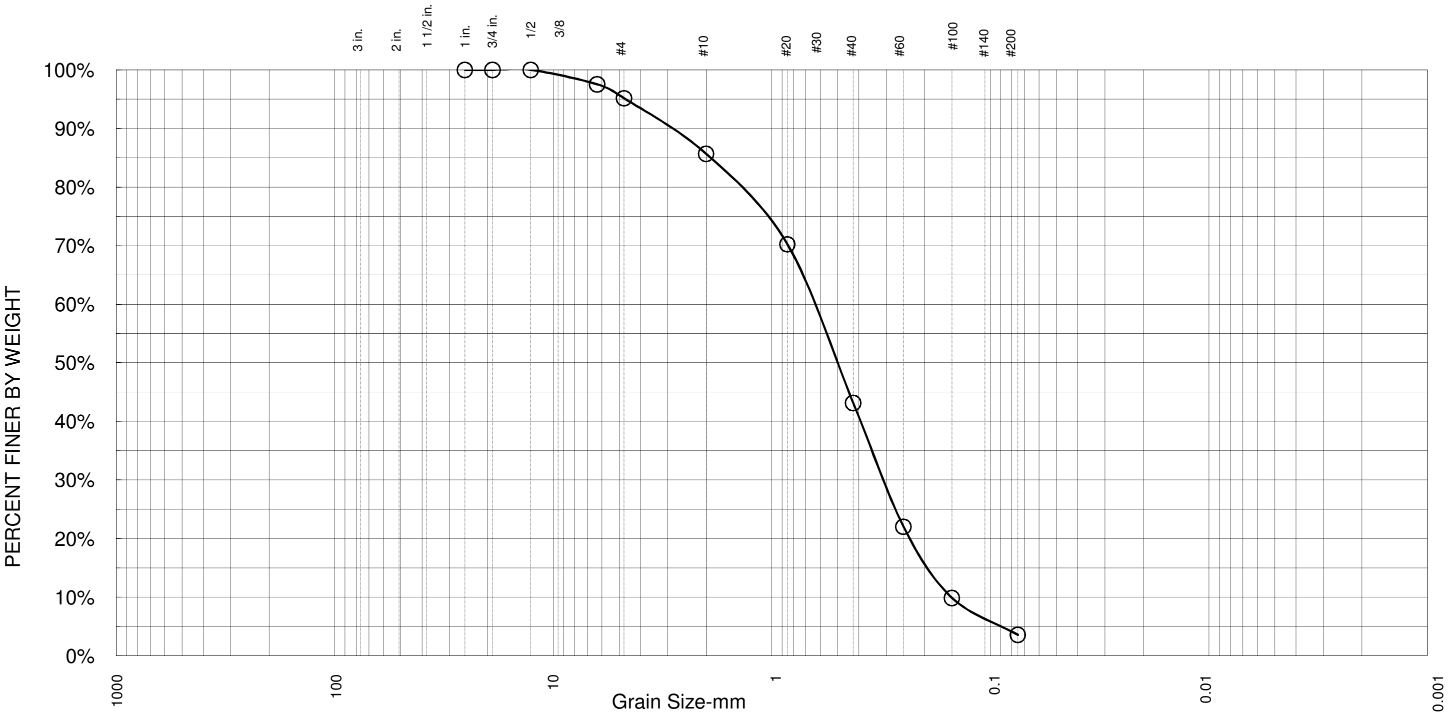
Date: 5/11/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	4.8%	9.5%	42.5%	39.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.5%		
4	95.2%		
10	85.7%		
20	70.2%		
40	43.2%		
60	22.0%		
100	9.9%		
200	3.6%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.90 D_{60}= 0.63 D_{50}= 0.50

D_{30}= 0.31 D_{15}= 0.20 D_{10}= 0.16

C_U= 3.94 C_C= 0.95

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-6C, SS-5 (18.5-20')
Area 1

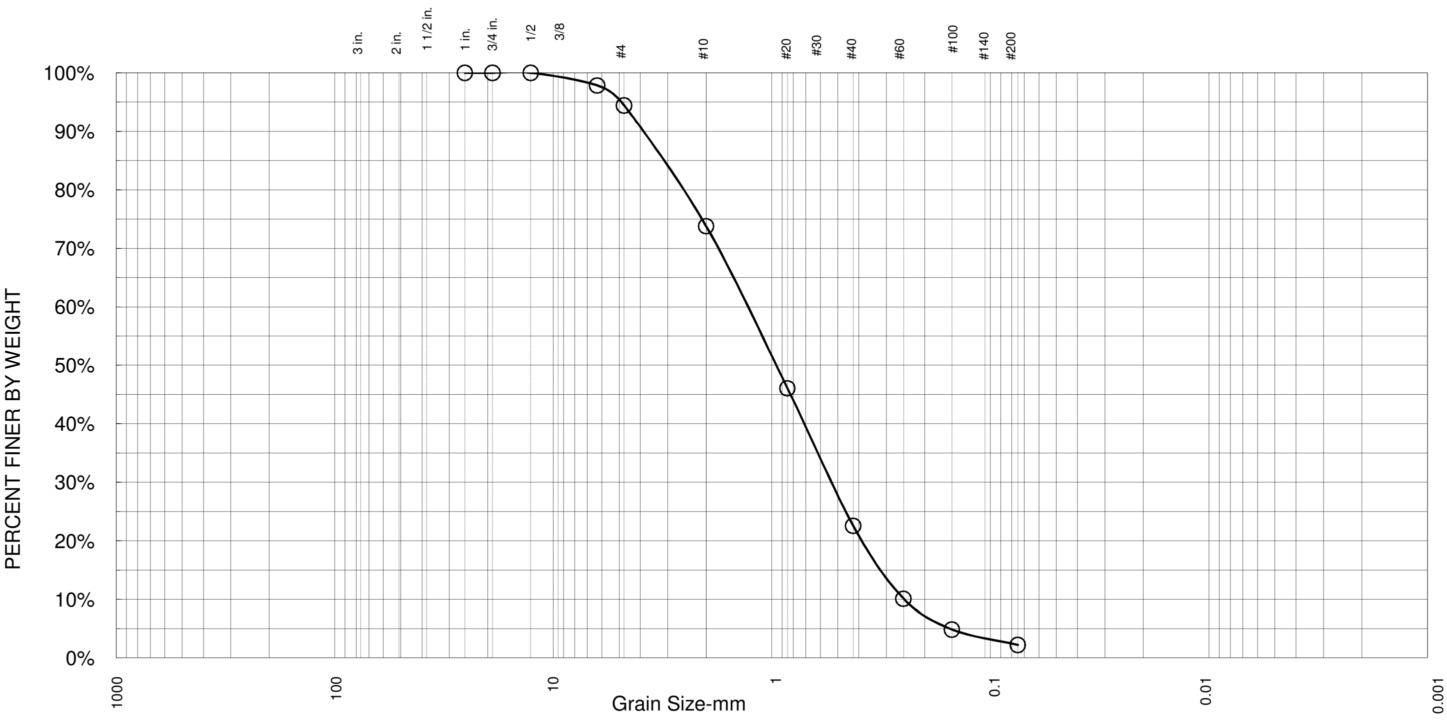
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	5.6%	20.6%	51.2%	20.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.8%		
4	94.4%		
10	73.8%		
20	46.1%		
40	22.6%		
60	10.1%		
100	4.8%		
200	2.2%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.10 D_{60}= 1.30 D_{50}= 0.98

D_{30}= 0.52 D_{15}= 0.31 D_{10}= 0.25

C_U= 5.20 C_C= 0.83

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-7C, SS-4 (13.5-15')
Area 1

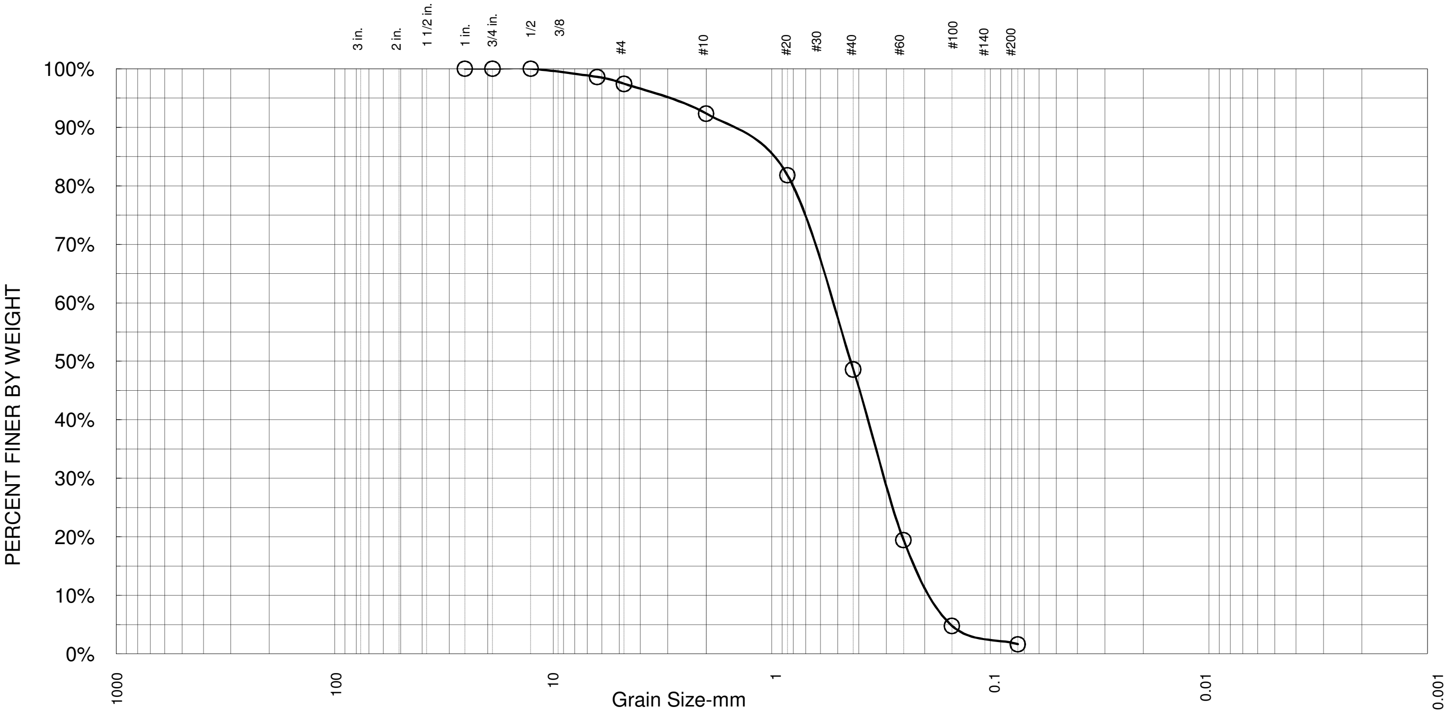
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	2.6%	5.1%	43.7%	47.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	98.6%		
4	97.4%		
10	92.3%		
20	81.8%		
40	48.6%		
60	19.4%		
100	4.8%		
200	1.6%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.00 D_{60}= 0.52 D_{50}= 0.43

D_{30}= 0.30 D_{15}= 0.23 D_{10}= 0.19

C_U= 2.74 C_C= 0.91

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-7C, SS-7 (28.5-30')
Area 1

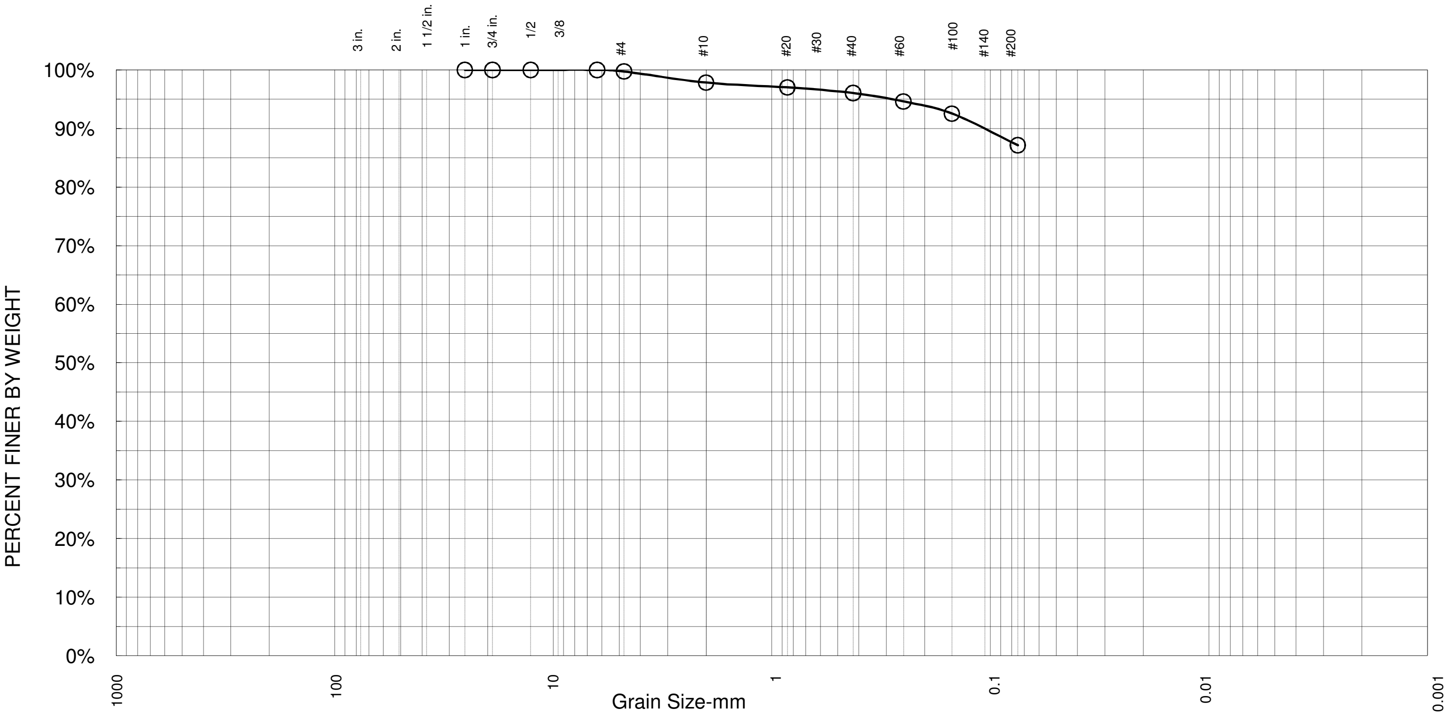
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.3%	1.9%	1.8%	8.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.7%		
10	97.8%		
20	97.0%		
40	96.1%		
60	94.6%		
100	92.5%		
200	87.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-7A, G-4 (6-7.5')
Area 1

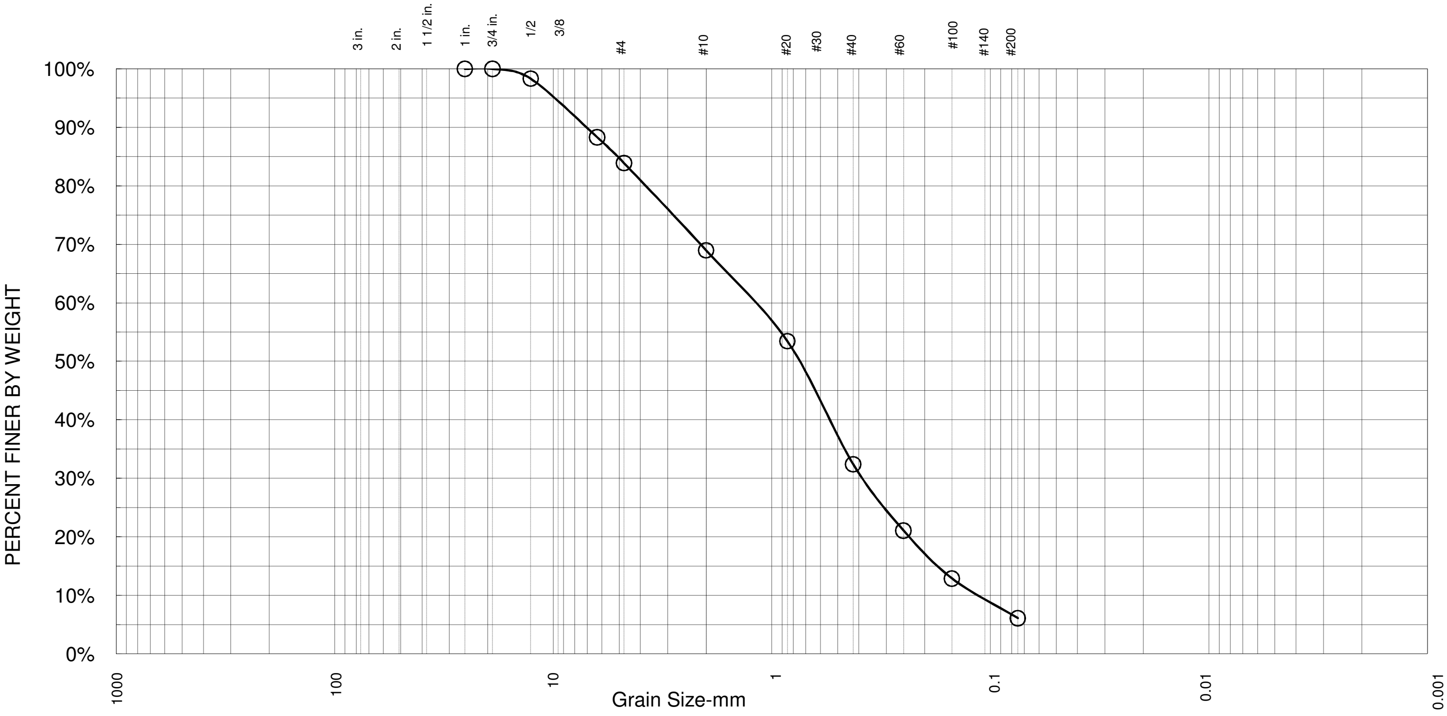
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	16.1%	14.9%	36.5%	26.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	98.3%		
1/4	88.3%		
4	83.9%		
10	69.0%		
20	53.4%		
40	32.4%		
60	21.1%		
100	12.9%		
200	6.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 5.00 D_{60}= 1.20 D_{50}= 0.74

D_{30}= 0.39 D_{15}= 0.18 D_{10}= 0.12

C_U= 10.00 C_C= 1.06

Classification

USCS= Well graded sand with clay and gravel (SW/SC)

Remarks

N/A- Not Applicable

Sample ID.: B-8B, SS-3 (8.5-10')
Area 1

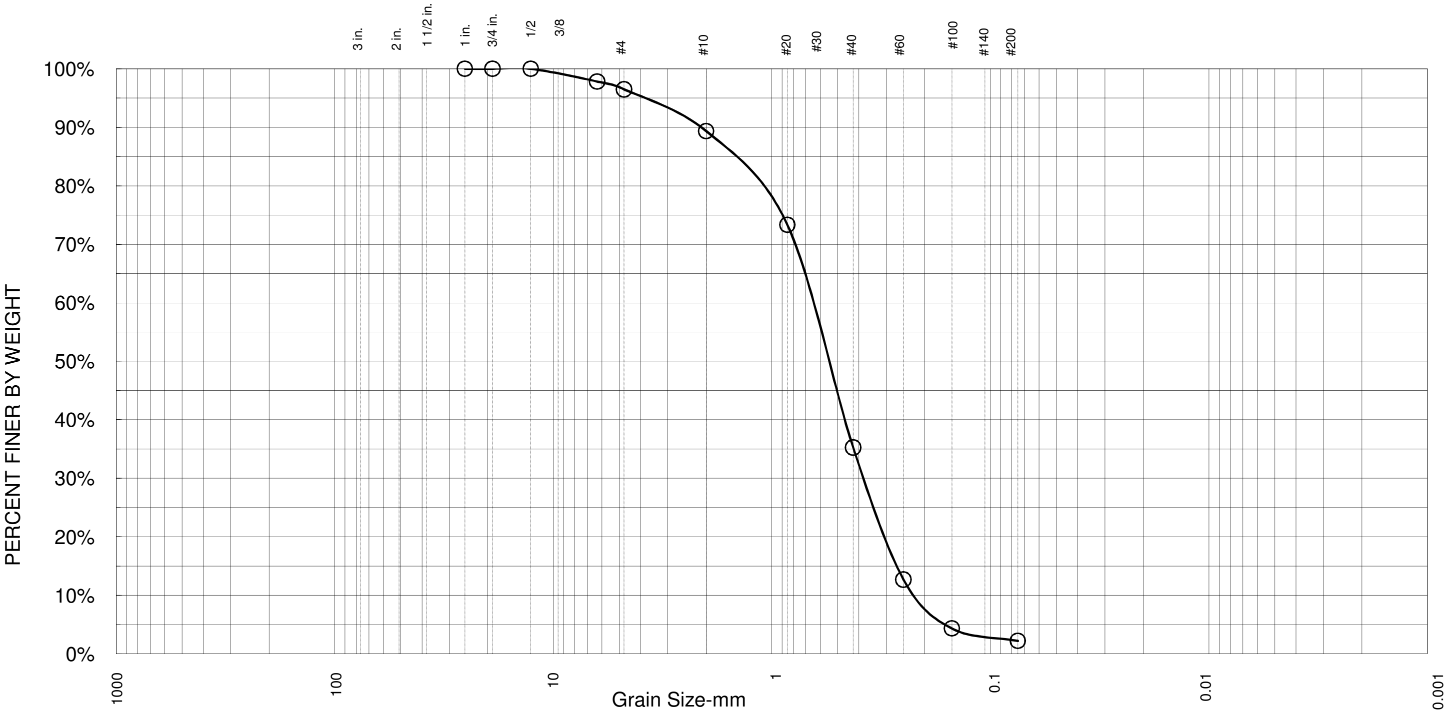
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	3.5%	7.1%	54.1%	33.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.8%		
4	96.5%		
10	89.4%		
20	73.3%		
40	35.2%		
60	12.7%		
100	4.3%		
200	2.2%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.60 D_{60}= 0.65 D_{50}= 0.55

D_{30}= 0.39 D_{15}= 0.27 D_{10}= 0.22

C_U= 2.95 C_C= 1.06

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-8B, SS-6 (23.5-25')
Area 1

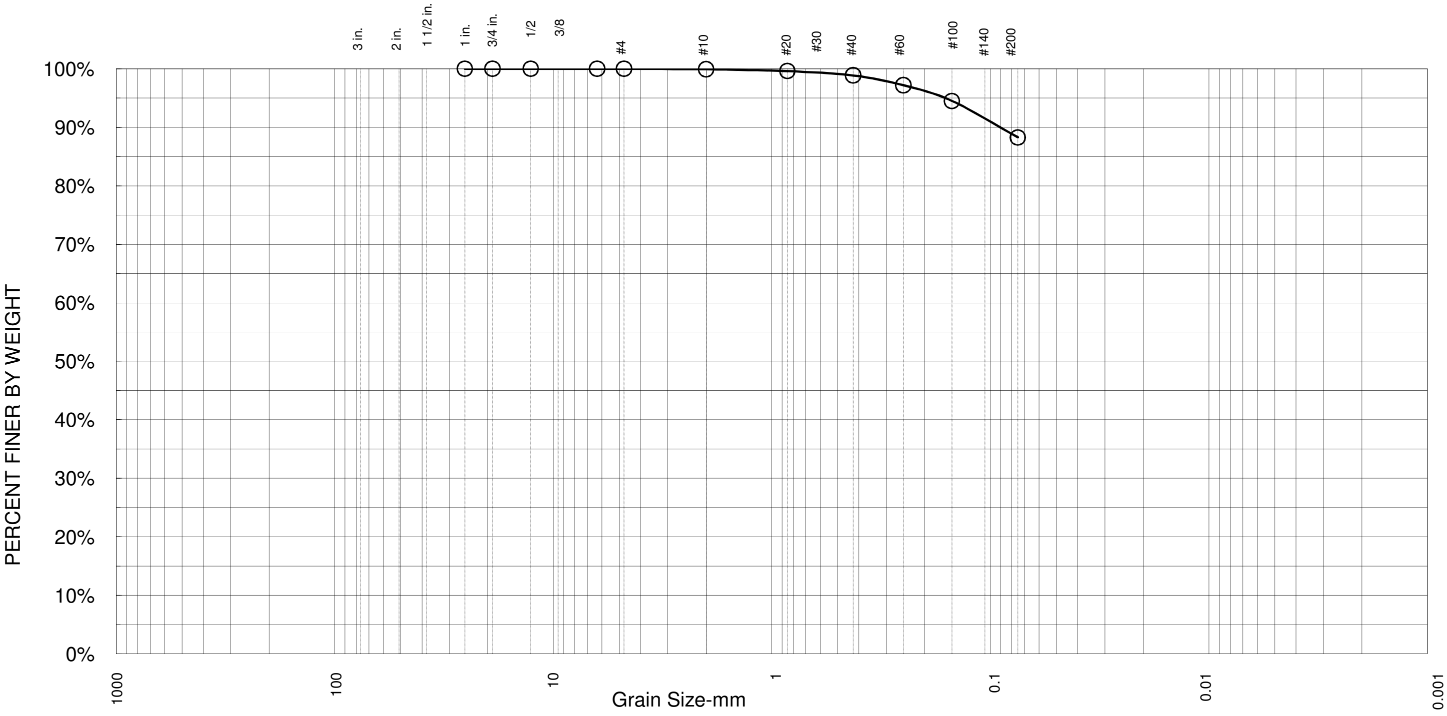
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.1%	1.0%	10.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.9%		
20	99.6%		
40	98.9%		
60	97.2%		
100	94.5%		
200	88.3%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= NA C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-8A, G-3 (2-3.0')
Area 1

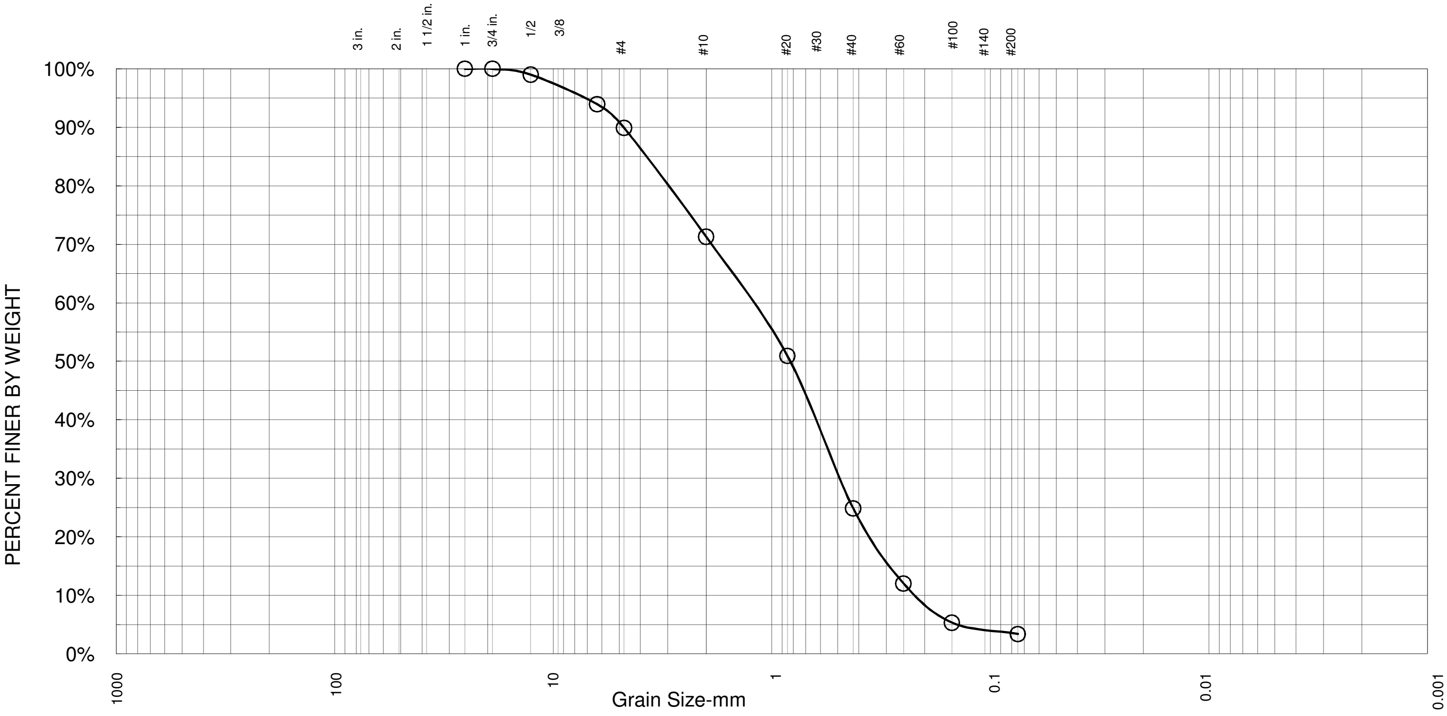
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	10.1%	18.6%	46.4%	21.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	99.0%		
1/4	93.9%		
4	89.9%		
10	71.3%		
20	50.9%		
40	24.9%		
60	12.0%		
100	5.3%		
200	3.4%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.90 D_{60}= 1.30 D_{50}= 0.82

D_{30}= 0.49 D_{15}= 0.29 D_{10}= 0.22

C_U= 5.91 C_C= 0.84

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-10C, SS-5 (18.5-20')
Area 1

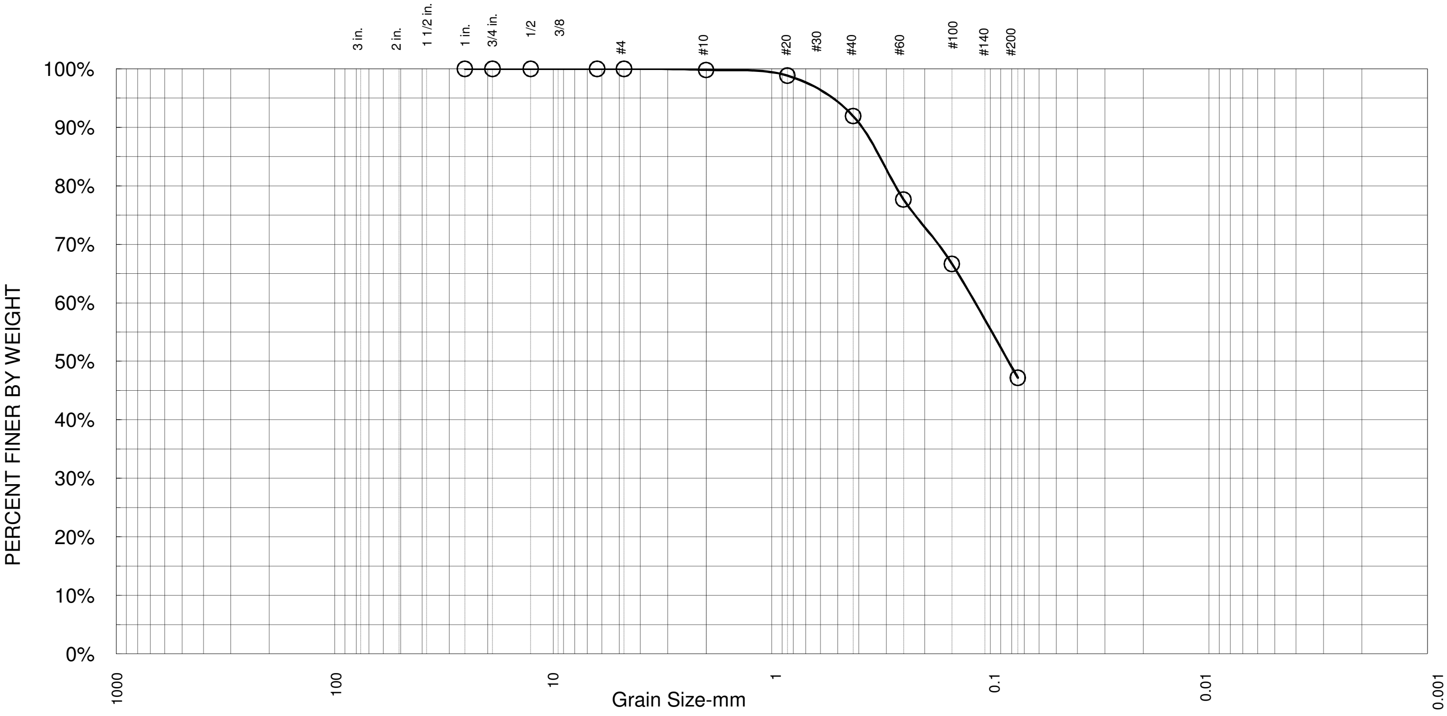
Date: 5/11/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.2%	7.9%	44.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.8%		
20	98.8%		
40	91.9%		
60	77.7%		
100	66.6%		
200	47.2%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.32 D_{60}= 0.13 D_{50}= 0.08

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-11C, SS-3 (8.5-10')
Area 1

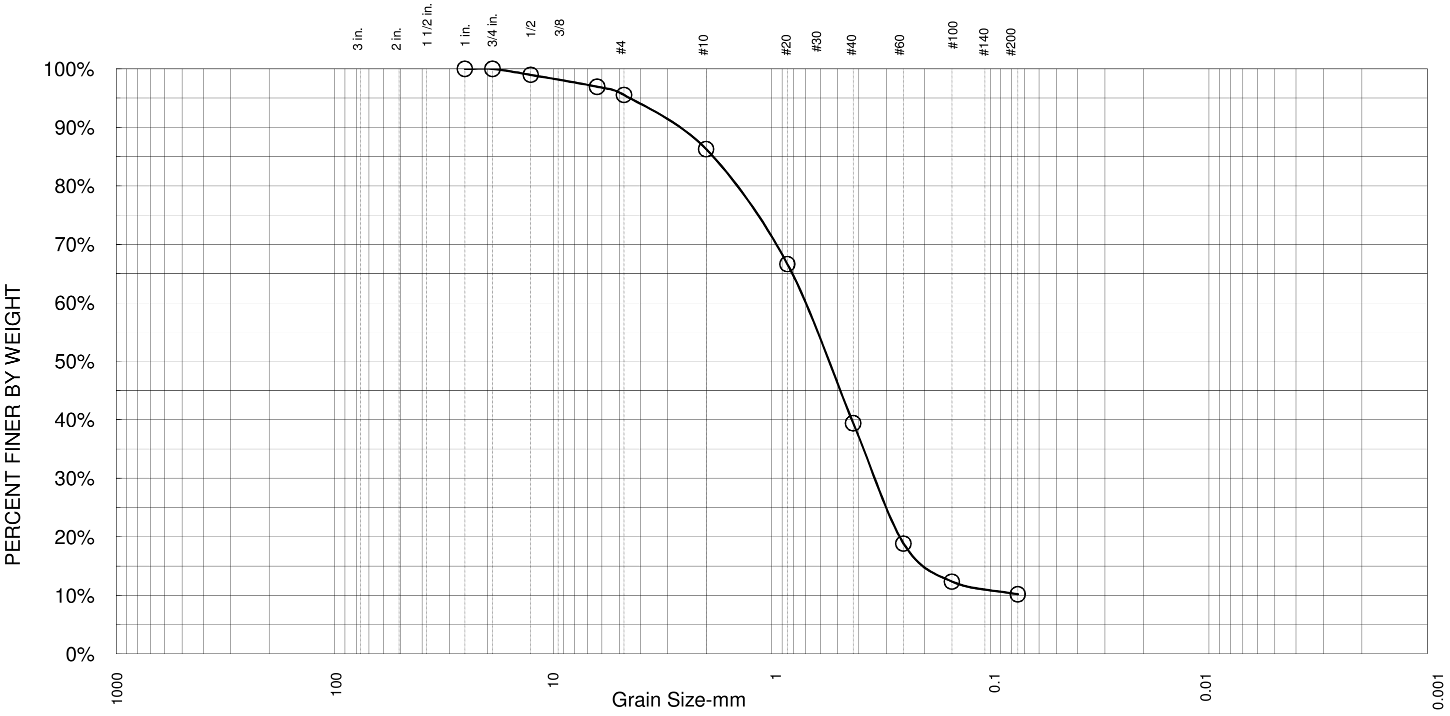
Date: 6/6/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	4.5%	9.3%	46.8%	29.2%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	99.0%		
1/4	96.9%		
4	95.5%		
10	86.3%		
20	66.6%		
40	39.4%		
60	18.9%		
100	12.4%		
200	10.2%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.90 D_{60}= 0.70 D_{50}= 0.55

D_{30}= 0.34 D_{15}= 0.20 D_{10}= 0.08

C_U= 8.75 C_C= 2.06

Classification

USCS= Well graded sand with clay (SW/SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-11C, SS-6 (23.5-25')
Area 1

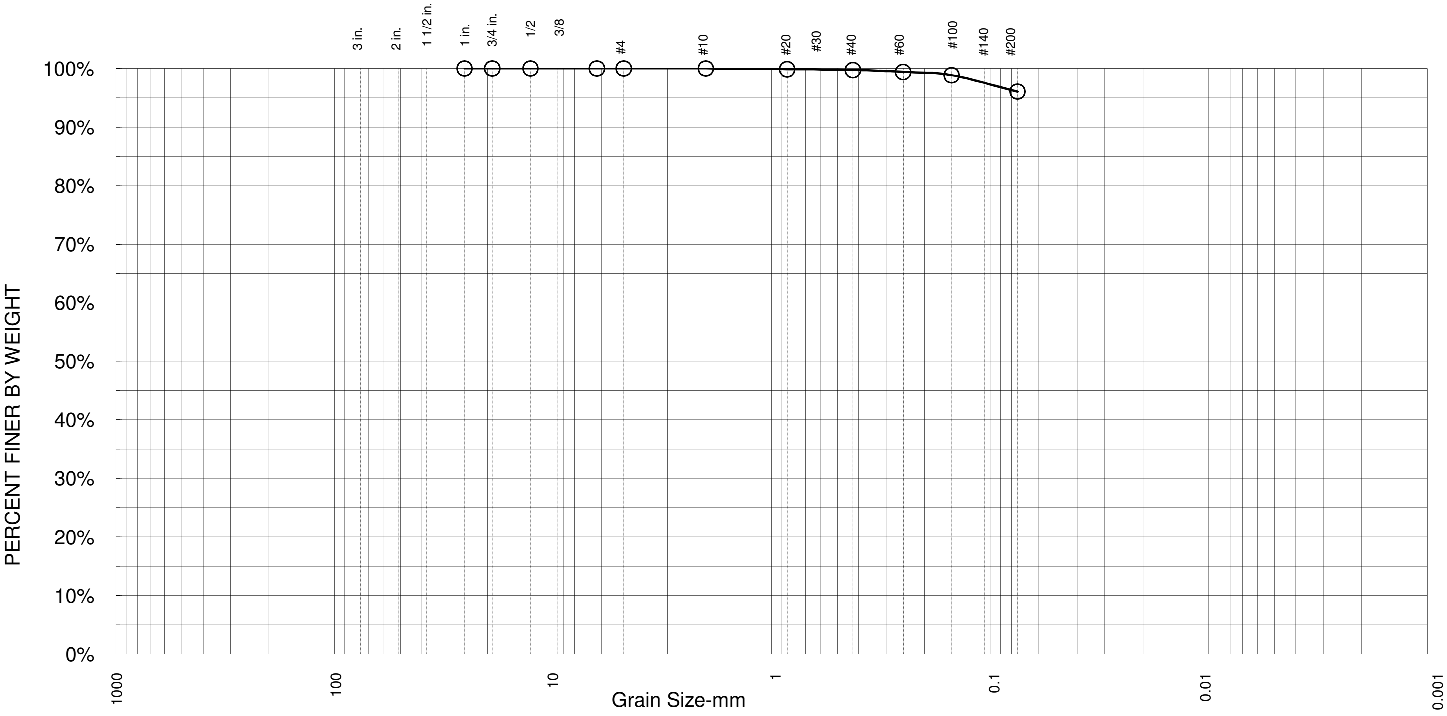
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.3%	3.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.9%		
40	99.7%		
60	99.4%		
100	98.9%		
200	96.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-11A, G-2 (1-2')
Area 1

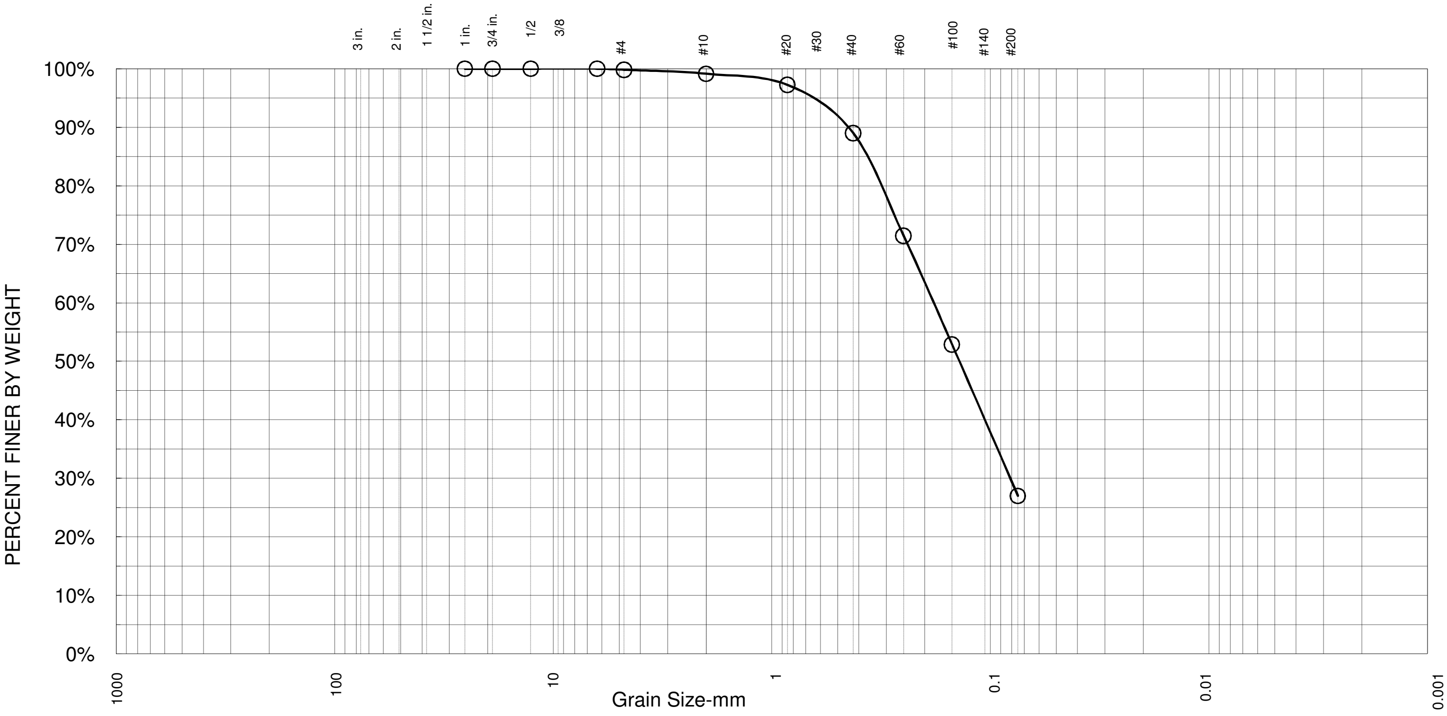
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.2%	0.7%	10.1%	62.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.8%		
10	99.1%		
20	97.2%		
40	89.0%		
60	71.5%		
100	52.9%		
200	27.0%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.37 D_{60}= 0.18 D_{50}= 0.14

D_{30}= 0.08 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

Sample ID.: B-13, U-2 (3.5-5')
Area 1

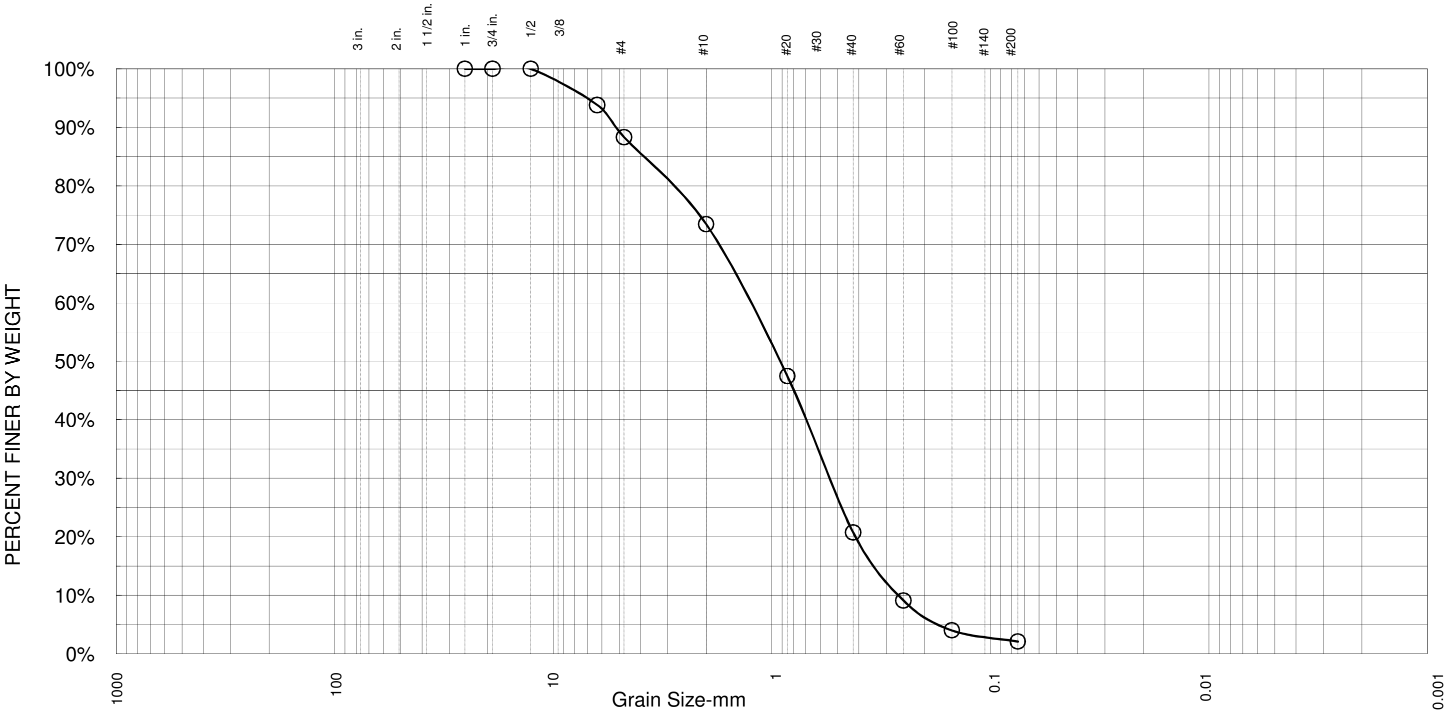
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	11.7%	14.9%	52.7%	18.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	93.8%		
4	88.3%		
10	73.4%		
20	47.5%		
40	20.7%		
60	9.1%		
100	4.0%		
200	2.1%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.80 D_{60}= 1.30 D_{50}= 0.92

D_{30}= 0.56 D_{15}= 0.35 D_{10}= 0.27

C_U= 4.81 C_C= 0.89

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-13, G-3 (6.5-8.5')
Area 1

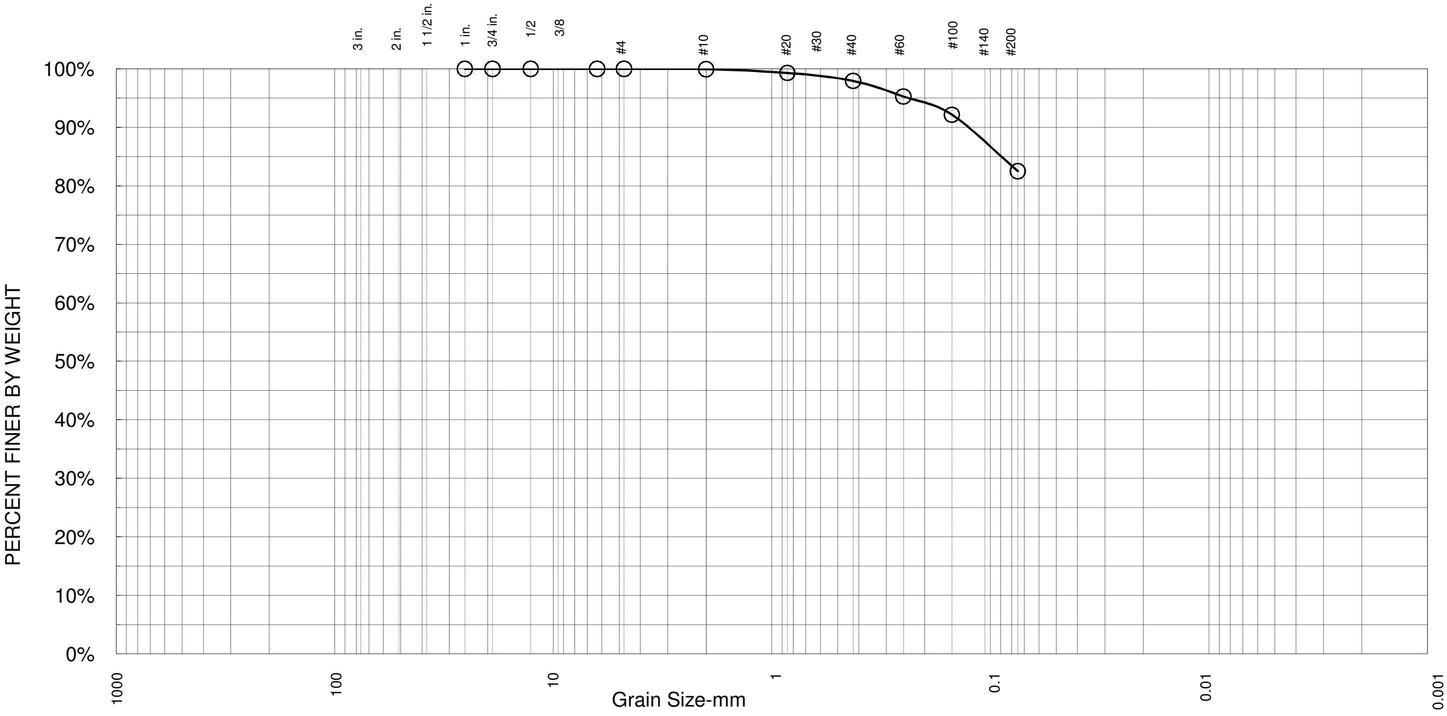
Date: 6/10/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.1%	2.0%	15.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.9%		
20	99.3%		
40	97.9%		
60	95.3%		
100	92.1%		
200	82.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.09 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay with sand (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-13, G-2 (1-3.0')
Area 1

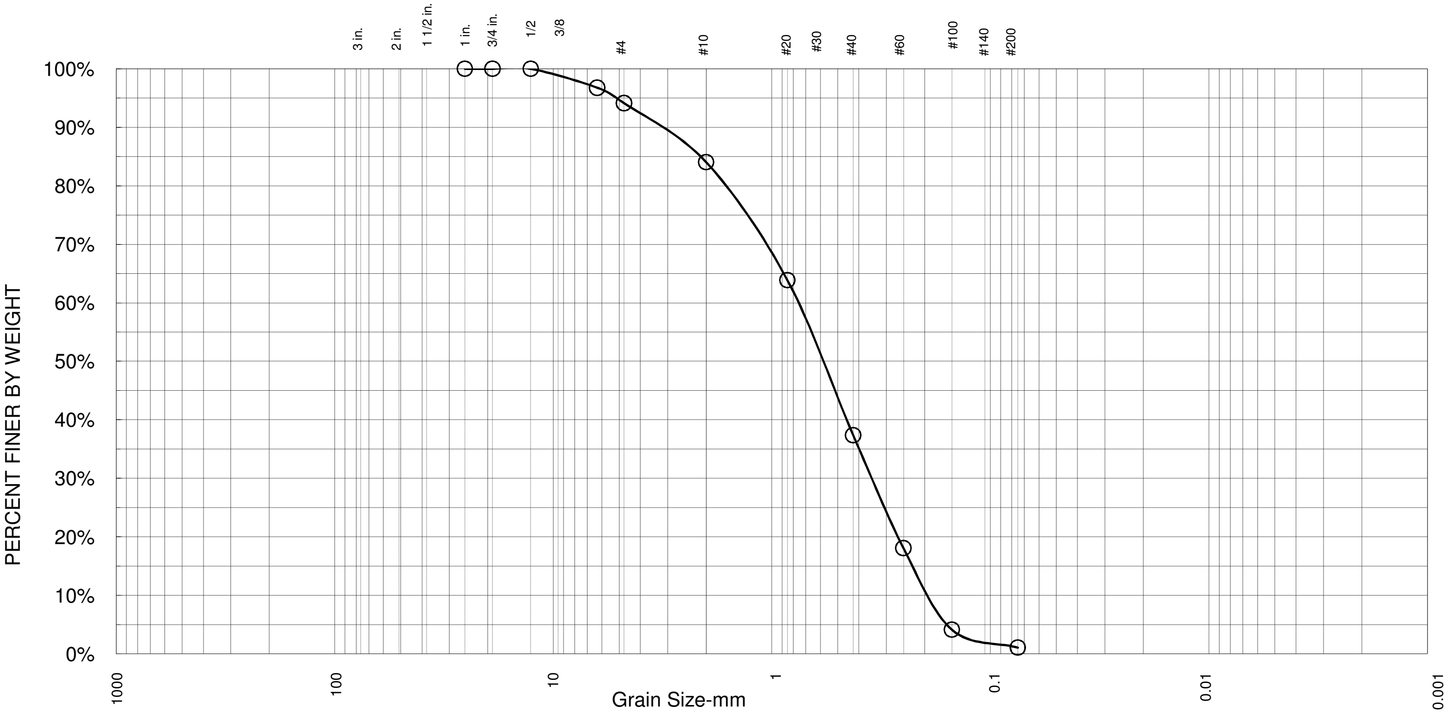
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study- Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	5.9%	10.1%	46.7%	36.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	96.8%		
4	94.1%		
10	84.1%		
20	63.9%		
40	37.4%		
60	18.1%		
100	4.1%		
200	1.1%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.10 D_{60}= 0.76 D_{50}= 0.59

D_{30}= 0.36 D_{15}= 0.23 D_{10}= 0.20

C_U= 3.80 C_C= 0.85

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-15, SS-3 (8.5-10')
Area 1

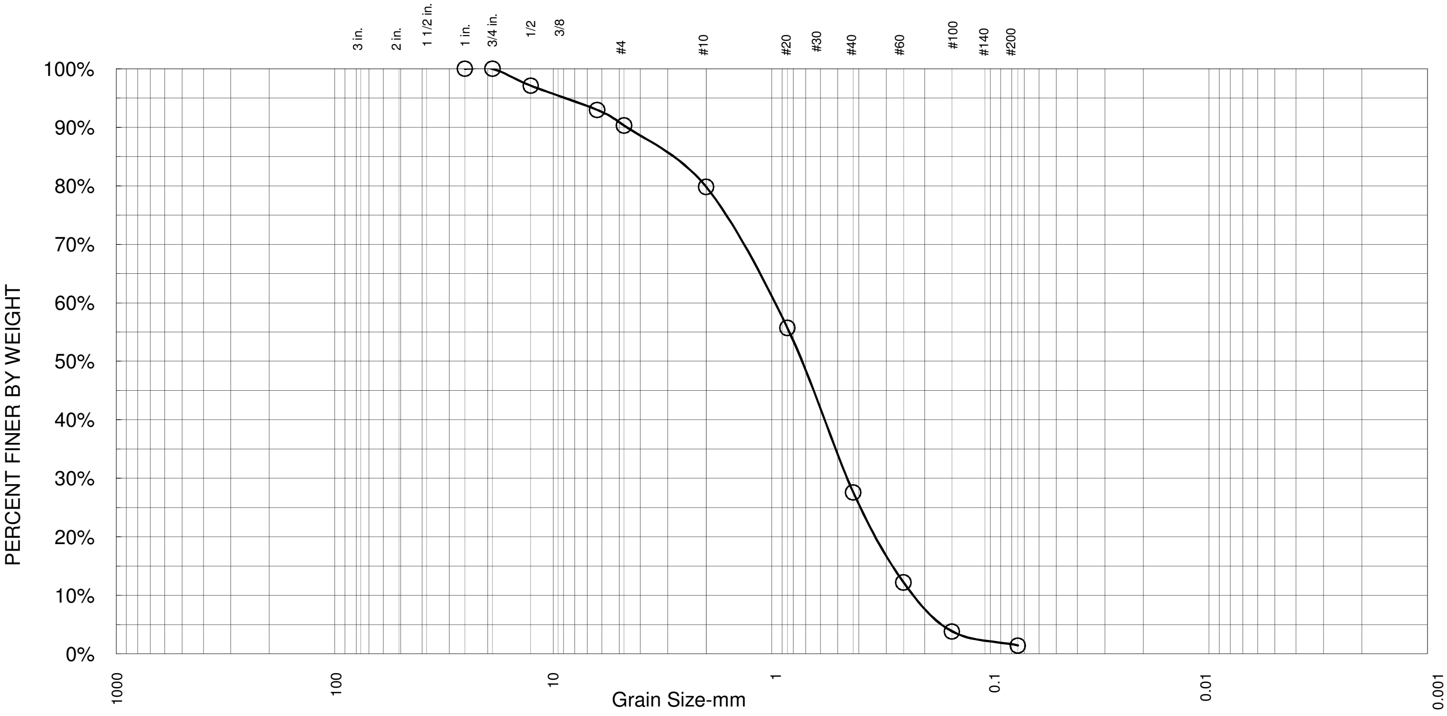
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	9.7%	10.5%	52.2%	26.2%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	97.1%		
1/4	93.0%		
4	90.3%		
10	79.8%		
20	55.7%		
40	27.6%		
60	12.2%		
100	3.8%		
200	1.4%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.90 D_{60}= 0.99 D_{50}= 0.72

D_{30}= 0.46 D_{15}= 0.28 D_{10}= 0.23

C_U= 4.30 C_C= 0.93

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-16, SS-3 (8.5-10')
Area 1

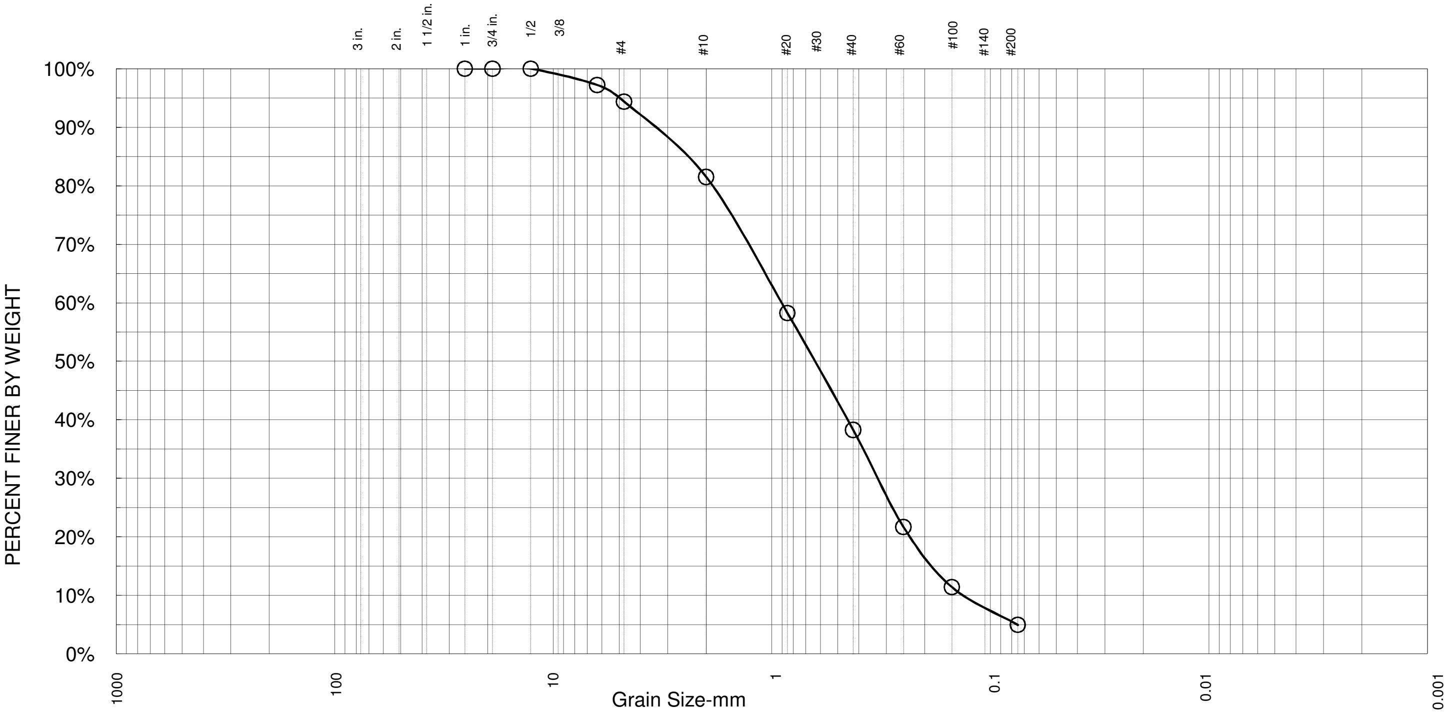
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	5.6%	12.9%	43.2%	33.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.2%		
4	94.4%		
10	81.5%		
20	58.3%		
40	38.3%		
60	21.7%		
100	11.4%		
200	5.0%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.50 D_{60}= 0.90 D_{50}= 0.63

D_{30}= 0.32 D_{15}= 0.19 D_{10}= 0.14

C_U= 6.43 C_C= 0.81

Classification

USCS= Poorly graded sand with clay (SP/SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-17, SS-4 (13.5-15')
Area 1

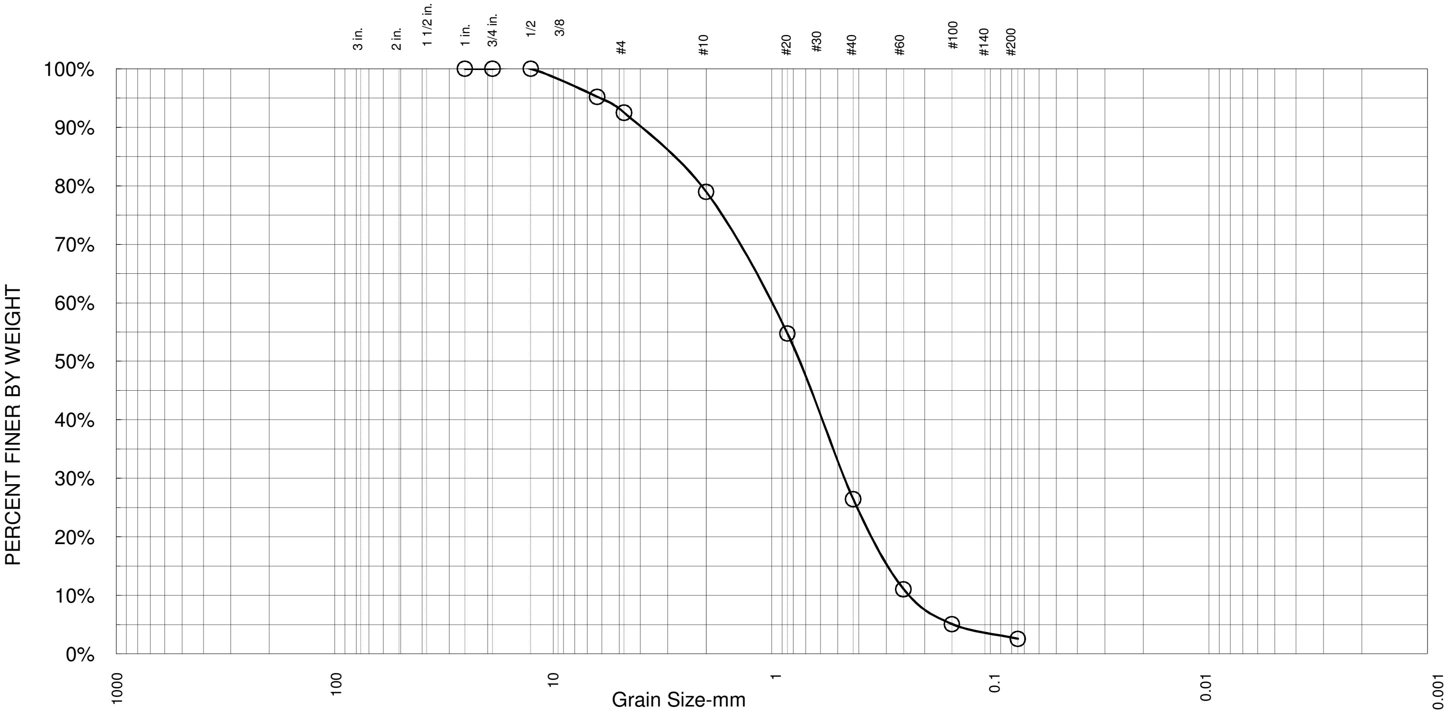
Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	7.5%	13.5%	52.5%	23.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	95.2%		
4	92.5%		
10	79.0%		
20	54.8%		
40	26.4%		
60	11.0%		
100	5.1%		
200	2.6%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.80 D_{60}= 1.00 D_{50}= 0.74

D_{30}= 0.47 D_{15}= 0.30 D_{10}= 0.24

C_U= 4.17 C_C= 0.92

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-18, SS-3 (8.5-10')
Area 1

Date: 5/11/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 5/17/2010
Project No.: A09-1466
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1
Lab #: N/A

Revision Date: 3/28/2005
Revision #: 1

Sample Information

Location of Sample: B-6C, U-2 (3.5-5')
Sample Description: Yellowish brown, Lean clay
USCS Classificiation: CL
Liquid Limit: 36
Plasticity Index: 18

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 304.40
Tare = 14.94
Dry Sample Weight = 289.46

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 57.07
Tare = 8.4
Dry Sample Weight = 48.67

Sieve	Cumul. Wt. retained	Percent Finer
#20	1.01	97.92%
#40	1.87	96.16%
#60	2.84	94.16%
#100	4.08	91.62%
#200	6.82	85.99%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 297.8
Weight of Hydrometer sample = 50

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	30.98	Moist weight & tare=	34.93
Dry weight & tare =	30.53	Dry weight & tare =	34.4
Tare =	14.95	Tare =	15.01
Hygroscopic moist. =	2.89%	Hygroscopic moist. =	2.73%
Calculated biased wt. =	289.46	Calculated biased wt.=	48.67

F:\ADMIN\Teams\CSGeotech\AASHTO\Lab Forms\hydrometer1

Hydrometer Analysis (ASTM D-422)

Revision Date: 3/28/2005
Revision #: 1

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1
Sample Loc. B-6C, U-2 (3.5-5')
Project # A09-1466
Date 5/17/2010
Lab # N/A
Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.023	0.004167	1.0188335	48.67	61.46	10.20	0.01328	0.0300
5	21	1.0195	0.004167	1.0153335	48.67	50.04	11.15	0.01328	0.0198
15	21	1.018	0.004167	1.0138335	48.67	45.14	11.50	0.01328	0.0116
30	21	1.017	0.004167	1.0128335	48.67	41.88	11.80	0.01328	0.0083
60	21	1.016	0.004167	1.0118335	48.67	38.62	12.10	0.01328	0.0060
250	21	1.015	0.004167	1.0108335	48.67	35.35	12.30	0.01328	0.0029
1440	20	1.014	0.004000	1.0100002	48.67	32.63	12.60	0.01344	0.0013

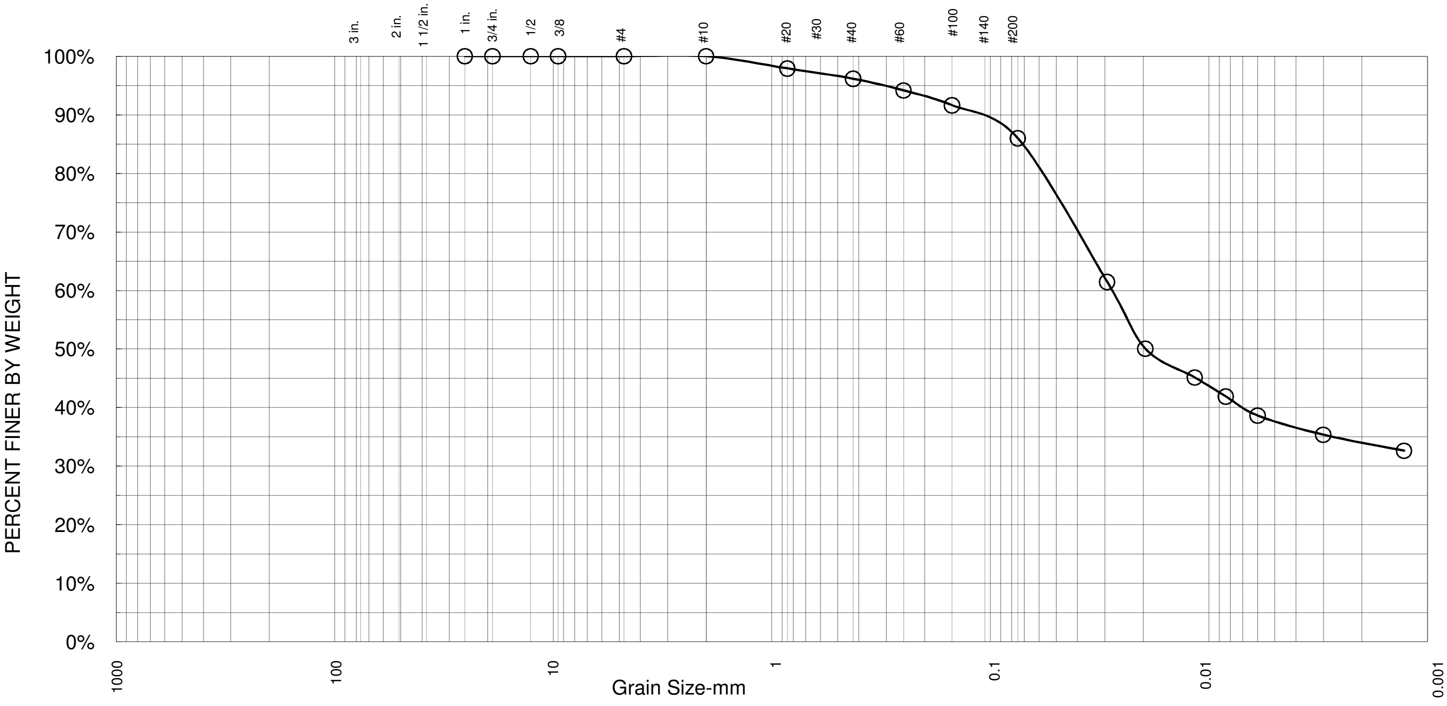
Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve

% +3 in. =	0
% Gravel =	0
% Sand =	14.0
% Silt =	48.5
% Clay =	37.5

Diameters:

D85 =	0.072
D60 =	0.028
D50 =	0.019
D30 =	N/A
D10 =	N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	3.8%	10.2%	48.5%	37.5%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	97.9%		
40	96.2%		
60	94.2%		
100	91.6%		
200	86.0%		
0.029	61.5%		
0.020	50.0%		
0.012	45.1%		
0.008	41.9%		
0.006	38.6%		
0.003	35.4%		
0.001	32.6%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=36 PL=18 PI=18

Coefficients

D_{85}= 0.072 D_{60}= 0.028 D_{50}= 0.019

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-6C, U-2 (3.5-5')

Date: 5/17/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date:	5/17/2010	Revision Date: 3/28/2005
Project No.:	A09-1466	Revision #: 1
Project:	CNPPID Reregulating Reservoir Feasibility Study - Area 1	
Lab #:	N/A	

Sample Information

Location of Sample:	B-7C, U-1 (1-2.5')
Sample Description:	Dark yellowish brown, Lean clay
USCS Classificiation:	CL
Liquid Limit:	33
Plasticity Index:	11

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 122.49
Tare = 14.94
Dry Sample Weight = 107.55

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 57.14
Tare = 8.4
Dry Sample Weight = 48.74

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.00	100.00%
#40	0.10	99.79%
#60	0.26	99.47%
#100	0.74	98.48%
#200	2.58	94.71%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 110.3
Weight of Hydrometer sample = 50.05

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	33.03	Moist weight & tare=	41.78
Dry weight & tare =	32.58	Dry weight & tare =	41.08
Tare =	14.91	Tare =	15.08
Hygroscopic moist. =	2.55%	Hygroscopic moist. =	2.69%
Calculated biased wt. =	107.55	Calculated biased wt.=	48.74

Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Sample Loc. B-7C, U-1 (1-2.5')

Revision Date: 3/28/2005

Revision #: 1

Project # A09-1466

Date 5/17/2010

Lab # N/A

Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.025	0.004167	1.0208335	48.74	67.89	9.70	0.01328	0.0292
5	21	1.0205	0.004167	1.0163335	48.74	53.23	10.85	0.01328	0.0196
15	21	1.018	0.004167	1.0138335	48.74	45.08	11.50	0.01328	0.0116
30	21	1.0165	0.004167	1.0123335	48.74	40.19	11.95	0.01328	0.0084
60	21	1.0155	0.004167	1.0113335	48.74	36.93	12.20	0.01328	0.0060
250	21	1.0135	0.004167	1.0093335	48.74	30.42	12.75	0.01328	0.0030
1440	20	1.012	0.004000	1.0080002	48.74	26.07	13.10	0.01344	0.0013

Fractional Components:

Gravel/Sand based on #4 Sieve

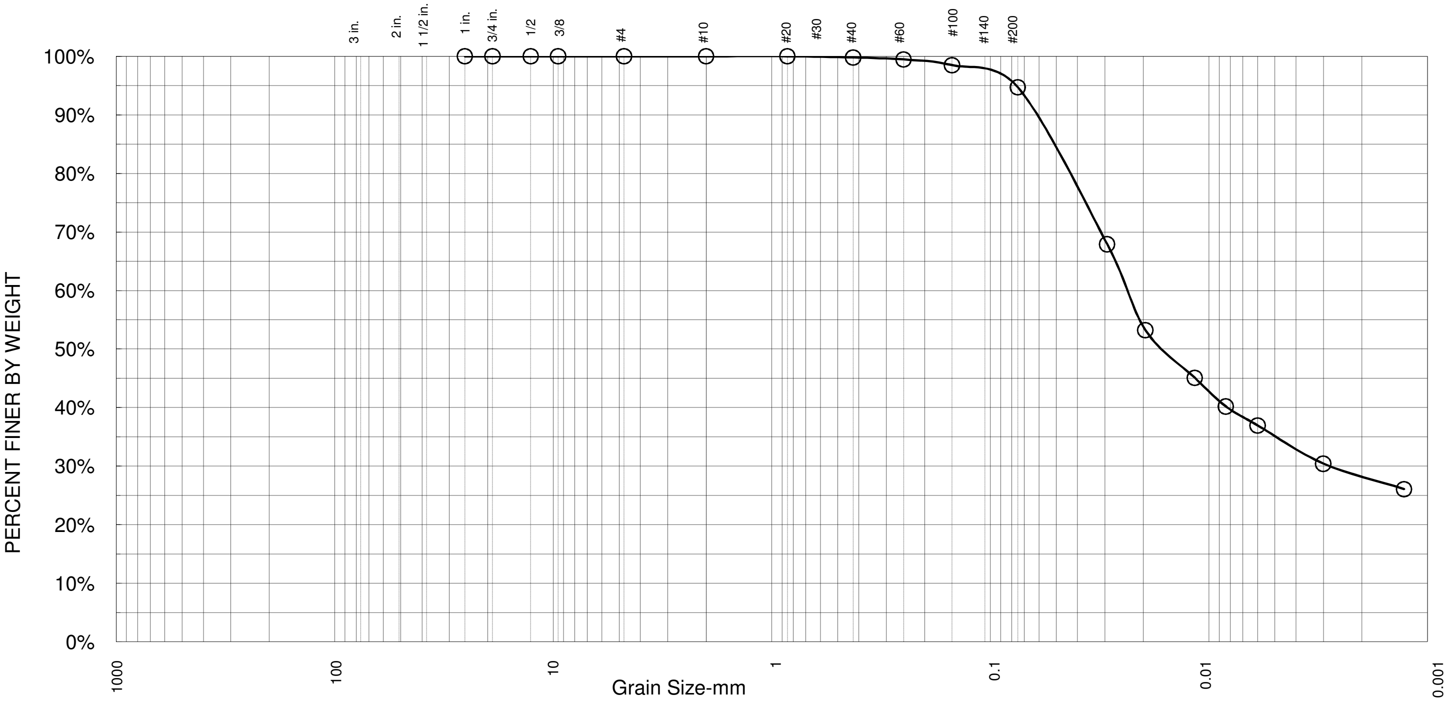
Sand/Fines based on #200 Sieve

% +3 in. =	0
% Gravel =	0
% Sand =	5.3
% Silt =	59.7
% Clay =	35.0

Diameters:

D85 =	0.052
D60 =	0.024
D50 =	0.017
D30 =	0.003
D10 =	N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.2%	5.1%	59.7%	35.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	100.0%		
40	99.8%		
60	99.5%		
100	98.5%		
200	94.7%		
0.029	67.9%		
0.020	53.2%		
0.012	45.1%		
0.008	40.2%		
0.006	36.9%		
0.003	30.4%		
0.001	26.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=33 PL=22 PI=11

Coefficients

D_{85}= 0.052 D_{60}= 0.024 D_{50}= 0.017

D_{30}= 0.003 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-7C, U-1 (1-2.5')

Date: 6/12/2007

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 6/18/2010
Project No.: A09-1466
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1
Lab #: N/A

Revision Date: 3/28/2005
Revision #: 1

Sample Information

Location of Sample: B-16, U-2 (3.5-5')
Sample Description: Yellowish brown, Sandy lean clay
USCS Classificiation: CL
Liquid Limit: 26
Plasticity Index: 11

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 236.13
Tare = 14.94
Dry Sample Weight = 221.19

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	7.18	96.75%
#10	7.66	96.54%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 122.82
Tare = 8.4
Dry Sample Weight = 118.53

Sieve	Cumul. Wt. retained	Percent Finer
#20	5.91	95.01%
#40	16.03	86.48%
#60	27.77	76.57%
#100	35.36	70.17%
#200	47.00	60.35%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 225.4
Weight of Hydrometer sample = 116.79

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	39.4	Moist weight & tare=	27.33
Dry weight & tare =	38.94	Dry weight & tare =	27.08
Tare =	14.95	Tare =	14.99
Hygroscopic moist. =	1.92%	Hygroscopic moist. =	2.07%
Calculated biased wt. =	221.19	Calculated biased wt.=	114.42

Hydrometer Analysis (ASTM D-422)

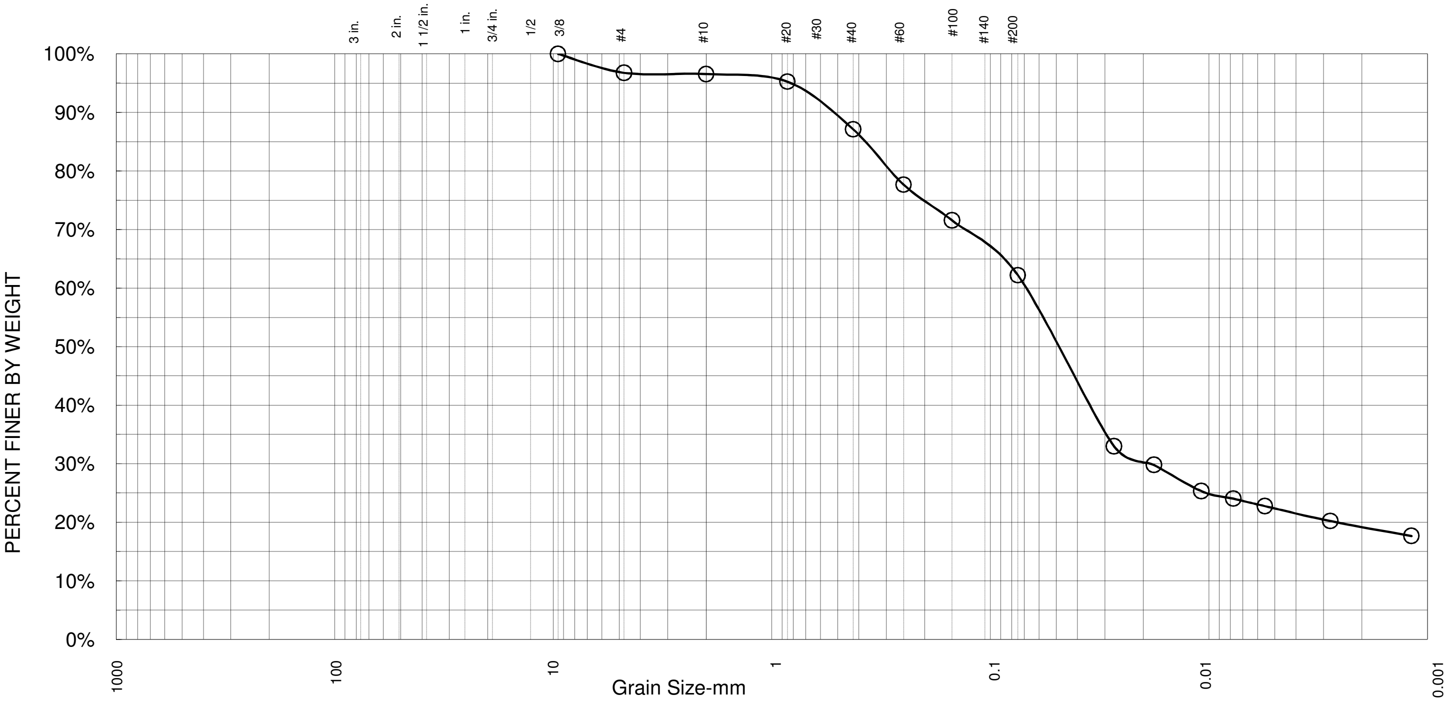
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1
Sample Loc. B-16, U-2 (3.5-5')
Revision Date: 3/28/2005
Revision #: 1
Project # A09-1466
Date 6/18/2010
Lab # N/A
Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.03	0.004167	1.0258335	118.53	34.62	8.40	0.01328	0.0272
5	21	1.0275	0.004167	1.0233335	118.53	31.27	9.05	0.01328	0.0179
15	21	1.024	0.004167	1.0198335	118.53	26.58	10.00	0.01328	0.0108
30	21	1.023	0.004167	1.0188335	118.53	25.24	10.20	0.01328	0.0077
60	21	1.022	0.004167	1.0178335	118.53	23.90	10.50	0.01328	0.0056
250	21	1.02	0.004167	1.0158335	118.53	21.22	11.00	0.01328	0.0028
1440	21	1.018	0.004167	1.0138335	118.53	18.54	11.50	0.01328	0.0012

Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve
% +3 in. = 0
% Gravel = 3.3
% Sand = 34.5
% Silt = 39.7
% Clay = 22.5

Diameters:
D85 = 0.037
D60 = 0.068
D50 = 0.048
D30 = 0.018
D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	3.3%	0.2%	9.4%	24.9%	39.7%	22.5%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	96.5%		
20	95.3%		
40	87.1%		
60	77.7%		
100	71.6%		
200	62.2%		
0.027	33.0%		
0.018	29.8%		
0.011	25.3%		
0.008	24.1%		
0.006	22.8%		
0.003	20.2%		
0.001	17.7%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=26 PL=15 PI=11

Coefficients

D_{85}= 0.370 D_{60}= 0.068 D_{50}= 0.048

D_{30}= 0.018 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Sandy lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-16, U-2 (3.5-5')

Date: 6/18/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date:	6/18/2010	Revision Date: 3/28/2005
Project No.:	A09-1466	Revision #: 1
Project:	CNPPID Re-regulating Reservoir Feasibility Study - Area 1	
Lab #:	N/A	

Sample Information

Location of Sample:	B-18, U-2 (3.5-5')
Sample Description:	Light grayish brown, Lean clay
USCS Classificiation:	CL
Liquid Limit:	42
Plasticity Index:	26

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 258.58
Tare = 14.94
Dry Sample Weight = 243.64

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 74.25
Tare = 8.4
Dry Sample Weight = 65.85

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.50	99.24%
#40	1.15	98.25%
#60	2.56	96.11%
#100	3.01	95.43%
#200	3.76	94.29%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 251.1
Weight of Hydrometer sample = 67.91

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	40.58	Moist weight & tare=	41.87
Dry weight & tare =	39.86	Dry weight & tare =	41.05
Tare =	16.23	Tare =	14.89
Hygroscopic moist. =	3.05%	Hygroscopic moist. =	3.13%
Calculated biased wt. =	243.64	Calculated biased wt.=	65.85

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Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Sample Loc. B-18, U-2 (3.5-5')

Revision Date: 3/28/2005

Revision #: 1

Project # A09-1466

Date 6/18/2010

Lab # N/A

Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.029	0.004167	1.0248335	65.85	59.90	8.60	0.01328	0.0275
5	21	1.026	0.004167	1.0218335	65.85	52.66	9.40	0.01328	0.0182
15	21	1.024	0.004167	1.0198335	65.85	47.84	10.00	0.01328	0.0108
30	21	1.023	0.004167	1.0188335	65.85	45.43	10.20	0.01328	0.0077
60	21	1.0225	0.004167	1.0183335	65.85	44.22	10.35	0.01328	0.0055
250	21	1.021	0.004167	1.0168335	65.85	40.60	10.70	0.01328	0.0027
1440	21	1.019	0.004167	1.0148335	65.85	35.78	11.30	0.01328	0.0012

Fractional Components:

Gravel/Sand based on #4 Sieve

Sand/Fines based on #200 Sieve

% +3 in. = 0

% Gravel = 0

% Sand = 5.7

% Silt = 50.8

% Clay = 43.5

Diameters:

D85 = 0.055

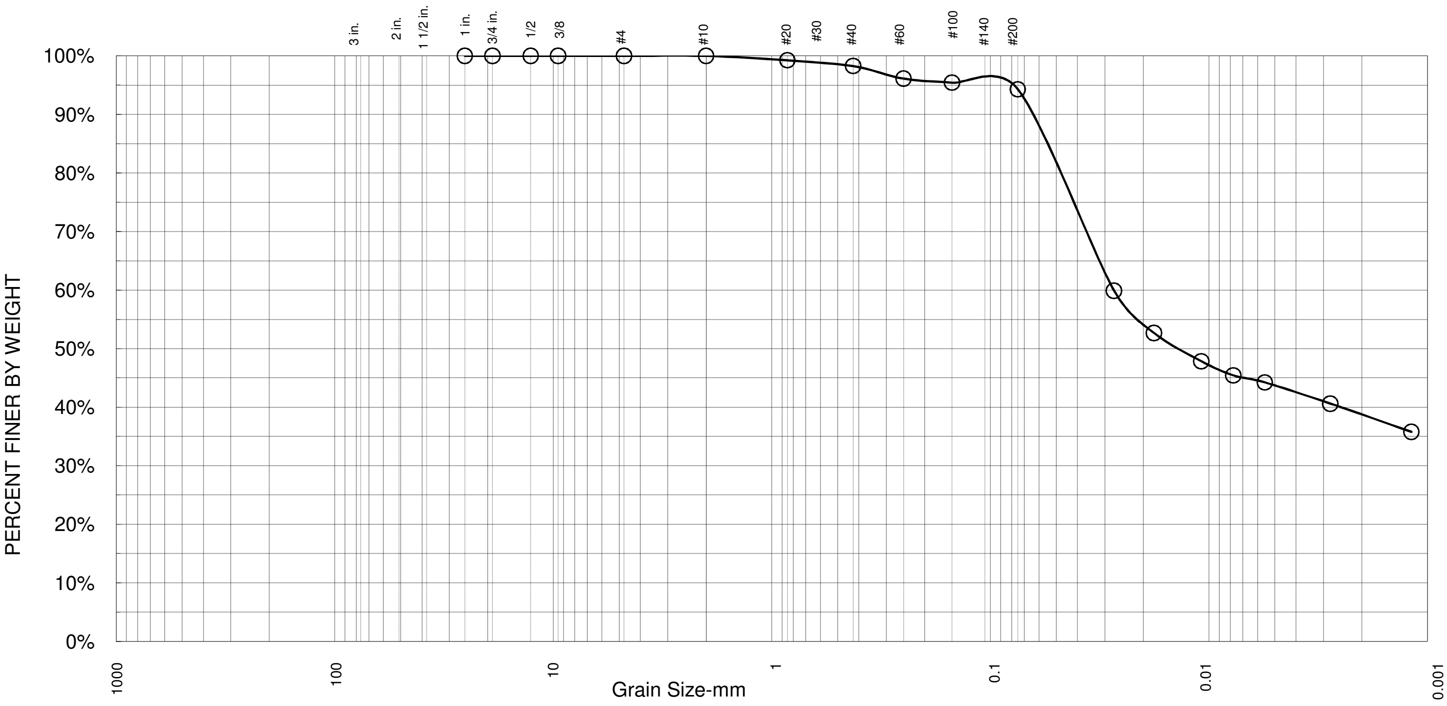
D60 = 0.027

D50 = 0.015

D30 = N/A

D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	1.7%	4.0%	50.8%	43.5%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	99.2%		
40	98.3%		
60	96.1%		
100	95.4%		
200	94.3%		
0.027	59.9%		
0.018	52.7%		
0.011	47.8%		
0.008	45.4%		
0.006	44.2%		
0.003	40.6%		
0.001	35.8%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=42 PL=16 PI=26

Coefficients

D_{85}= 0.055 D_{60}= 0.027 D_{50}= 0.015

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-18, U-2 (3.5-5')

Date: 6/18/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 6/18/2010 — Revision Date: 3/28/2005
Project No.: A09-1466 — Revision #: 1
Project: CNPPID Re-regulating Reservoir Feasibility Study - Area 1
Lab #: N/A

Sample Information

Location of Sample: B-10C (0-4'), B-11C (0-1.5')
Sample Description: Dark grayish brown to dark brown, Lean clay
USCS Classificiation: CL
Liquid Limit: 35
Plasticity Index: 17

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 264.03
Tare = 14.94
Dry Sample Weight = 249.09

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 71.74
Tare = 8.4
Dry Sample Weight = 63.34

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.16	99.75%
#40	0.54	99.15%
#60	1.02	98.39%
#100	1.68	97.35%
#200	3.59	94.33%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 259.6
Weight of Hydrometer sample = 65.87

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	38.93	Moist weight & tare=	44.5
Dry weight & tare =	37.96	Dry weight & tare =	43.36
Tare =	15.03	Tare =	14.86
Hygroscopic moist. =	4.23%	Hygroscopic moist. =	4.00%
Calculated biased wt. =	249.09	Calculated biased wt.=	63.34

Hydrometer Analysis (ASTM D-422)

Revision Date: 3/28/2005
Revision #: 1

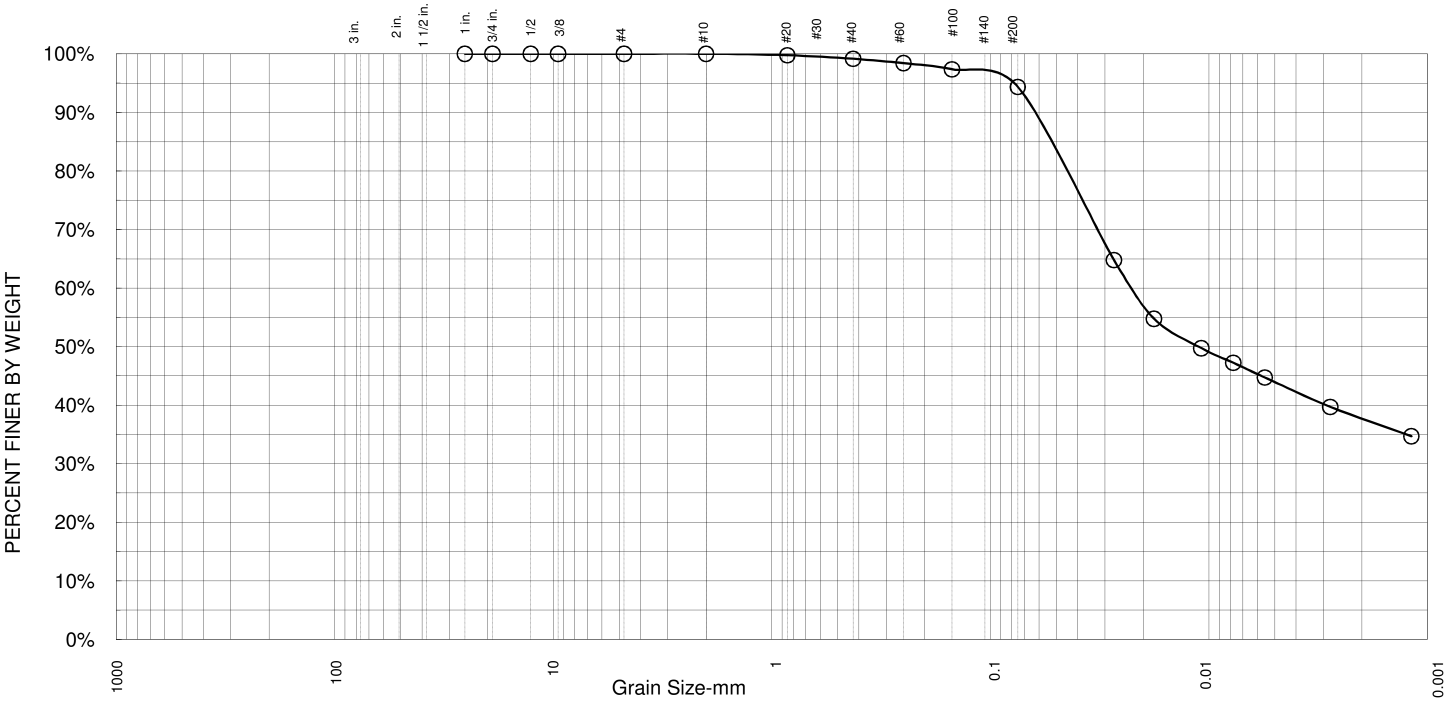
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1
Sample Loc. B-10C (0-4'), B-11C (0-1.5')
Project # A09-1466
Date 6/18/2010
Lab # N/A
Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.03	0.004167	1.0258335	63.34	64.78	8.40	0.01328	0.0272
5	21	1.026	0.004167	1.0218335	63.34	54.75	9.40	0.01328	0.0182
15	21	1.024	0.004167	1.0198335	63.34	49.73	10.00	0.01328	0.0108
30	21	1.023	0.004167	1.0188335	63.34	47.23	10.20	0.01328	0.0077
60	21	1.022	0.004167	1.0178335	63.34	44.72	10.50	0.01328	0.0056
250	21	1.02	0.004167	1.0158335	63.34	39.70	11.00	0.01328	0.0028
1440	21	1.018	0.004167	1.0138335	63.34	34.69	11.50	0.01328	0.0012

Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve
% +3 in. = 0
% Gravel = 0
% Sand = 5.7
% Silt = 50.8
% Clay = 43.5

Diameters:
D85 = 0.053
D60 = 0.024
D50 = 0.012
D30 = N/A
D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.9%	4.8%	50.8%	43.5%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	99.7%		
40	99.1%		
60	98.4%		
100	97.3%		
200	94.3%		
0.027	64.8%		
0.018	54.8%		
0.011	49.7%		
0.008	47.2%		
0.006	44.7%		
0.003	39.7%		
0.001	34.7%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=35 PL=18 PI=17

Coefficients

D_{85}= 0.053 D_{60}= 0.024 D_{50}= 0.012

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-10C (0-4.0'), B-11C (0-1.5')

Date: 6/18/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Project #: A09-1466

OLSSON ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466

Test Date: 5/12/2010
Tech.:

Boring Number: B-4C Area 1
Sample Number: U-1
Laboratory Number:

Time	Sample Description
11:13	Gray clay
11:23	1: No Dispersion
11:43	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-5C Area 1
Sample Number: U-2
Laboratory Number:

Time	Sample Description
11:39	Dark grayish brown lean clay
11:49	1: No Dispersion
12:09	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-6C Area 1
Sample Number: U-2
Laboratory Number:

Time	Sample Description
2:49	Dark brown clay
2:59	1: No Dispersion
3:19	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

F\Admin\Teams\CsGeotech\AASHTO\Lab forms\Crumb.xls

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-8B Area 1
Sample Number: U-2
Laboratory Number:

Time	Sample Description
9:37	Light grayish brown
9:47	1: No Dispersion
10:07	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-13 Area 1
Sample Number: U-1
Laboratory Number:

Time	Sample Description
2:27	Brown clay
2:37	1: No Dispersion
2:57	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-15 Area 1
Sample Number: U-1
Laboratory Number:

Time	Sample Description
9:50	Brown clay
10:00	1: No Dispersion
10:20	2: Possible Dispersion Problem

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466

Test Date: 5/12/2010
Tech.:

Boring Number: B-17 Area 1
Sample Number: U-1
Laboratory Number:

Time	Sample Description
9:01	Dark brown clay
9:11	1: No Dispersion
9:31	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 5/12/2010
Tech.:

Boring Number: B-18 Area 1
Sample Number: U-1
Laboratory Number:

Time	Sample Description
9:24	Brown clay
9:34	1: No Dispersion
9:54	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON ASSOCIATES

PINHOLE DISPERSION TEST RESULTS

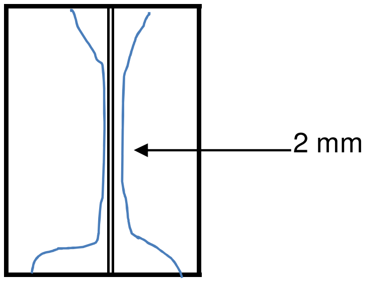
Project Name: CNPPID Reregulating Reservoir Feasiblity Study
Project Loc.: Phelps and Gosper County, Nebraska
Project No.: A09-1466

Test Date: 06/23/10
Technician: DK/CS

Sample I.D.: Area 1: B-15 U-1 (1-2.5')
Sample Desc.: Yellowish brown, Sandy lean clay

Init. Moisture Content (%): 14.1%
Remolded Sample: Yes No X
Dry Density: 105.3 pcf Percent Compaction: N/A
Distilled Water Added: Yes X No
Final Moisture Content (%) N/A
Cure Time: N/A

Specimen After Test

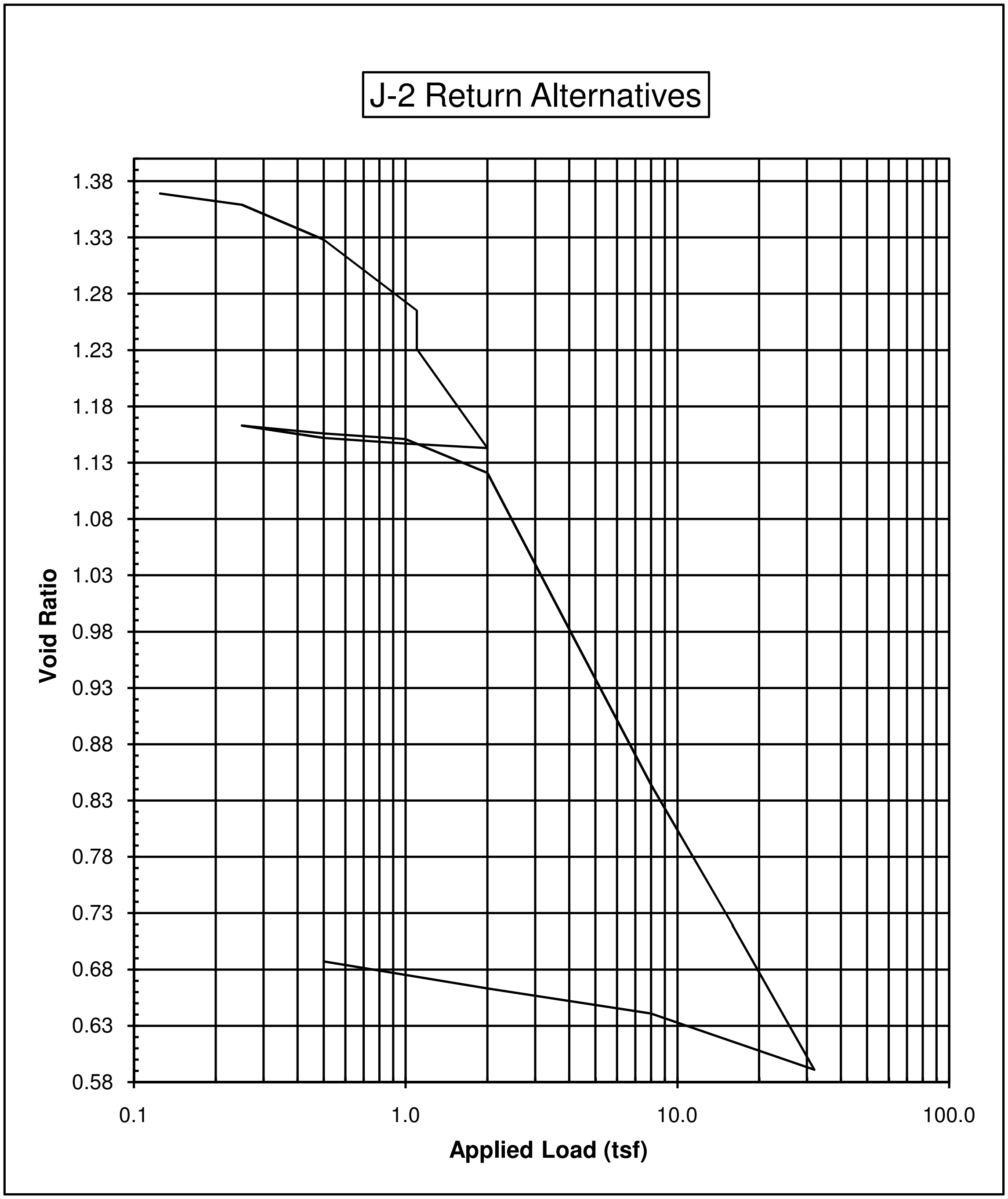


Disp. Classification: ND3 Slightly Dispersive

Time (sec)	Head (in.)	Flow Volume (mL)	Flow Rate (mL/sec)	Turbidity from Side						Clear From Top
				V Dark	Dark	M Dark	S Dark	B Vis.	Clear	
19	2	12	0.63				X			NO
17	2	13	0.76				X			NO
146	2	100	0.68				X			NO
96	2	93	0.97				X			NO
23	2	18.5	0.82				X			NO
100	2	96	0.96				X			NO
200	2	98	0.49					X		NO
67	7	97	1.45					X		NO
58	7	90.5	1.56					X		NO
62	7	92	1.48					X		NO
62	7	92	1.48					X		NO
51	7	76	1.49					X		NO
40	15	102	2.55					X		YES
39	15	100	2.56					X		YES
37	15	95	2.57					X		YES
33	15	81	2.45					X		YES
39	15	100	2.56					X		YES
39	15	100	2.56					X		YES
34	15	91	2.68					X		YES
39	15	102	2.62					X		YES
	NOTE: Fine sand observed at bottom of graduated cylinder throughout the test									

COLLAPSE / CONSOLIDATION TEST

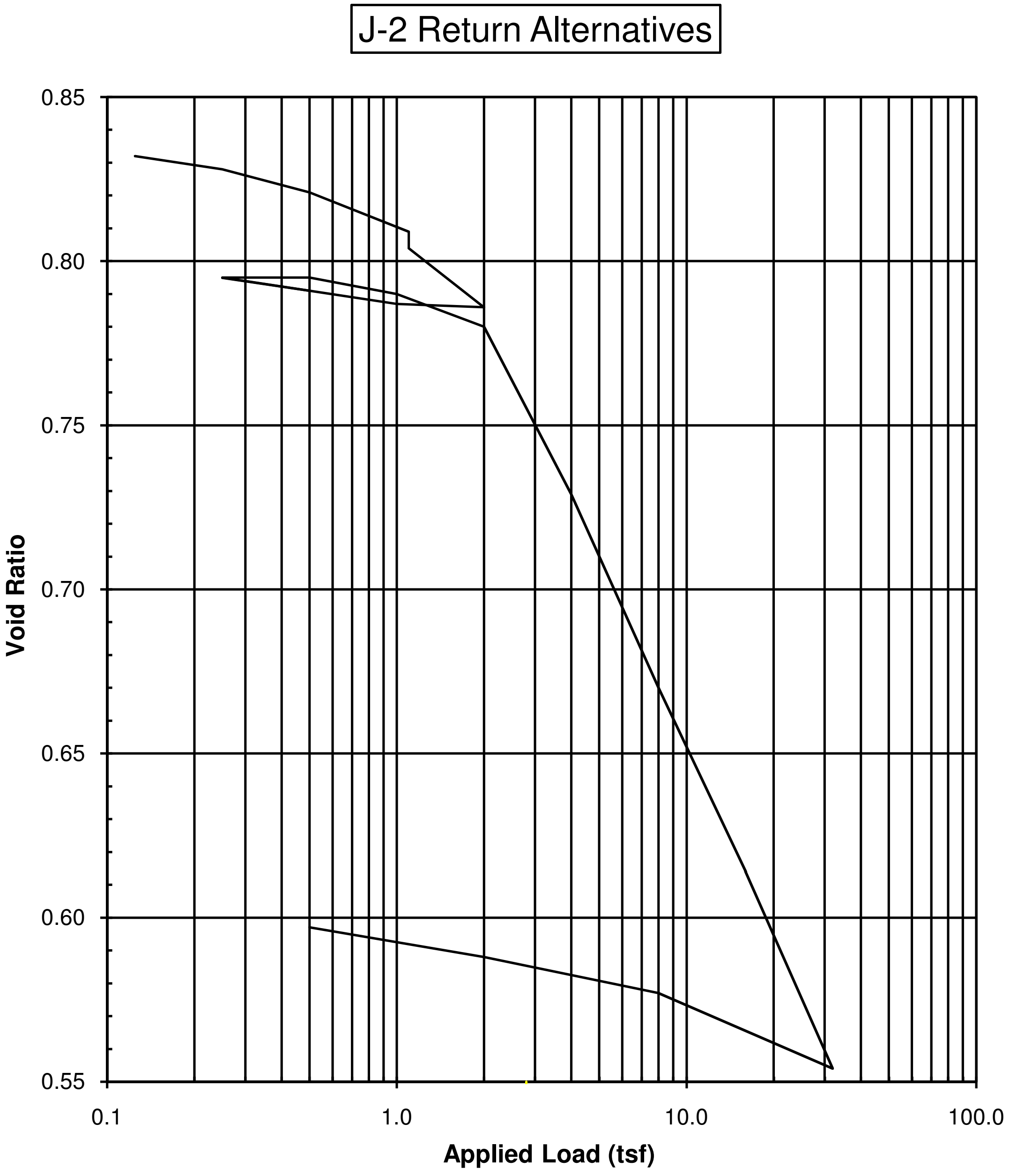
Drill Hole No.	B-7C	Sample No.	U-1 (1-2.5')		
Sample Description	Alluvium: Dark yellowish brown mottled with very dark grayish brown, Lean clay				
Initial Water Content	34.0%	Dry Unit Weight (pcf)	78.30	Initial Saturation	66.5%
Final Water Content	26.7%	Specific Gravity	2.7	X	Assumed
Liquid Limit	33	Plastic Limit	22	Plasticity Index	11
Classification	CL				



OLSSON ASSOCIATES	Project	CNPPID Reregulating Reservoir Feasibiltiy Sudy	
	Location	Phelps County, Nebraska	Area 1
	Job No.	A09-1460	Date: 05/21/10

COLLAPSE / CONSOLIDATION TEST

Drill Hole No.	B-13	Sample No.	U-1 (1-2.5')		
Sample Description	Alluvium: Yellowish brown, Lean clay with sand				
Initial Water Content	22.7%	Dry Unit Weight (pcf)	91.69	Initial Saturation	74.0%
Final Water Content	23.0%	Specific Gravity	2.7	X	Assumed
Liquid Limit	28	Plastic Limit	18	Plasticity Index	11
Classification	CL				



OLSSON ASSOCIATES

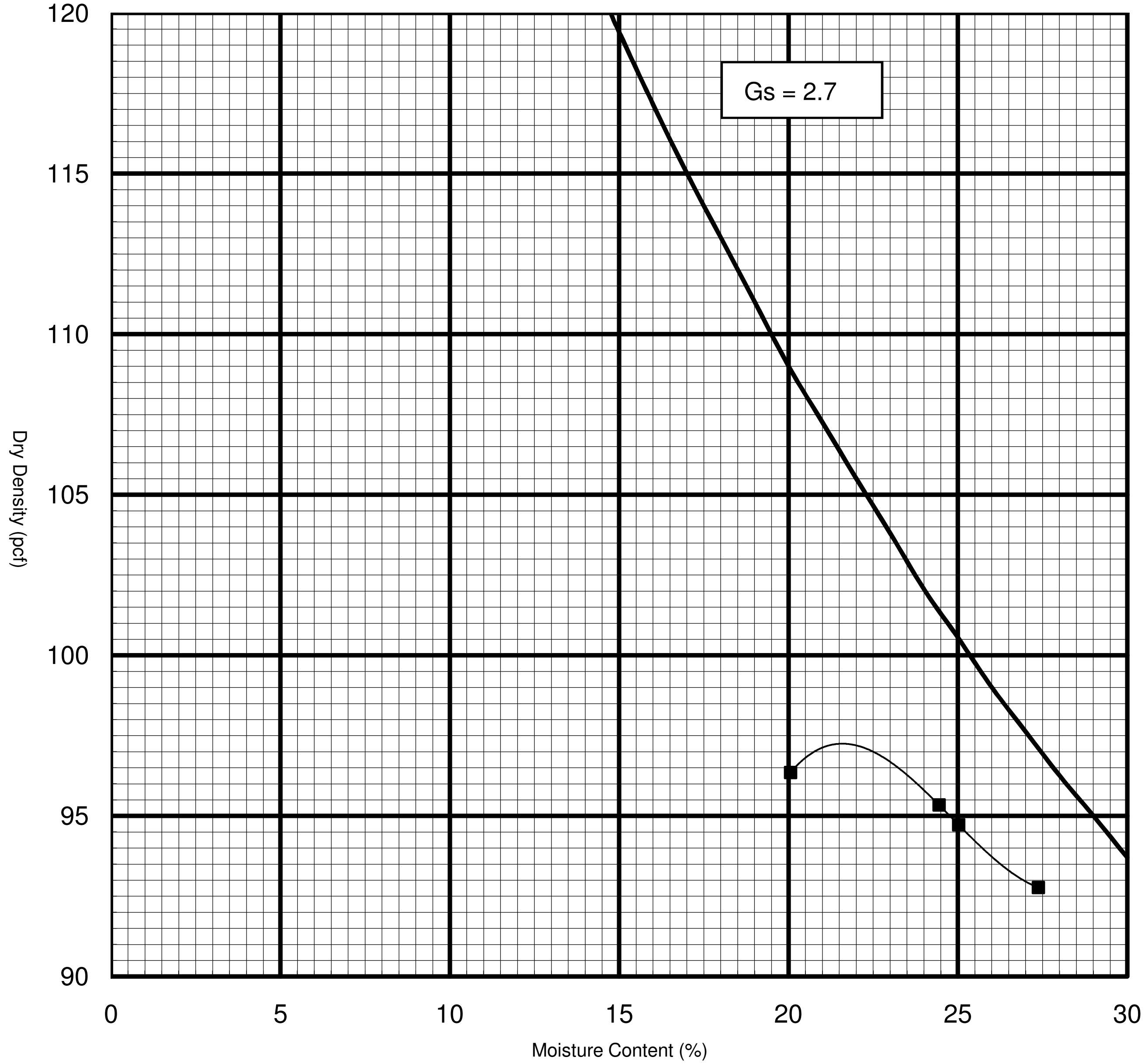
Project	CNPPID Reregulating Reservoir Feasibiltiy Sudy		
Location	Phelps County, Nebraska		Area 1
Job No.	A09-1460	Date:	05/21/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Composite Bulk Sample: B-10C (0-4.0') & B-11C (0-1.5')

Sample Description: Alluvium: Grayish brown, Lean clay

Liquid Limit	35	Plastic Limit	18	Plasticity Index	17	Classification	CL
Type of Test	D-698	Maximum Dry Density	97.3 pcf	Optimum Moisture Content	21.7%		



OLSSON ASSOCIATES

Project:	CNPPID Reregulating Reservoir Feasibility Study - Area 1
Location:	Phelps County, Nebraska
Job Number:	A09-1466
Date:	05/13/10

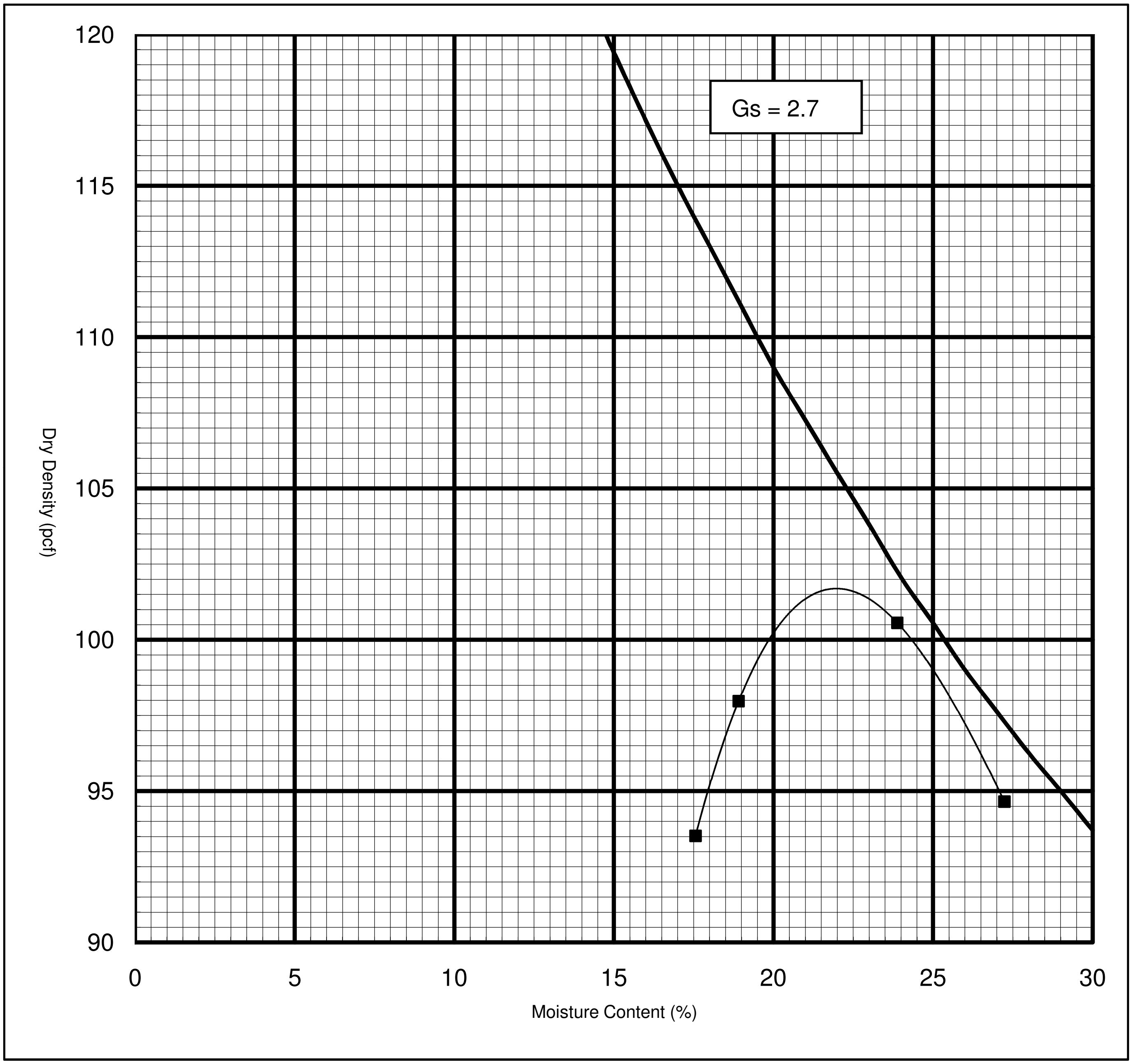
MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Composite Bulk Sample: B-10C (4.5-7') & B-11C (2-7.0')

Sample Description: Alluvium: Yellowish brown, Lean clay

Liquid Limit 41 Plastic Limit 18 Plasticity Index 23 Classification CL

Type of Test D-698 Maximum Dry Density 101.6 pcf Optimum Moisture Content 21.9%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Location: Phelps County, Nebraska

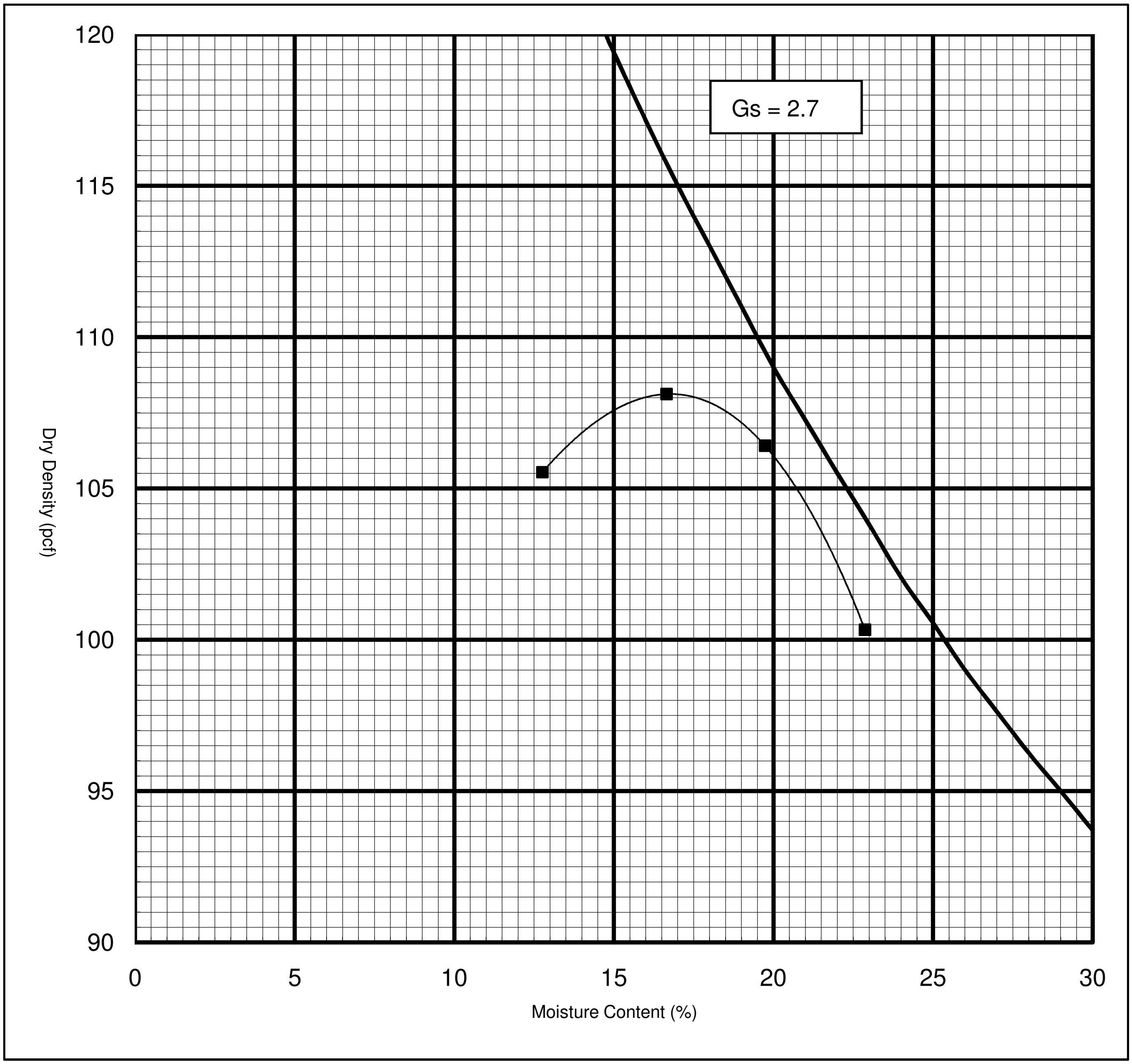
Job Number: A09-1466 Date: 05/13/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-17 (2.5-6.5')

Sample Description: Alluvium: Dark gray, Lean clay

Liquid Limit	31	Plastic Limit	17	Plasticity Index	14	Classification	CL
Type of Test	D-698	Maximum Dry Density	108.1 pcf			Optimum Moisture Content	16.9%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Location: Phelps County, Nebraska

Job Number: A09-1466

Date: 05/13/10

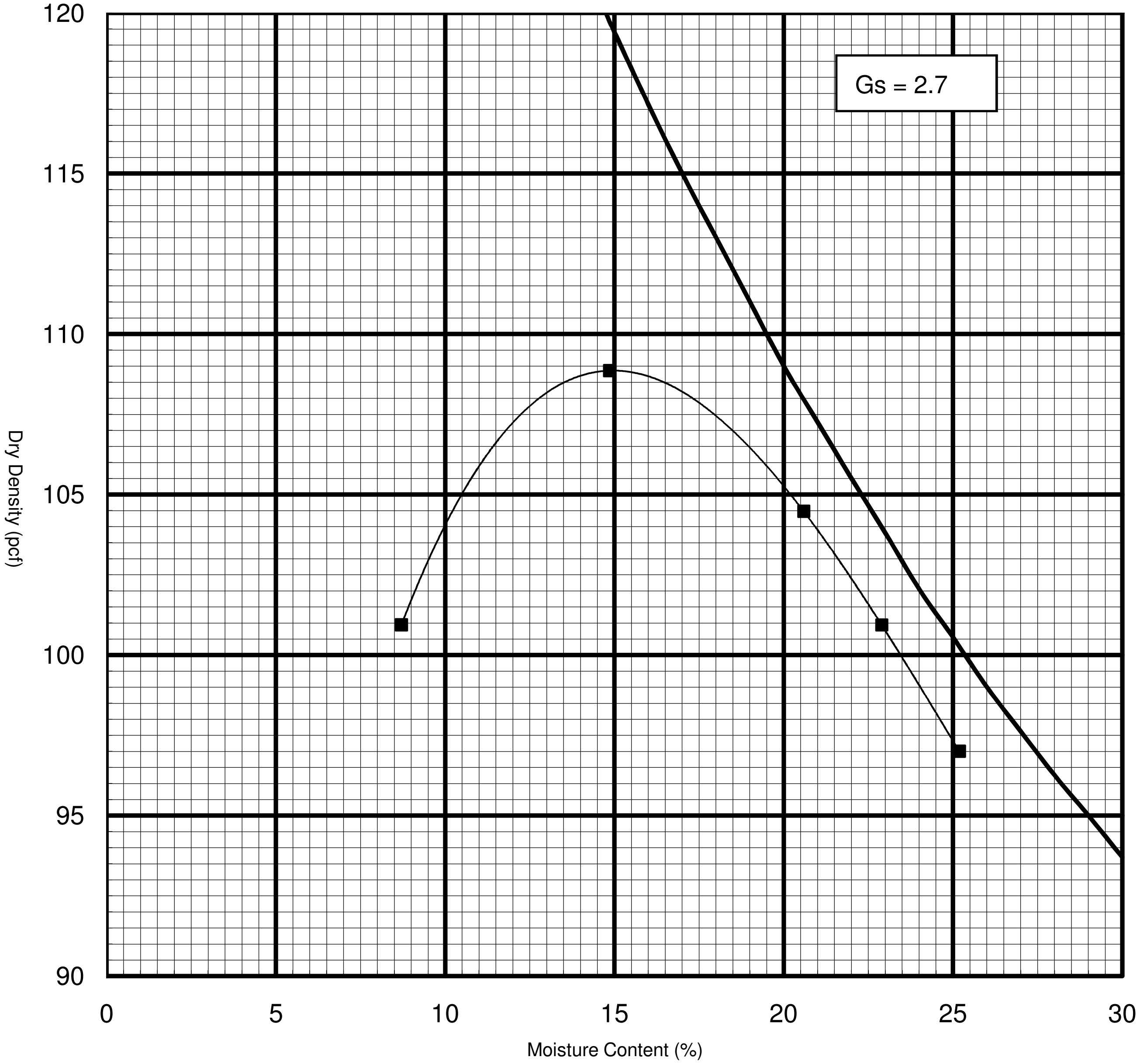
MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-18 (2.5 - 7.5')

Sample Description: Alluvium: Light grayish brown, Lean clay

Liquid Limit 33 Plastic Limit 19 Plasticity Index 13 Classification CL

Type of Test D-698 Maximum Dry Density 108.4 pcf Optimum Moisture Content 15.0%



Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

Location: Phelps County, Nebraska

Job Number: A09-1466

Date: 05/13/10

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1	Job Number: A09-1466	Date: 05/24/10
Sample Identification: B-7C (5-6.5'), B-7C (5.5-7'), B-7C (6.5-8')	Sample Description: Alluvium: Dark yellowish brown, Lean clay	

INDEX TEST DATA

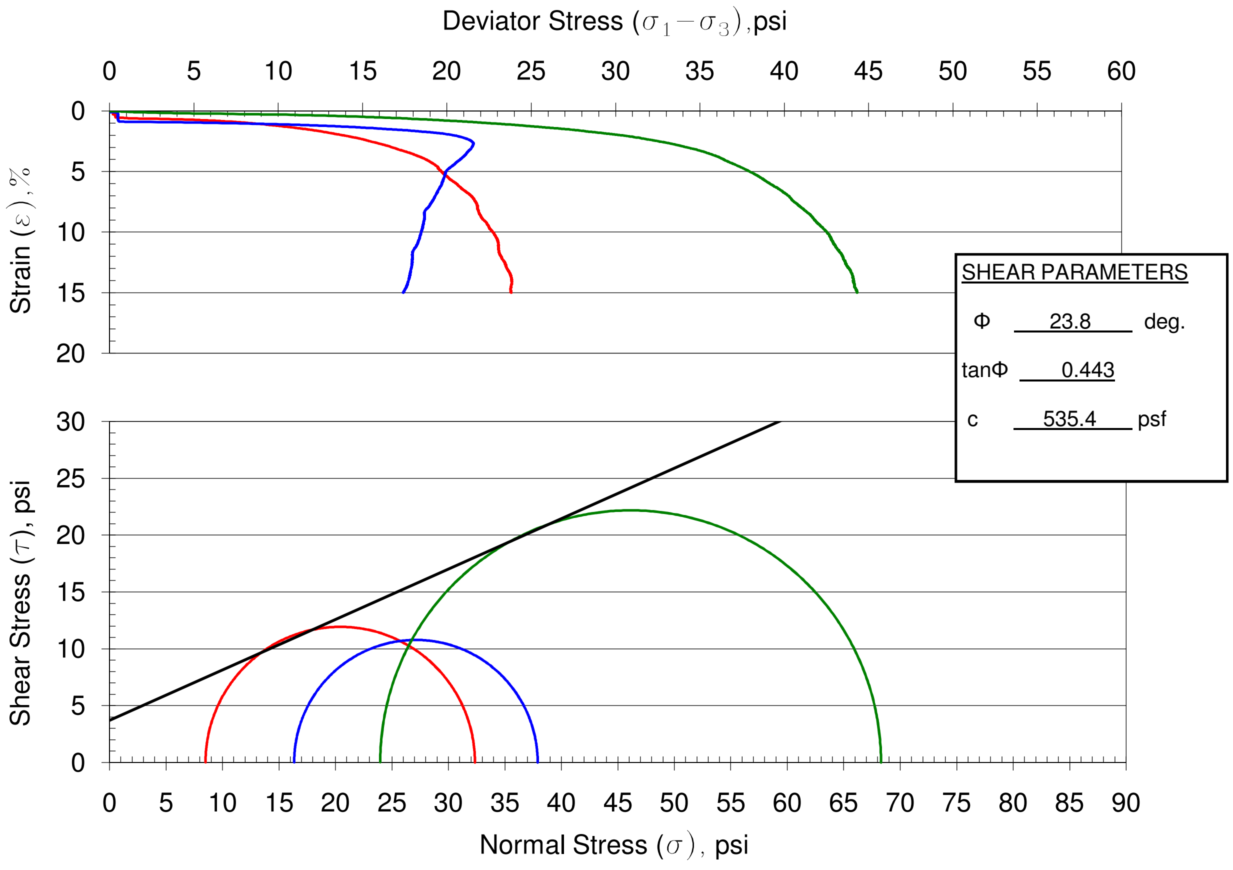
USCS Lean clay (CL) LL 38 ; PI 20 ;
%FINER (mm): 0.002 ____; 0.005____;
0.074 (#200) ____
G_s (-#4) ____ G_s (+#4) ____
Standard: γ_d MAX. ____ pcf w_{opt} ____ %
Modified: γ_d MAX. ____ pcf w_{opt} ____ %

SPECIMEN DATA

HEIGHT 6.021"; DIAMETER 2.865"
MATERIALS TESTED PASSED____ SIEVE
METHOD OF PREPARATION: In-situ
MOLDING MOISTURE ____ %
MOLDED AT ____ % OF γ_d MAX

TYPE OF TEST	
UU	☐
CU	☐
CU'	☒
CD	☐

DRY DENSITY		B PARAMETER	MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1-\sigma_3$ (psi)	AXIAL STRAIN AT FAILURE ε (%)
INITIAL pcf ☒ g/cc	CONSOLIDATED pcf ☒ g/cc		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
91.3	92.5	0.96	28.5	91.2	30.4	25.0	8.5	23.9	13.9
83.7	87.5	0.95	32.6	86.9	34.2	33.0	16.3	21.6	2.7
98.6	99.7	0.96	24.7	94.1	25.6	18.0	24.0	44.3	15.0



SHEAR PARAMETERS

Φ 23.8 deg.
tanΦ 0.443
c 535.4 psf

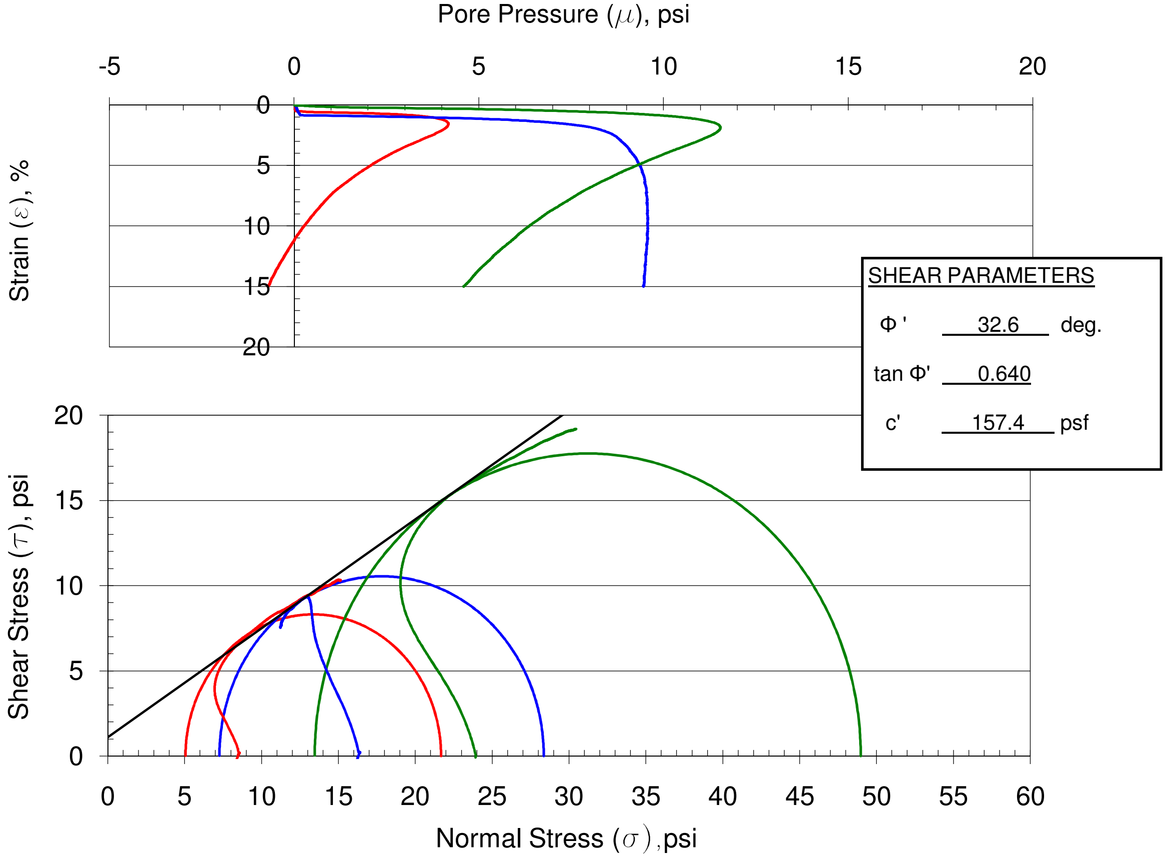
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1	Job Number: A09-1466	Date: 05/24/10
Sample Identification: B-7C (5-6.5'), B-7C (5.5-7'), B-7C (6.5-8')	Sample Description: Alluvium: Dark yellowish brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM PRINCIPAL EFFECTIVE STRESS RATIO	AXIAL STRAIN AT FAILURE ε (%)
8.5	3.4	5.1	16.6	$\left(\frac{\sigma_1'}{\sigma_3'}\right)_{max}$	2.9
16.3	9.1	7.3	21.1		3.7
24.0	10.5	13.5	35.5		3.5



SHEAR PARAMETERS

Φ ' 32.6 deg.

tan Φ' 0.640

c' 157.4 psf

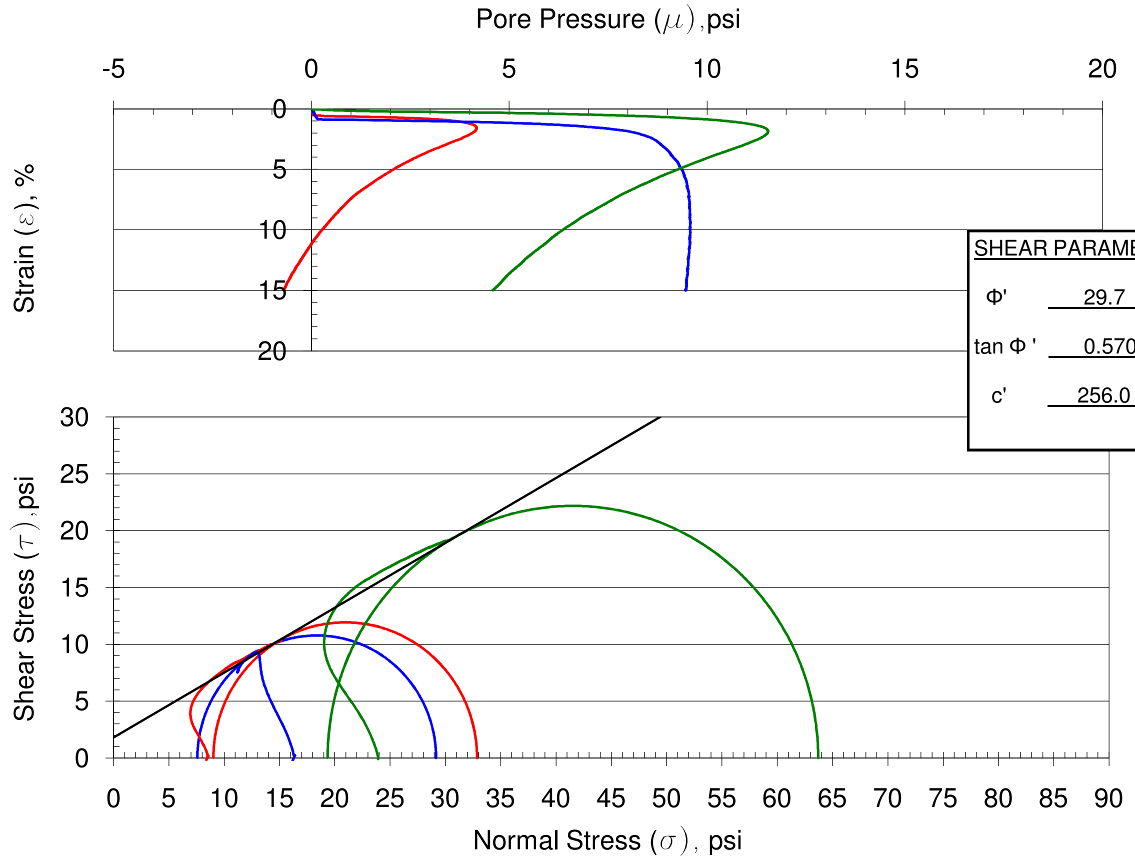
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1	Job Number: A09-1466	Date: 05/24/10
Sample Identification: B-7C (5-6.5'), B-7C (5.5-7'), B-7C (6.5-8')	Sample Description: Alluvium: Dark yellowish brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM DEVIATOR STRESS	AXIAL STRAIN AT FAILURE ε (%)
8.5	-0.5	9.0	23.9	$(\sigma_1 - \sigma_3)_{max}$	13.9
16.3	8.7	7.6	21.6		2.7
24.0	4.6	19.4	44.3		15.0



SHEAR PARAMETERS

Φ' 29.7 deg.

tan Φ ' 0.570

c' 256.0 psf

REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1	Job Number: A09-1466	Date: 08/10/10
Sample Identification: B-10C (0-4'), B-11C (0-1.5')	Sample Description: Alluvium: Dark grayish brown, Lean clay	

INDEX TEST DATA

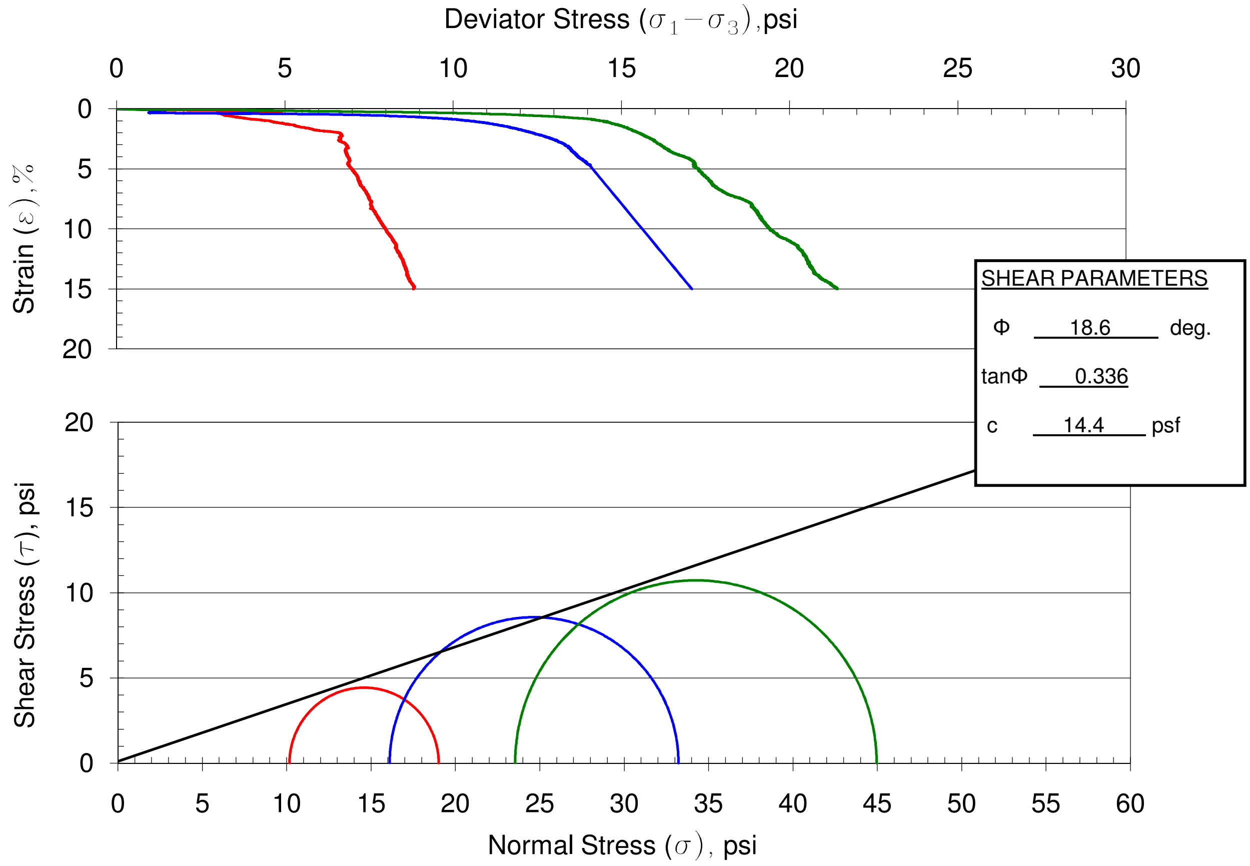
USCS Lean clay (CL) LL 35 ; PI 17 ;
%FINER (mm): 0.002 37.5%; 0.005 43.5%;
0.074 (#200) 90.6%
G_s (-#4) ____ G_s (+#4) ____
Standard: γ_d MAX. 97.3 pcf w_{opt} 21.7%
Modified: γ_d MAX. pcf w_{opt} %

SPECIMEN DATA

HEIGHT 6.021"; DIAMETER 2.865"
MATERIALS TESTED PASSED ____ SIEVE
METHOD OF PREPARATION:
Remolded in 5 lifts
MOLDING MOISTURE 21.70%
MOLDED AT 95% OF γ_d MAX

TYPE OF TEST	
UU	
CU	
CU'	☒
CD	

DRY DENSITY		B PARAMETER	MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE ε (%)
INITIAL pcf ☒ g/cc	CONSOLIDATED pcf ☒ g/cc		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
93.6	95.4	0.95	22.4	75.6	28.4	18.0	10.2	8.9	14.8
92.5	97.9	0.96	22.3	73.1	26.7	41.0	16.1	17.1	15.0
91.8	96.1	0.95	23.7	76.6	27.9	50.0	23.5	21.4	15.0



SHEAR PARAMETERS

Φ 18.6 deg.
tanΦ 0.336
c 14.4 psf

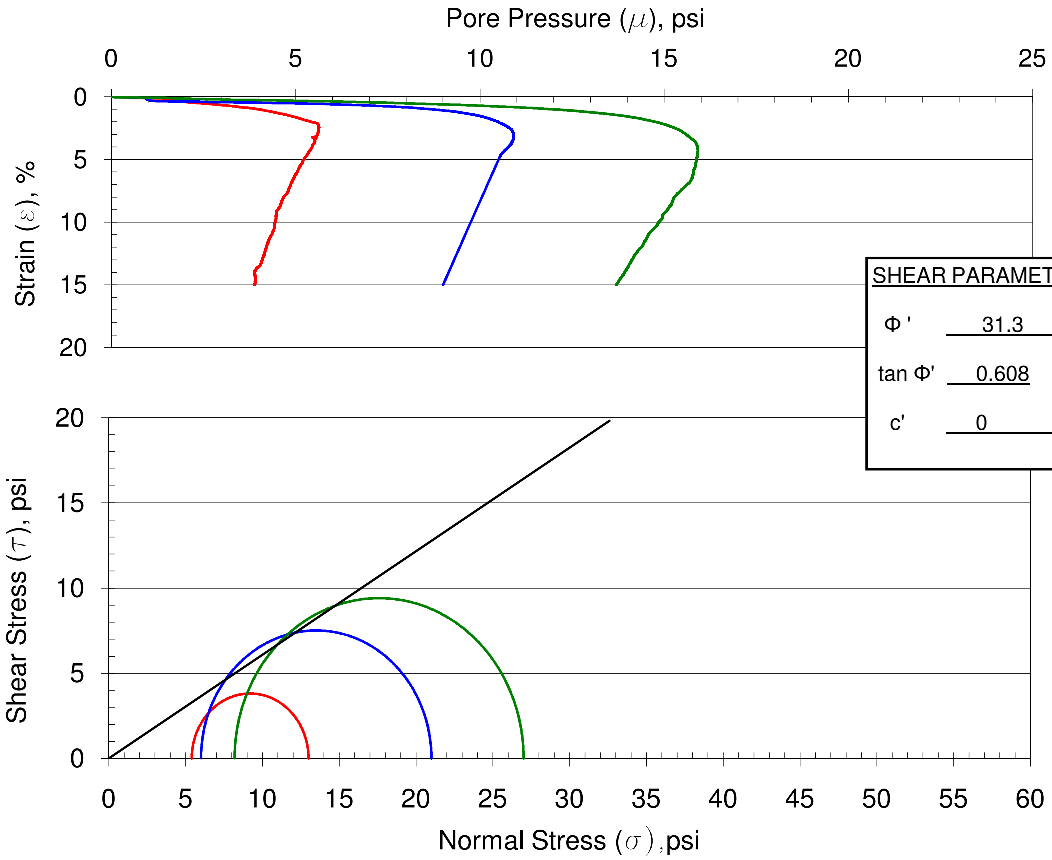
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1	Job Number: A09-1466	Date: 08/10/10
Sample Identification: B-10C (0-4'), B-11C (0-1.5')	Sample Description: Alluvium: Dark grayish brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM PRINCIPAL EFFECTIVE STRESS RATIO	AXIAL STRAIN AT FAILURE ε (%)
10.2	4.8	5.4	7.6	$\left(\frac{\sigma_1'}{\sigma_3'}\right)_{max}$	8.0
16.1	10.1	6.0	15.0		8.0
23.5	15.3	8.2	18.8		7.8



SHEAR PARAMETERS

Φ ' 31.3 deg.

tan Φ' 0.608

c' 0 psf

REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 1

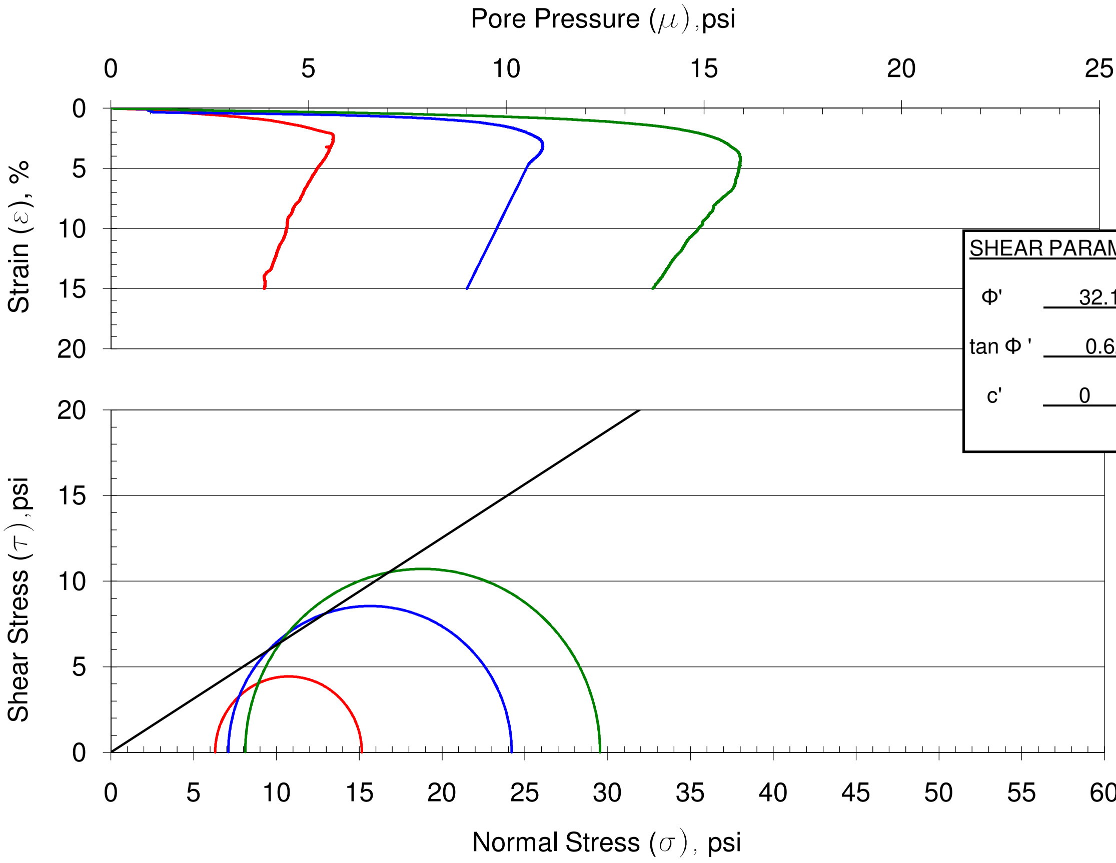
Job Number: A09-1466

Date: 08/10/10

Sample Identification: B-10C (0-4'), B-11C (0-1.5')

Sample Description: Alluvium: Dark grayish brown, Lean clay

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1-\sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM DEVIATOR STRESS	AXIAL STRAIN AT FAILURE ε (%)
10.2	3.9	6.3	8.9	$(\sigma_1-\sigma_3)_{max}$	14.8
16.1	9.0	7.1	17.1		15.0
23.5	15.4	8.1	21.4		15.0



SHEAR PARAMETERS

Φ' 32.1 deg.

tan Φ ' 0.627

c' 0 psf

REMARKS

Harris Laboratories
A Division of AgSource Cooperative Services

300 Speedway Circle, Suite 2
Lincoln, NE 68502

Tel: (402) 476-0300
Fax: (402) 476-0302

SOIL ANALYSIS

Submitted By: **6850221**

Olsson Associates

3800 South 6th Street
Lincoln, NE 68502

Submitted For:

J-2 AREAS 1 AND 2

Date Received	Date Reported	Samples Stored Until	Laboratory Sample #'s
28-May-2010	**1-Jun-2010**	**12-Jun-2010**	**AC11876 - AC11882**

Information Sheet Number: **022178**

REPORT OF ANALYTICAL RESULTS

Client Sample Identification	Analysis	Result
B-7BULK Area 2	Organic Matter %	1.7
B-4BULK Area 2	Organic Matter %	1.6
B-11BULK Area 2	Organic Matter %	1.2
5C Area 2	Organic Matter %	2.4
B4A1SURF Area 1	Organic Matter %	0.8
B4A2SURF Area 2	Organic Matter %	1.1
B15SURF Area 1	Organic Matter %	1.2

APPENDIX D

AREA 2

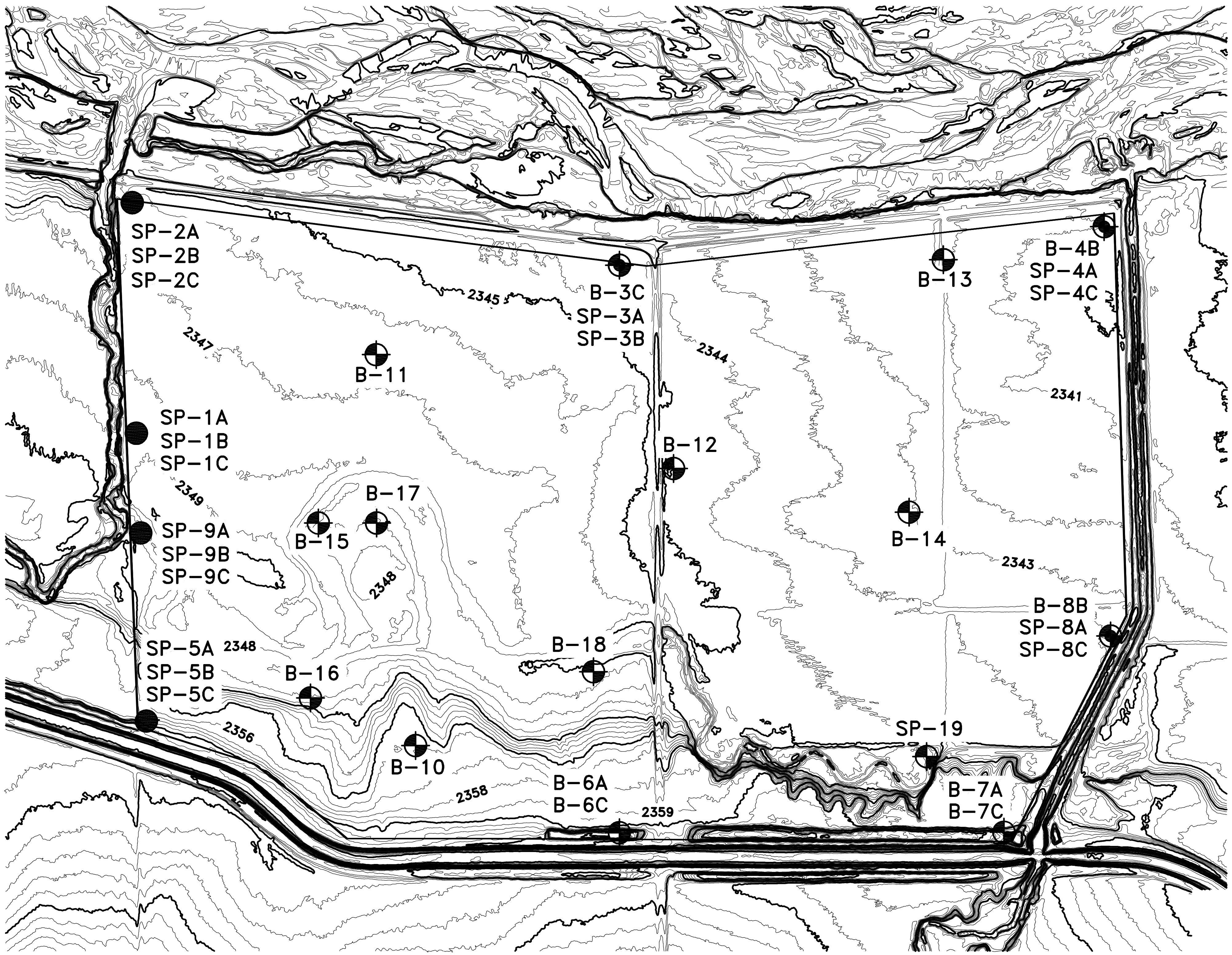
Site Location Plan

Boring Location Map

SITE LOCATION PLAN

CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY , NEBRASKA
OA PROJECT NO. A09-1466

F:\Projects\20051543\geotech\Site 15\dwg\Site15profile.dwg



N

0 300 600 1200
SCALE IN FEET

LEGEND
- ⊕ SOIL TEST BORING
- ● SOIL TEST PROBE
- ⊕ BORING & SOIL PROBE

BORING LOCATION MAP
CNPPID REREGULATING RESERVOIR
FEASIBILITY STUDY
AREA 2

J−2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA

DATE: 6/15/10 | DRAWN BY: SVJ
JOB NUMBER: A09−1466

OLSSON ASSOCIATES

APPENDIX E

AREA 2

Symbols & Nomenclature

Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample
U:	Thin-walled Tube Sample
% Rec:	Percentage of Thin-walled Tube sample recovered
SPT Blow Counts:	Standard Penetration Test blows per 6" penetration
HSA:	Hollow Stem Auger
CFA:	Continuous Flight Auger
N.E.:	Not Encountered
N.A.:	Not Available

DRILLING PROCEDURES

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance (SPT) ‘N’ value is the number of blows of a 140 pound hammer falling 30 inches to drive a 2 inch O.D., 1.4 inch I.D. split-spoon sampler one foot. The thin-walled tube sampling procedure is described by ASTM specification D 1587.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM Designations D-2487 and D-2488. The USCS group symbol shown on the boring logs correspond to the group names listed below.

Group Symbol	***Group Name***	***Group Symbol***	***Group Name***
GW	Well Graded Gravel	CL	Lean Clay
GP	Poorly Graded Gravel	ML	Silt
GM	Silty Gravel	OL	Organic Clay or Silt
GC	Clayey Gravel	CH	Fat Clay
SW	Well Graded Sand	MH	Elastic Silt
SP	Poorly Graded Sand	OH	Organic Clay or Silt
SM	Silty Sand	PT	Peat
SC	Clayey Sand		

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

COHESIONLESS SOILS

Consistency	**Unconfined Compressive Strength (Qu) (psf)**	**Relative Density**	**Angle Value**
Very Soft	<500	Very Loose	0 - 3
Soft	500 - 1000	Loose	4 - 9
Firm	1001 - 2000	Medium Dense	10 - 29
Stiff	2001 - 4000	Dense	30 - 49
Very Stiff	4001 - 8000	Very Dense	≥ 50
Hard	> 8000		

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

SOIL PROBE NO. SP-1A

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.5 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2348.00*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2347.0	***ALLUVIUM*** Lean clay (CL) Stiff, dark yellowish brown, moist, mostly lean clay, little fine sand **1.0'**	1	G-1	CL	--	--	24.9	--	--	88.8
2346.0	Lean clay (CL)	2	G-2	CL	--	--	26.8	--	--	94.8
2345.0	Stiff, yellowish brown, moist, mostly lean clay, few fine sand **3.0'**	3	G-3	CL	--	--	28.0	--	--	90.9
2344.0	Sandy lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, some fine sand	4	G-4	CL	--	--	23.1	--	--	67.5
2343.0	**5.0'**	5								
2342.0	Poorly graded sand (SP) ***BASE OF SOIL PROBE @ 5.5 FEET***	6								
2341.0	Driller's Note: 6-inch developed zone encountered at the surface	7								
2340.0		8								
2339.0		9								
2338.0		10								
2337.0		11								
2336.0		12								
2335.0		13								
2334.0		14								
2333.0		15								
2332.0		16								
2331.0		17								
2330.0		18								
2329.0		19								
2328.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-1A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-1B**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2348.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2347.0	***ALLUVIUM*** Lean clay (CL) Stiff, very dark grayish brown, moist, mostly lean clay, few fine sand **1.0'**	1	G-1	CL	--	--	24.4	--	--	91.7
2346.0	Lean clay (CL) Stiff, dark yellowish brown, very moist, mostly lean clay, few fine sand	2	G-2	CL	--	--	28.2	--	--	89.1
2345.0		3	G-3	CL	--	--	25.7	--	--	65.2
2344.0	Sandy lean clay (CL) Stiff, dark yellowish brown, very moist, mostly lean clay, some fine sand	4								
2343.0	**5.0'**	5								
2342.0	Poorly graded sand (SP) ***BASE OF SOIL PROBE @ 5.5 FEET***	6								
2341.0	Driller's Note: 6-inch developed zone encountered at the surface	7								
2340.0		8								
2339.0		9								
2338.0		10								
2337.0		11								
2336.0		12								
2335.0		13								
2334.0		14								
2333.0		15								
2332.0		16								
2331.0		17								
2330.0		18								
2329.0		19								
2328.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-1B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1

SOIL PROBE NO. SP-1C

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2348.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2347.0	***DEVELOPED ZONE*** 6.0" ***ALLUVIUM***	1	U-1	CL	--	--	23.4	--	--	89.4
2346.0	Lean clay (CL) Stiff, dark yellowish brown, very moist, mostly lean clay, few fine sand	2	U-2	CL	--	--	25.9	--	--	93.8
2345.0		3	U-3	CL	--	--	24.7	--	--	91.5
2344.0	4.8'	4	U-4	CL	--	--	30.0	--	--	70.8
2343.0	Lean clay with sand (CL) Stiff, black, very moist 5.1' Poorly graded sand (SP)	5								
2342.0	***BASE OF SOIL PROBE @ 5.5 FEET***	6								
2341.0		7								
2340.0		8								
2339.0		9								
2338.0		10								
2337.0		11								
2336.0		12								
2335.0		13								
2334.0		14								
2333.0		15								
2332.0		16								
2331.0		17								
2330.0		18								
2329.0		19								
2328.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-1C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-2A
LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 3.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2346.00									
	DEVELOPED ZONE 1.0"		G-1	CL	--	--	22.8	--	--	85.7
2345.0	***ALLUVIUM***	1								
	Clayey sand (SC)		G-2	SC	--	--	14.1	--	--	47.0
2344.0	Medium dense, black, dry to moist, mostly fine to medium sand, some lean clay 2.5'	2								
2343.0	Poorly graded sand (SP)	3								
	BASE OF SOIL PROBE @ 3.0 FEET									
2342.0		4								
2341.0		5								
2340.0		6								
2339.0		7								
2338.0		8								
2337.0		9								
2336.0		10								
2335.0		11								
2334.0		12								
2333.0		13								
2332.0		14								
2331.0		15								
2330.0		16								
2329.0		17								
2328.0		18								
2327.0		19								
2326.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-2A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-2B
LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 3.5 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2346.00*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 1.0"									
2345.0	***ALLUVIUM*** Lean clay with sand (CL) Stiff, yellowish brown mottled with black, moist, mostly	1	G-1	CL	--	--	21.5	--	--	80.0
2344.0	lean clay, little fine sand 2.0'	2	G-2	CL	--	--	19.2	--	--	70.6
2343.0	Clayey sand (SC) Medium dense, yellowish brown mottled with black, moist, mostly fine sand, some lean clay 3.0'	3	G-3	SC	--	--	10.1	--	--	41.1
	Poorly graded sand (SP)									
2342.0	***BASE OF SOIL PROBE @ 3.5 FEET***	4								
2341.0		5								
2340.0		6								
2339.0		7								
2338.0		8								
2337.0		9								
2336.0		10								
2335.0		11								
2334.0		12								
2333.0		13								
2332.0		14								
2331.0		15								
2330.0		16								
2329.0		17								
2328.0		18								
2327.0		19								
2326.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-2B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1	**SOIL PROBE NO. SP-2C**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING

NE 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE AT 3.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2346.00

			TEST DATA							
ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 1.0"									
2345.0	***ALLUVIUM*** Lean clay with sand (CL) Stiff, yellowish brown, moist, mostly lean clay, few fine sand 1.5'	1	G-1	CL	--	--	18.7	--	--	74.2
2344.0	Lean clay (CL) Stiff, dark grayish brown, moist, mostly lean clay, few fine sand, iron 2.5'	2	G-2	CL	--	--	22.6	--	--	86.0
2343.0	Clayey sand (SC) Medium dense, grayish brown, moist, mostly fine sand, some lean clay	3	G-3	SC	--	--	15.5	--	--	41.0
2342.0	***BASE OF SOIL PROBE @ 3.5 FEET***	4								
2341.0		5								
2340.0		6								
2339.0		7								
2338.0		8								
2337.0		9								
2336.0		10								
2335.0		11								
2334.0		12								
2333.0		13								
2332.0		14								
2331.0		15								
2330.0		16								
2329.0		17								
2328.0		18								
2327.0		19								
2326.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**SOIL PROBE NO. SP-2C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 3	**BORING NO. B-3C**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2009
DATE FINISH:	3/26/2009
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	D. HUMANN
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

13.0' WHILE DRILLING

11.6' 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 50.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2342.92

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 1.0"									
2341.9	***ALLUVIUM*** Lean clay (CL)	1								
2340.9	Stiff, dark grayish brown, moist, mostly lean clay, little fine sand 2.0'	2	**U-1**	CL	--	31/20	19.5	98.1	--	86.3
2339.9		3								
2338.9	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, little silt, few fine sand, iron	4	**SS-2**	CL	3 2 3	--	24.7	--	--	93.5
2337.9		5								
2336.9		6								
2335.9	Lean clay with sand (CL) Firm, light grayish brown, very moist, mostly lean clay, little fine sand	7	**G-1**	CL	--	--	37.0	--	--	80.9
2334.9	8.0'	8								
2333.9	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine to coarse sand, trace fine gravel	9	**SS-3**	SP	8 7 6	--	2.6	--	--	2.5
2332.9		10								
2331.9	∇	11								
2330.9		12								
2329.9		13								
2328.9	Poorly graded sand with clay (SP/SC) Loose, yellowish brown, wet, mostly fine to coarse sand, few lean clay, trace fine gravel	14	**SS-4**	SP	1 0 3	--	10.1	--	--	9.3
2327.9		15								
2326.9		16								
2325.9		17								
2324.9		18								
2323.9	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to coarse sand, trace fine gravel	19	**SS-5**	SP	10 10 11	--	5.5	--	--	0.6
2322.9		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-3C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 3 **BORING NO. B-3C**

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2009
DATE FINISH:	3/26/2009
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	D. HUMANN
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

13.0' WHILE DRILLING
11.6' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 50.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2342.92

ALLUVIUM

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
2321.9		21								
2320.9		22								
2319.9		23								
2318.9	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand, trace fine gravel	24	SS-6	SP	4 5 8	--	4.9	--	--	2.3
2317.9		25								
2316.9		26								
2315.9		27								
2314.9		28								
2313.9	Poorly graded sand (SP) Loose, yellowish brown, wet, mostly fine to coarse sand, sand, trace fine gravel	29	SS-7	SP	6 7 8	--	7.8	--	--	1.9
2312.9		30								
2311.9		31								
2310.9		32								
2309.9		33								
2308.9	Sandy lean clay (CL) Stiff, yellowish brown, wet, mostly lean clay, some fine sand, few silt	34	SS-8	CL	4 4 5	--	31.5	--	--	61.7
2307.9		35								
2306.9		36								
2305.9		37								
2304.9		38								
2303.9	Sandy lean clay (CL) Stiff, yellowish brown, wet, mostly lean clay, some fine sand, few silt **39.5'**	39	SS-9	CL	4 6 12	--	32.2	--	--	59.8
2302.9	Poorly graded sand (SP)	40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-3C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 3 OF 3

BORING NO. B-3C

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/26/2009
DATE FINISH:	3/26/2009
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	D. HUMANN
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

13.0'	WHILE DRILLING	
11.6'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 50.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2342.92									
	ALLUVIUM									
2301.9		41								
2300.9		42								
2299.9		43								
2298.9	Clayey sand (SC) Medium dense, brown, wet, mostly fine to coarse sand, some lean clay **44.5'**	44	**SS-10**	SC	18 8 11	--	20.7	--	--	28.8
	WEATHERED OGALLALA FORMATION									
2297.9		45								
2296.9		46								
2295.9		47								
2294.9		48								
2293.9	Clayey sand (SC) Dense, olive brown, wet, mostly fine sand, some lean clay	49	**SS-11**	SC	20 20 16	--	23.8	--	--	29.0
2292.9		50								
	BASE OF BORING @ 50.0 FEET									
2291.9		51								
2290.9		52								
2289.9		53								
2288.9		54								
2287.9		55								
2286.9		56								
2285.9		57								
2284.9		58								
2283.9		59								
2282.9		60								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B-3C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-3A**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 4.5 FEET

	SOIL PROFILE		TEST DATA							
ELEV (ft)	***APPROX. SURFACE ELEV. (ft): 2343.00***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE 1.0"		G-1	SC	--	--	13.7	--	--	41.5
2342.0	***ALLUVIUM***	1	G-2	SC	--	--	7.0	--	--	20.9
2341.0	Clayey sand (SC)	2	G-3	SC	--	--	8.2	--	--	17.4
2340.0	Medium dense, dark yellowish brown, dry, mostly fine sand, little lean clay, trace medium sand	3								
2339.0		4								
2338.0	***BASE OF SOIL PROBE @ 4.5FEET***	5								
2337.0		6								
2336.0		7								
2335.0		8								
2334.0		9								
2333.0		10								
2332.0		11								
2331.0		12								
2330.0		13								
2329.0		14								
2328.0		15								
2327.0		16								
2326.0		17								
2325.0		18								
2324.0		19								
2323.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-3A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1

SOIL PROBE NO.	**SP-3B**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 7.6 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2343.00

DEVELOPED ZONE **1.0"**

ALLUVIUM Clayey sand (SC)
Medium dense, dark yellowish brown, dry, mostly fine sand, some lean clay **2.0'**

Sandy lean clay (CL)
Stiff, yellowish brown, moist, mostly lean clay, some fine sand **4.5'**

Lean clay with sand (CL)
Stiff, dark yellowish brown, moist, mostly lean clay, little fine sand, iron **7.5'**

Sandy lean clay (CL)

BASE OF SOIL PROBE @ 7.6 FEET

ELEV (ft)	DEPTH (ft)
2342.0	1
2341.0	2
2340.0	3
2339.0	4
2338.0	5
2337.0	6
2336.0	7
2335.0	8
2334.0	9
2333.0	10
2332.0	11
2331.0	12
2330.0	13
2329.0	14
2328.0	15
2327.0	16
2326.0	17
2325.0	18
2324.0	19
2323.0	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	16.2	--	--	54.4
G-2	SC	--	--	8.0	--	--	34.6
G-3	CL	--	--	11.5	--	--	60.5
G-4	CL	--	--	19.1	--	--	74.3
G-5	CL	--	--	19.4	--	--	80.7
G-6	CL	--	--	20.0	--	--	74.9
G-7	CL	--	--	18.0	--	--	62.4

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

SOIL PROBE NO. SP-3B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
11.0' WHILE DRILLING
9.7' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 25.0 FEET

PAGE 1 OF 2 **BORING NO. B- 4B**
LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

			TEST DATA							
ELEV (ft)	**SOIL PROFILE** ***APPROX. SURFACE ELEV. (ft): 2340.23***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE 1.0"									
2339.2	***ALLUVIUM*** Clayey sand (SC) Medium dense, yellowish brown, dry, mostly fine sand, some lean clay, few silt 2.0'	1	Surface	CL	--	31/18	19.2	98.7	--	53.3
2338.2		2	U-1	SC	--	--	8.9	95.0	--	44.0
2337.2		3								
2336.2	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine to medium sand	4	SS-2	SP	5 6 6	--	1.5	--	--	3.1
2335.2		5								
2334.2		6								
2333.2		7								
2332.2		8								
2331.2	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine to medium sand, trace coarse sand	9	SS-3	SP	6 6 10	--	1.5	--	--	1.4
2330.2	∇	10								
2329.2		11								
2328.2		12								
2327.2		13								
2326.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	14	SS-4	SP	5 5 8	--	11.0	--	--	0.9
2325.2		15								
2324.2		16								
2323.2		17								
2322.2		18								
2321.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to medium sand	19	SS-5	SP	9 11 17	--	13.2	--	--	0.7
2320.2		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER
NE - Not Encountered
NP - Not Performed

BORING NO. B- 4B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 2 OF 2

BORING NO. B- 4B

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
11.0' WHILE DRILLING
9.7' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 25.0 FEET

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	APPROX. SURFACE ELEV. (ft): 2340.23									
	ALLUVIUM									
2319.2		21								
2318.2		22								
2317.2		23								
2316.2	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	24	**SS-6**	SP	4 6 9	--	9.3	--	--	0.8
2315.2		25								
	BASE OF BORING @ 26.5 FEET									
2314.2		26								
2313.2		27								
2312.2		28								
2311.2		29								
2310.2		30								
2309.2		31								
2308.2		32								
2307.2		33								
2306.2		34								
2305.2		35								
2304.2		36								
2303.2		37								
2302.2		38								
2301.2		39								
2300.2		40								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B- 4B**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-4A**
LOCATION:	AREA 2
LAT/LONG:	N--˚--'--", W--˚--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING

NE 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 5.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2341.00*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2340.0	***ALLUVIUM*** Sandy lean clay (CL) Firm, dark yellowish brown, moist, mostly lean clay, some sand **1.0'**	1	G-1	CL	--	--	17.0	--	--	59.0
2339.0	Clayey sand (SC) Medium dense, yellowish brown, moist, mostly fine sand, some lean clay, iron **2.0'**	2	G-2	SC	--	--	12.6	--	--	47.9
2338.0	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine sand	3								
2337.0		4								
2336.0		5								
	BASE OF SOIL PROBE @ 5.0 FEET									
2335.0	Driller's Note: 1-inch developed zone encountered at the surface	6								
2334.0		7								
2333.0		8								
2332.0		9								
2331.0		10								
2330.0		11								
2329.0		12								
2328.0		13								
2327.0		14								
2326.0		15								
2325.0		16								
2324.0		17								
2323.0		18								
2322.0		19								
2321.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**SOIL PROBE NO. SP-4A**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-4C**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 5.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2341.00									
	DEVELOPED ZONE 1.0"		G-1	SC	--	--	11.7	--	--	40.8
2340.0	***ALLUVIUM*** Clayey sand (SC) Medium dense, dark yellowish brown, dry to moist, mostly fine sand, some lean clay 2.0'	1	G-2	SC	--	--	8.3	--	--	28.3
2339.0	Poorly graded sand (SP)	2								
2338.0	***BASE OF SOIL PROBE @ 2.2 FEET***	3								
2337.0		4								
2336.0		5								
2335.0		6								
2334.0		7								
2333.0		8								
2332.0		9								
2331.0		10								
2330.0		11								
2329.0		12								
2328.0		13								
2327.0		14								
2326.0		15								
2325.0		16								
2324.0		17								
2323.0		18								
2322.0		19								
2321.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-4C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PAGE 1 OF 1 **SOIL PROBE NO. SP-5A**

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2356.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)
2355.0	*DEVELOPED ZONE* 1.0'	1
2354.0	*ALLUVIUM*	2
2353.0	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, few fine sand	3
2352.0		4
2351.0		5
2350.0		6
2349.0	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, few fine sand	7
2348.0		8
2347.0		9
2346.0	10.0'	10
2345.0	Poorly graded sand (SP) *BASE OF SOIL PROBE @ 10.5 FEET*	11
2344.0		12
2343.0		13
2342.0		14
2341.0		15
2340.0		16
2339.0		17
2338.0		18
2337.0		19
2336.0		20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	--	--	--	25.8	--	--	95.0
G-2	--	--	--	24.0	--	--	96.2
G-3	--	--	--	20.8	--	--	95.2
G-4	--	--	--	25.3	--	--	97.8
G-5	--	--	--	23.0	--	--	91.8
G-6	--	--	--	21.5	--	--	94.6
G-7	--	--	--	21.8	--	--	82.5
G-8	--	--	--	24.8	--	--	87.3

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-5A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

SOIL PROBE NO. SP-5B

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 9.5 FEET

			TEST DATA							
ELEV (ft)	SOIL PROFILE ***APPROX. SURFACE ELEV. (ft): 2356.00***	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE									
2355.0	1.0'	1								
2354.0	***ALLUVIUM*** Lean clay with sand (CL) Stiff, very dark grayish brown, moist, mostly lean clay, little fine sand	2	G-1	CL	--	35/20	23.0	--	--	82.7
2353.0		3								
2352.0	3.5'	4	G-2	CL	--	--	21.5	--	--	97.5
2351.0	Lean clay (CL) Stiff, yellowish brown, very moist, mostly lean clay, trace fine sand	5	G-3	CL	--	--	25.2	--	--	95.2
2350.0		6								
2349.0		7	G-4	CL	--	--	23.0	--	--	93.6
2348.0	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, few fine sand	8	G-5	CL	--	--	20.8	--	--	94.7
2347.0		9								
2346.0	***BASE OF SOIL PROBE @ 9.5 FEET***	10								
2345.0		11								
2344.0		12								
2343.0		13								
2342.0		14								
2341.0		15								
2340.0		16								
2339.0		17								
2338.0		18								
2337.0		19								
2336.0		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

SOIL PROBE NO. SP-5B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1
SOIL PROBE NO. SP-5C

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.2 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2356.00

TEST DATA

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2355.0	*DEVELOPED ZONE* 1.0'	1	G-1	CL	--	--	--	--	--	--
2354.0	*ALLUVIUM*	2	G-2	CL	--	--	23.2	--	--	89.8
2353.0	Lean clay (CL) Stiff, dark yellowish brown mottled with dark brown, moist, mostly lean cay, few fine sand	3								
2352.0		4	G-3	CL	--	35/20	23.2	--	--	94.2
2351.0	5.0'	5								
2350.0		6	G-4	CL	--	--	15.6	--	--	95.7
2349.0	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	7	G-5	CL	--	--	20.9	--	--	98.5
2348.0		8	G-6	CL	--	--	21.2	--	--	80.7
2347.0		9	G-7	CL	--	--	21.7	--	--	94.4
2346.0	10.0'	10								
2345.0	Poorly graded sand (SP) *BASE OF SOIL PROBE @ 10.2 FEET*	11								
2344.0		12								
2343.0		13								
2342.0		14								
2341.0		15								
2340.0		16								
2339.0		17								
2338.0		18								
2337.0		19								
2336.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-5C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1	**BORING NO. B-6A**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 18.5 FEET

TEST DATA

ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	APPROX. SURFACE ELEV. (ft): 2359.50									
	DEVELOPED ZONE									
2358.5	1.0'	1								
	ALLUVIUM									
2357.5		2								
2356.5	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	3								
2355.5		4								
2354.5		5								
2353.5		6								
2352.5		7								
2351.5	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	8								
2350.5		9								
2349.5		10								
2348.5		11								
2347.5		12								
2346.5		13								
2345.5		14								
2344.5	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, trace fine sand	15								
2343.5		16								
2342.5		17								
2341.5		18								
2340.5	***BASE OF BORING @ 18.5 FEET***	19								
2339.5		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-6A**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-6C

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 15.0 FEET

ELEV (ft)	**SOIL PROFILE** *APPROX. SURFACE ELEV. (ft): 2359.45*	DEPTH (ft)	**TEST DATA** SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE									
2358.5	1.0'	1								
2357.5	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, trace fine sand	2	U-1	CL	--	31/21	21.4	82.0	--	95.2
2356.5		3								
2355.5	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, little fine sand	4	U-2	CL	--	32/18	20.8	79.0	--	88.6
2354.5		5								
2353.5		6								
2352.5		7								
2351.5		8								
2350.5	Silty lean clay with sand (CL/ML) Stiff, dark brown mottled with yellowish brown, moist, mostly silty lean clay, some fine sand	9	U-3	CL/ML	--	25/19	16.0	103.1	--	73.6
2349.5		10								
2348.5		11								
2347.5		12								
2346.5		13								
2345.5	Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, little silt, trace fine sand	14	U-4	CL	--	--	26.2	93.5	0.4	--
2344.5		15								
	BASE OF BORING @ 15.0 FEET									
2343.5		16								
2342.5		17								
2341.5		18								
2340.5		19								
2339.5		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-6C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1

BORING NO. B-7A

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 18.5 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2358.40*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE									
2357.4	**1.0'**	1								
	ALLUVIUM									
2356.4		2								
2355.4	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	3								
2354.4		4								
2353.4		5								
2352.4		6								
2351.4		7								
2350.4	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	8								
2349.4		9								
2348.4		10								
2347.4		11								
2346.4		12								
2345.4		13								
2344.4		14								
2343.4		15								
2342.4	Lean clay (CL) Stiff, yellowish brown, moist, mostly lean clay, trace fine sand	16								
2341.4		17								
2340.4		18								
2339.4	***BASE OF BORING @ 18.5 FEET***	19								
2338.4		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-7A

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2	**BORING NO. B- 7C**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

21.5'	WHILE DRILLING	
23.0'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 26.5 FEET

	SOIL PROFILE		**TEST DATA**							
ELEV (ft)	***APPROX. SURFACE ELEV. (ft): 2358.43***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE									
2357.4	**1.0'**	1								
2356.4	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, few fine sand	2	U-1	CL	--	31/21	21.8	78.8	--	92.5
2355.4		3								
2354.4	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, few fine sand	4	U-2	CL	--	30/19	21.6	83.7	--	92.8
2353.4		5								
2352.4		6								
2351.4		7								
2350.4		8								
2349.4	Lean clay (CL) Firm, yellowish brown, very moist, mostly lean clay, few fine sand	9	U-3	CL	--	--	29.5	83.5	0.4	--
2348.4		10								
2347.4		11								
2346.4		12								
2345.4		13								
2344.4	Lean clay with sand (CL) Firm, yellowish brown, moist, mostly lean clay, little fine sand	14	SS-4	CL	1 2 4	--	20.4	--	--	81.0
2343.4		15								
2342.4		16								
2341.4		17								
2340.4	**18.5'**	18								
2339.4	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, trace fine sand	19	U-5	CL	--	--	--	--	--	--
2338.4		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B- 7C**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B- 7C**

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
21.5' WHILE DRILLING
23.0' 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 26.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2358.43

			TEST DATA							
ELEV (ft)	**SOIL PROFILE**	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	ALLUVIUM									
2337.4		**21**								
2336.4		**22**								
2335.4	∇	**23**								
	23.5'									
2334.4	Clayey sand (SC) Loose, yellowish brown, wet, mostly fine to coarse sand, little lean clay **25.0'**	**24**	**SS-6**	SC	1 2 5	--	13.3	--	--	19.4
2333.4		**25**								
2332.4	Poorly graded sand with clay (SP/SC) Loose, yellowish brown, wet, mostly fine to coarse sand, few lean clay	**26**	**SS-7**	SP/SC	2 1 2	--	6.2	--	--	9.0
2331.4	***BASE OF BORING @ 26.5 FEET***	**27**								
2330.4		**28**								
2329.4		**29**								
2328.4		**30**								
2327.4		**31**								
2326.4		**32**								
2325.4		**33**								
2324.4		**34**								
2323.4		**35**								
2322.4		**36**								
2321.4		**37**								
2320.4		**38**								
2319.4		**39**								
2318.4		**40**								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 7C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 2

BORING NO. B- 8B

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER

7.5'	WHILE DRILLING	
8.8'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 25.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2342.40									
	DEVELOPED ZONE **6.0"**									
2341.4	***ALLUVIUM*** Lean clay (CL) Stiff, dark brown, moist, mostly lean clay, few silt, trace fine sand **1.5'**	1								
2340.4	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, trace fine sand, iron	2	**U-1**	SC	--	--	20.0	90.2	--	97.3
2339.4		3								
2338.4	Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, few fine sand, iron	4	**SS-2**	SC	2 2 5	--	24.4	--	--	93.9
2337.4		5								
2336.4		6								
2335.4	**7.5'**	7								
2334.4	∇ Lean clay with sand (CL) Soft, yellowish brown mottled with dark brown, very moist, mostly lean clay, little fine sand **9.0'**	8								
2333.4		9	**NR-3**	SC	--	--	--	--	--	--
2332.4	Clayey sand (SC) Loose, dark yellowish brown mottled with grayish brown, wet, mostly fine sand, some lean clay	10								
2331.4		11	**SS-3**	SC	1 2 2	--	16.7	--	--	41.4
2330.4		12								
2329.4		13								
2328.4	Clayey sand (SC) Loose, dark yellowish brown mottled with grayish brown, wet, mostly fine sand, little lean clay	14	**SS-4**	SC	1 1 3	--	11.4	--	--	13.1
2327.4		15								
2326.4		16								
2325.4	**17.0'**	17								
2324.4		18								
2323.4	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	19	**U-5**	SP	3 7 11	--	11.7	--	--	1.5
2322.4		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 8B

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 2 OF 2

BORING NO. B- 8B

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

7.5'	WHILE DRILLING	
8.8'	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 25.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2342.40									
	ALLUVIUM									
2321.4		21								
2320.4		22								
2319.4		23								
2318.4	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, wet, mostly fine to coarse sand, few lean clay	24	**SS-6**	SP/SC	7 10 14	--	4.5	--	--	11.1
2317.4		25								
	BASE OF BORING @ 26.5 FEET									
2316.4		26								
2315.4		27								
2314.4		28								
2313.4		29								
2312.4		30								
2311.4		31								
2310.4		32								
2309.4		33								
2308.4		34								
2307.4		35								
2306.4		36								
2305.4		37								
2304.4		38								
2303.4		39								
2302.4		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B- 8B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-8A**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF SOIL PROBE
AT 18.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2343.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	ALLUVIUM Lean clay (CL) Firm, very dark grayish brown, moist, mostly lean clay, few fine sand **1.0'**									
2342.0		1								
2341.0	Lean clay with sand (CL) Firm, dark yellowish brown, moist, mostly lean clay, little fine sand	2								
2340.0		3								
2339.0		4								
2338.0		5								
	BASE OF SOIL PROBE @ 5.0 FEET									
2337.0		6								
	Driller's Note: 6-inch developed zone encountered at the surface									
2336.0		7								
2335.0		8								
2334.0		9								
2333.0		10								
2332.0		11								
2331.0		12								
2330.0		13								
2329.0		14								
2328.0		15								
2327.0		16								
2326.0		17								
2325.0		18								
2324.0		19								
2323.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-8A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO.** **SP-8C**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING

NE 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 18.5 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2348.00									
	DEVELOPED ZONE **6.0"**									
2347.0	***ALLUVIUM*** Lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, trace fine sand, iron **2.0'**	1								
2346.0		2								
2345.0	Sandy lean clay (CL) Firm, yellowish brown, moist, mostly lean clay, little fine sand	3								
2344.0		4								
2343.0		5								
	BASE OF SOIL PROBE @ 5.0 FEET									
2342.0		6								
2341.0		7								
2340.0		8								
2339.0		9								
2338.0		10								
2337.0		11								
2336.0		12								
2335.0		13								
2334.0		14								
2333.0		15								
2332.0		16								
2331.0		17								
2330.0		18								
2329.0		19								
2328.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-8C

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**SOIL PROBE NO. SP-9A**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	SOIL PROBE
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2347.30

DEVELOPED ZONE 6.0"

ALLUVIUM

Lean clay with sand (CL)
Firm, yellowish brown, moist, mostly lean clay, little fine to medium sand

Lean clay (CL)
Firm, yellowish brown, moist, mostly lean clay, little fine to medium sand

6.5'

Poorly graded sand (SP)
Medium dense, yellowish brown, moist, mostly fine to medium sand

BASE OF SOIL PROBE @ 10.0 FEET

ELEV (ft)	DEPTH (ft)
2346.3	1
2345.3	2
2344.3	3
2343.3	4
2342.3	5
2341.3	6
2340.3	7
2339.3	8
2338.3	9
2337.3	10
2336.3	11
2335.3	12
2334.3	13
2333.3	14
2332.3	15
2331.3	16
2330.3	17
2329.3	18
2328.3	19
2327.3	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	17.6	--	--	79.6
G-2	CL	--	--	16.2	--	--	76.8
G-3	CL	--	--	19.0	--	--	91.9
G-4	CL	--	--	18.1	--	--	85.0
G-5	CL	--	--	20.6	--	--	91.0

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

SOIL PROBE NO. SP-9A

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

SOIL PROBE NO. SP-9B

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.0 FEET

			TEST DATA							
ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2347.30*	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE **6.0"**									
2346.3	***ALLUVIUM*** Lean clay (CL)	1	G-1	CL	--	--	23.6	--	--	92.7
2345.3	Stiff, dark brown, very moist, mostly lean clay, few fine sand **2.0'**	2	G-2	CL	--	--	26.4	--	--	89.0
2344.3		3	G-3	CL	--	--	29.4	--	--	87.9
2343.3	Lean clay with sand (CL) Stiff, grayish brown, very moist, mostly lean clay, little fine sand	4	G-4	CL	--	--	26.9	--	--	74.7
2342.3		5								
2341.3	**6.0'**	6	G-5	CL	--	--	30.4	--	--	82.6
2340.3	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine sand	7								
2339.3		8								
2338.3		9								
2337.3		10								
2336.3	***BASE OF SOIL PROBE @ 10.0 FEET***	11								
2335.3		12								
2334.3		13								
2333.3		14								
2332.3		15								
2331.3		16								
2330.3		17								
2329.3		18								
2328.3		19								
2327.3		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-9B

OLSSON ASSOCIATES

SOIL PROBE REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1 **SOIL PROBE NO. SP-9C**

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: SOIL PROBE
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF SOIL PROBE
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	APPROX. SURFACE ELEV. (ft): 2347.30									
	DEVELOPED ZONE **6.0"**									
2346.3	***ALLUVIUM***	1								
2345.3	Lean clay with sand (CL) Stiff, dark brown, very moist, mostly lean clay, little fine sand	2	G-1	CL	--	35/17	28.1	--	--	75.7
2344.3		3								
2343.3	**4.0'**	4	G-2	CL	--	--	20.5	--	--	81.0
2342.3	Lean clay with sand (CL) Stiff, dark yellowish brown, moist, mostly lean clay, little fine sand	5	G-3	CL	--	--	16.5	--	--	73.1
2341.3	**6.0'**	6	G-4	CL	--	--	17.6	--	--	69.9
2340.3	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to medium sand	7								
2339.3		8								
2338.3		9								
2337.3		10								
	BASE OF SOIL PROBE @ 10.0 FEET									
2336.3		11								
2335.3		12								
2334.3		13								
2333.3		14								
2332.3		15								
2331.3		16								
2330.3		17								
2329.3		18								
2328.3		19								
2327.3		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

SOIL PROBE NO. SP-9C

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1 **BORING NO. B-10**

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA							
			SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2355.05									
	DEVELOPED ZONE									
2354.1	**1.0'**	1								
	ALLUVIUM Lean clay (CL)									
2353.1	Firm, yellowish brown, moist, mostly lean clay, little silt, few fine sand	2	**U-1**	CL	--	36/17	23.5	92.7	--	94.5
2352.1		3								
2351.1	Lean clay (CL)	4								
	Firm, yellowish brown, moist, mostly lean clay, little silt, few fine sand		**U-2**	CL	--	29/20	21.3	93.5	0.5	92.7
2350.1		5								
2349.1		6								
2348.1		7								
2347.1		8								
2346.1	Sandy lean clay (CL)	9								
	Firm, yellowish brown mottled with dark brown, very moist, mostly lean clay, some fine sand		**U-3**	CL	--	31/16	25.4	84.6	0.5	57.2
2345.1		10								
	BASE OF BORING @ 10.0 FEET									
2344.1		11								
2343.1		12								
2342.1		13								
2341.1		14								
2340.1		15								
2339.1		16								
2338.1		17								
2337.1		18								
2336.1		19								
2335.1		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-10

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-11

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2345.66									
	DEVELOPED ZONE 6.0"									
2344.7	***ALLUVIUM***	1								
2343.7	Lean clay with sand (CL) Firm, yellowish brown, very moist, mostly lean clay, little fine sand	2	U-1	CL	--	--	27.5	89.6	--	81.9
2342.7		3								
2341.7	Lean clay with sand (CL) Firm, yellowish brown, very moist, mostly lean clay, little fine sand 5.0'	4	SS-2	CL	3 3 4	44/19	32.2	--	--	80.2
2340.7		5								
2339.7		6								
2338.7		7								
2337.7		8								
2336.7	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown, dry, mostly fine to coarse sand, few lean clay	9	SS-3	SP/SC	7 9 11	--	4.0	--	--	5.1
2335.7		10								
	BASE OF BORING @ 10.0 FEET									
2334.7		11								
2333.7		12								
2332.7		13								
2331.7		14								
2330.7		15								
2329.7		16								
2328.7		17								
2327.7		18								
2326.7		19								
2325.7		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-11

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1	**BORING NO. B-12**
LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/28/2010
DATE FINISH:	3/28/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	▽
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2344.21									
	DEVELOPED ZONE 6.0"									
2343.2	*ALLUVIUM*	1								
	Lean clay (CL)									
2342.2	Soft, dark yellowish brown, very moist, mostly lean clay, few fine sand	2	U-1	CL	--	31/22	25.2	90.3	0.2	91.6
2341.2		3								
	3.5'									
2340.2	Clayey sand (SC)	4								
	Loose, very dark grayish brown, moist, mostly fine sand, some lean clay		U-2	SC	--	37/16	18.7	98.2	--	37.1
2339.2		5								
2338.2		6								
2337.2		7								
	7.5'									
2336.2		8								
2335.2	Poorly graded sand (SP)	9	SS-3	SP	6 6 8	--	--	--	--	--
2334.2	Medium dense, yellowish brown, moist, mostly fine to medium sand, trace coarse sand	10								
	BASE OF BORING @ 10.0 FEET									
2333.2		11								
2332.2		12								
2331.2		13								
2330.2		14								
2329.2		15								
2328.2		16								
2327.2		17								
2326.2		18								
2325.2		19								
2324.2		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B-12

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-13

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/28/2010
DATE FINISH: 3/28/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

			TEST DATA							
ELEV (ft)	**SOIL PROFILE** ***APPROX. SURFACE ELEV. (ft): 2341.84***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE 1.0"									
2340.8	***ALLUVIUM***	1								
2339.8	Lean clay with sand (CL) Stiff, dark yellowish brown, very moist, mostly lean clay, little fine sand	2	U-1	CL	--	35/20	25.9	90.7	0.5	83.8
2338.8		3								
2337.8	4.0'	4	SS-2	SP	4 6 7	--	2.9	--	--	1.3
2336.8	Poorly graded sand (SP) Medium dense, yellowish brown, dry to moist, mostly fine to medium sand, trace coarse sand	5								
2335.8		6								
2334.8		7								
2333.8		8								
2332.8	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to coarse sand, trace fine gravel	9	SS-3	SP	7 9 10	--	--	--	--	2.5
2331.8	***BASE OF BORING @ 10.0 FEET***	10								
2330.8		11								
2329.8		12								
2328.8		13								
2327.8		14								
2326.8		15								
2325.8		16								
2324.8		17								
2323.8		18								
2322.8		19								
2321.8		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER
NE - Not Encountered
NP - Not Performed

BORING NO. B-13

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1			**BORING NO. B-14**
LOCATION:	AREA 2		
LAT/LONG:	N--°--'--", W--°--'--"		
JOB NO.:	A09-1466		
DATE START:	3/28/2010		
DATE FINISH:	3/28/2010		
DRILL COMPANY:	OLSSON ASSOCIATES		
EQUIPMENT USED:	CME 55		
DRILLED BY:	A. SNOOK		
PREPARED BY:	S. JENSEN		

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

7.5' WHILE DRILLING

NP 0 HOURS AFTER COMP. ∇

NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE *APPROX. SURFACE ELEV. (ft): 2341.83*	DEPTH (ft)	TEST DATA SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 6.0"									
2340.8	***ALLUVIUM***	1								
2339.8	Lean clay with sand (CL) Firm, yellowish brown, very moist, mostly lean clay, little fine sand **2.5'**	2	**U-1**	CL	--	30/19	25.4	96.6	--	79.5
2338.8	Clayey sand (SC) Loose, dark yellowish brown mottled with dark gray, very moist, mostly fine sand, some lean clay	3								
2337.8	**4.5'**	4	**SS-2**	SC	6 8 9	--	15.5	--	--	45.4
2336.8	Poorly graded sand (SP) Medium dense, yellowish brown, moist, mostly fine to coarse sand	5								
2335.8		6								
2334.8	∇	7								
2333.8		8								
2332.8	Poorly graded sand (SP) Medium dense, yellowish brown, wet, mostly fine to coarse sand	9	**SS-3**	SP	4 4 5	--	--	--	--	--
2331.8		10								
	BASE OF BORING @ 10.0 FEET									
2330.8		11								
2329.8		12								
2328.8		13								
2327.8		14								
2326.8		15								
2325.8		16								
2324.8		17								
2323.8		18								
2322.8		19								
2321.8		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-14**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1

BORING NO. B-15

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ▽
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

			TEST DATA							
ELEV (ft)	**SOIL PROFILE** ***APPROX. SURFACE ELEV. (ft): 2346.20***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE 6.0"									
2345.2	***FILL*** Lean clay (CL)	1								
2344.2	Soft, grayish brown, very moist, mostly lean clay, few fine sand 2.0'	2	SS-1	CL	1 1 2	--	27.2	--	--	91.6
2343.2	Lean clay (CL) Firm, dark brown, very moist, mostly lean clay, few fine sand	3								
2342.2	4.0'	4								
2341.2	***ALLUVIUM*** Sandy fat clay (CH) Stiff, yellowish brown, very moist, mostly fat clay, some fine to medium sand 5.5'	5	U-2	CH	--	50/20	35.9	80.8	0.3	57.0
2340.2		6								
2339.2		7								
2338.2		8								
2337.2	Lean clay (CL)	9								
2336.2	Stiff, yellowish brown, dry to moist, mostly lean clay, few fine to medium sand	10	SS-3	CL	7 7 8	--	9.3	--	--	94.1
	BASE OF BORING @ 10.0 FEET									
2335.2		11								
2334.2		12								
2333.2		13								
2332.2		14								
2331.2		15								
2330.2		16								
2329.2		17								
2328.2		18								
2327.2		19								
2326.2		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	**BORING NO. B-15**
		>30	Hard	NR	NO RECOVERY			

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1

BORING NO. B-16

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

	SOIL PROFILE		**TEST DATA**							
ELEV (ft)	***APPROX. SURFACE ELEV. (ft): 2346.96***	**DEPTH (ft)**	**SAMPLE**	**CLASSIFICATION (USCS)**	**SPT BLOW COUNTS**	**LL/PL (%)**	**MOISTURE (%)**	**DRY DENSITY (pcf)**	**Qu (UNCONF. STR.) (tsf)**	**PASSING #200 SIEVE (%)**
	DEVELOPED ZONE 6.0"									
2346.0	***ALLUVIUM***	1								
2345.0	Lean clay (CL) Stiff, dark brown, very moist, mostly lean clay, trace fine sand	2	U-1	CL	--	37/18	27.3	92.4	--	96.9
2344.0		3								
2343.0	Lean clay (CL) Stiff, dark brown, very moist, mostly silty lean clay, few fine sand	4	U-2	CL	--	45/18	27.6	93.4	--	88.9
2342.0		5								
2341.0	6.0'	6								
2340.0	Clayey sand (SC) Medium dense, grayish brown, moist, mostly fine to medium sand, some lean clay	7								
2339.0	8.5'	8								
2338.0	Clayey sand (SC) Medium dense, gray mottled with yellowish brown, dry to moist, mostly fine to coarse sand, some lean clay, few silt	9	SS-3	SC	7 3 7	--	12.5	--	--	31.2
2337.0	***BASE OF BORING @ 10.0 FEET***	10								
2336.0		11								
2335.0		12								
2334.0		13								
2333.0		14								
2332.0		15								
2331.0		16								
2330.0		17								
2329.0		18								
2328.0		19								
2327.0		20								

BLOWS/FT	**DENSITY**	**BLOWS/FT**	**CONSISTENCY**	**SAMPLE ID.**		**COMPONENT %**		**GROUNDWATER**
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-16

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

PAGE 1 OF 1

BORING NO. B-17

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

DEPTH TO GROUNDWATER
NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2346.20									
	DEVELOPED ZONE 6.0"									
2345.2	***ALLUVIUM***	1								
	Sandy lean clay (CL)									
2344.2	Stiff, dark brown, moist, mostly lean clay, some fine sand 2.5'	2	U-1	CL	--	23/14	19.4	107.0	--	63.2
2343.2		3								
2342.2	Sandy lean clay (CL)	4	U-2	CL	4 5 7	--	17.2	--	--	66.6
2341.2	Stiff, yellowish brown, moist, mostly lean clay, some fine sand 5.5'	5								
2340.2		6								
2339.2		7								
2338.2		8								
2337.2	Clayey sand (SC)	9	SS-3	SC	3 4 6	--	7.8	--	--	15.4
2336.2	Medium dense, yellowish brown, dry to moist, mostly fine to medium sand, little lean clay	10								
	BASE OF BORING @ 10.0 FEET									
2335.2		11								
2334.2		12								
2333.2		13								
2332.2		14								
2331.2		15								
2330.2		16								
2329.2		17								
2328.2		18								
2327.2		19								
2326.2		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-17

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1

BORING NO. B-18

LOCATION: AREA 2
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: A09-1466
DATE START: 3/30/2010
DATE FINISH: 3/30/2010
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 55
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP. ∇
NP 24 HOURS AFTER COMP. ▼

BASE OF BORING
AT 10.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 2344.36									
	DEVELOPED ZONE 6.0"									
2343.4	***ALLUVIUM***	1								
2342.4	Silty lean clay with sand (CL/ML) Firm, yellowish brown, moist, mostly silty lean clay, some fine sand, iron	2	U-1	CL/ML	--	24/19	23.5	99.2	0.7	72.2
2341.4		3								
2340.4	Silty lean clay (CL/ML) Stiff, yellowish brown, very moist, mostly silty lean clay, little fine sand, iron	4	U-2	CL/ML	--	--	26.1	97.8	--	89.8
2339.4		5								
2338.4		6								
2337.4	7.0'	7								
2336.4		8								
2335.4	Poorly graded sand with clay (SP/SC) Medium dense, yellowish brown mottled with gray, dry to moist, mostly fine to coarse sand, few lean clay	9	SS-3	SP/SC	5 9 11	--	6.5	--	--	6.9
2334.4	***BASE OF BORING @ 10.0 FEET***	10								
2333.4		11								
2332.4		12								
2331.4		13								
2330.4		14								
2329.4		15								
2328.4		16								
2327.4		17								
2326.4		18								
2325.4		19								
2324.4		20								

BLOWS/FT	DENSITY
0-3	Very Loose
4-9	Loose
10-29	Med. Dense
30-49	Dense
>49	Very Dense

BLOWS/FT	CONSISTENCY
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER

NE - Not Encountered
NP - Not Performed

BORING NO. B-18

OLSSON ASSOCIATES

SOIL TEST PROBE REPORT

PAGE 1 OF 1
SOIL PROBE NO. SP-19

LOCATION:	AREA 2
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	A09-1466
DATE START:	3/30/2010
DATE FINISH:	3/30/2010
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 55
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: CNPPID REREGULATING RESERVOIR FEASIBILITY STUDY

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF PROBE
AT 10.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 2340.00

DEVELOPED ZONE — 1.0'

ALLUVIUM Sandy lean clay (CL)
Stiff, dark yellowish brown, moist, mostly lean clay, trace fine sand — 2.5'

Lean clay with sand (CL)
Firm, dark yellowish brown, moist, mostly lean clay, little fine sand

Lean clay with sand (CL)
Firm, dark yellowish brown, moist, mostly lean clay, little fine sand — 9.5'

Poorly graded sand (SP)

BASE OF PROBE @ 10.0 FEET

ELEV (ft)	DEPTH (ft)
2339.0	1
2338.0	2
2337.0	3
2336.0	4
2335.0	5
2334.0	6
2333.0	7
2332.0	8
2331.0	9
2330.0	10
2329.0	11
2328.0	12
2327.0	13
2326.0	14
2325.0	15
2324.0	16
2323.0	17
2322.0	18
2321.0	19
2320.0	20

TEST DATA

SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
G-1	CL	--	--	27.0	--	--	91.3
G-2	CL	--	28/16	24.0	--	--	74.6
G-3	CL	--	--	19.2	--	--	65.9
G-4	CL	--	--	22.7	--	--	82.0

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0-3	Very Loose	0-1	Very Soft
4-9	Loose	2-4	Soft
10-29	Med. Dense	5-8	Firm
30-49	Dense	9-15	Stiff
>49	Very Dense	16-30	Very Stiff
		>30	Hard

SAMPLE ID.	
SS	SPLIT SPOON
U	TUBE
CA	CALIFORNIA
G	GRAB SAMPLE
X	OTHER
NR	NO RECOVERY

COMPONENT %	
MOSTLY	50-100%
SOME	30-45%
LITTLE	15-25%
FEW	5-10%
TRACE	<5%

GROUNDWATER
NE - Not Encountered
NP - Not Performed

PROBE NO. SP-19

APPENDIX F

AREA 2

Summary of Laboratory Test Results

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA
OA Project #: A09-1466

BORING	SAMPLE	SAMPLE	MOISTURE	DRY	VOID	SAT.	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS	%Passing
No.	I.D.	DEPTH (ft.)	CONTENT (%)	DENSITY (pcf)	RATIO	(%)	STRENGTH (tsf)	STRAIN (%)	LL	PL	PI	CLASS.	#200 Sieve
AREA 2													
SP-1A	G-1	0-1.0'	24.9										88.8
	G-2	1-2.0'	26.8										94.8
	G-3	2-3.0'	28.0										90.9
	G-4	3-5.0'	23.1										67.5
SP-1B	G-1	0-1.0'	24.4										91.7
	G-2	1-2.0'	28.2										89.1
	G-3	2-4.0'	25.7										65.2
SP-1C	G-1	0-1.0'	23.4										89.4
	G-2	1-2.0'	25.9										93.8
	G-3	2-3.0'	24.7										91.5
	G-4	3-5.0'	30.0										70.8
SP-2A	G-1	0-1.0'	22.8										85.7
	G-2	1-2.0'	14.1										47.0
SP-2B	G-1	0-1.0'	21.5										80.0
	G-2	1-2.0'	19.2										70.6
	G-3	2-3.0'	10.1										41.1
SP-2C	G-1	0-1.0'	18.7										74.2
	G-2	1-2.0'	22.6										86.0
	G-3	2-3.0'	15.5										41.0
B-3C	U-1	1-2.5'	19.5	98.1	0.717	73.4			31	20	11	CL	86.3
	SS-2	3.5-5'	24.7										93.5
	G-1	6-7.5'	37.0										80.9
	SS-3	8.5-10'	2.6										2.5
	SS-4	13.5-15'	10.1										9.3
	SS-5	18.5-20'	5.5										0.6
	SS-6	23.5-25'	4.9										2.3
	SS-7	28.5-30'	7.8										1.9
	SS-8	33.5-35'	31.5										61.7
	SS-9	38.5-40'	32.2										59.8
	SS-10	43.5-45'	20.7										28.8
	SS-11	48.5-50'	23.8										29.0

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA
OA Project #: A09-1466

BORING	SAMPLE	SAMPLE	MOISTURE	DRY	VOID	SAT.	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS	%Passing
No.	I.D.	DEPTH (ft.)	CONTENT (%)	DENSITY (pcf)	RATIO	(%)	STRENGTH (tsf)	STRAIN (%)	LL	PL	PI	CLASS.	#200 Sieve
SP-3A	G-1	0-1.0'	13.7										41.5
	G-2	1-2.0'	7.0										20.9
	G-3	2-3.0'	8.2										17.4
SP-3B	G-1	0-1.0'	16.2										54.4
	G-2	1-2.0'	8.0										34.6
	G-3	2-3.0'	11.5										60.5
	G-4	3-4.0'	19.1										74.3
	G-5	4-5.0'	19.4										80.7
	G-6	5-7.0'	20.0										74.9
	G-7	7-7.5'	18.0										62.4
B-4B	Surface	0-1.0'	19.2	98.7	0.707	73.4			31	18	13	CL	53.3
	U-1	1-2.5'	8.9	95.0	0.774	31.2							44.0
	SS-2	3.5-5'	1.5										3.1
	SS-3	8.5-10'	1.5										1.4
	SS-4	13.5-15'	11.0										0.9
	SS-5	18.5-20'	13.2										0.7
	SS-6	23.5-25'	9.3										0.8
SP-4A	G-1	0-1.0'	17.0										59.0
	G-2	1-2.0'	12.6										47.9
SP-4C	G-1	0-1.0'	11.7										40.8
	G-2	1-2.0'	8.3										28.3
SP-5A	G-1	0-1.0'	25.8										95.0
	G-2	1-2.0'	24.0										96.2
	G-3	2-3.5'	20.8										95.2
	G-4	3.5-5'	25.3										97.8
	G-5	5-6.5'	23.0										91.8
	G-6	6.5-7.5'	21.5										94.6
	G-7	7.5-8.5'	21.8										82.5
	G-8	8.5-9.5'	24.8										87.3
SP-5B	G-1	0-3.0'	23.0						35	20	16	CL	82.7
	G-2	3-4.5'	21.5										97.5
	G-3	4.5-6.0'	25.2										95.2

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA
OA Project #: A09-1466

BORING	SAMPLE	SAMPLE	MOISTURE	DRY	VOID	SAT.	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS	%Passing
No.	I.D.	DEPTH (ft.)	CONTENT (%)	DENSITY (pcf)	RATIO	(%)	STRENGTH (tsf)	STRAIN (%)	LL	PL	PI	CLASS.	#200 Sieve
SP-5B	G-4	6-7.5'	23.0										93.6
	G-5	7.5-9.0'	20.8										94.7
SP-5C	G-2	1-2.0'	23.2										89.8
	G-3	2-5.0'	23.2						35	20	16	CL	94.2
	G-4	5-6.0'	15.6										95.7
	G-5	6-7.0'	20.9										98.5
	G-6	7-8.0'	21.2										80.7
	G-7	8-9.5'	21.7										94.4
B-6C	U-1	1-2.5'	21.4	82.0	1.056	54.7			31	21	10	CL	95.2
	U-2	3.5-5'	20.8	79.0	1.134	49.6			32	18	14	CL	88.6
	U-3	8.5-10'	16.0	103.1	0.634	67.9			25	19	6	CL/ML	73.6
	U-4	13.5-15'	26.2	93.5	0.801	88.2	0.4	1.8					
B-7C	U-1	1-2.5'	21.8	78.8	1.137	51.8			31	21	10	CL	92.5
	U-2	3.5-5'	21.6	83.7	1.012	57.6			30	19	12	CL	92.8
	U-3	8.5-10'	29.5	83.5	1.019	78.1	0.4	0.3					
	SS-4	13.5-15'	20.4										81.0
	SS-6	23.5-25'	13.3										19.4
	SS-7	25-26.5'	6.2										9.0
B-8B	U-1	1-2.5'	20.0	90.2	0.868	62.2			28	N/A	N/A		97.3
	SS-2	3.5-5'	24.4										93.9
	SS-3	10-11.5'	16.7										41.4
	SS-4	13.5-15'	11.4										13.1
	U-5	18.5-20'	11.7										1.5
	SS-6	23.5-25'	4.5										11.1
SP-9A	G-1	0-1.0'	17.6										79.6
	G-2	1-2.0'	16.2										76.8
	G-3	2-3.0'	19.0										91.9
	G-4	3-5.0'	18.1										85.0
	G-5	5-6.0'	20.6										91.0
SP-9B	G-1	0-1.0'	23.6										92.7
	G-2	1-2.0'	26.4										89.0
	G-3	2-3.0'	29.4										87.9

SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA
OA Project #: A09-1466

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
SP-9B	G-4	3-5.0'	26.9										74.7
	G-5	5-6.0'	30.4										82.6
SP-9C	G-1	0-3.0'	28.1						35	17	18	CL	75.7
	G-2	3-4.0'	20.5										81.0
	G-3	4-5.0'	16.5										73.1
	G-4	5-5.5'	17.6										69.9
B-10	U-1	1-2.5'	23.5	92.7	0.817	77.8			36	17	19	CL	94.5
	U-2	3.5-5'	21.3	93.5	0.803	71.7	0.5	2.0	29	20	9	CL	92.7
	U-3	8.5-10'	25.4	84.6	0.992	69.2	0.5	1.4	31	16	16	CL	57.2
B-11	U-1	1-2.5'	27.5	89.6	0.880	84.5							81.9
	SS-2	3.5-5'	32.2						44	19	25	CL	80.2
	SS-3	8.5-10'	4.0										5.1
B-12	U-1	1-2.5'	25.2	90.3	0.866	78.4	0.2	1.2	31	22	9	CL	91.6
	U-2	3.5-5'	18.7	98.2	0.716	70.5			37	16	21	SC	37.1
B-13	U-1	1-2.5'	25.9	90.7	0.857	81.7	0.5	2.1	35	20	15	CL	83.8
	SS-2	3.5-5'	2.9										1.3
	SS-3	8.5-10'											2.5
B-14	U-1	1-2.5'	25.4	96.6	0.743	92.2			30	19	11	CL	79.5
	SS-2	3.5-5'	15.5										45.4
B-15	SS-1	1-2.5'	27.2										91.6
	U-2	3.5-5'	35.9	80.8	1.086	89.2	0.3	1.1	50	20	30	CH	57.0
	SS-3	8.5-10'	9.3										94.1
B-16	U-1	1-2.5'	27.3	92.4	0.823	89.7			37	18	19	CL	96.9
	U-2	3.5-5'	27.6	93.4	0.803	92.6			45	18	27	CL	88.9
	U-3	8.5-10'	12.5										31.2
B-17	U-1	1-2.5'	19.4	107.0	0.574	91.2			23	14	9	CL	63.2
	U-2	3.5-5'	17.2										66.6
	U-3	8.5-10'	7.8										15.4
B-18	U-1	1-2.5'	23.5	99.2	0.698	90.7	0.7	6.2	24	19	5	CL/ML	72.2
	U-2	3.5-5'	26.1	97.8	0.723	97.3							89.8
	U-3	8.5-10'	6.5										6.9
SP-19	G-1	0-1.0'	27.0										91.3

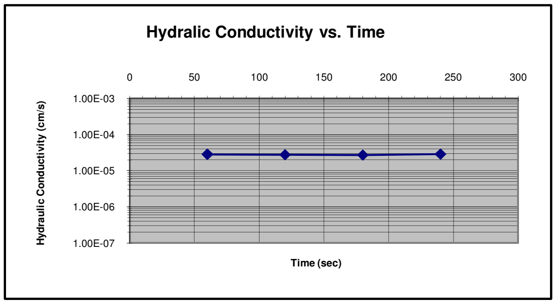
SUMMARY OF LABORATORY TEST RESULTS
CNPPID REREGULATING RESERVOIR FEASIBILTIY STUDY
J-2 RETURN ALTERNATIVES
PHELPS & GOSPER COUNTY, NEBRASKA
OA Project #: A09-1466

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
SP-19	G-2	1-5.0'	24.0						28	16	13	CL	74.6
	G-3	5-7.0'	19.2										65.9
	G-4	7-9.0'	22.7										82.0
BULK TOPSOIL: B-4B				**Max Dry Density = 109.0 pcf, Optimum Moisture Content = 15.5%**									19.6
BULK TOPSOIL: B-7C (0-1.5')				**Max Dry Density = 102.5 pcf, Optimum Moisture Content = 19.1%**					32	18	14	CL	93.6
BULK CL/ML: B-8B (3-8.0')				**Max Dry Density = 108.4 pcf, Optimum Moisture Content = 15.6%**					24	18	6	CL/ML	84.2
BULK TOPSOIL: B-11													92.4
BULK CL: B-11 (1-4.5')				**Max Dry Density = 105.7pcf, Optimum Moisture Content = 18.8%**					28	20	8	CL	90.6
BULK FILL: C-16 (1-6.0')				**Max Dry Density = 96.6 pcf, Optimum Moisture Content = 21.4%**					39	18	22	CL	91.3
COMPOSITE BULK: B-17A (2-4.0') & B-17 (2-4.0')				**Max Dry Density = 97.3 pcf, Optimum Moisture Content = 22.9%**					43	20	23	CL	90.7
BULK ALLUVIUM: B-12 (3-8')				**Max Dry Density = 107.6 pcf, Optimum Moisture Content = 16.9%**					29	24	5	CL/ML	65.5

Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 2
Date 6/14/2010
Project No. A09-1466
Boring No. B-6C
Sample No. U-3
Scale No.
Laboratory #



Sample Parameters

	Initial	Final
Height of Sample (cm)	8.301	8.296
Diameter of Sample (cm)	7.319	7.232
Wet density, lb/cu ft	112.144	129.570
Dry density, lb/cu ft	96.106	104.692
Water content	16.69%	23.76%
SG of solids	2.70	2.70
Saturation	59.83%	100.00%

	Test 1	**Test 2**	**Test 3**	**Test 4**
Cell Pressure (psi)	90.19	90.19	90.19	90.19
Upper Cap Pressure (psi)	80.00	80.00	80.00	80.00
Lower Cap Pressure (psi)	82.37	82.37	82.37	82.37
Differential Pressure (psi)	2.37	2.37	2.37	2.37
Hydraulic Gradient	20	20	20	20
Test time (sec)	60	60	60	60
Elapsed Time (sec)	60	120	180	240
Upper Cap Burette Initial Reading (mL)	14	12.7	11.5	10.3
Upper Cap Burette Final Reading (mL)	12.7	11.5	10.3	9.1
Lower Cap Burette Initial Reading (mL)	34.2	35.4	36.6	37.7
Lower Cap Burette Final Reading (mL)	35.4	36.6	37.7	38.9
Inflow/Outflow Ratio (0.75-1.25)	0.92	1.00	0.92	1.00
Permeability (cm/sec)	2.86E-05	2.80E-05	2.73E-05	2.91E-05
Temperature ©	20.3	20.3	20.3	20.2
Temperature Correction	0.99	0.99	0.99	1.00
Permeability, K @ 20 C (cm/sec)	2.84E-05	2.78E-05	2.72E-05	2.89E-05
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **2.81E-05**

Remarks:

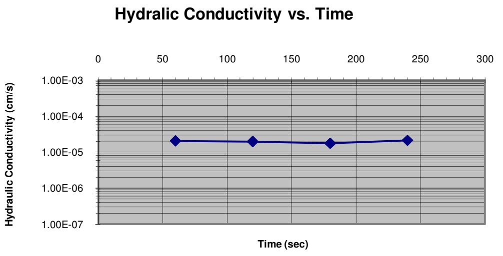
Technician: DK
Computed By: AP
Checked By: AP

OLSSON ASSOCIATES

Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 2
Date 6/14/2010
Project No. A09-1466
Boring No. B-12
Sample No. U-2 (3.5-5')
Scale No.
Laboratory #



Sample Parameters

	Initial	Final
Height of Sample (cm)	9.326	9.335
Diameter of Sample (cm)	7.296	7.318
Wet density, lb/cu ft	121.591	123.056
Dry density, lb/cu ft	94.402	97.322
Water content	28.80%	26.44%
SG of solids	2.70	2.70
Saturation	99.10%	97.64%

	Test 1	Test 2	Test 3	Test 4
Cell Pressure (psi)	56.57	56.57	56.57	56.57
Upper Cap Pressure (psi)	50.03	50.03	50.03	50.03
Lower Cap Pressure (psi)	52.61	52.61	52.61	52.61
Differential Pressure (psi)	2.58	2.58	2.58	2.58
Hydraulic Gradient	19	19	19	19
Test time (sec)	60	60	60	60
Elapsed Time (sec)	60	120	180	240
Upper Cap Burette Initial Reading (mL)	13.5	12.6	11.7	11
Upper Cap Burette Final Reading (mL)	12.6	11.7	11	10
Lower Cap Burette Initial Reading (mL)	36	36.9	37.7	38.5
Lower Cap Burette Final Reading (mL)	36.9	37.7	38.5	39.3
Inflow/Outflow Ratio (0.75-1.25)	1.00	0.89	1.14	0.80
Permeability (cm/sec)	2.14E-05	2.05E-05	1.83E-05	2.22E-05
Temperature ©	21.8	21.7	21.7	21.7
Temperature Correction	0.96	0.96	0.96	0.96
Permeability, K @ 20 C (cm/sec)	2.05E-05	1.97E-05	1.75E-05	2.13E-05
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **1.98E-05**

Remarks:

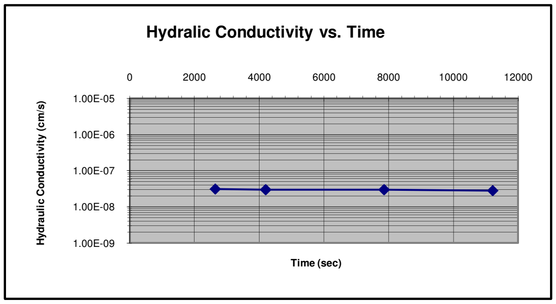
Technician: DK
Computed By: AP
Checked By: AP

OLSSON ASSOCIATES

Revision No. 2
Revision Date 4/23/2006

Flexible Wall Permeability (ASTM D 5084-03)

Project Name CNPPID Reregulating Reservoir Feasibility Study - Area 2 **Date** 6/28/2010
Project No. A09-1466 **Boring No.** Composite Bulk **Sample No.**
Scale No. B-15 (2-4') & B-17 (2-4') **Laboratory #**



Sample Parameters	**Initial**	**Final**
Height of Sample (cm)	7.575	7.609
Diameter of Sample (cm)	7.118	7.121
Wet density, lb/cu ft	118.370	121.726
Dry density, lb/cu ft	95.730	95.087
Water content	23.65%	28.01%
SG of solids	2.70	2.70
Saturation	84.02%	98.00%

	Test 1	**Test 2**	**Test 3**	**Test 4**
Cell Pressure (psi)	51.51	51.51	51.51	51.51
Lower Cap Pressure (psi)	47.15	47.15	47.15	47.15
Upper Cap Pressure (psi)	45.00	45.00	45.00	45.00
Differential Pressure (psi)	2.15	2.15	2.15	2.15
Hydraulic Gradient	20	20	20	20
Test time (sec)	2640	1560	3660	3360
Elapsed Time (sec)	2640	4200	7860	11220
Lower Cap Burette Initial Reading (mL)	27.3	28.1	28.6	29.6
Lower Cap Burette Final Reading (mL)	28.1	28.6	29.6	30.5
Upper Cap Burette Initial Reading (mL)	22.2	21.4	21	19.9
Upper Cap Burette Final Reading (mL)	21.4	21	19.9	19
Inflow/Outflow Ratio (0.75-1.25)	1.00	1.25	0.91	1.00
Permeability (cm/sec)	3.26E-08	3.13E-08	3.15E-08	2.99E-08
Temperature ©	22.0	22.1	22.4	22.7
Temperature Correction	0.95	0.95	0.94	0.94
Permeability, K @ 20 C (cm/sec)	3.11E-08	2.98E-08	2.98E-08	2.80E-08
Average +/- 25%	Pass	Pass	Pass	Pass

AVERAGE PERMEABILITY (cm/s) **2.97E-08**

Remarks:

Technician: DK
Computed By: AP
Checked By: AP

OLSSON ASSOCIATES

Falling Head Permeability Test

Date: 07/02/10

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Boring No. B-8B

Sample No. U-1 (1-2.5')

Specimen No.	Ring & Plate	Classification	
Specimen & Ring Wet	322.29	Diameter of Specimen, sq cm	6.338
Tare Plus Wet	117.46	Area of specimen, sq cm	31.55
Tare Plus Dry	100.83	Initial Height of Specimen, cm	2.54
Tare	15.02	Initial Volum of Spec., cc	80.137
Dry Soil	115.05	Initial Void Ratio	0.880
Ring	184.94	Constant	0.0531
Specific Gravity	2.7	Initial Dial Reading, in	0.0198
Volume of solids,cc	42.63	Height Constant, cm	44.60
Area of Standardpipe, sq cm	0.727		
Capillary rise, cm	0.00		

TEST NO.	1	2	3	4	5	6
Load Increment, T/sq ft.	0.5	0.5	0.5	0.5	0.5	0.5
Dial Reading at Start, in.	0.0198	0.0198	0.0198	0.0198	0.0198	0.0198
Change of Ht. of Spec., in.	0.0198	0.0198	0.0198	0.0198	0.0198	0.0198
Ht. of Spec., cm	2.4897	2.4897	2.4897	2.4897	2.4897	2.4897
Void Ratio	0.843	0.843	0.843	0.843	0.843	0.843
Date (7/02/10)	07/02/10	07/02/10	07/02/10	07/02/10	07/02/10	07/02/10
Initial Time (10:30 AM)	10:30 AM	10:32 AM	10:34 AM	10:36 AM	10:38 AM	10:40 AM
Date (7/02/10)	07/02/10	07/02/10	07/02/10	07/02/10	07/02/10	07/02/10
Final Time (10:42 AM)	10:32 AM	10:34 AM	10:36 AM	10:38 AM	10:40 AM	10:42 AM
Elapsed Time, sec	120	120	120	120	120	120
Total Elapsed Time, sec	120	240	360	480	600	720
Initial Height, cm	53.70	46.80	42.90	37.80	33.90	30.40
Final Height, cm	46.80	42.90	37.80	33.90	30.40	26.70
Viscosity Correction Factor	0.953	0.953	0.953	0.953	0.953	0.953
Coefficient of Permeability, cm/sec	3.32E-05	1.99E-05	2.74E-05	2.21E-05	2.08E-05	2.31E-05

AVERAGE PERMEABILITY (cm/s) **2.33E-05**

Remarks:

Technician: Dan Kowalski

Computed by: Andrew Phillips

Falling Head Permeability Test

Date: 07/06/10

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Boring No. B-11 Sample No. U-1 (1-2.5')

Specimen No.	Ring & Plate	Classification	
Specimen & Ring Wet	325.34	Diameter of Specimen, sq cm	6.338
Tare Plus Wet	95.79	Area of specimen, sq cm	31.55
Tare Plus Dry	78.38	Initial Height of Specimen, cm	2.54
Tare	14.90	Initial Volum of Spec., cc	80.137
Dry Soil	110.17	Initial Void Ratio	0.963
Ring	184.96	Constant	0.0531
Specific Gravity	2.7	Initial Dial Reading, in	0.0353
Volume of solids,cc	40.82	Height Constant, cm	44.50
Area of Standardpipe, sq cm	0.727		
Capillary rise, cm	0.00		

TEST NO.	1	2	3	4	5	6
Load Increment, T/sq ft.	0.5	0.5	0.5	0.5	0.5	0.5
Dial Reading at Start, in.	0.0353	0.0353	0.0353	0.0353	0.0353	0.0353
Change of Ht. of Spec., in.	0.0353	0.0353	0.0353	0.0353	0.0353	0.0353
Ht. of Spec., cm	2.4503	2.4503	2.4503	2.4503	2.4503	2.4503
Void Ratio	0.895	0.895	0.895	0.895	0.895	0.895
Date (7/06/10)	07/06/10	07/06/10	07/06/10	07/06/10	07/06/10	07/06/10
Initial Time (9:20 PM)	9:20 AM	9:20 AM	9:20 AM	9:20 AM	9:20 AM	9:20 AM
Date (7/06/10)	07/06/10	07/06/10	07/06/10	07/06/10	07/06/10	07/06/10
Final Time (9:21 AM)	9:20 AM	9:20 AM	9:20 AM	9:20 AM	9:20 AM	9:21 AM
Elapsed Time, sec	10	10	10	10	10	10
Total Elapsed Time, sec	10	20	30	40	50	60
Initial Height, cm	54.50	54.90	54.10	55.00	55.10	54.80
Final Height, cm	18.30	18.50	18.00	18.60	18.90	18.70
Viscosity Correction Factor	0.953	0.953	0.953	0.953	0.953	0.953
Coefficient of Permeability, cm/sec	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.43E-03	2.43E-03

AVERAGE PERMEABILITY (cm/s) **2.44E-03**

Remarks:

Technician: Dan Kowalski Computed by: Andrew Phillips

Falling Head Permeability Test

Date: 06/10/10

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Boring No. B-4B

Sample No. SS-6 (23.5-25')

Specimen No.	Ring & Plate	Classification	
Specimen & Ring Wet	1425.30	Diameter of Specimen, sq cm	6.338
Tare Plus Wet	N/A	Area of specimen, sq cm	31.55
Tare Plus Dry	N/A	Initial Height of Specimen, cm	2.54
Tare	1287.90	Initial Volum of Spec., cc	80.137
Dry Soil	N/A	Initial Void Ratio	0.705
Ring	184.94	Constant	0.0531
Specific Gravity	2.7	Initial Dial Reading, in	0.0032
Volume of solids,cc	N/A	Height Constant, cm	45.10
Area of Standardpipe, sq cm	0.727		
Capillary rise, cm	0.00		

TEST NO.	1	2	3	4	5	6
Load Increment, T/sq ft.	0.5	0.5	0.5	0.5	0.5	0.5
Dial Reading at Start, in.	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032
Change of Ht. of Spec., in.	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032
Ht. of Spec., cm	2.5319	2.5319	2.5319	2.5319	2.5319	2.5319
Void Ratio	0.705	0.705	0.705	0.705	0.705	0.705
Date (6/22/10)	06/22/10	06/22/10	06/22/10	06/22/10	06/22/10	06/22/10
Initial Time (9:30 AM)	9:30 AM	9:30 AM	9:30 AM	9:30 AM	9:30 AM	9:30 AM
Date (6/22/10)	06/22/10	06/22/10	06/22/10	06/22/10	06/22/10	06/22/10
Final Time (9:31 AM)	9:30 AM	9:30 AM	9:30 AM	9:30 AM	9:30 AM	9:31 AM
Elapsed Time, sec	10.00	10.00	10.00	10.00	10.00	10.00
Total Elapsed Time, sec	10.00	20.00	30.00	40.00	50.00	60.00
Initial Height, cm	66.90	66.70	68.50	68.70	69.80	68.30
Final Height, cm	7.00	6.80	9.20	9.10	9.10	8.00
Viscosity Correction Factor	0.953	0.953	0.953	0.953	0.953	0.953
Coefficient of Permeability, cm/sec	4.26E-03	4.27E-03	4.10E-03	4.12E-03	4.18E-03	4.22E-03

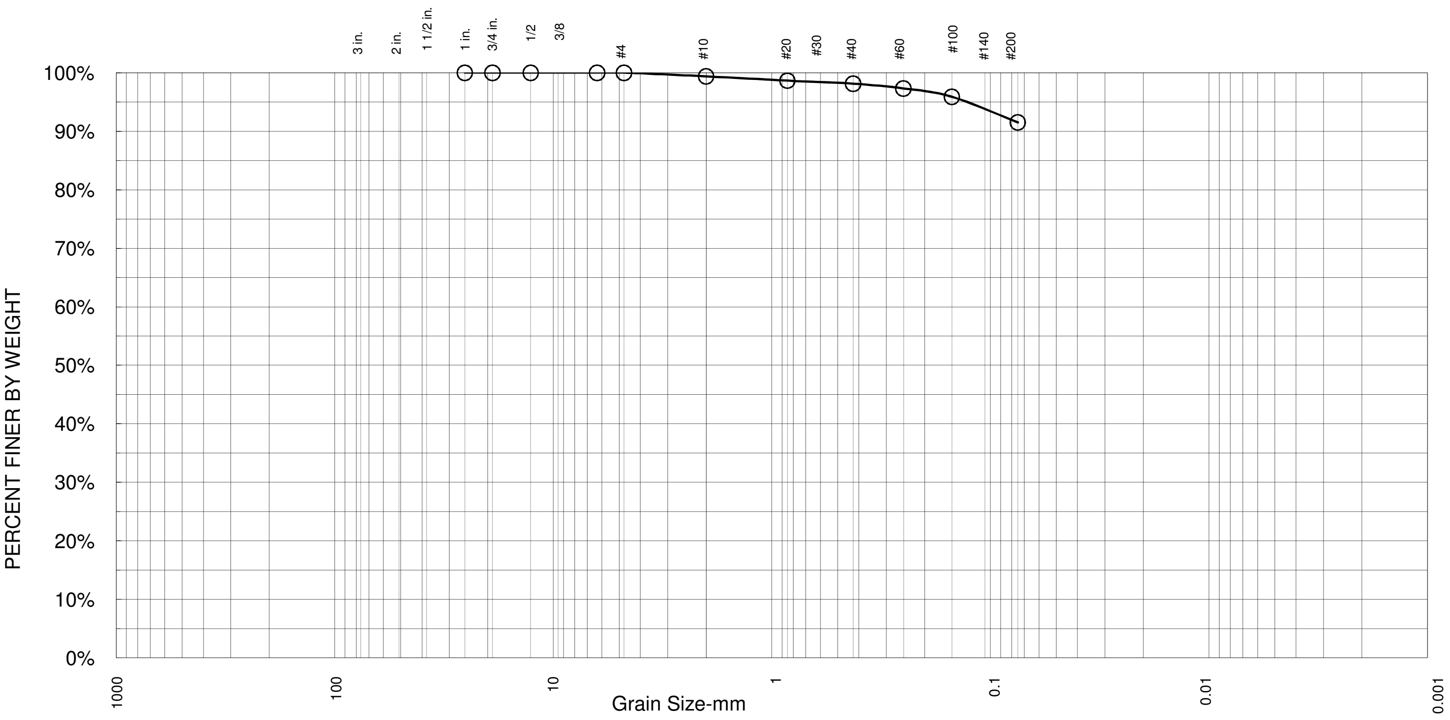
AVERAGE PERMEABILITY (cm/s) **4.16E-03**

Remarks:

Technician: Dan Kowalski

Computed by: Caleb Strate

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.6%	1.3%	6.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.4%		
20	98.6%		
40	98.1%		
60	97.3%		
100	95.9%		
200	91.5%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-1C, G-3 (2-3.0')
Area 2

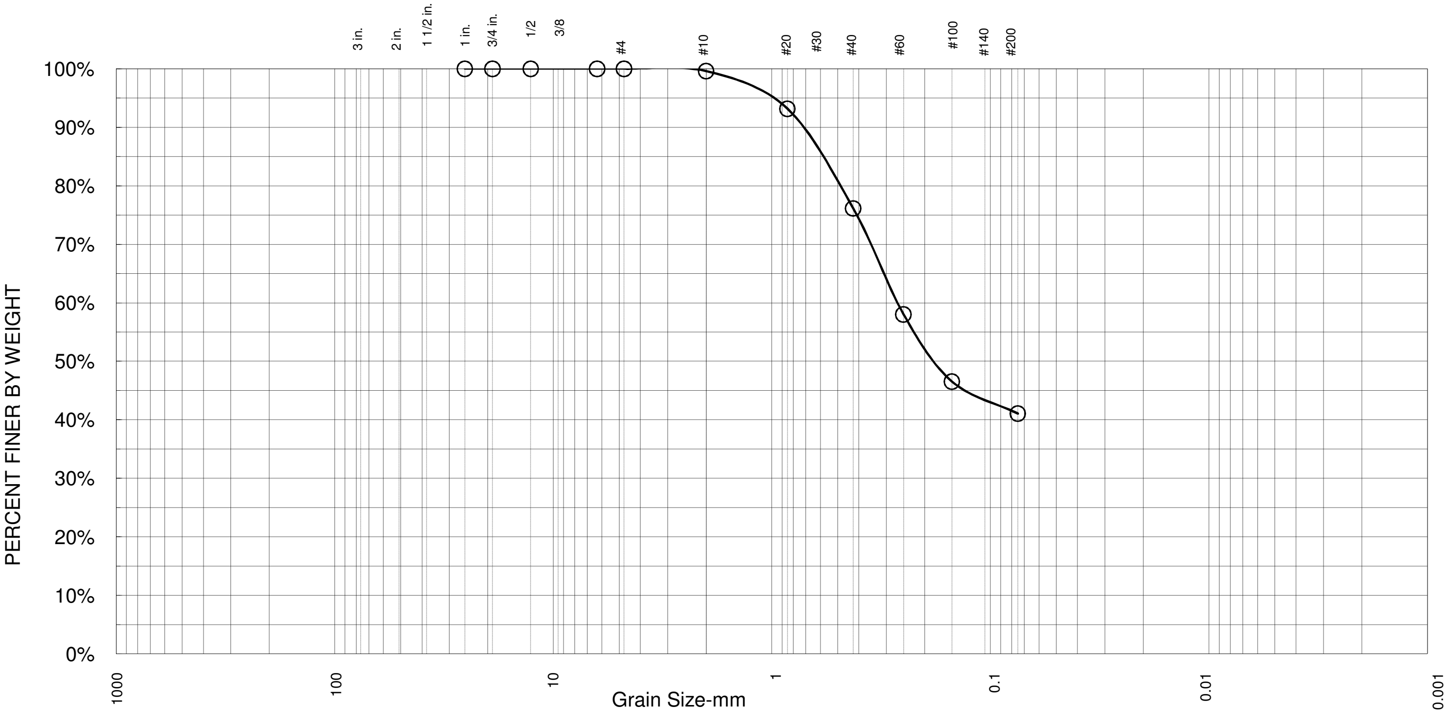
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.4%	23.5%	35.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.6%		
20	93.2%		
40	76.1%		
60	58.0%		
100	46.5%		
200	41.1%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.59 D_{60}= 0.27 D_{50}= 0.18

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-2B, G-3 (2-3.0')
Area 2

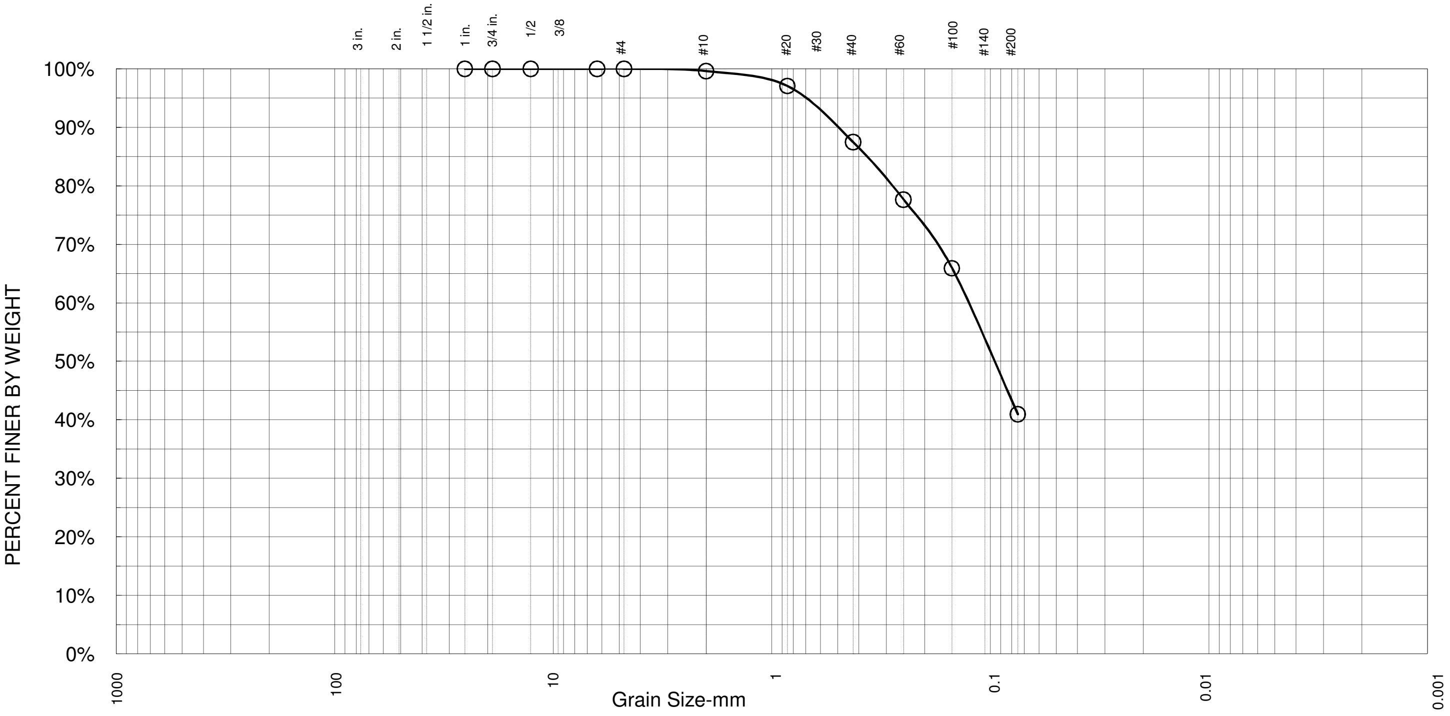
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.4%	12.1%	46.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.6%		
20	97.1%		
40	87.5%		
60	77.6%		
100	65.9%		
200	41.0%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.38 D_{60}= 0.14 D_{50}= 0.10

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Sandy lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-2C, G-3 (2-3.0')
Area 2

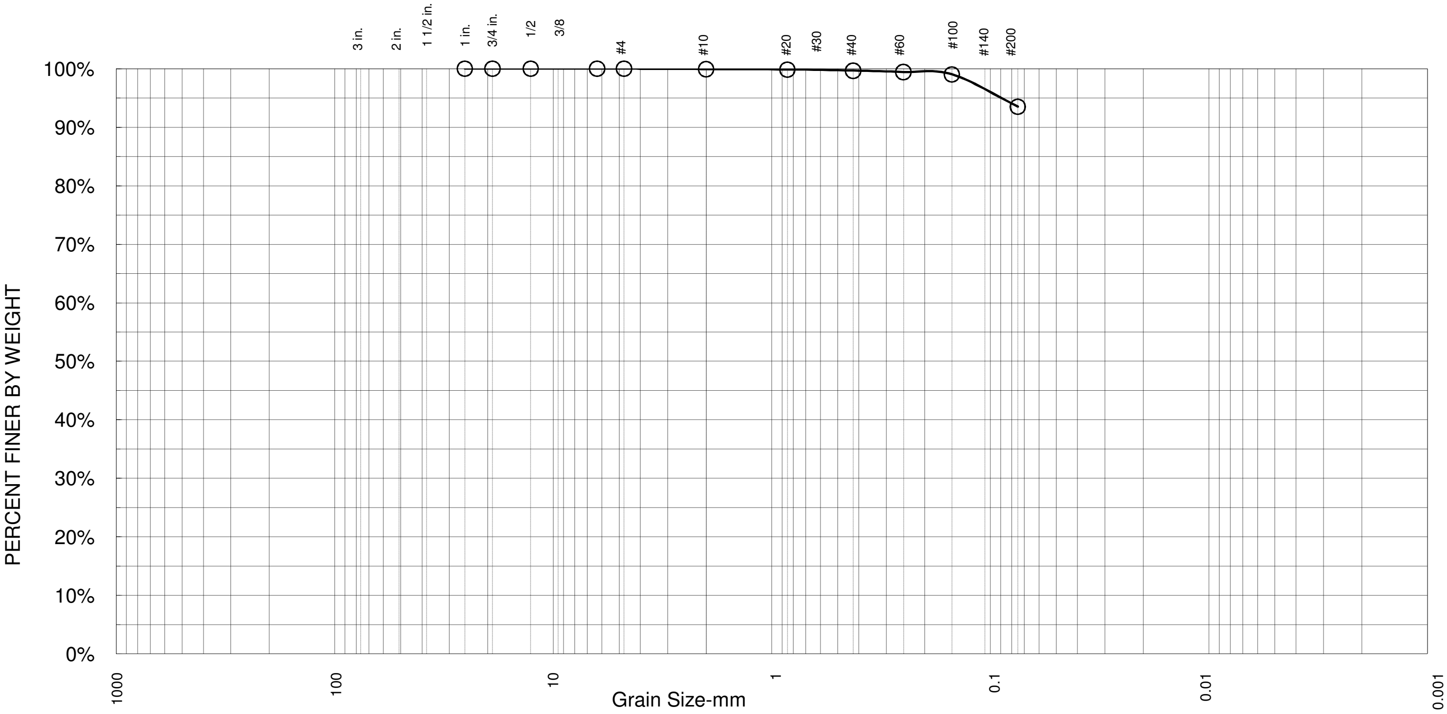
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.1%	0.3%	6.2%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.9%		
20	99.9%		
40	99.7%		
60	99.4%		
100	99.0%		
200	93.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: B-3C, SS-2 (3.5-5')
Area 2

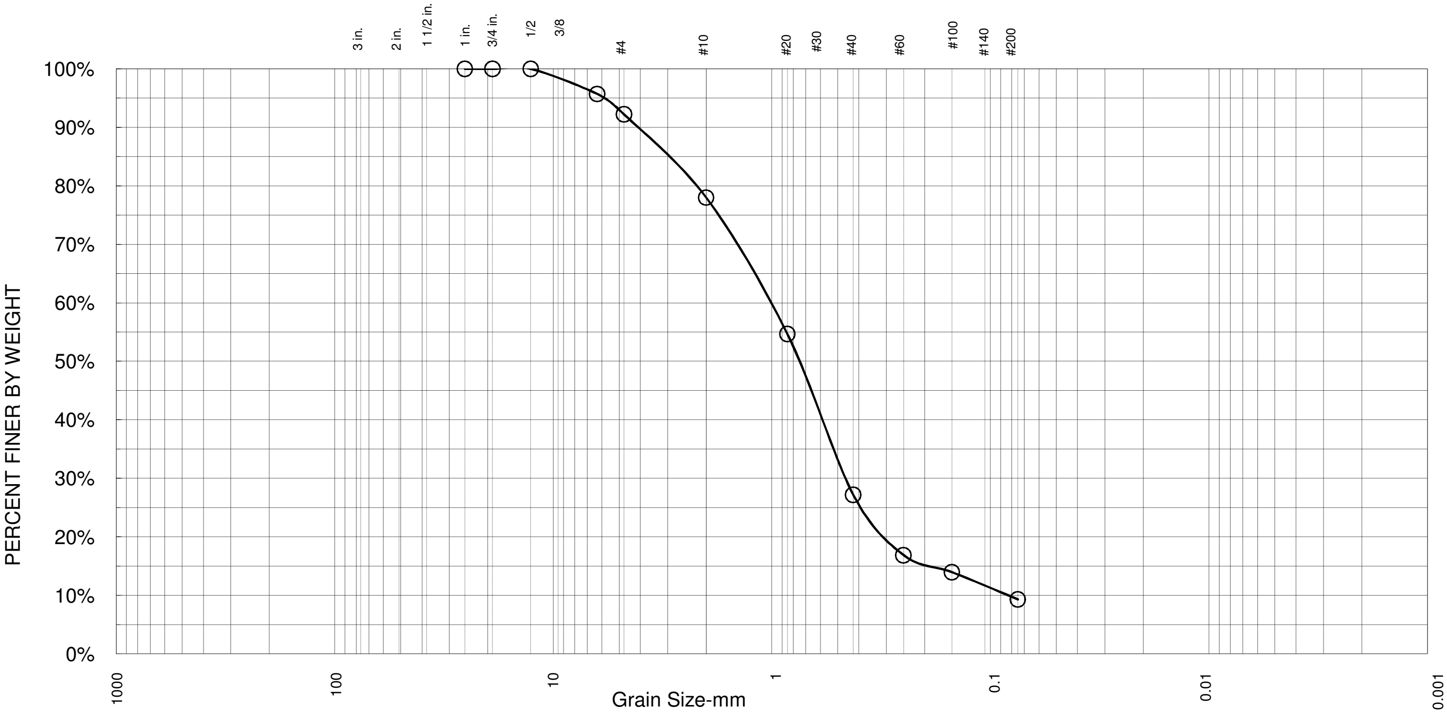
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	7.8%	14.2%	50.8%	17.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	95.7%		
4	92.2%		
10	78.0%		
20	54.7%		
40	27.2%		
60	16.9%		
100	14.0%		
200	9.3%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.90 D_{60}= 1.00 D_{50}= 0.75

D_{30}= 0.47 D_{15}= 0.19 D_{10}= 0.09

C_U= 11.11 C_C= 2.45

Classification

USCS= Well graded sand with clay (SW/SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-3C, SS-4 (13.5-15')
Area 2

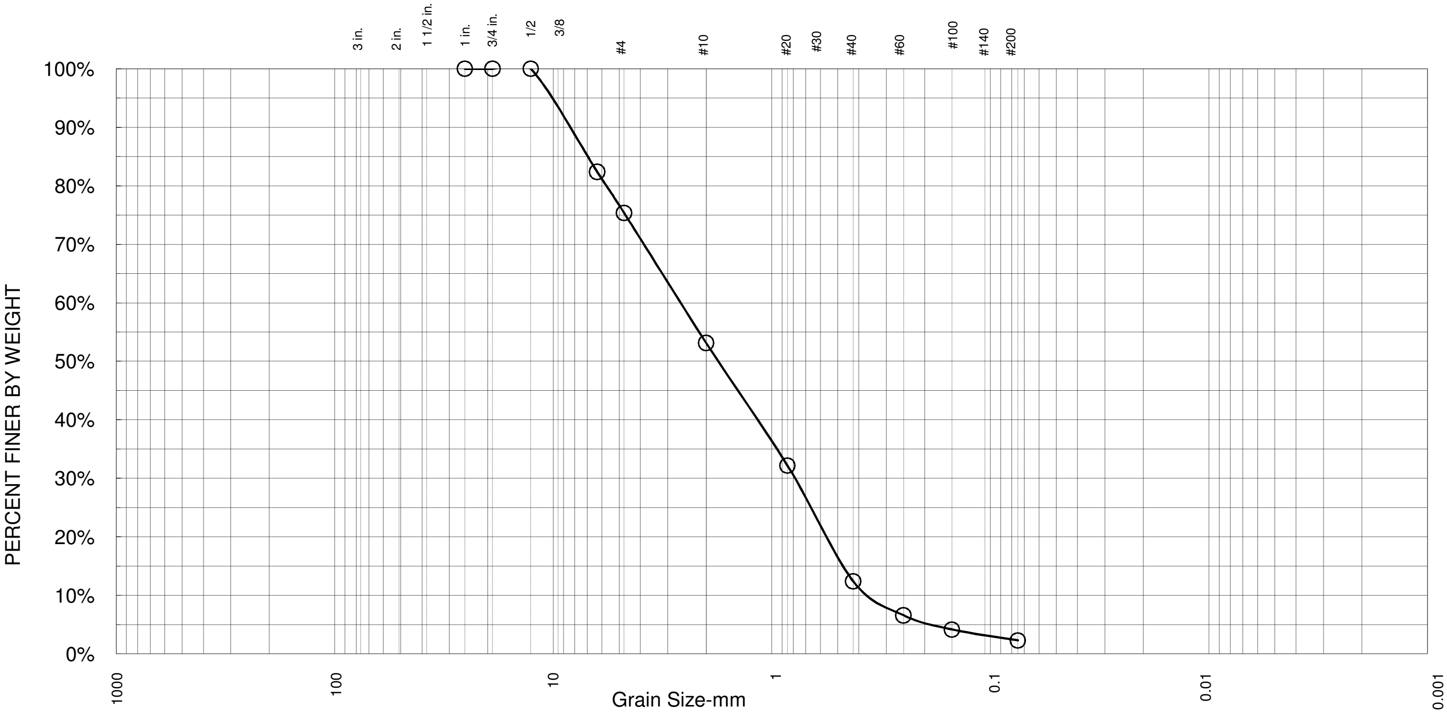
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	24.6%	22.2%	40.8%	10.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	82.4%		
4	75.4%		
10	53.1%		
20	32.2%		
40	12.4%		
60	6.6%		
100	4.1%		
200	2.3%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 7.00 D_{60}= 2.80 D_{50}= 1.70

D_{30}= 0.79 D_{15}= 0.48 D_{10}= 0.36

C_U= 7.78 C_C= 0.62

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-3C, SS-6 (23.5-25')
Area 2

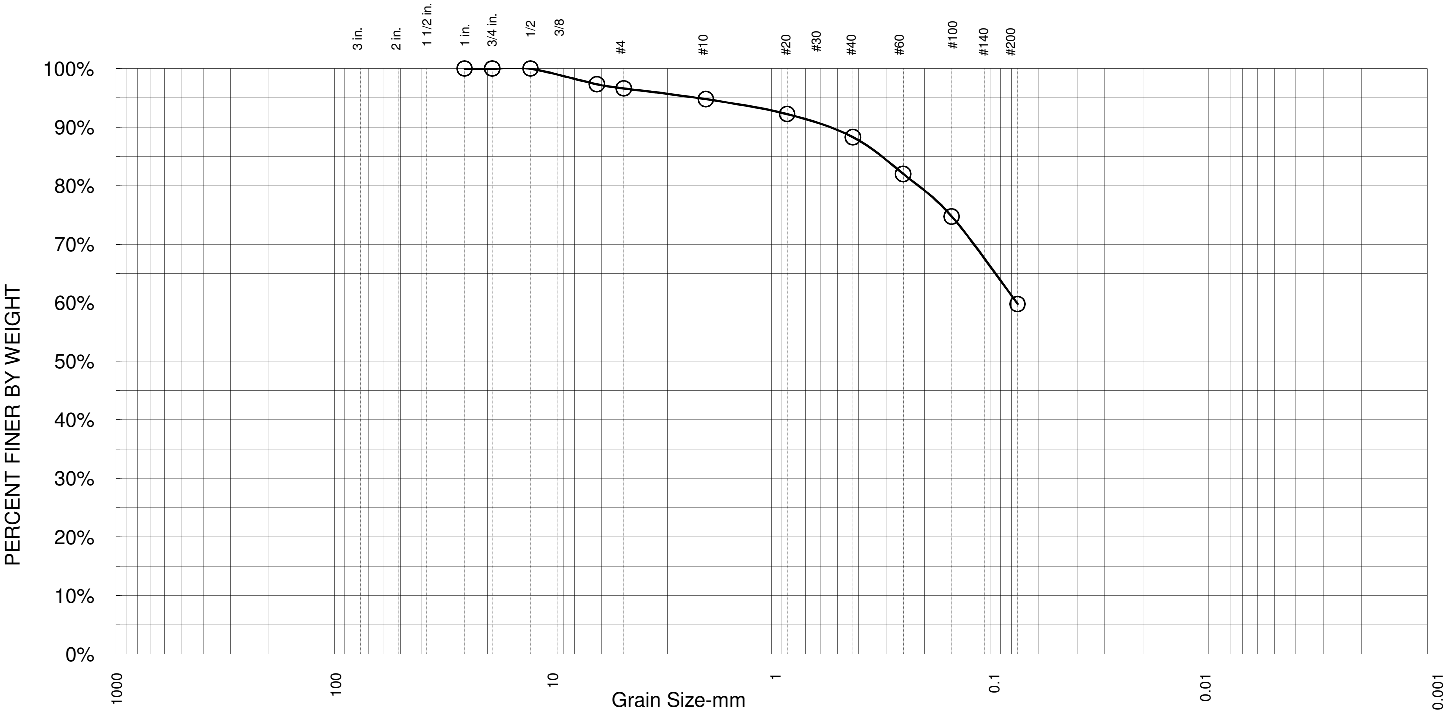
Date: 6/3/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	3.4%	1.8%	6.5%	28.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.3%		
4	96.6%		
10	94.8%		
20	92.2%		
40	88.3%		
60	82.0%		
100	74.7%		
200	59.8%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.31 D_{60}= 0.08 D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Sandy silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: B-3C, SS-9 (38.5-40')
Area 2

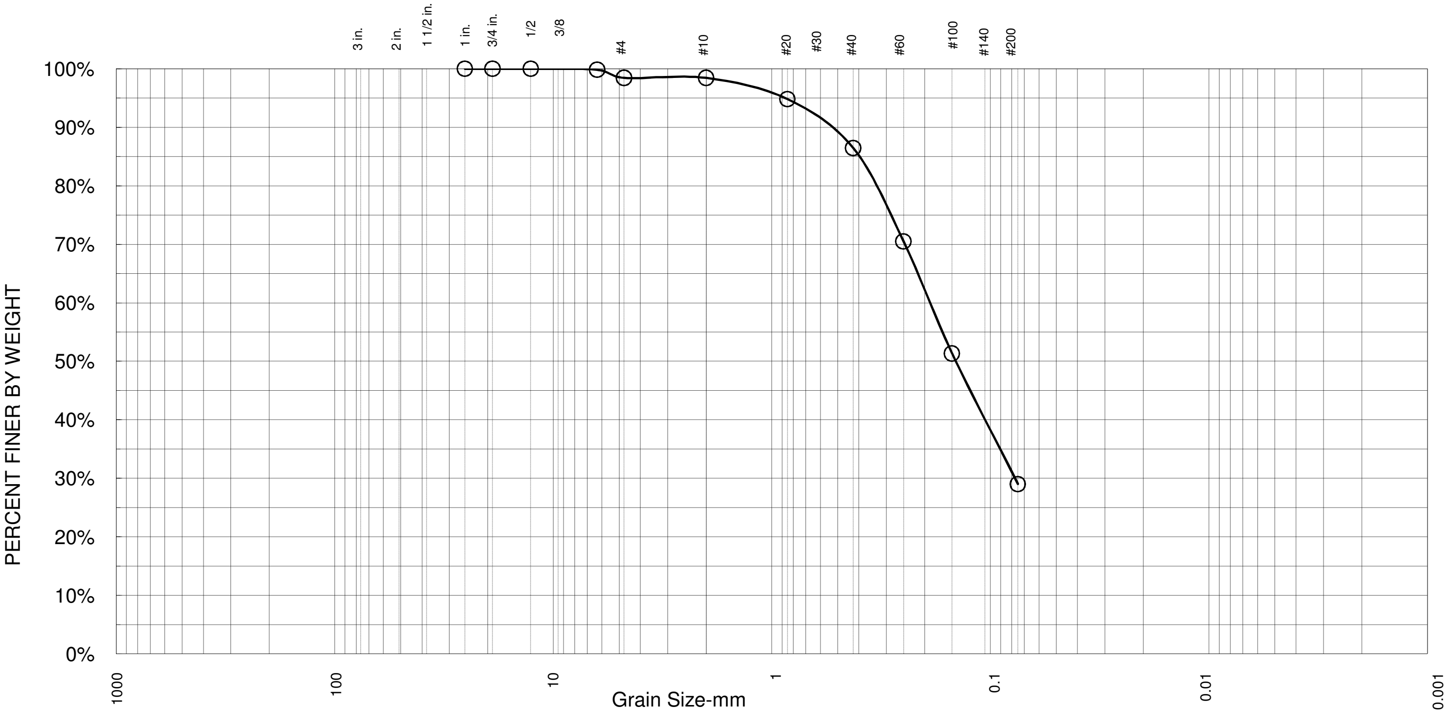
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	1.6%	0.0%	12.0%	57.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	99.8%		
4	98.4%		
10	98.4%		
20	94.8%		
40	86.5%		
60	70.5%		
100	51.3%		
200	29.0%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.40 D_{60}= 0.19 D_{50}= 0.15

D_{30}= 0.08 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty, clayey sand (SC/SM)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-3C, SS-11 (48.5-50')
Area 2

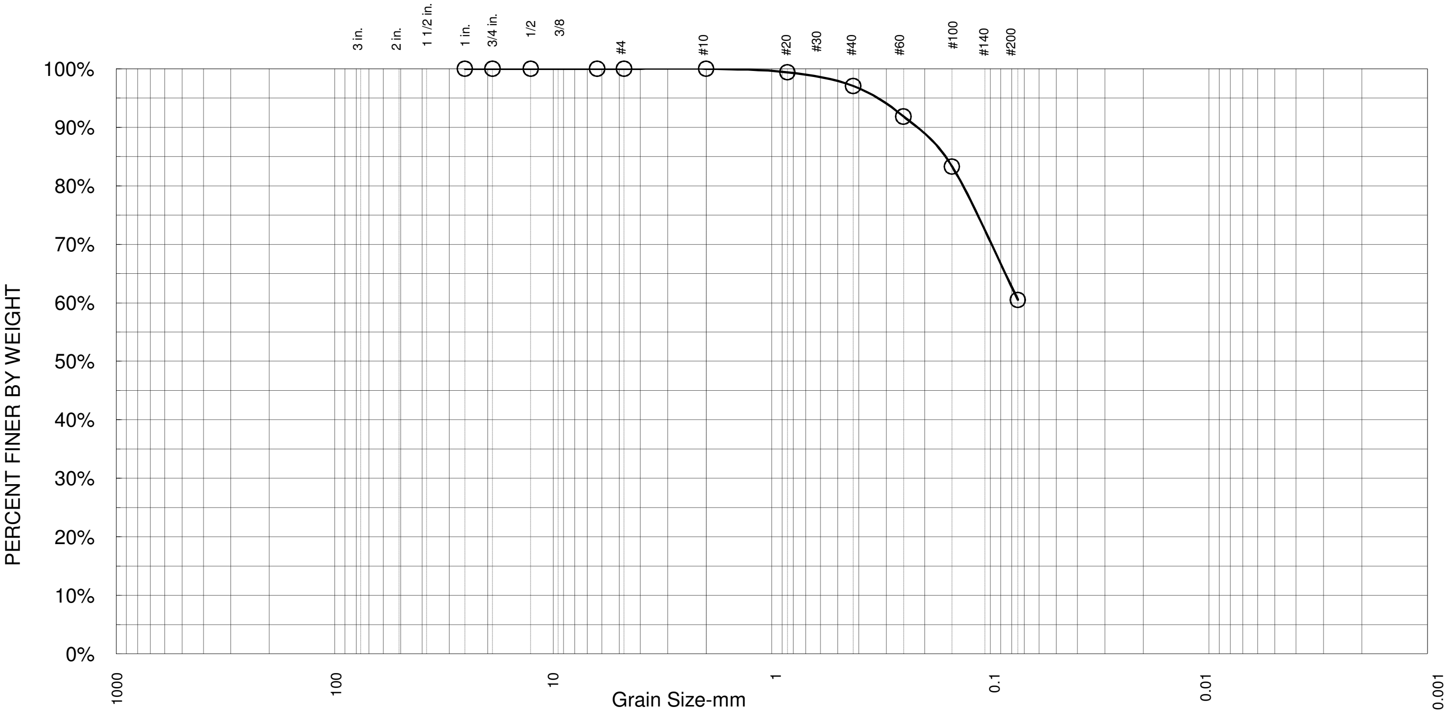
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	2.9%	36.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.4%		
40	97.1%		
60	91.8%		
100	83.3%		
200	60.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.16 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Sandy silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: SP-3B, G-3 (2-3.0')
Area 2

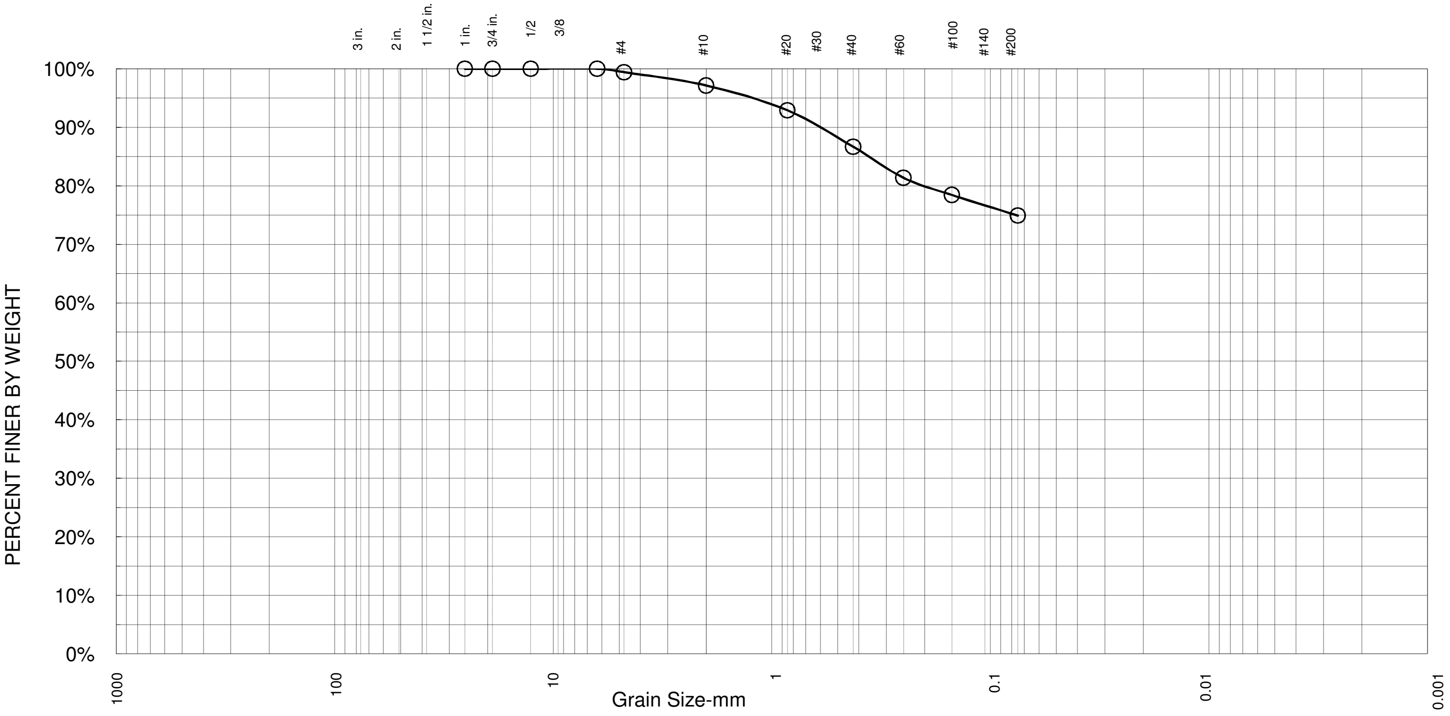
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.6%	2.3%	10.5%	11.8%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.4%		
10	97.1%		
20	92.9%		
40	86.7%		
60	81.4%		
100	78.4%		
200	74.9%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.36 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay with sand (CL/ML)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-3B, G-6 (5-7.0')
Area 2

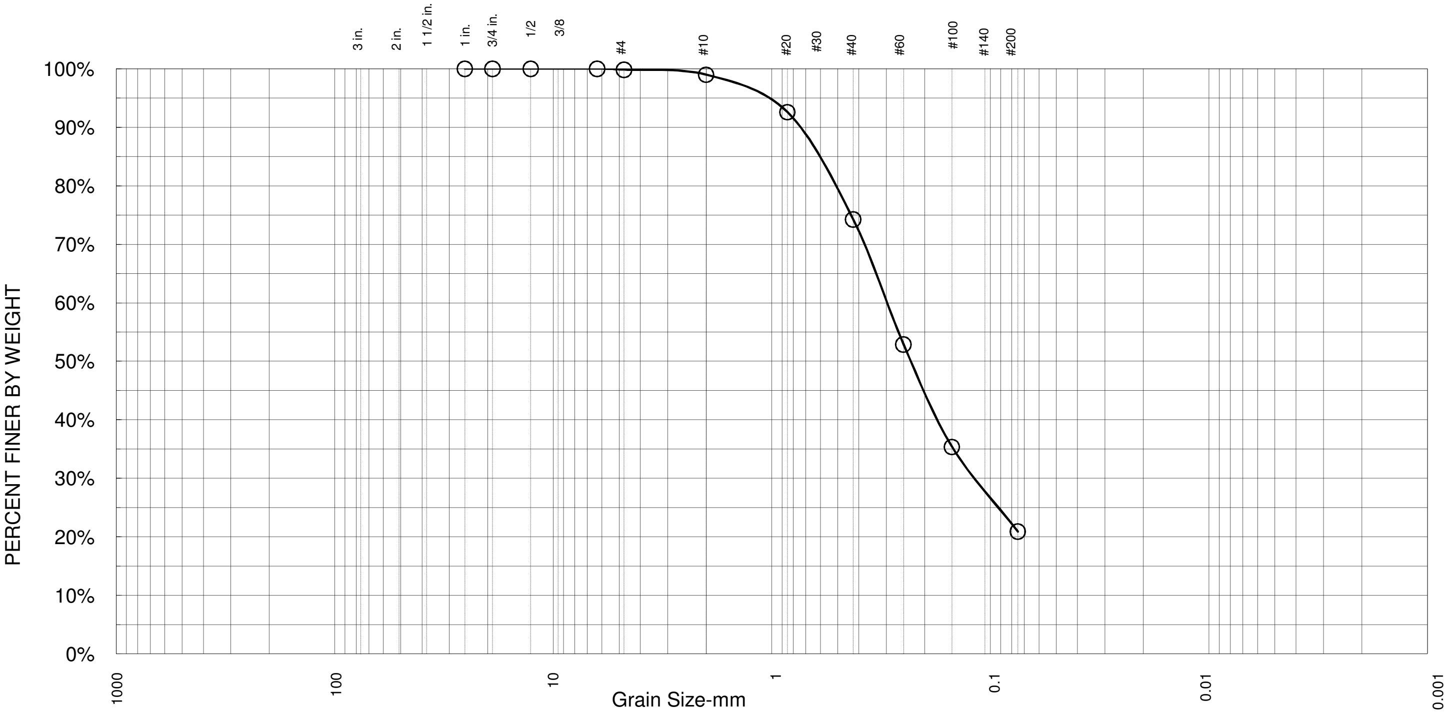
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.2%	0.9%	24.7%	53.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.8%		
10	99.0%		
20	92.6%		
40	74.2%		
60	52.9%		
100	35.4%		
200	20.9%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.60 D_{60}= 0.30 D_{50}= 0.24

D_{30}= 0.13 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty, clayey sand (SC/SM)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-3C, G-2 (1-2.0')
Area 2

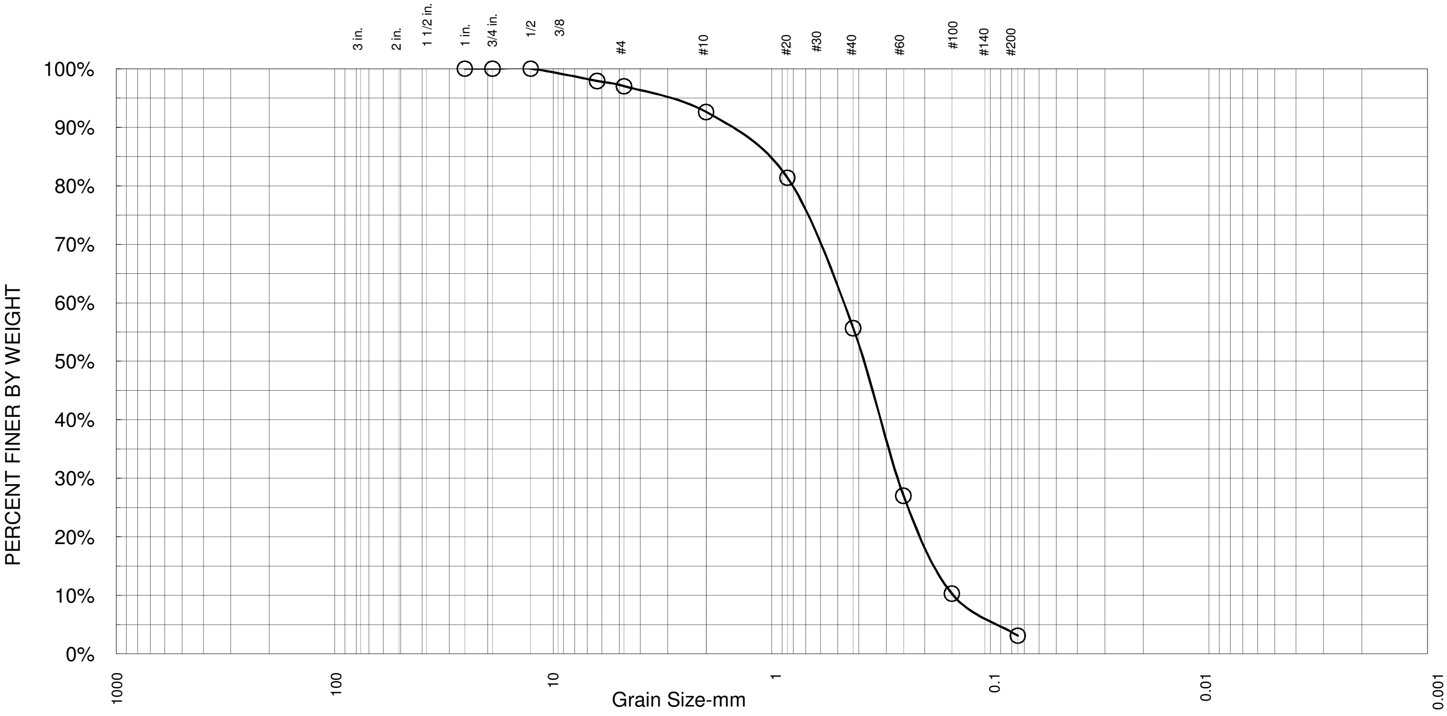
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	3.0%	4.4%	36.9%	52.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.9%		
4	97.0%		
10	92.6%		
20	81.4%		
40	55.7%		
60	27.0%		
100	10.3%		
200	3.1%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.00 D_{60}= 0.47 D_{50}= 0.38

D_{30}= 0.26 D_{15}= 0.16 D_{10}= 0.15

C_U= 3.13 C_C= 0.96

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-4B, SS-2 (3.5-5')
Area 2

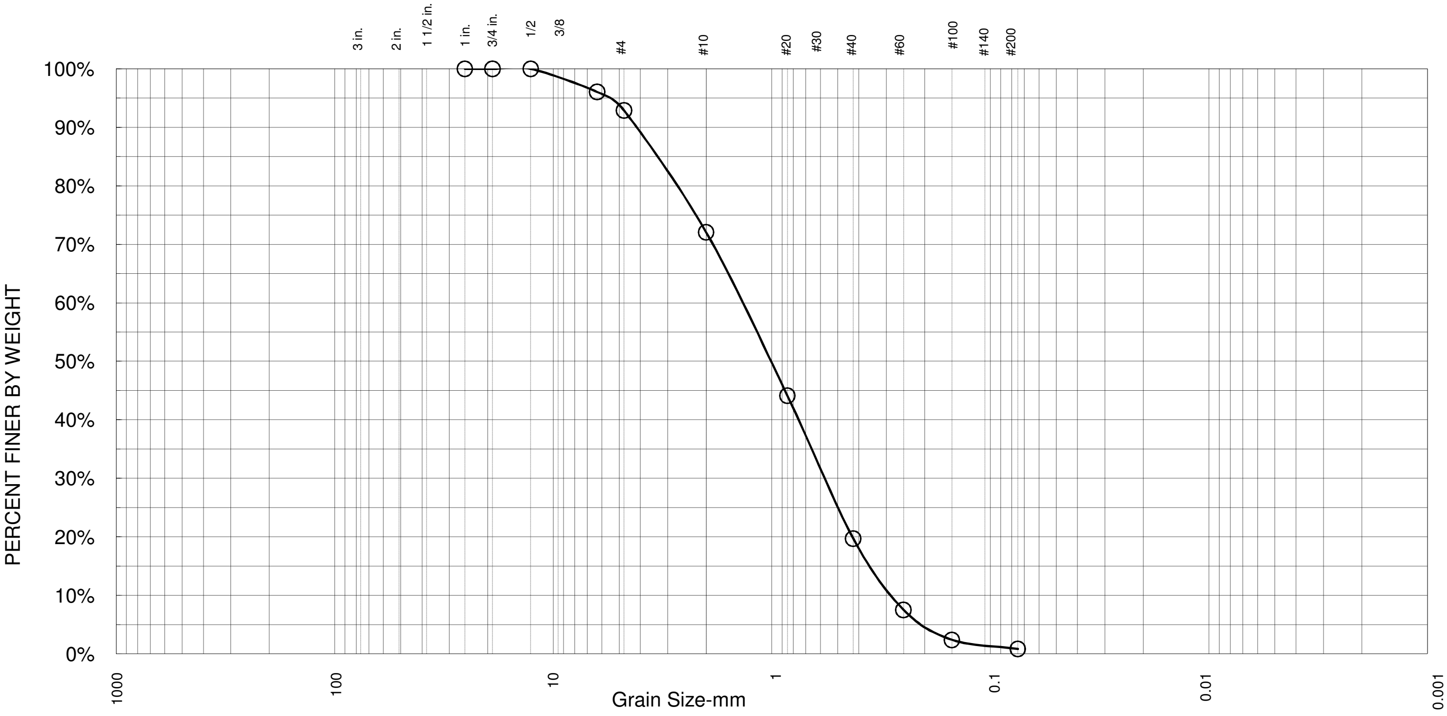
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	7.1%	20.8%	52.4%	18.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	96.0%		
4	92.9%		
10	72.1%		
20	44.1%		
40	19.7%		
60	7.5%		
100	2.4%		
200	0.8%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.20 D_{60}= 1.40 D_{50}= 1.00

D_{30}= 0.58 D_{15}= 0.36 D_{10}= 0.29

C_U= 4.83 C_C= 0.83

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-4B, SS-6 (23.5-25')
Area 2

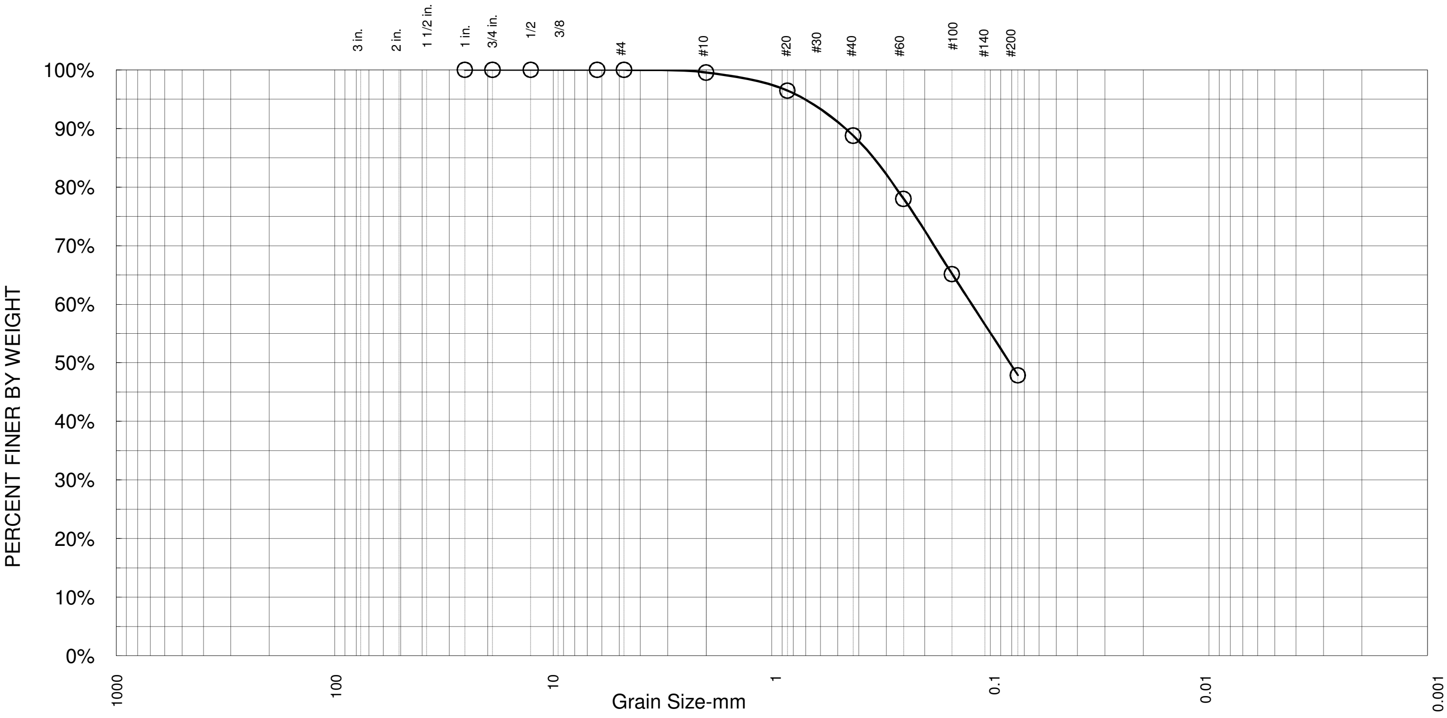
Date: 6/8/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.5%	10.8%	40.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.5%		
20	96.5%		
40	88.8%		
60	78.0%		
100	65.1%		
200	47.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.35 D_{60}= 0.13 D_{50}= 0.08

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

Sample ID.: SP-4A, G-2 (1-2.0')
Area 2

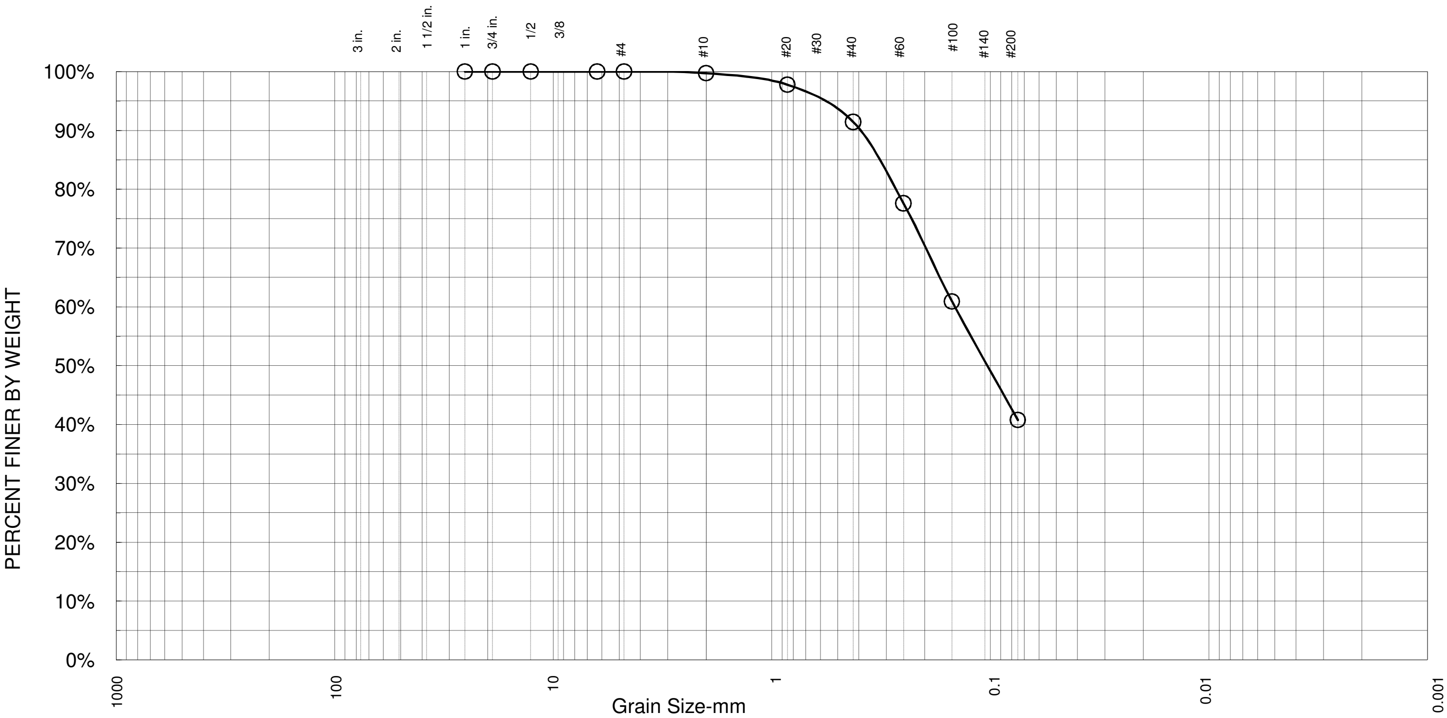
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.3%	8.3%	50.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.7%		
20	97.8%		
40	91.4%		
60	77.6%		
100	60.9%		
200	40.8%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.32 D_{60}= 0.15 D_{50}= 0.10

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

Sample ID.: SP-4C, G-1 (0-1.0')
Area 2

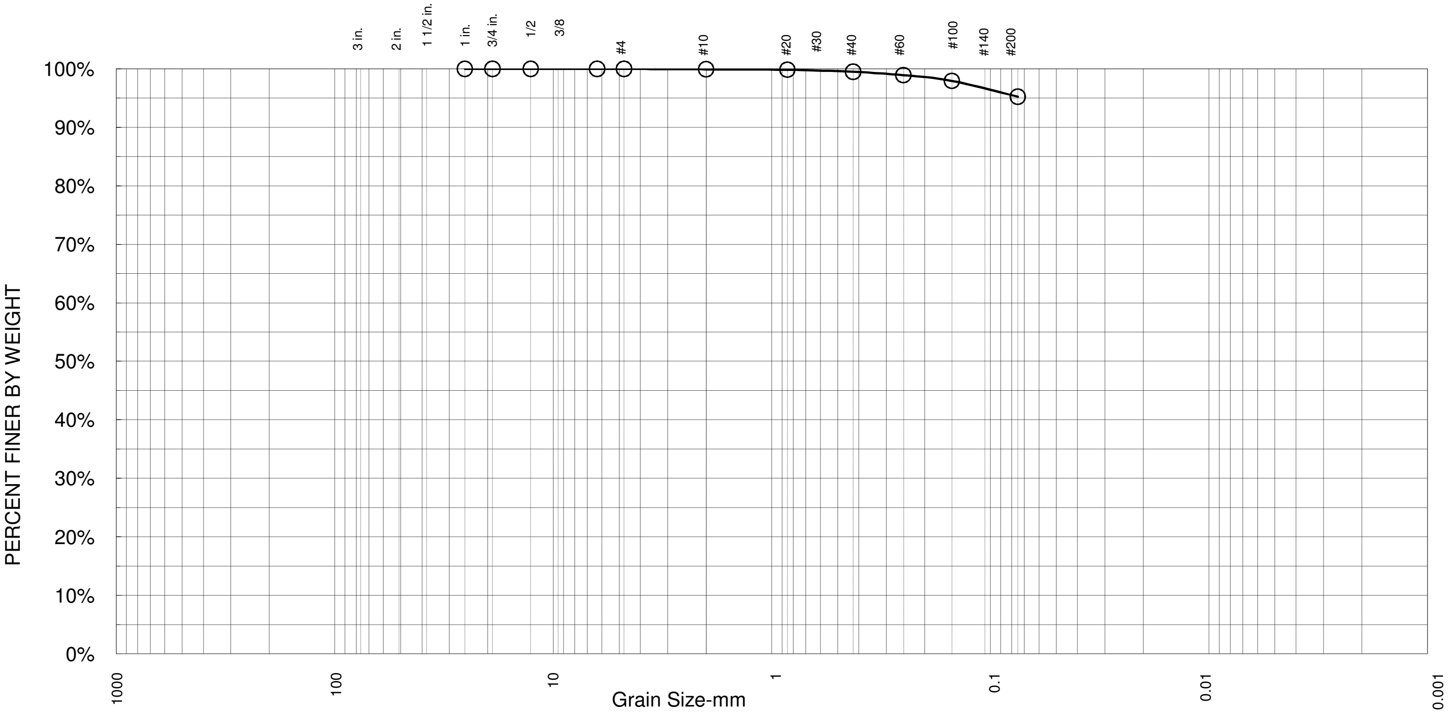
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.1%	0.4%	4.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.9%		
20	99.8%		
40	99.5%		
60	98.9%		
100	97.9%		
200	95.2%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: SP-5A, G-3 (2-3.5')
Area 2

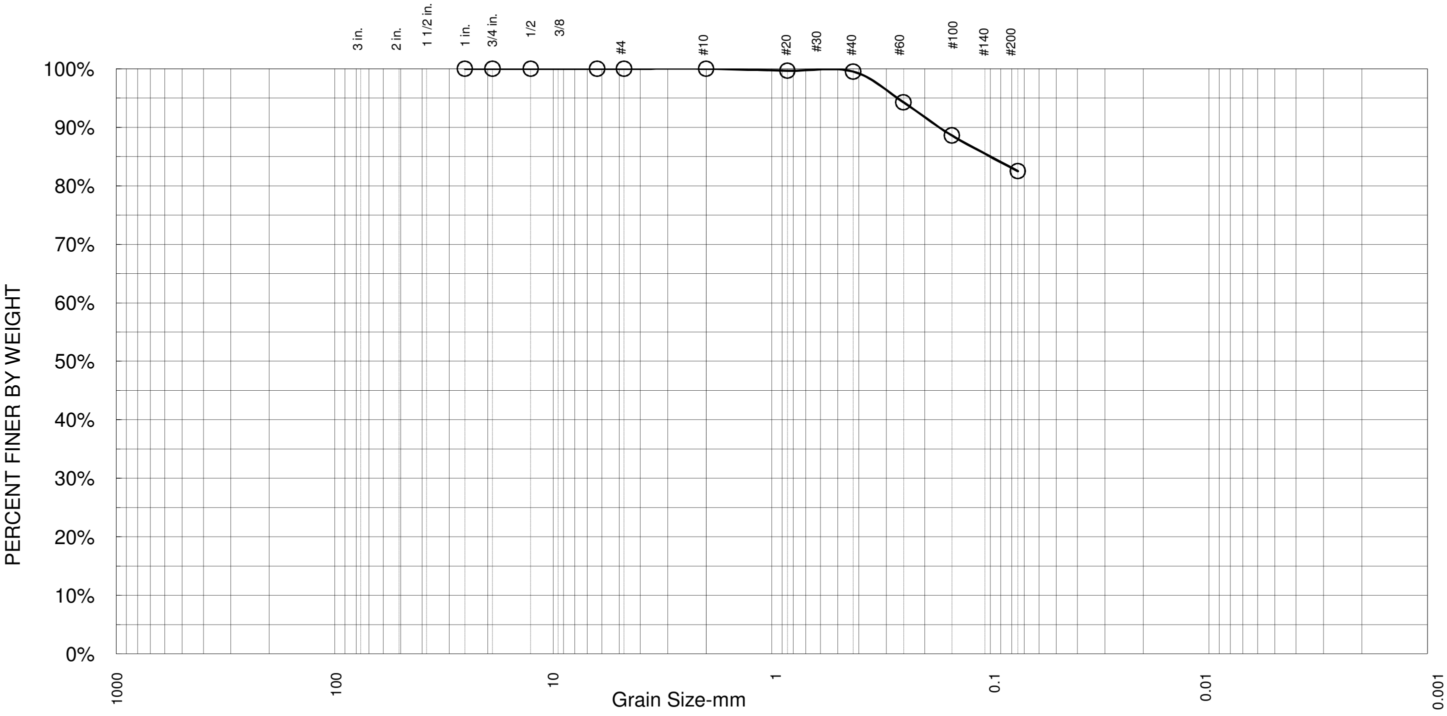
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.5%	17.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.7%		
40	99.5%		
60	94.3%		
100	88.6%		
200	82.5%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.00 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay with sand (CL)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-5A, G-7 (7.5-8.5')
Area 2

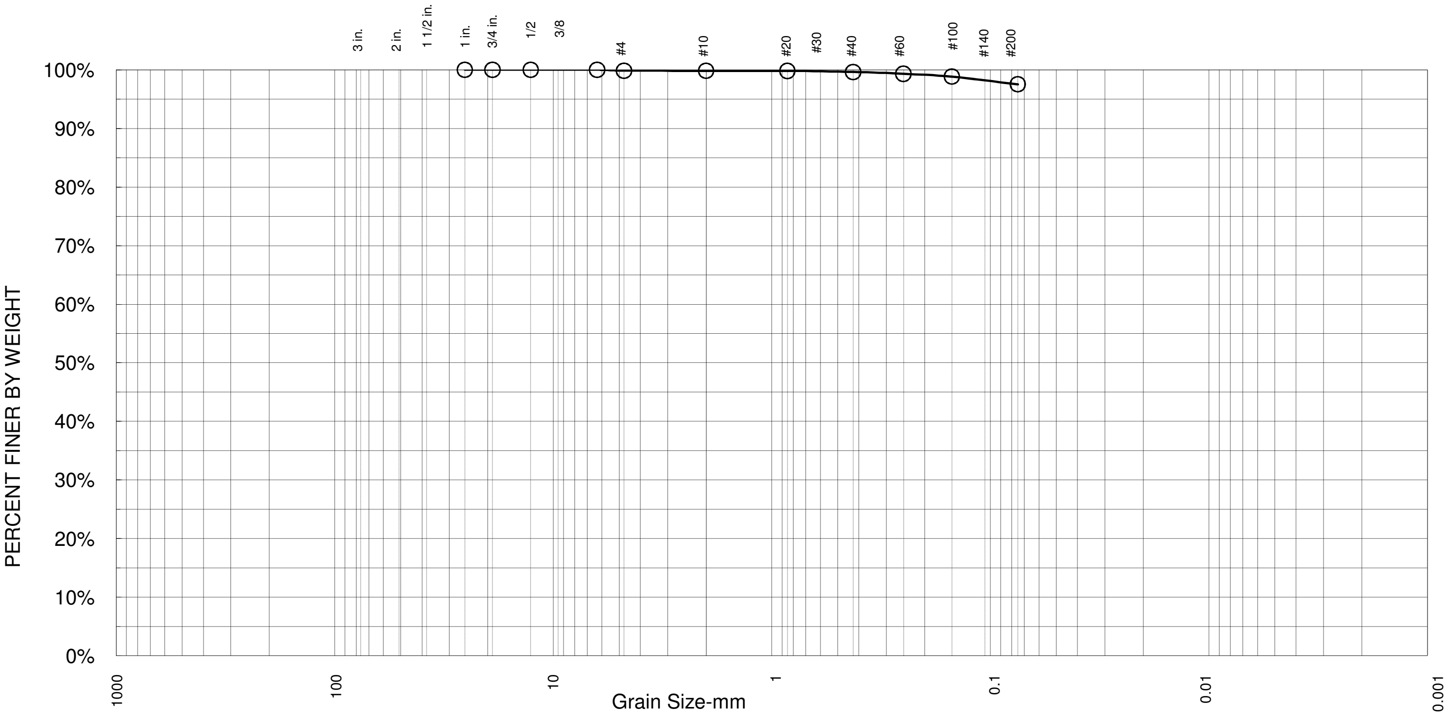
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.1%	0.0%	0.2%	2.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.9%		
10	99.8%		
20	99.8%		
40	99.6%		
60	99.3%		
100	98.8%		
200	97.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: SP-5B, G-2 (3-4.5')
Area 2

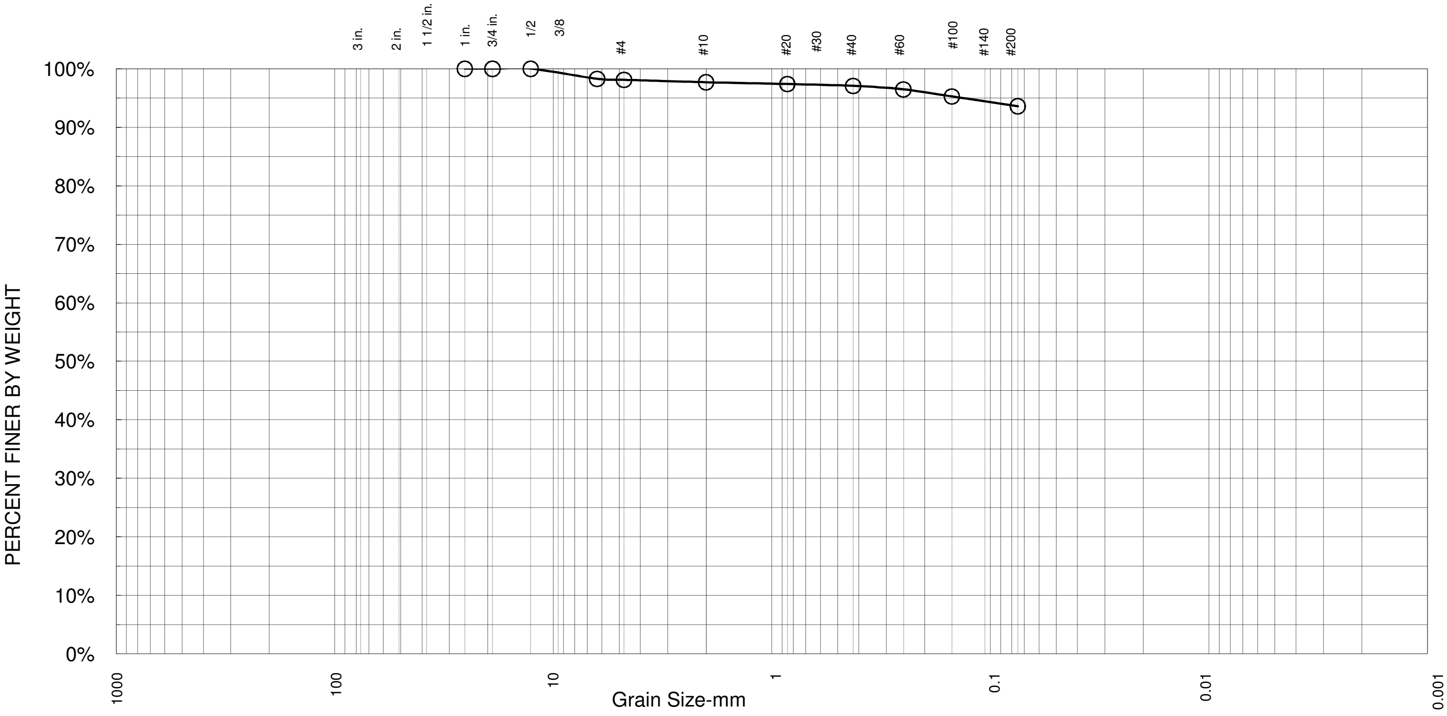
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	1.9%	0.4%	0.6%	3.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	98.3%		
4	98.1%		
10	97.7%		
20	97.4%		
40	97.1%		
60	96.5%		
100	95.3%		
200	93.6%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-5B, G-4 (6-7.5')
Area 2

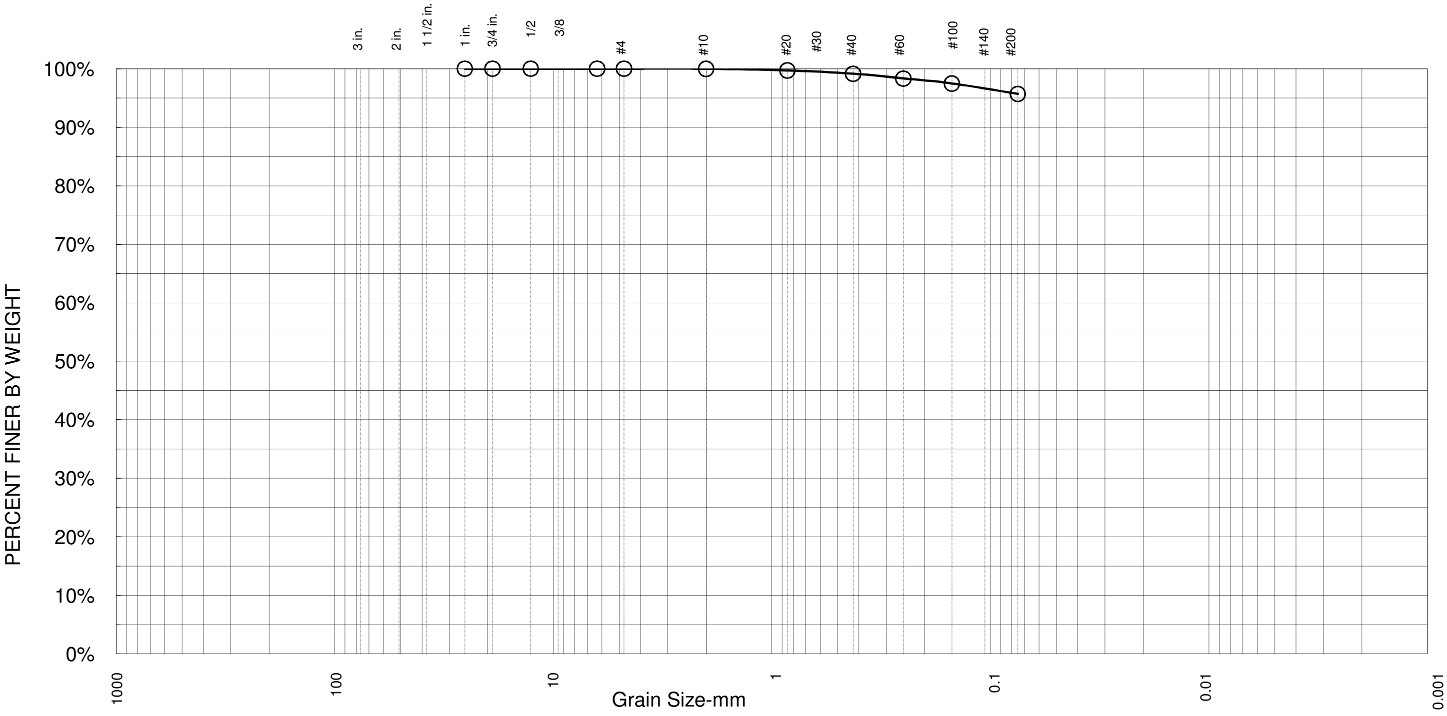
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.8%	3.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.7%		
40	99.2%		
60	98.3%		
100	97.5%		
200	95.7%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-5C, G-4 (5-6.0)
Area 2

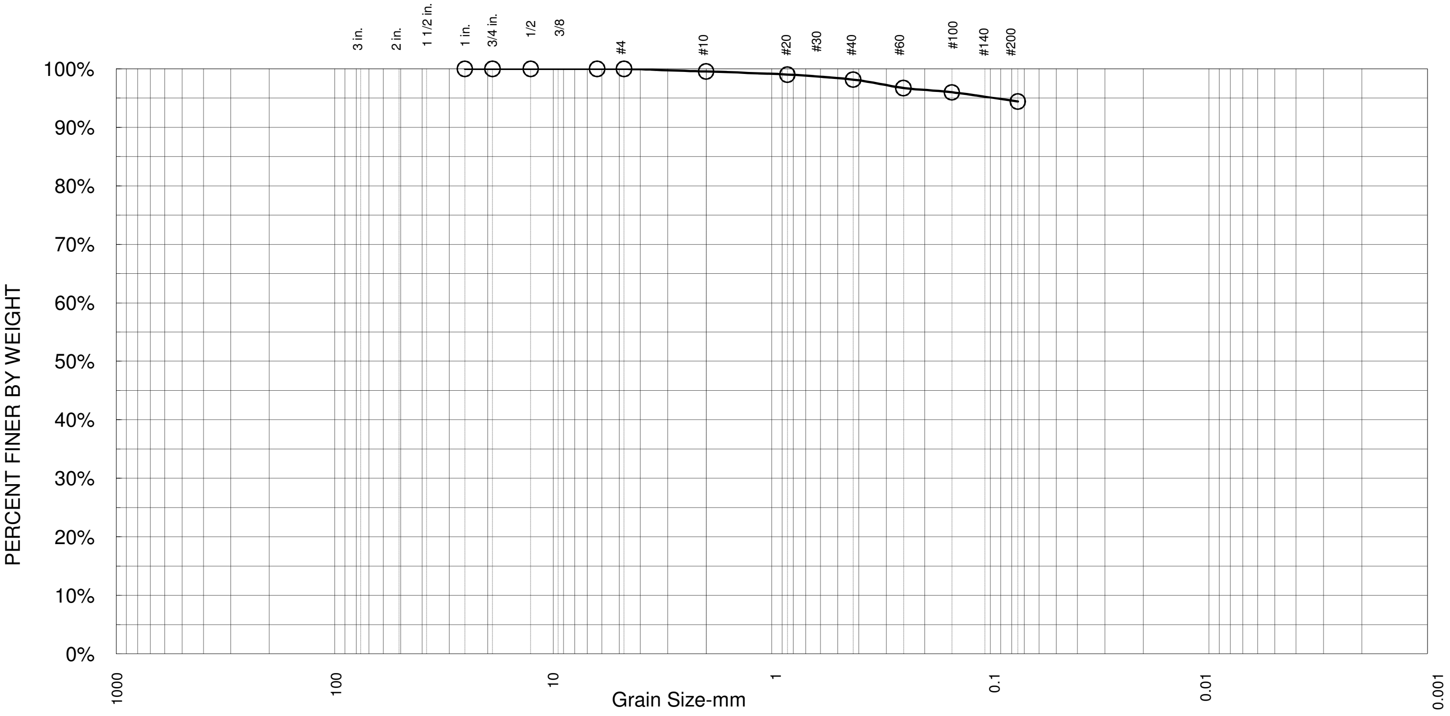
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.5%	1.4%	3.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.5%		
20	99.0%		
40	98.2%		
60	96.7%		
100	96.0%		
200	94.4%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty lean clay (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: SP-5C, G-7 (8-9.5')
Area 2

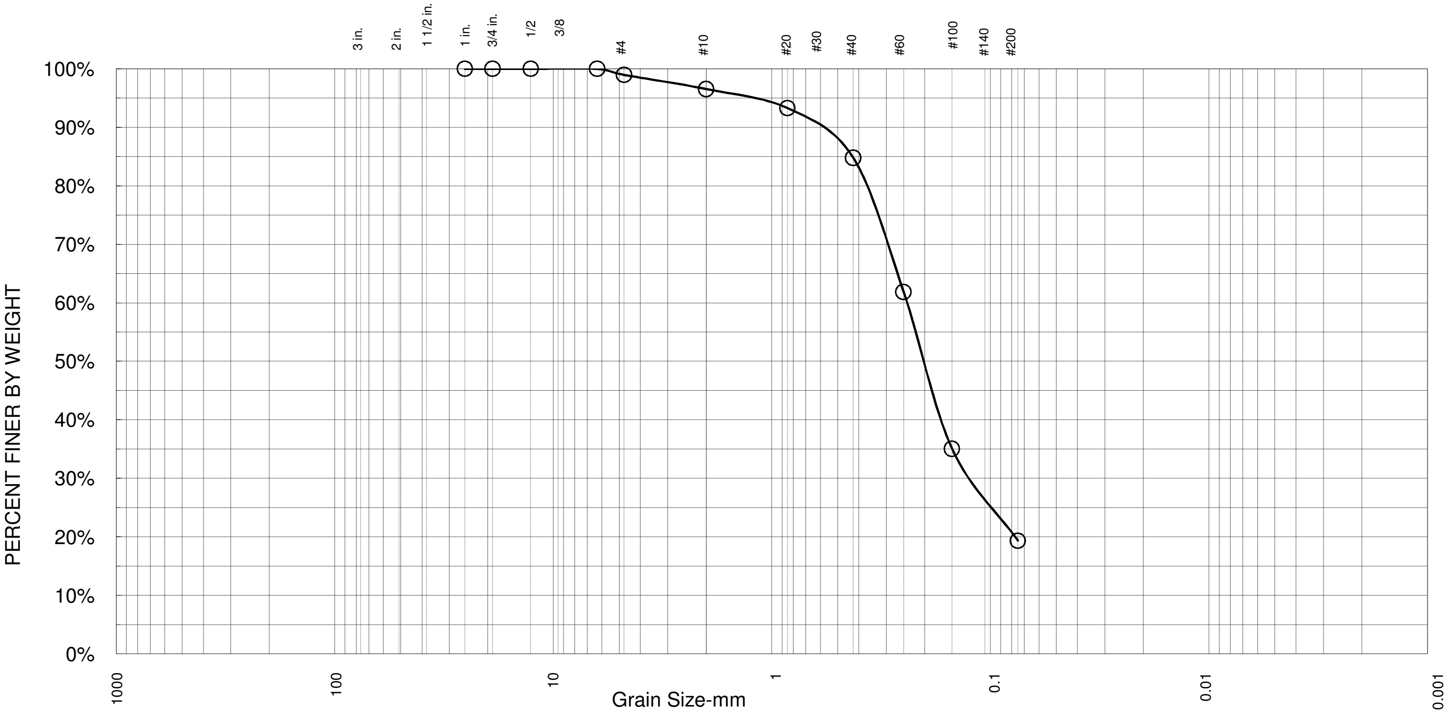
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	1.0%	2.4%	11.7%	65.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.0%		
10	96.6%		
20	93.3%		
40	84.8%		
60	61.9%		
100	35.1%		
200	19.4%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.42 D_{60}= 0.24 D_{50}= 0.20

D_{30}= 0.13 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-7C, SS-6 (23.5-25')
Area 2

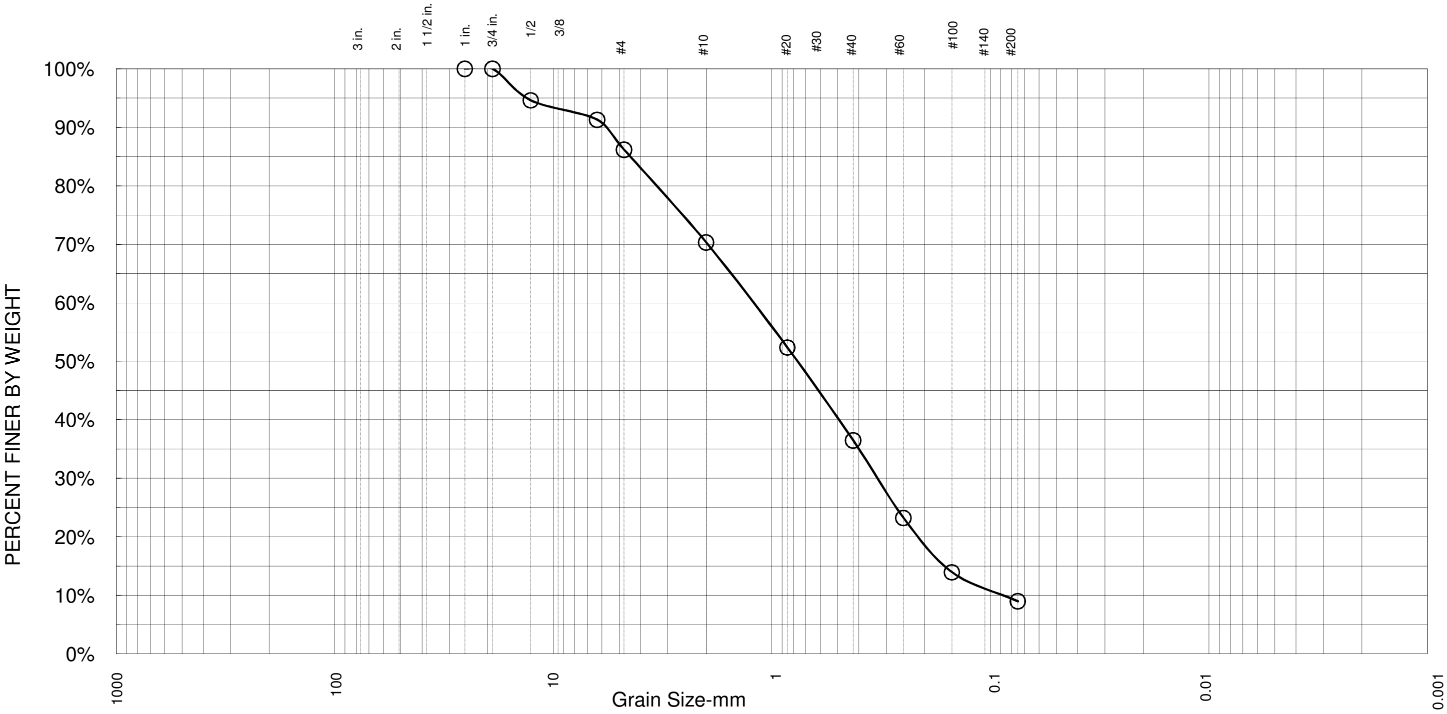
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	13.8%	15.9%	33.8%	27.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	94.6%		
1/4	91.3%		
4	86.2%		
10	70.3%		
20	52.4%		
40	36.5%		
60	23.2%		
100	14.0%		
200	9.0%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 4.40 D_{60}= 1.20 D_{50}= 0.78

D_{30}= 0.32 D_{15}= 0.17 D_{10}= 0.09

C_U= 13.33 C_C= 0.95

Classification

USCS= Poorly graded sand with clay (SP/SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-7C, SS-7 (25-26.5')
Area 2

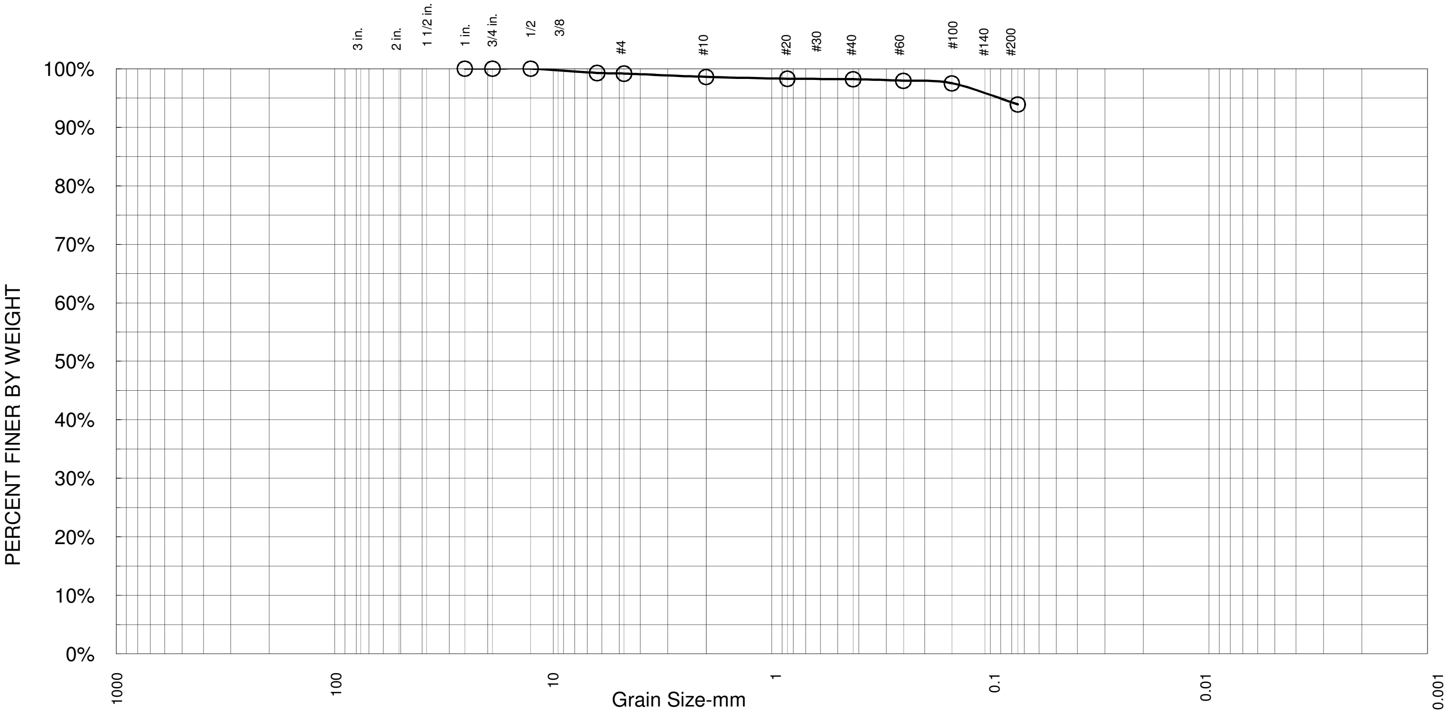
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.8%	0.6%	0.4%	4.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	99.3%		
4	99.2%		
10	98.6%		
20	98.3%		
40	98.2%		
60	97.9%		
100	97.5%		
200	93.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-8B, SS-2 (3.5-5.0')
Area 2

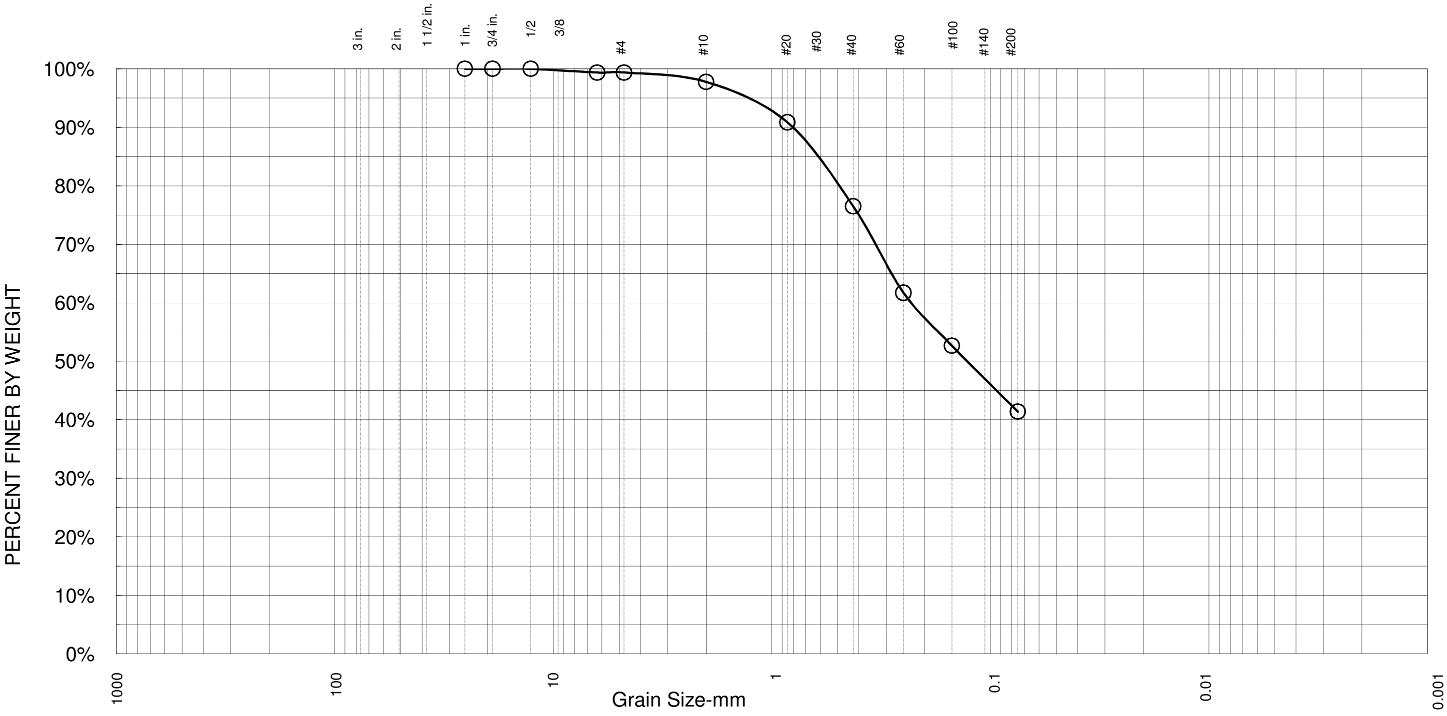
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.6%	1.6%	21.3%	35.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	99.4%		
4	99.4%		
10	97.8%		
20	90.9%		
40	76.5%		
60	61.7%		
100	52.7%		
200	41.4%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.60 D_{60}= 0.24 D_{50}= 0.13

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-8B, SS-3 (10-11.5)
Area 2

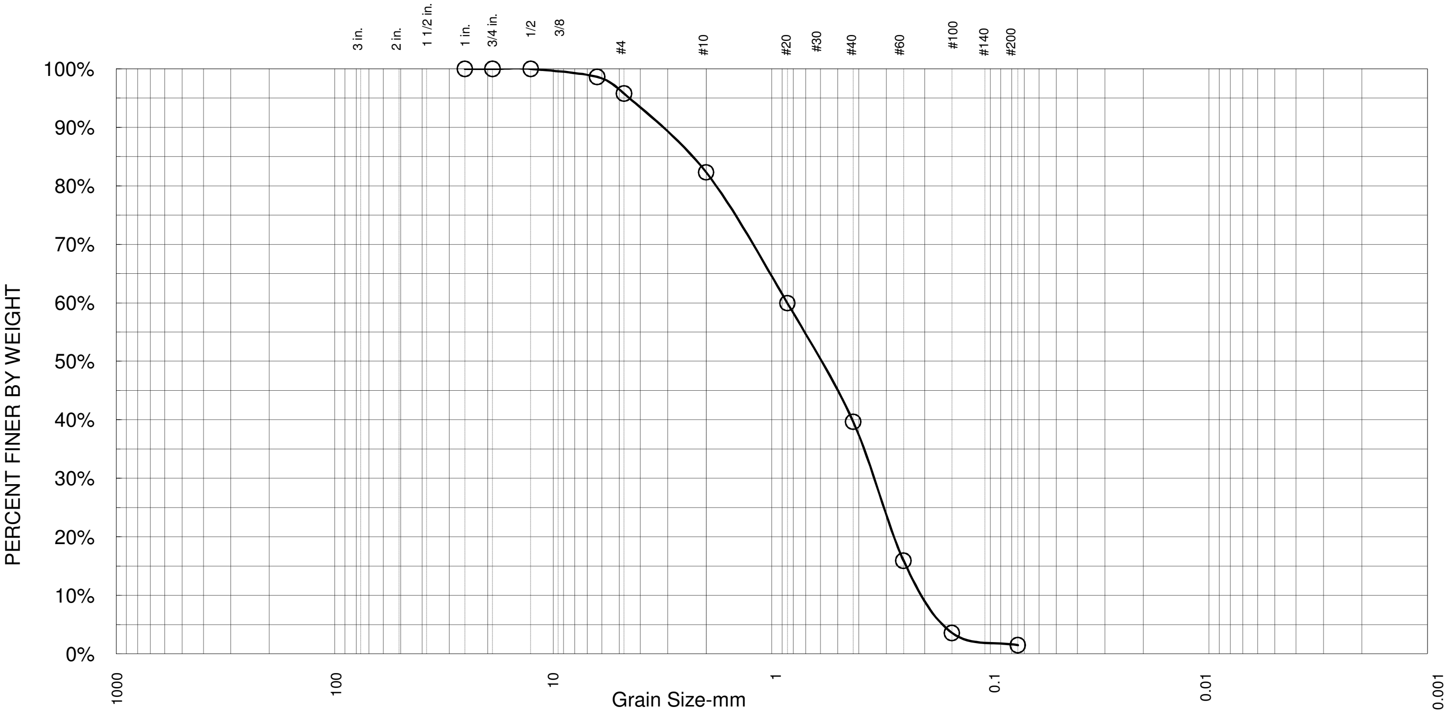
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	4.2%	13.5%	42.6%	38.2%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	98.6%		
4	95.8%		
10	82.3%		
20	59.9%		
40	39.7%		
60	15.9%		
100	3.6%		
200	1.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.30 D_{60}= 0.85 D_{50}= 0.59

D_{30}= 0.33 D_{15}= 0.25 D_{10}= 0.21

C_U= 4.05 C_C= 0.61

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-8B, SS-5 (18.5-20')
Area 2

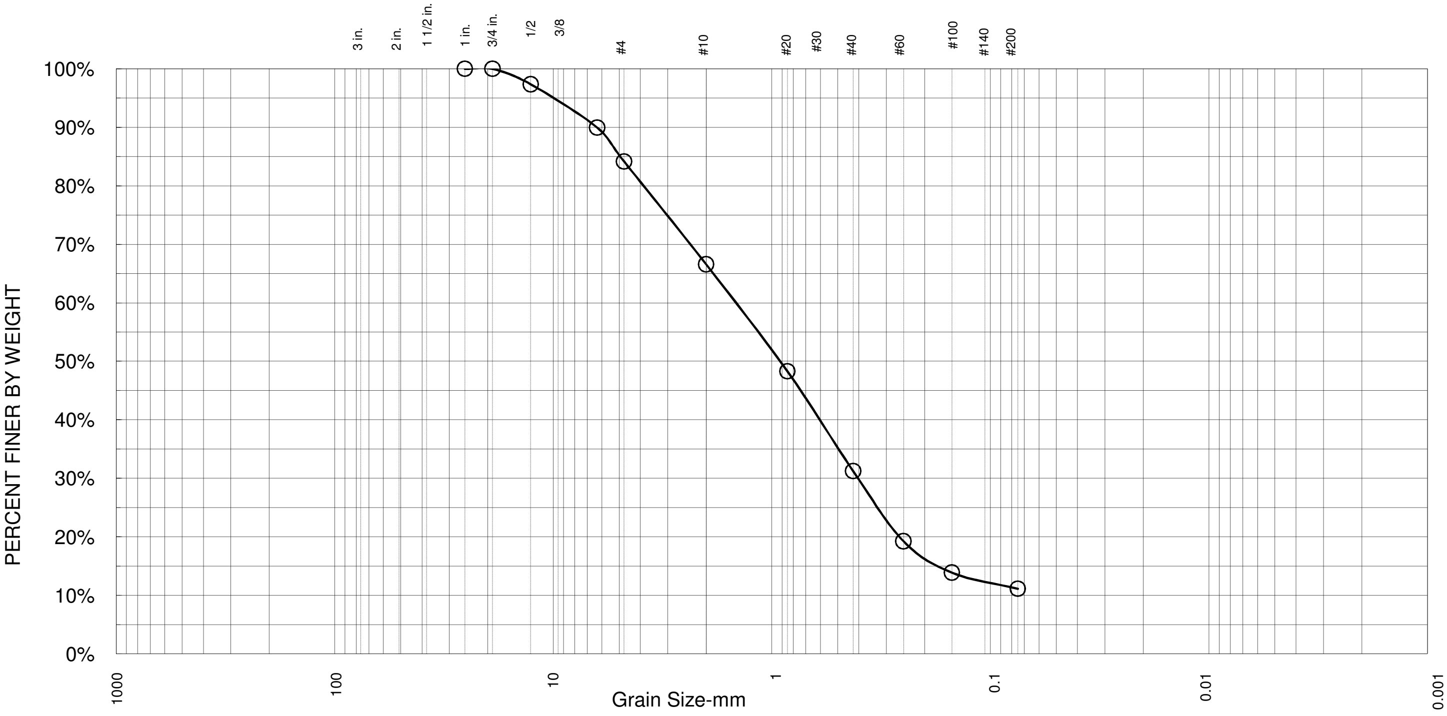
Date: 6/8/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	15.8%	17.6%	35.3%	20.1%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	97.4%		
1/4	90.0%		
4	84.2%		
10	66.6%		
20	48.3%		
40	31.2%		
60	19.2%		
100	13.9%		
200	11.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 4.90 D_{60}= 1.50 D_{50}= 0.90

D_{30}= 0.40 D_{15}= 0.17 D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Poorly graded sand with clay (SP/SC)

Remarks

N/A- Not Applicable

Sample ID.: B-8B, SS-6 (23.5-25')
Area 2

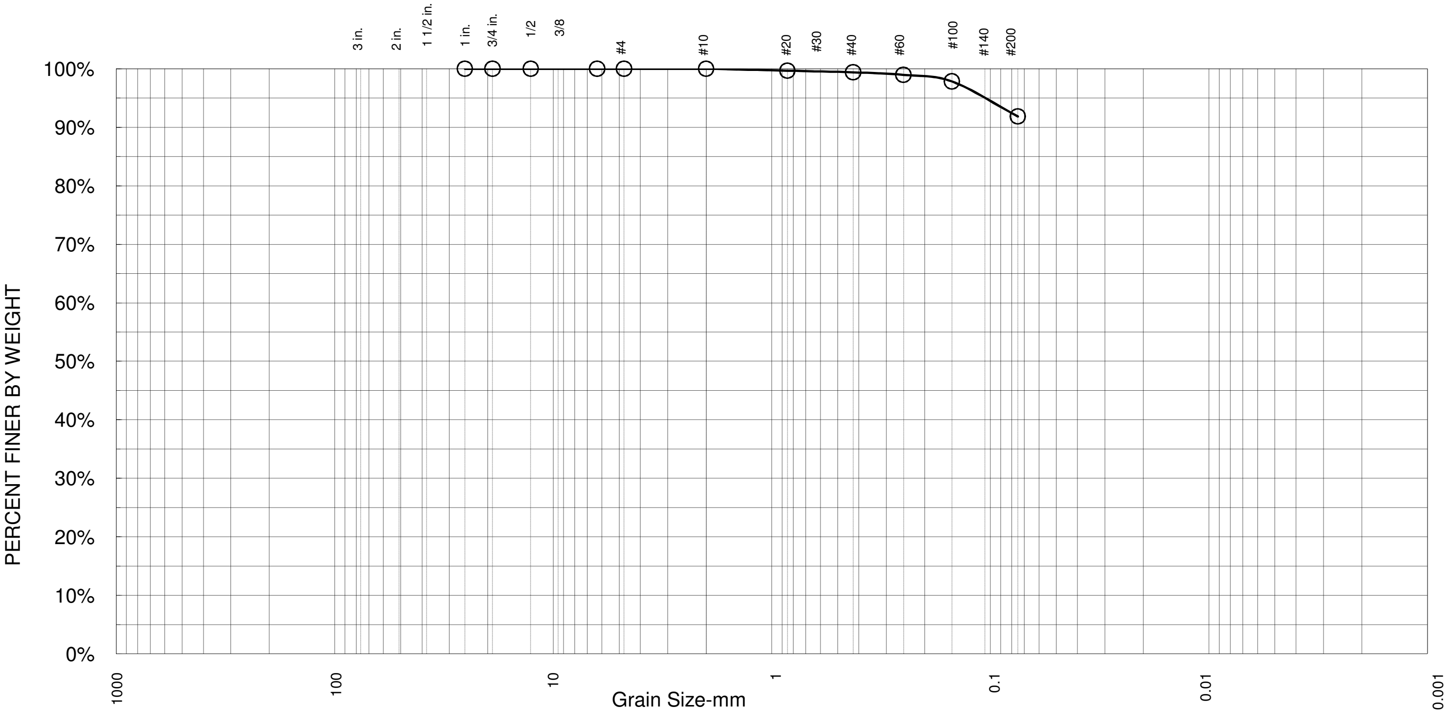
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.6%	7.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.7%		
40	99.4%		
60	99.0%		
100	97.8%		
200	91.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-9A, G-3 (2-3.0')
Area 2

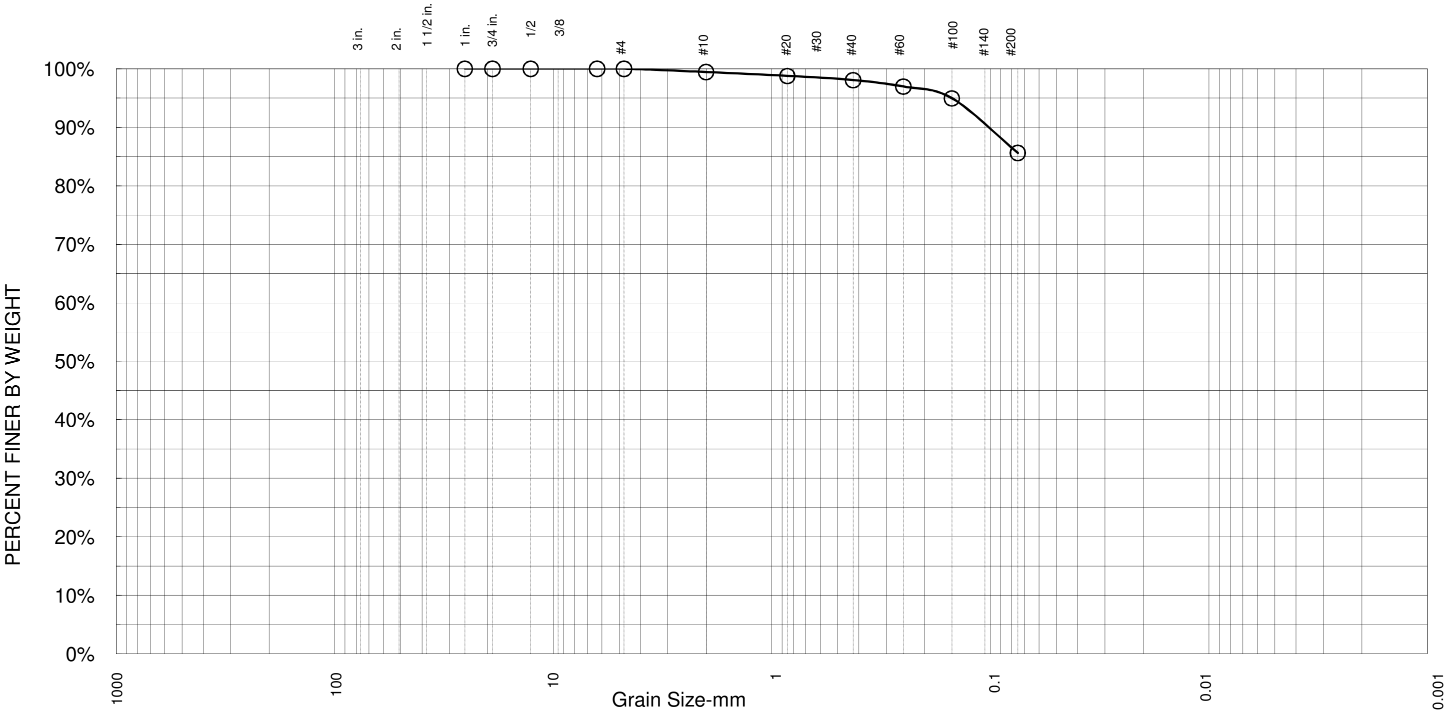
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.6%	1.4%	12.4%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.4%		
20	98.8%		
40	98.1%		
60	97.0%		
100	94.9%		
200	85.6%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-9A, G-4 (3-5.0')
Area 2

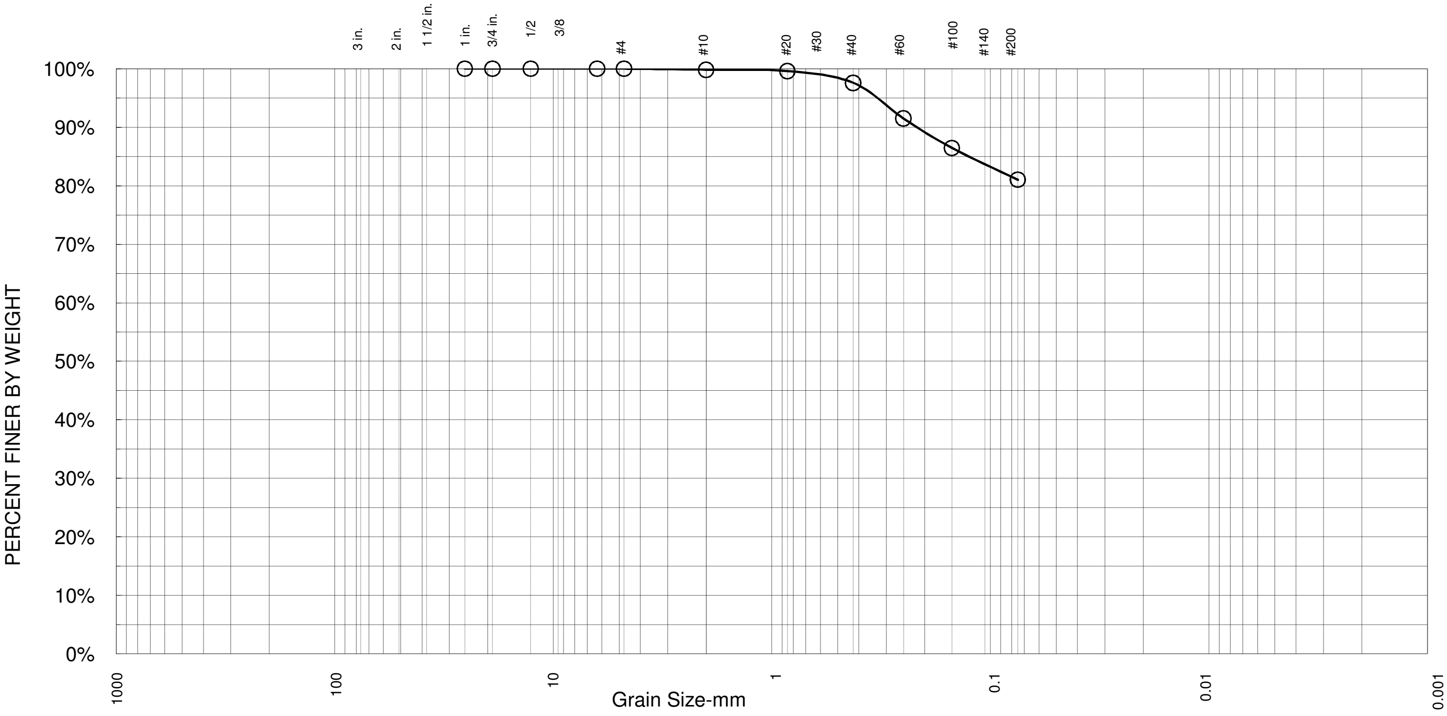
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.2%	2.2%	16.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.8%		
20	99.6%		
40	97.6%		
60	91.5%		
100	86.5%		
200	81.0%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.14 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay with sand (CL)

Remarks

N/A- Not Applicable

Sample ID.: SP-9C, G-2 (3-4.0)
Area 2

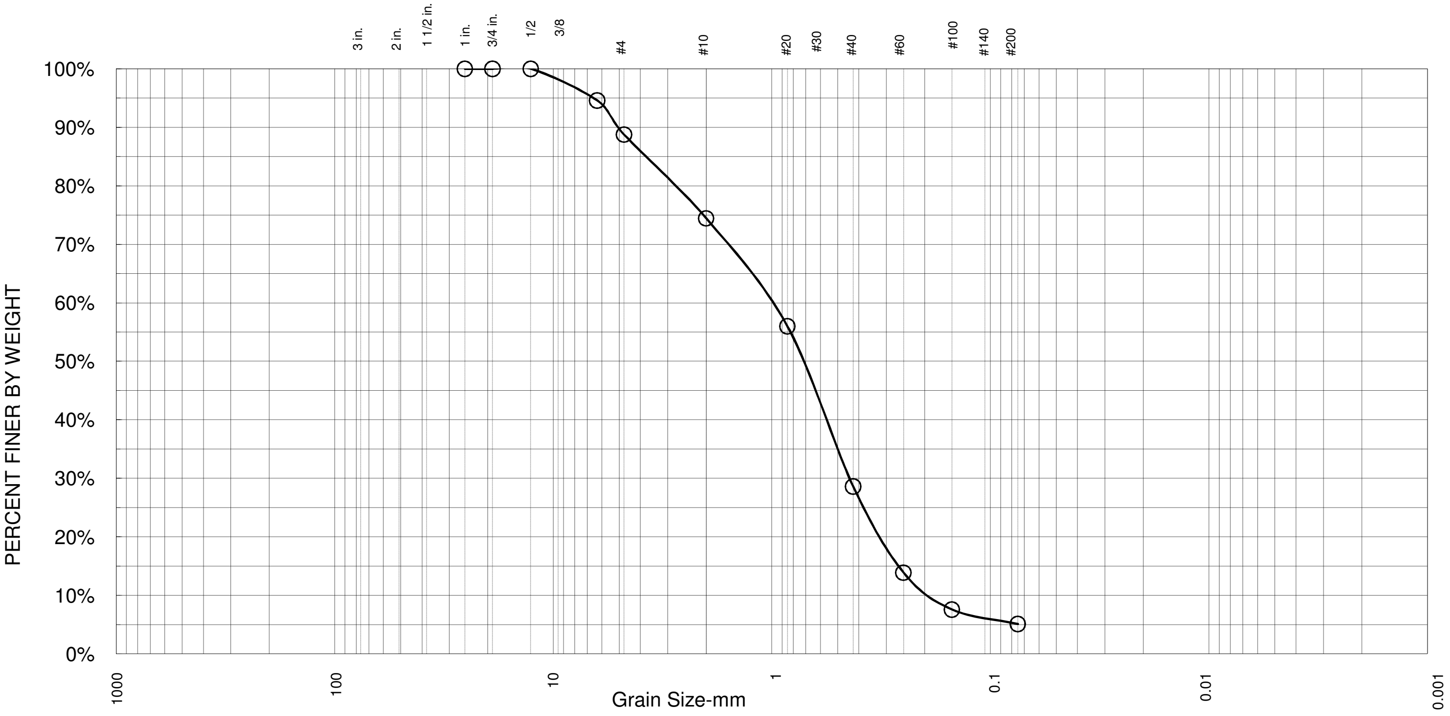
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	11.3%	14.3%	45.8%	23.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	94.6%		
4	88.7%		
10	74.4%		
20	56.0%		
40	28.6%		
60	13.9%		
100	7.6%		
200	5.1%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 3.80 D_{60}= 1.00 D_{50}= 0.71

D_{30}= 0.44 D_{15}= 0.27 D_{10}= 0.20

C_U= 5.00 C_C= 0.97

Classification

USCS= Poorly graded sand with clay (SP/SC)

Remarks

N/A- Not Applicable

Sample ID.: B-11, SS-3 (8.5-10')
Area 2

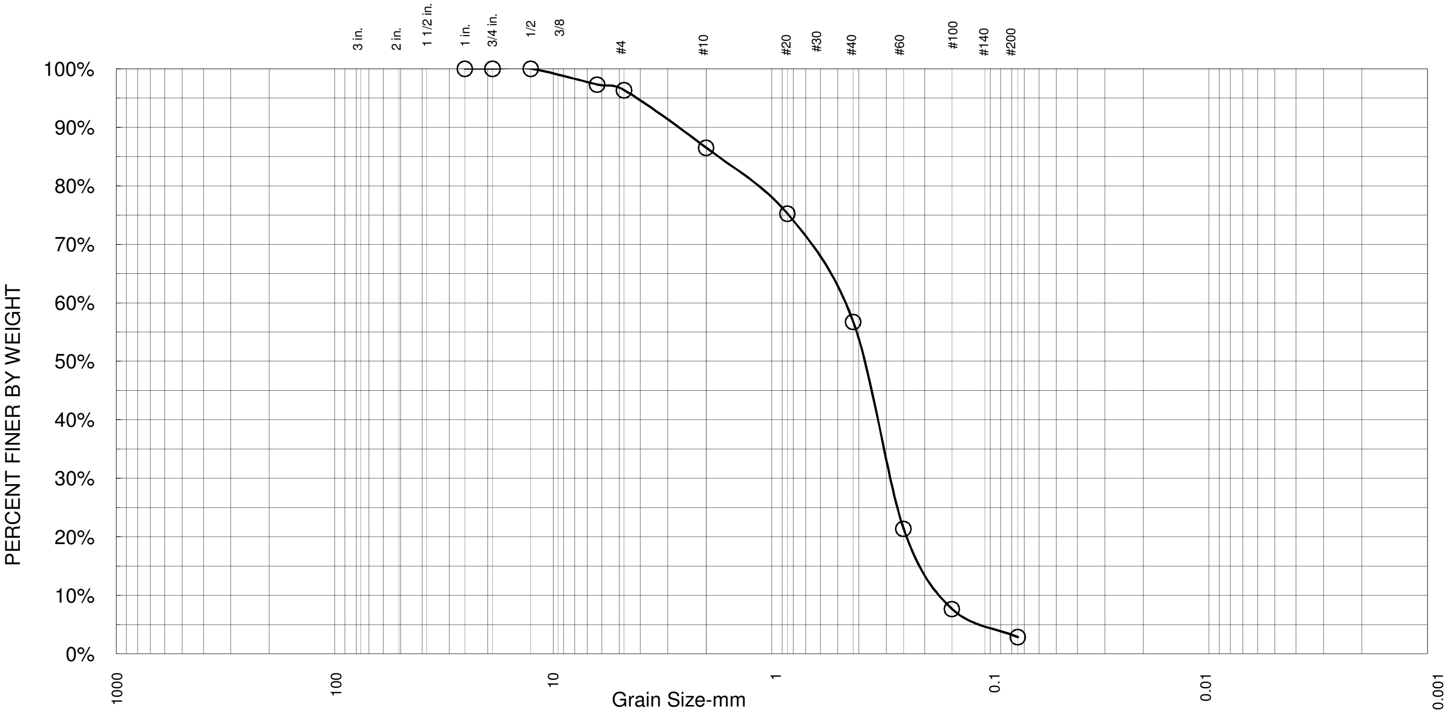
Date: 6/8/2010

OLSSON
ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	3.7%	9.8%	29.8%	53.9%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.3%		
4	96.3%		
10	86.5%		
20	75.2%		
40	56.7%		
60	21.4%		
100	7.6%		
200	2.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.70 D_{60}= 0.46 D_{50}= 0.38

D_{30}= 0.29 D_{15}= 0.21 D_{10}= 0.17

C_U= 2.71 C_C= 1.08

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: B-13, SS-2 (3.5-5')
Area 2

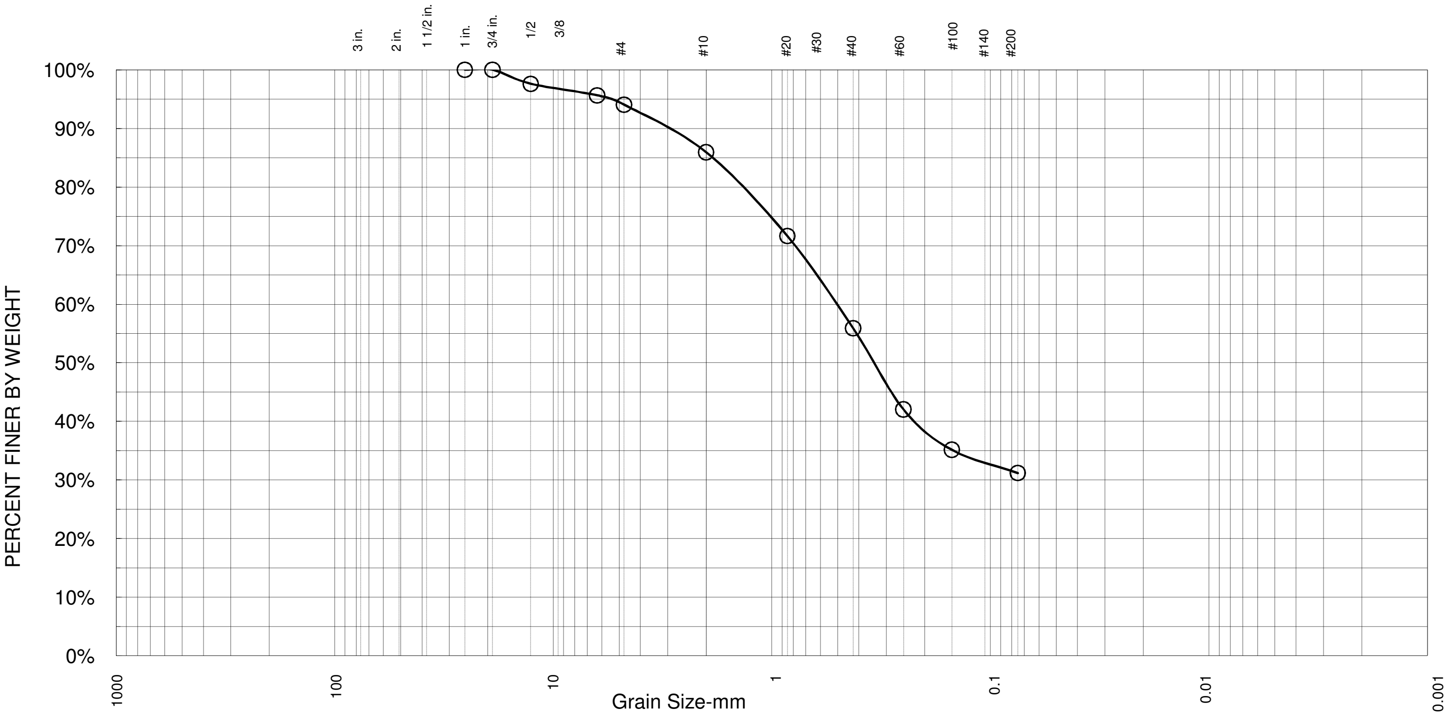
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	5.9%	8.1%	30.1%	24.7%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	97.6%		
1/4	95.6%		
4	94.1%		
10	85.9%		
20	71.6%		
40	55.9%		
60	42.0%		
100	35.1%		
200	31.2%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 1.90 D_{60}= 0.50 D_{50}= 0.33

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Silty, clayey sand (SC/SM)

Remarks

N/A- Not Applicable

Sample ID.: B-16, SS-3 (8.5-10')
Area 2

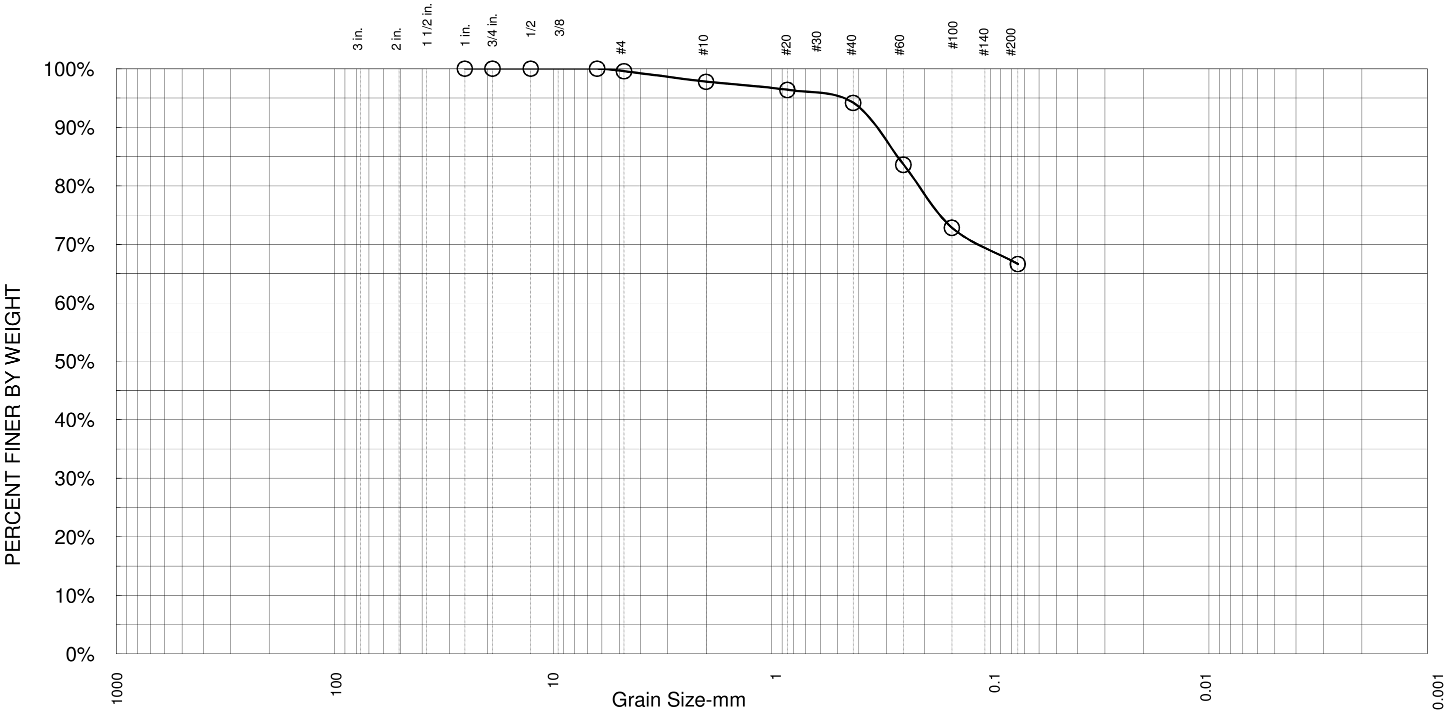
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.4%	1.8%	3.6%	27.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	99.6%		
10	97.8%		
20	96.4%		
40	94.2%		
60	83.6%		
100	72.8%		
200	66.6%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.27 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Sandy lean clay (CL)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: B-17, SS-2 (3.5-5')
Area 2

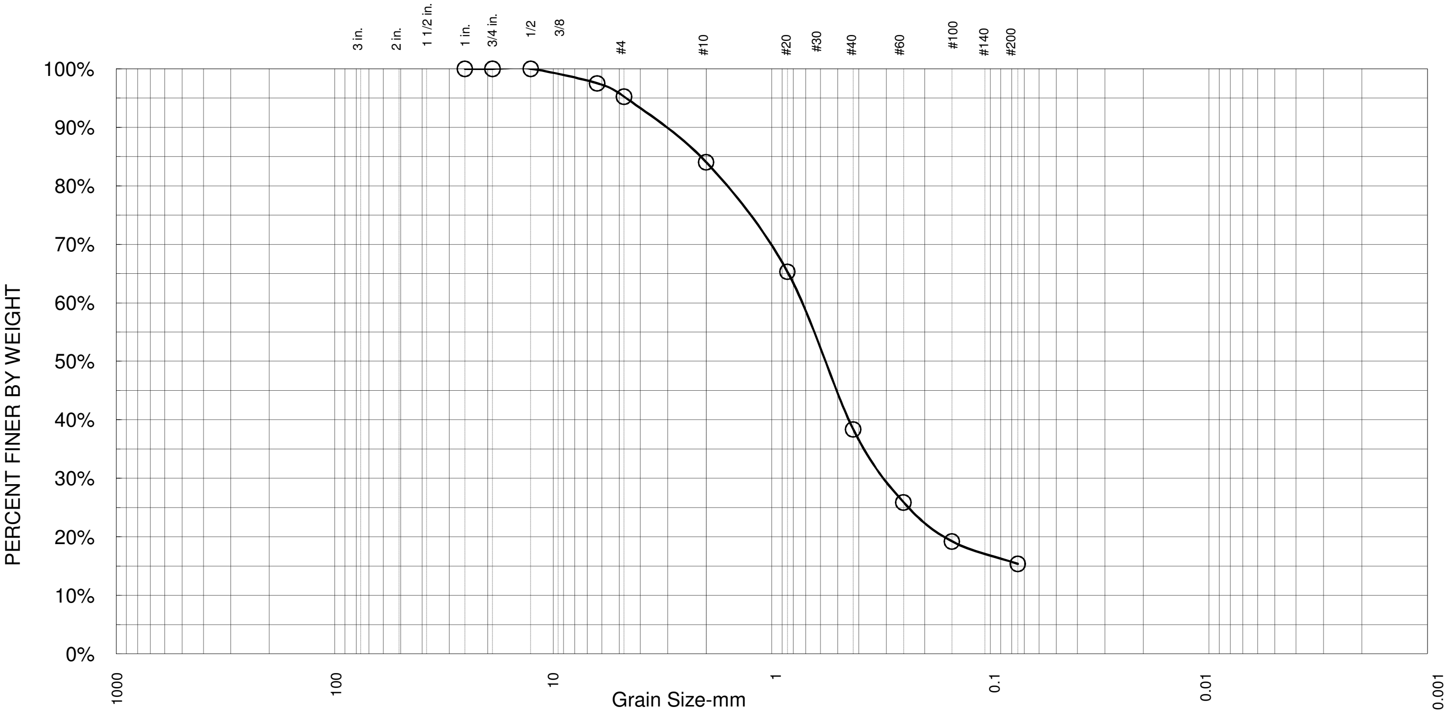
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	4.8%	11.2%	45.6%	23.0%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	97.5%		
4	95.2%		
10	84.0%		
20	65.3%		
40	38.4%		
60	25.9%		
100	19.2%		
200	15.4%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 2.10 D_{60}= 0.71 D_{50}= 0.58

D_{30}= 0.30 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Clayey sand (SC)

Remarks

N/A- Not Applicable

Sample ID.: B-17, SS-3 (8.5-10')
Area 2

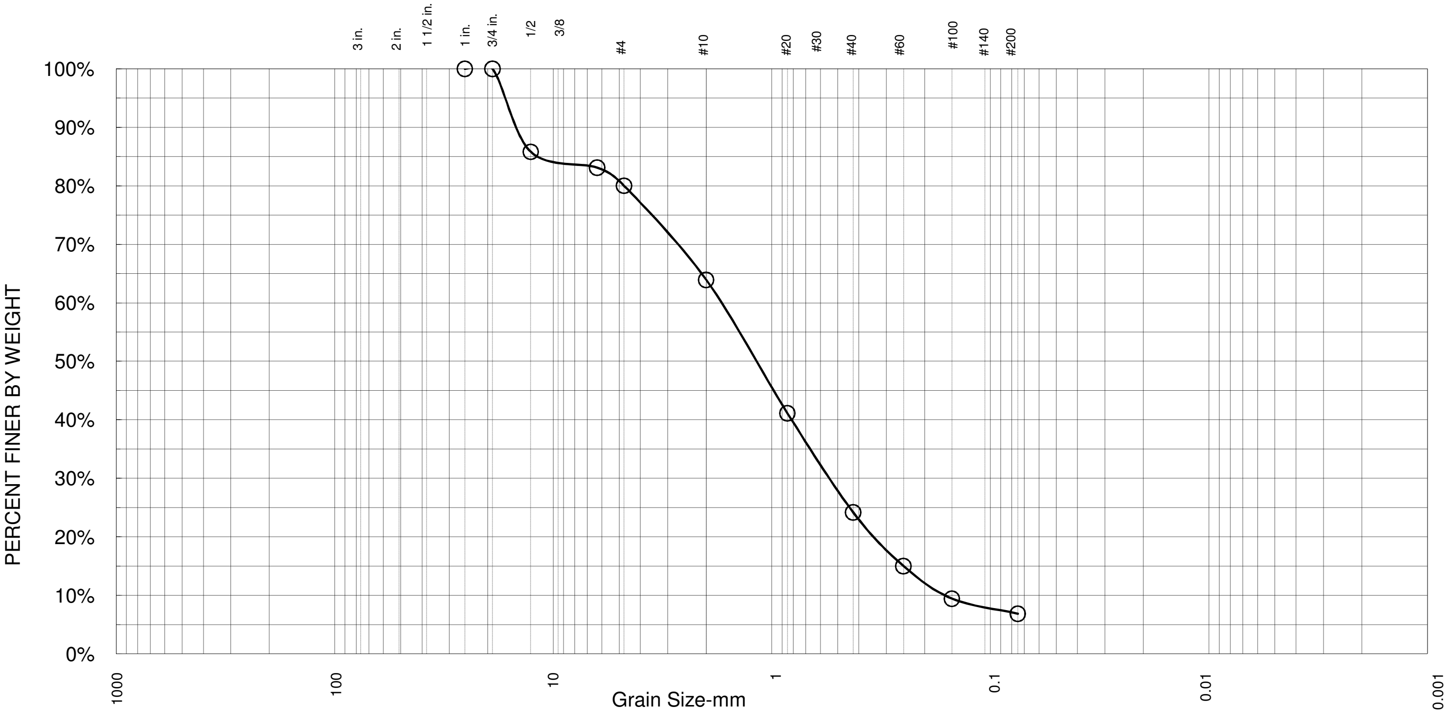
Date: 6/8/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	20.0%	16.1%	39.7%	17.3%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	85.8%		
1/4	83.1%		
4	80.0%		
10	63.9%		
20	41.1%		
40	24.2%		
60	15.0%		
100	9.4%		
200	6.9%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 13.00 D_{60}= 1.70 D_{50}= 1.20

D_{30}= 0.55 D_{15}= 0.25 D_{10}= 0.16

C_U= 10.63 C_C= 1.11

Classification

USCS= Well graded sand with clay (SW/SC)

Remarks

N/A- Not Applicable

Sample ID.: B-18, SS-3 (8.5-10')
Area 2

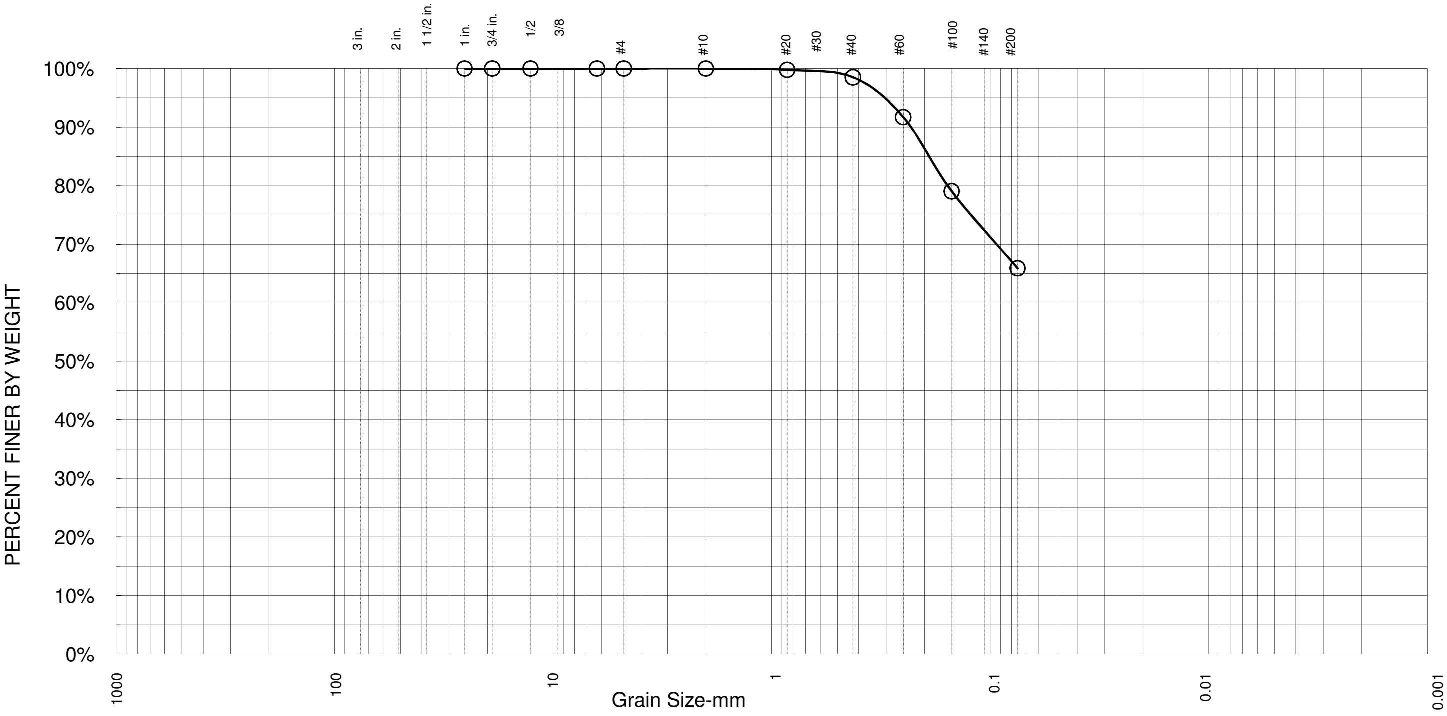
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	1.5%	32.6%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.8%		
40	98.5%		
60	91.7%		
100	79.0%		
200	65.9%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.19 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Sandy lean clay (CL)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: SP-19, G-3 (5-7.0')
Area 2

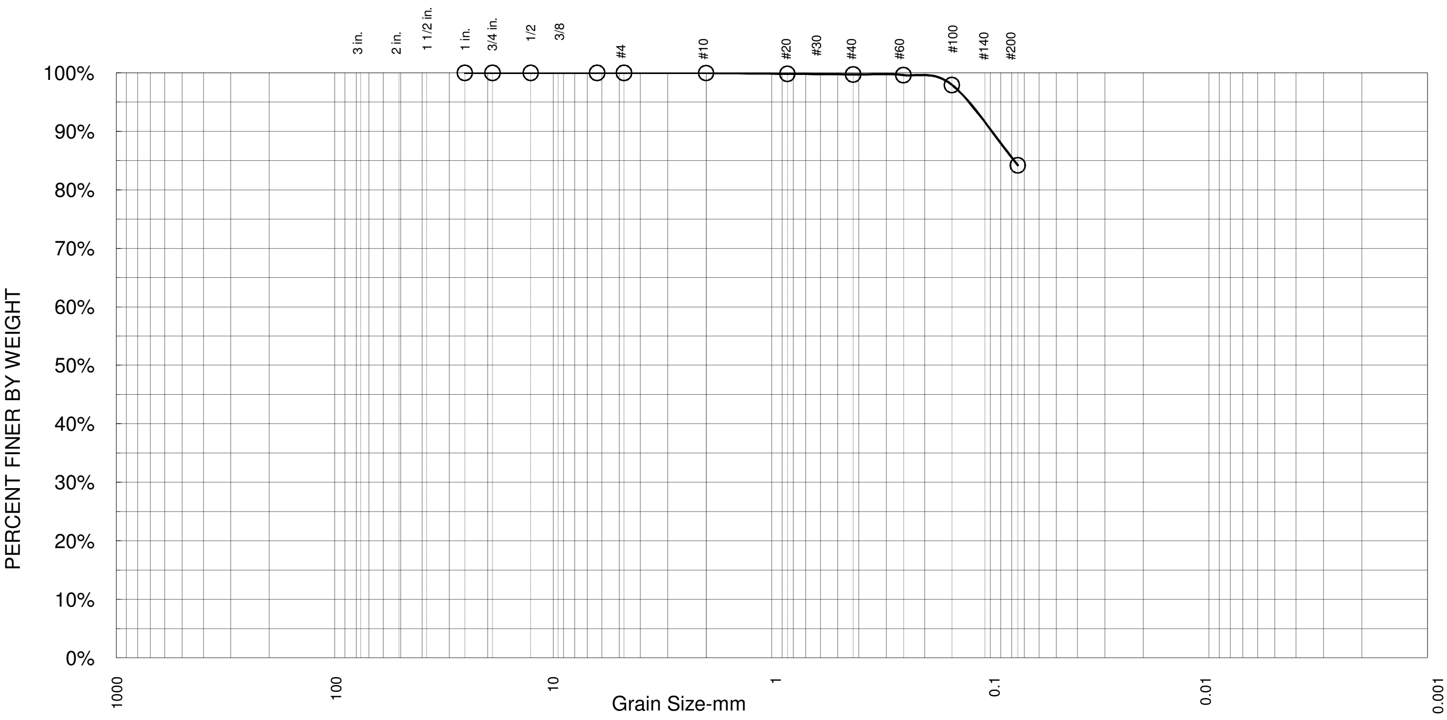
Date: 6/3/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.3%	15.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	100.0%		
20	99.8%		
40	99.7%		
60	99.6%		
100	97.9%		
200	84.2%		

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.08 D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay with sand (CL)

Remarks

N/A- Not Applicable

*-(no specification provided)

Sample ID.: Bulk Sample: B-8B (3-8.0')
Area 2

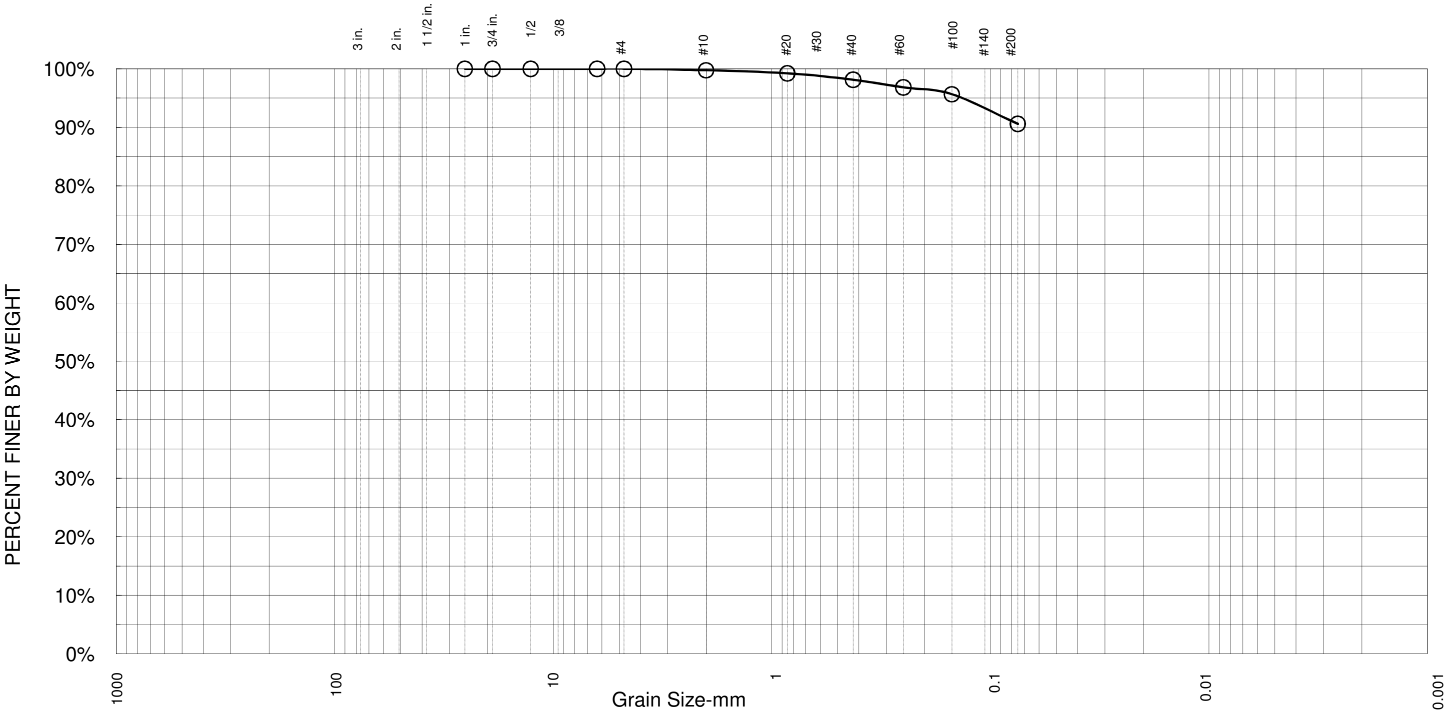
Date: 5/27/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Reasibility Study - Area 2

Project #: A09-1466

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.3%	1.6%	7.5%	N/A	N/A

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
1	100.0%		
3/4	100.0%		
1/2	100.0%		
1/4	100.0%		
4	100.0%		
10	99.7%		
20	99.2%		
40	98.1%		
60	96.8%		
100	95.6%		
200	90.6%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= N/A D_{60}= N/A D_{50}= N/A

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

USCS= Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: Bulk Sample: B-11 (1-4.5')
Area 2

Date: 5/17/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 7/1/2010
Project No.: A09-1466
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2
Lab #: N/A

Revision Date: 3/28/2005
Revision #: 1

Sample Information

Location of Sample: B-6C, U-3 (8.5-10')
Sample Description: Yellowish brown, Silty lean clay with sand
USCS Classificiation: CL/ML
Liquid Limit: 25
Plasticity Index: 6

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 79.00
Tare = 14.94
Dry Sample Weight = 64.06

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 55.26
Tare = 8.4
Dry Sample Weight = 46.86

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.00	100.00%
#40	0.00	100.00%
#60	0.00	100.00%
#100	2.62	94.41%
#200	5.48	88.31%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 66.4
Weight of Hydrometer sample = 48.22

Hygroscopic moisture correction #1:
Moist weight & tare = 27.63
Dry weight & tare = 27.35
Tare = 19.61
Hygroscopic moist. = 3.62%
Calculated biased wt. = 64.06

Hygroscopic moisture correction #2:
Moist weight & tare= 26.48
Dry weight & tare = 26.16
Tare = 15.1
Hygroscopic moist. = 2.89%
Calculated biased wt.= 46.86

Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Sample Loc. B-6C, U-3 (8.5-10')

Revision Date: 3/28/2005

Revision #: 1

Project # A09-1466

Date 7/1/2010

Lab # N/A

Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.018	0.004167	1.0138335	46.86	46.88	11.50	0.01328	0.0318
5	21	1.016	0.004167	1.0118335	46.86	40.10	12.10	0.01328	0.0207
15	21	1.014	0.004167	1.0098335	46.86	33.33	12.60	0.01328	0.0122
30	21	1.013	0.004167	1.0088335	46.86	29.94	12.90	0.01328	0.0087
60	21	1.012	0.004167	1.0078335	46.86	26.55	13.10	0.01328	0.0062
250	21	1.0115	0.004167	1.0073335	46.86	24.85	13.25	0.01328	0.0031
1440	21	1.011	0.004167	1.0068335	46.86	23.16	13.40	0.01328	0.0013

Fractional Components:

Gravel/Sand based on #4 Sieve

Sand/Fines based on #200 Sieve

% +3 in. = 0

% Gravel = 0

% Sand = 11.7

% Silt = 62.3

% Clay = 26.0

Diameters:

D85 = 0.068

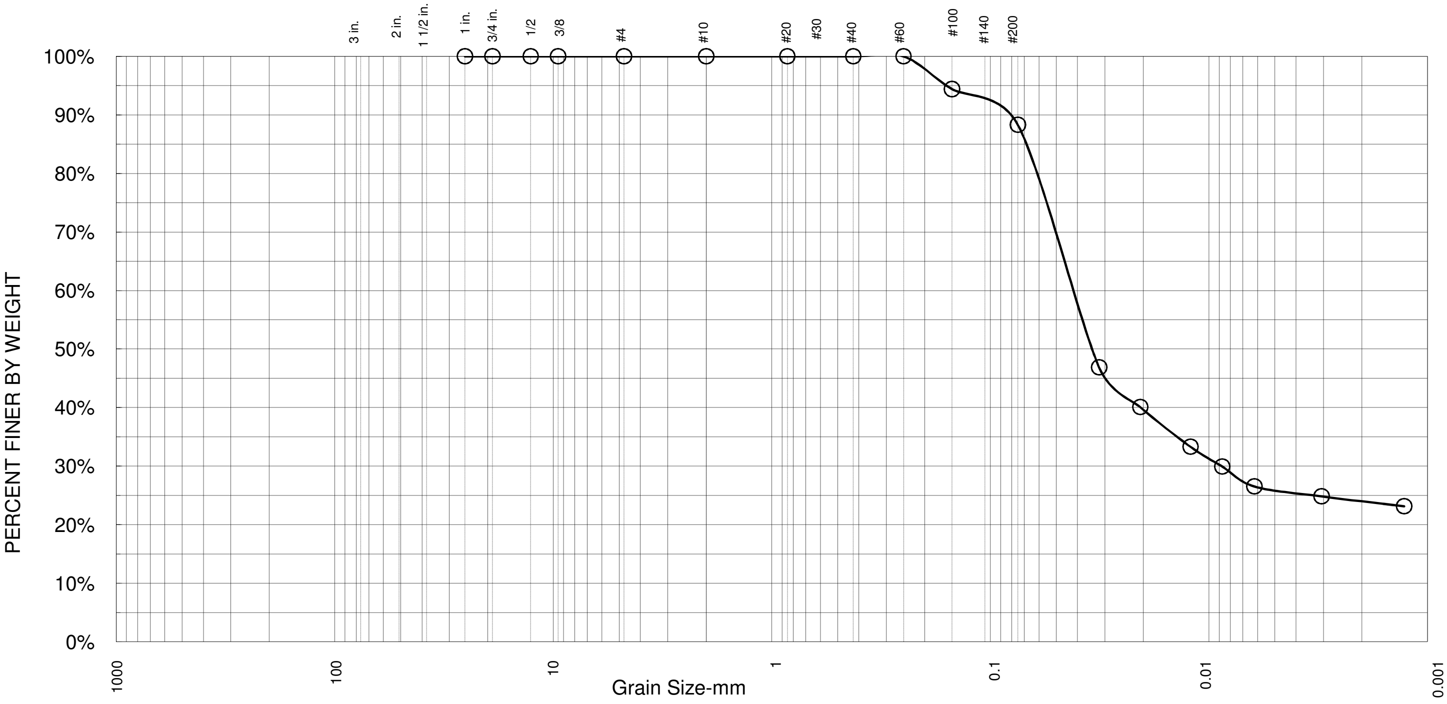
D60 = 0.043

D50 = 0.034

D30 = 0.0086

D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.0%	11.7%	62.3%	26.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	100.0%		
40	100.0%		
60	100.0%		
100	94.4%		
200	88.3%		
0.032	46.9%		
0.021	40.1%		
0.012	33.3%		
0.009	29.9%		
0.006	26.5%		
0.003	24.9%		
0.001	23.2%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=25 PL=19 PI=6

Coefficients

D_{85}= 0.068 D_{60}= 0.043 D_{50}= 0.034

D_{30}= 0.009 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Silty lean clay with sand (CL/ML)

Remarks

N/A- Not Applicable

Sample ID.: B-6C, U-3 (8.5-10')

Date: 7/1/2007

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 7/1/2010
Project No.: A09-1466
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2
Lab #: N/A

Revision Date: 3/28/2005
Revision #: 1

Sample Information

Location of Sample: B-8B, U-1 (1-2.5')
Sample Description: Yellowish brown, Lean clay
USCS Classificiation: CL
Liquid Limit: 28
Plasticity Index: N/A

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 224.16
Tare = 14.94
Dry Sample Weight = 209.22

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 70.75
Tare = 8.4
Dry Sample Weight = 62.35

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.00	100.00%
#40	0.00	100.00%
#60	0.00	100.00%
#100	0.28	99.55%
#200	2.54	95.93%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 214.9
Weight of Hydrometer sample = 64.03

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	45.23	Moist weight & tare=	51.49
Dry weight & tare =	44.43	Dry weight & tare =	50.53
Tare =	15.13	Tare =	14.86
Hygroscopic moist. =	2.73%	Hygroscopic moist. =	2.69%
Calculated biased wt. =	209.22	Calculated biased wt.=	62.35

Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Sample Loc. B-8B, U-1 (1-2.5')
Feasibility Study - Area 2
Project # A09-1466 Date 7/1/2010

Lab # N/A Technician

Revision Date: 3/28/2005
Revision #: 1

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.021	0.004167	1.0168335	62.35	42.88	10.70	0.01328	0.0307
5	21	1.017	0.004167	1.0128335	62.35	32.69	11.80	0.01328	0.0204
15	21	1.015	0.004167	1.0108335	62.35	27.60	12.30	0.01328	0.0120
30	22	1.014	0.004333	1.0096668	62.35	24.62	12.60	0.01312	0.0085
60	22	1.0135	0.004333	1.0091668	62.35	23.35	12.75	0.01312	0.0060
250	22	1.013	0.004333	1.0086668	62.35	22.08	12.90	0.01312	0.0030
1440	22	1.0125	0.004333	1.0081668	62.35	20.80	13.00	0.01312	0.0012

Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve
% +3 in. = 0
% Gravel = 0
% Sand = 4.1
% Silt = 72.9
% Clay = 23.0

Diameters:
D85 = 0.061
D60 = 0.042
D50 = 0.035
D30 = 0.017
D10 = N/A

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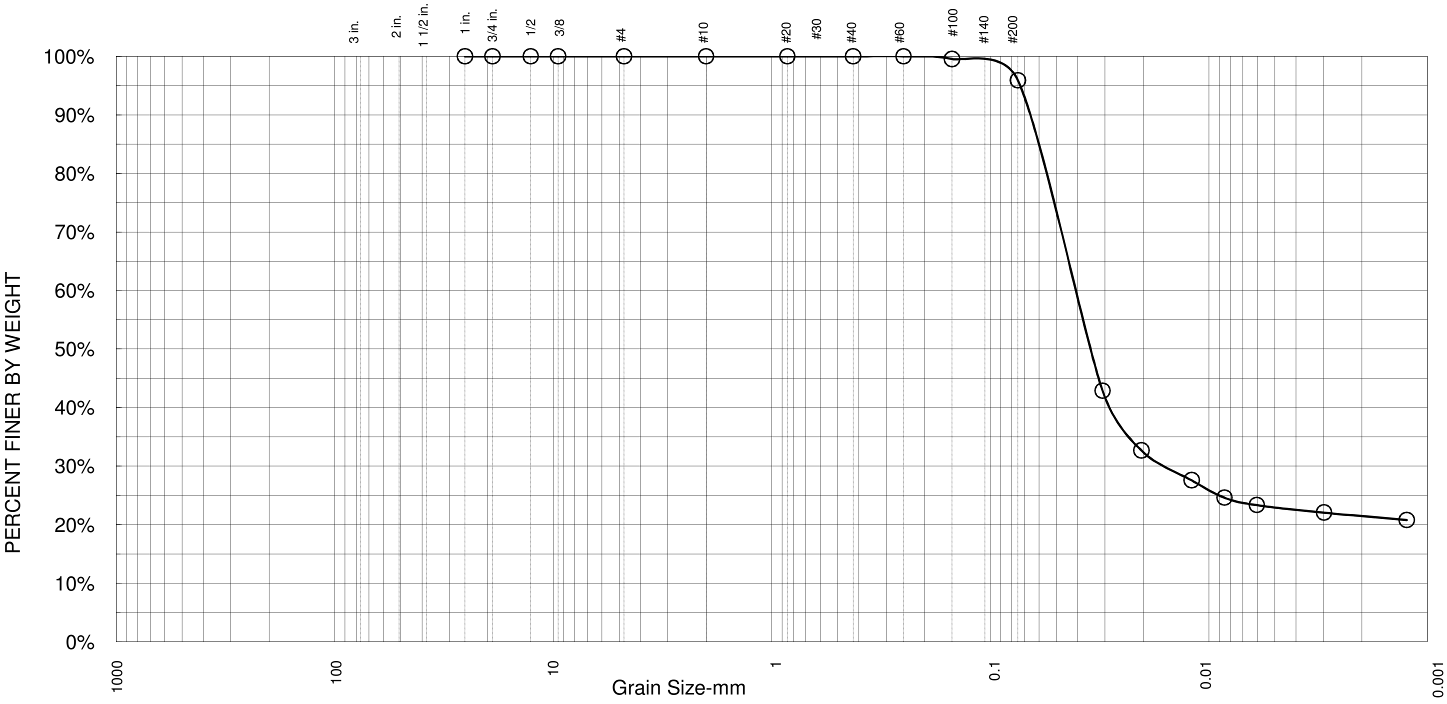
Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.0%	4.1%	72.9%	23.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	100.0%		
40	100.0%		
60	100.0%		
100	99.6%		
200	95.9%		
0.031	42.9%		
0.020	32.7%		
0.012	27.6%		
0.009	24.6%		
0.006	23.3%		
0.003	22.1%		
0.001	20.8%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=28 PL=N/A PI=N/A

Coefficients

D_{85}= 0.061 D_{60}= 0.042 D_{50}= 0.035

D_{30}= 0.017 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-8B, U-1 (1-2.5')

Date: 7/1/2007

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Revision Date: 3/28/2005
Revision #: 1

Date: 6/30/2010
Project No.: A09-1466
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2
Lab #: N/A

Sample Information

Location of Sample: B-11, U-1 (1-2.5')
Sample Description: Yellowish brown, Lean clay
USCS Classificiation: CL
Liquid Limit: N/A
Plasticity Index: N/A

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 212.74
Tare = 14.94
Dry Sample Weight = 197.80

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 80.24
Tare = 8.4
Dry Sample Weight = 71.84

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.09	99.87%
#40	0.19	99.74%
#60	0.28	99.61%
#100	0.51	99.29%
#200	2.94	95.91%

Hydrometer Analysis Data

Separation sieve is number 10
Weight of complete sample = 201.8
Weight of Hydrometer sample = 73.62

Hygroscopic moisture correction #1:
Moist weight & tare = 44.26
Dry weight & tare = 43.7
Tare = 16.01
Hygroscopic moist. = 2.02%
Calculated biased wt. = 197.80

Hygroscopic moisture correction #2:
Moist weight & tare= 40.58
Dry weight & tare = 39.96
Tare = 14.94
Hygroscopic moist. = 2.48%
Calculated biased wt.= 71.84

Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Sample Loc. B-11, U-1 (1-2.5')

Revision Date: 3/28/2005

Revision #: 1

Project # A09-1466

Date 6/30/2010

Lab # N/A

Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.023	0.004167	1.0188335	71.84	41.64	10.20	0.01328	0.0300
5	21	1.019	0.004167	1.0148335	71.84	32.79	11.30	0.01328	0.0200
15	21	1.016	0.004167	1.0118335	71.84	26.16	12.10	0.01328	0.0119
30	21	1.0155	0.004167	1.0113335	71.84	25.06	12.20	0.01328	0.0085
60	21	1.015	0.004167	1.0108335	71.84	23.95	12.30	0.01328	0.0060
250	21	1.014	0.004167	1.0098335	71.84	21.74	12.60	0.01328	0.0030
1440	21	1.013	0.004167	1.0088335	71.84	19.53	12.90	0.01328	0.0013

Fractional Components:

Gravel/Sand based on #4 Sieve

Sand/Fines based on #200 Sieve

% +3 in. = 0

% Gravel = 0

% Sand = 4.1

% Silt = 71.7

% Clay = 23.0

Diameters:

D85 = 0.060

D60 = 0.042

D50 = 0.035

D30 = 0.017

D10 = N/A

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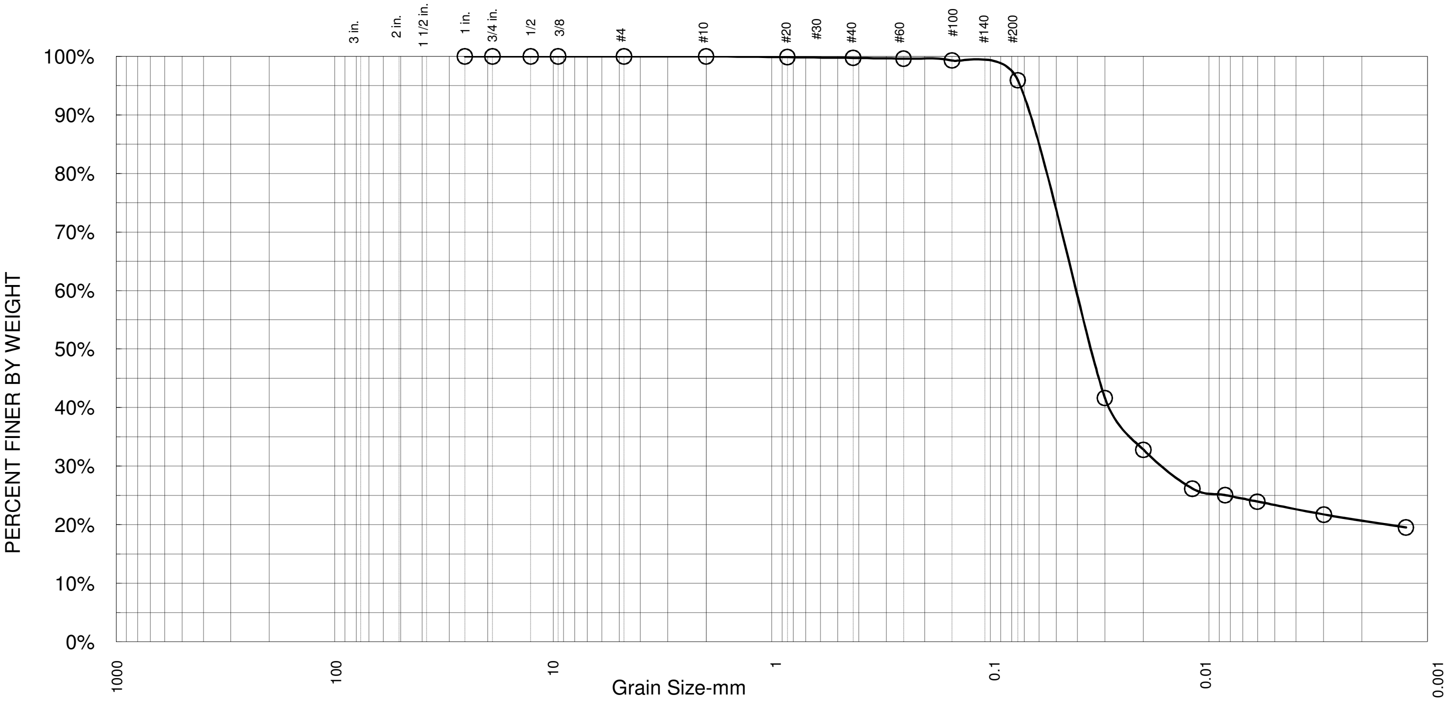
Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.3%	3.8%	71.7%	23.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	99.9%		
40	99.7%		
60	99.6%		
100	99.3%		
200	95.9%		
0.030	41.6%		
0.020	32.8%		
0.012	26.2%		
0.008	25.1%		
0.006	24.0%		
0.003	21.7%		
0.001	19.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=N/A LL=N/A PI=N/A

Coefficients

D_{85}= 0.060 D_{60}= 0.042 D_{50}= 0.035

D_{30}= 0.017 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-11, U-1 (1-2.5')

Date: 6/30/2010

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 7/1/2010

Project No.: A09-1466

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Lab #: N/A

Revision Date: 3/28/2005

Revision #: 1

Sample Information

Location of Sample:	B-12, U-2 (3.5-5')
Sample Description:	
USCS Classificiation:	CL
Liquid Limit:	N/A
Plasticity Index:	N/A

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 182.42

Tare = 14.94

Dry Sample Weight = 167.48

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	17.45	89.58%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 120.39

Tare = 8.4

Dry Sample Weight = 125.02

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.01	89.57%
#40	0.05	89.54%
#60	7.65	83.46%
#100	13.51	78.77%
#200	18.54	74.75%

Hydrometer Analysis Data

Separation sieve is number 10

Weight of complete sample = 176.7

Weight of Hydrometer sample = 118.29

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	55.22	Moist weight & tare=	47.37
Dry weight & tare =	53.1	Dry weight & tare =	45.7
Tare =	14.73	Tare =	16
Hygroscopic moist. =	5.53%	Hygroscopic moist. =	5.62%
Calculated biased wt. =	167.48	Calculated biased wt.=	111.99

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Hydrometer Analysis (ASTM D-422)

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Sample Loc. B-12, U-2 (3.5-5')

Revision Date: 3/28/2005

Revision #: 1

Project # A09-1466

Date 7/1/2010

Lab # N/A

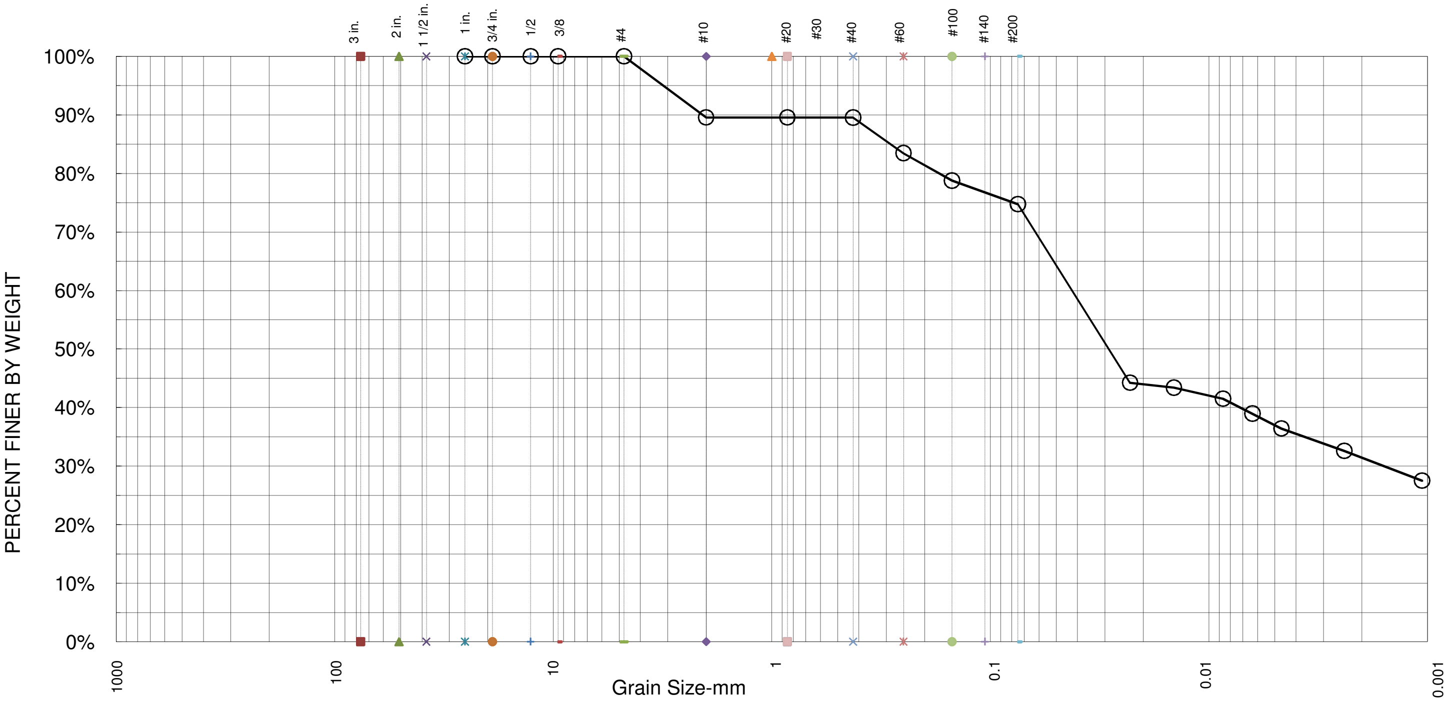
Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.039	0.004167	1.0348335	125.02	44.25	6.00	0.01328	0.0230
5	22	1.0385	0.004333	1.0341668	125.02	43.41	6.10	0.01312	0.0145
15	22	1.037	0.004333	1.0326668	125.02	41.50	6.50	0.01312	0.0086
30	22	1.035	0.004333	1.0306668	125.02	38.96	7.00	0.01312	0.0063
60	22	1.033	0.004333	1.0286668	125.02	36.42	7.60	0.01312	0.0047
250	22	1.03	0.004333	1.0256668	125.02	32.61	8.40	0.01312	0.0024
1440	22	1.026	0.004333	1.0216668	125.02	27.53	9.40	0.01312	0.0011

Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve
% +3 in. = 0
% Gravel = 0
% Sand = 25.2
% Silt = 37.8
% Clay = 37.0

Diameters:
D85 = 0.29
D60 = 0.043
D50 = 0.028
D30 = 0.0016
D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	10.4%	0.0%	14.8%	37.8%	37.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	89.6%		
20	89.6%		
40	89.5%		
60	83.5%		
100	78.8%		
200	74.8%		
0.023	44.3%		
0.014	43.4%		
0.009	41.5%		
0.006	39.0%		
0.005	36.4%		
0.002	32.6%		
0.001	27.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

PL=37 LL=16 PI=21

Coefficients

D_{85}= 0.290 D_{60}= 0.043 D_{50}= 0.028

D_{30}= 0.0016 D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay with sand (CL)

Remarks

N/A- Not Applicable

Sample ID.: B-11, U-1 (1-2.5')

Date: 7/1/2007

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

Grain Size Distribution Test Data

ASTM D-422

Date: 7/2/2010

Project No.: A09-1466

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Lab #: N/A

Revision Date: 3/28/2005

Revision #: 1

Sample Information

Location of Sample: Composite Bulk: B-15 (2-4') & B-17 (2-4')

Sample Description: Dark brown, Lean clay

USCS Classificiation: CL

Liquid Limit: 43

Plasticity Index: 23

Mechanical Analysis Data-Soil Retained on #10 Sieve

Dry Sample and Tare = 148.59

Tare = 14.94

Dry Sample Weight = 133.65

Sieve	Cumul. Wt. retained	Percent Finer
1.5"	0.00	100.00%
1"	0.00	100.00%
3/4"	0.00	100.00%
3/8"	0.00	100.00%
#4	0.00	100.00%
#10	0.00	100.00%

Mechanical Analysis Data-Soil Passing #10 Sieve

Dry Sample and Tare = 74.80

Tare = 8.4

Dry Sample Weight = 66.40

Sieve	Cumul. Wt. retained	Percent Finer
#20	0.00	100.00%
#40	0.00	100.00%
#60	0.00	100.00%
#100	0.81	98.78%
#200	2.49	96.25%

Hydrometer Analysis Data

Separation sieve is number 10

Weight of complete sample = 139.6

Weight of Hydrometer sample = 69.32

Hygroscopic moisture correction #1:		Hygroscopic moisture correction #2:	
Moist weight & tare =	56.45	Moist weight & tare=	39.6
Dry weight & tare =	54.74	Dry weight & tare =	38.6
Tare =	16.1	Tare =	15.83
Hygroscopic moist. =	4.43%	Hygroscopic moist. =	4.39%
Calculated biased wt. =	133.65	Calculated biased wt.=	66.40

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Hydrometer Analysis (ASTM D-422)

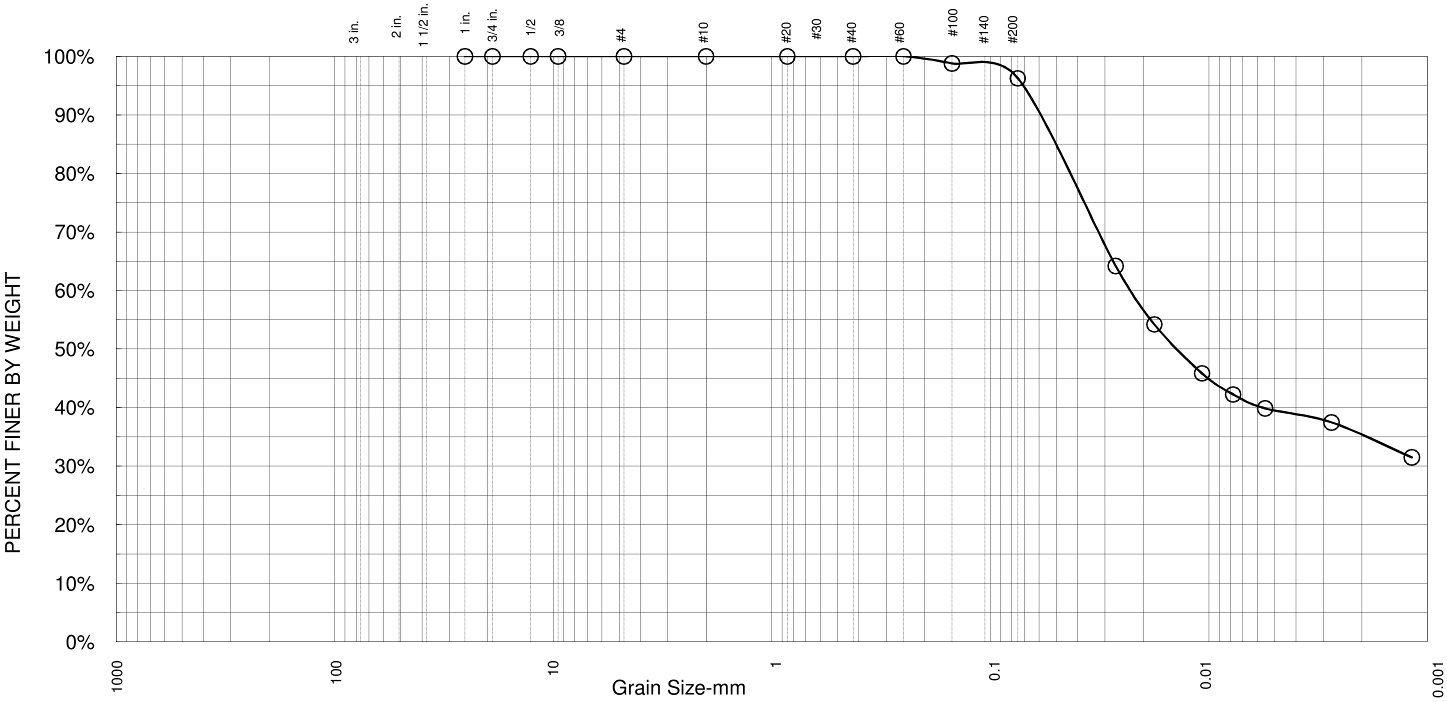
Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2
Sample Loc. Composite Bulk: B-15 (2-4') & B-17 (2-4')
Revision Date: 3/28/2005
Revision #: 1
Project # A09-1466
Date 7/2/2010
Lab # N/A
Technician

Time (min)	Temperture (celsius)	Actual Hydrometer Reading	Correction Factor	R, Corrected Hydrometer Reading	Ws (grams)	Percent Finer (%)	L (cm)	K	Diameter (mm)
2	21	1.031	0.004167	1.0268335	66.40	64.18	8.10	0.01328	0.0267
5	22	1.027	0.004333	1.0226668	66.40	54.21	9.20	0.01312	0.0178
15	22	1.0235	0.004333	1.0191668	66.40	45.84	10.10	0.01312	0.0108
30	22	1.022	0.004333	1.0176668	66.40	42.26	10.50	0.01312	0.0078
60	22	1.021	0.004333	1.0166668	66.40	39.86	10.70	0.01312	0.0055
250	22	1.02	0.004333	1.0156668	66.40	37.47	11.00	0.01312	0.0028
1440	22	1.0175	0.004333	1.0131668	66.40	31.49	11.65	0.01312	0.0012

Fractional Components:
Gravel/Sand based on #4 Sieve
Sand/Fines based on #200 Sieve
% +3 in. = 0
% Gravel = 0
% Sand = 11.7
% Silt = 62.3
% Clay = 26.0

Diameters:
D85 = 0.050
D60 = 0.023
D50 = 0.015
D30 = N/A
D10 = N/A

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	0.0%	0.0%	0.0%	0.0%	3.7%	57.3%	39.0%

SIEVE SIZE	PERCENT FINER	SPEC* PERCENT	PASS? (X=NO)
10	100.0%		
20	100.0%		
40	100.0%		
60	100.0%		
100	98.8%		
200	96.3%		
0.027	64.2%		
0.018	54.2%		
0.011	45.8%		
0.008	42.3%		
0.006	39.9%		
0.003	37.5%		
0.001	31.5%		

*-(no specification provided)

Soil Description

Atterberg Limits

LL=43 PL=20 PI=23

Coefficients

D_{85}= 0.050 D_{60}= 0.023 D_{50}= 0.015

D_{30}= N/A D_{15}= N/A D_{10}= N/A

C_U= N/A C_C= N/A

Classification

Lean clay (CL)

Remarks

N/A- Not Applicable

Sample ID.: Composite Bulk: B-15 (2-4') & B-17 (2-4')

Date: 7/1/2007

OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Project #: A09-1466

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466

Test Date: 6/2/2010
Tech.:

Boring Number: B-3C Area 2
Sample Number: U-1
Laboratory Number:

Time	Sample Description
Start	1: No Dispersion
10 min	1: No Dispersion
20 min	1: No Dispersion
30 min	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466
Test Date: 6/2/2010
Tech.:

Boring Number: B-4B Area 2
Sample Number: Surface Sample
Laboratory Number:

Time	Sample Description
Start	1: No Dispersion
10 min	1: No Dispersion
20 min	1: No Dispersion
30 min	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

OLSSON
ASSOCIATES

CRUMB TEST

Project Name: CNPPID Reregulating Reservoir
Project Number: A09-1466

Test Date: 6/2/2010
Tech.:

Boring Number: B-4B Area 2
Sample Number: U-1
Laboratory Number:

Time	Sample Description
Start	2: Possible Dispersion
10 min	1: No Dispersion
20 min	1: No Dispersion
30 min	1: No Dispersion

Dispersion is detected by the formation of a colloidal cloud, which appears as a fine misty halo around the soil crumb (crumb is 5-10 grams). The Crumb test is rated for reaction or colloidal cloud formation as follows:

1: no sign of cloudy water caused by colloidal suspension.
2: bare hint of colloidal cloud formation at surface of soil crumb.
3: easily recognized colloidal cloud covering one-fourth to one-half of the bottom of the glass container.
4: strong reaction with colloidal cloud covering most of the bottom of the container.

Crumb test may be used as an indicator of dispersive soils using the following evaluation of soil crumb reaction:

No dispersion problem=	1
Possible dispersion problem=	2
Definite dispersion problem=	3 or 4

Revision No: 02
Revision Date: 02/02/06

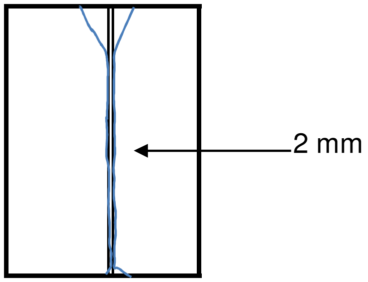
OLSSON
ASSOCIATES

PINHOLE DISPERSION TEST RESULTS

Project Name: CNPPID Reregulating Reservoir Feasiblity Study
Test Date: 06/29/10
Project Loc.: Phelps and Gosper County, Nebraska
Technician: DK
Project No.: A09-1466

Sample I.D.: B-4B Surface (0-1.0')
Sample Desc. Dark Sandy Silt

Specimen After Test



Init. Moisture Content (%): 18.9%
Remolded Sample: Yes No X
Dry Density: 105.3 pcf Percent Compaction: N/A
Distilled Water Added: Yes X No
Final Moisture Content (%) N/A
Cure Time: N/A
Disp. Classification: ND3 Slightly Dispersive

Time (sec)	Head (in.)	Flow Volume (mL)	Flow Rate (mL/sec)	Turbidity from Side						Clear From Top
				V Dark	Dark	M Dark	S Dark	B Vis.	Clear	
114	2	86	0.75			X				NO
103	2	86	0.83			X				NO
83	2	78	0.94				X			NO
111	2	88	0.79					X		YES
98	2	93	0.95					X		YES
91	2	78	0.86					X		YES
47	7	91	1.94					X		YES
49	7	91	1.86					X		YES
51	7	88	1.73				X			YES
53	7	86	1.62					X		YES
44	7	88	2.00					X		YES
56	7	108	1.93					X		YES
37	15	105	2.84					X		YES
36	15	95	2.64					X		YES
36	15	94	2.61					X		YES
33	15	93	2.82					X		YES
33	15	93	2.82					X		YES
34	15	91	2.68					X		YES
33	15	94	2.85						X	YES
33	15	93	2.82						X	YES
25	15	72	2.88						X	YES

COLLAPSE / CONSOLIDATION TEST

Drill Hole No. B-6C Sample No. U-2 (3.5-5')

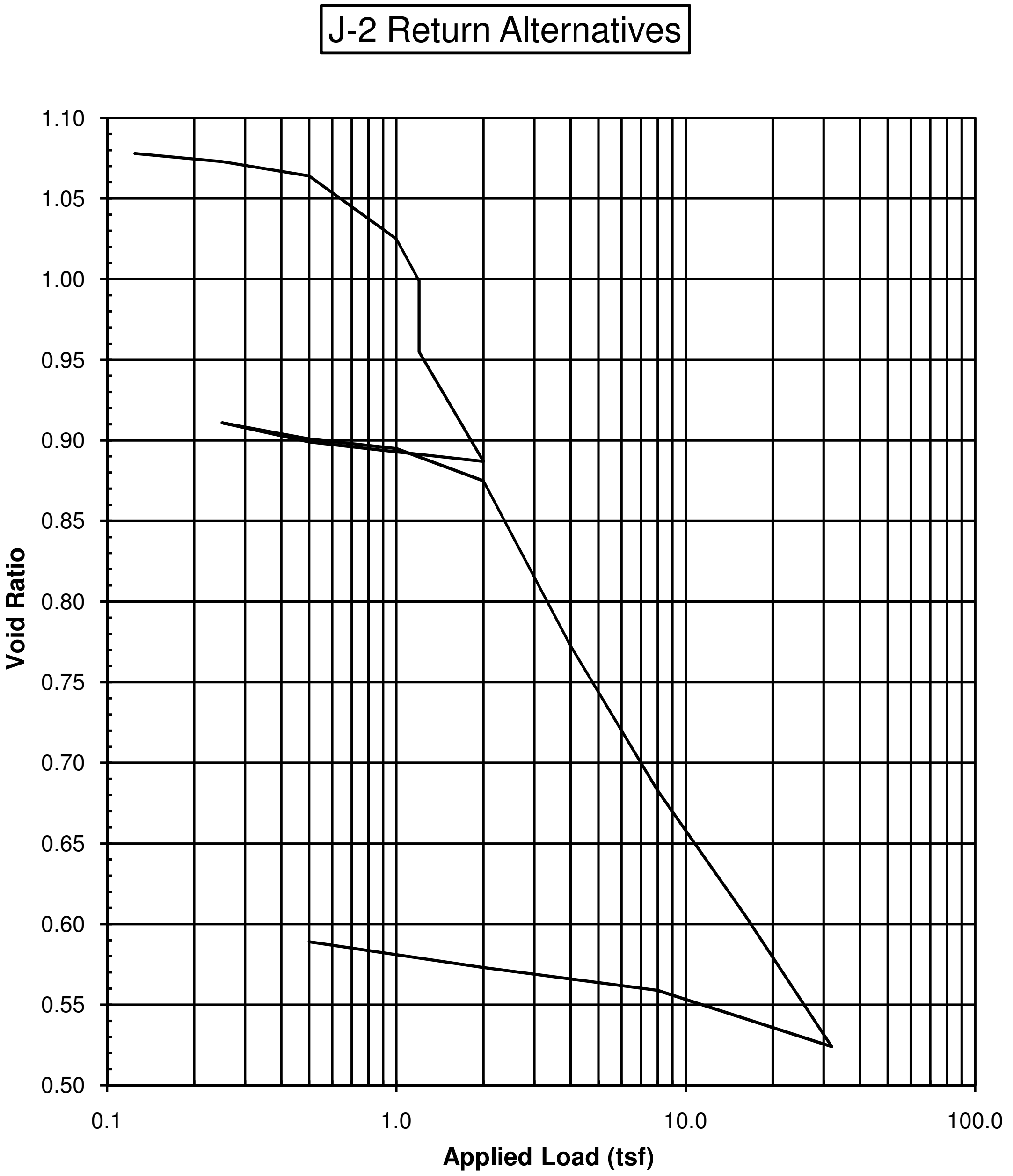
Sample Description Alluvium: Yellowish brown, Lean clay

Initial Water Content 20.0% Dry Unit Weight (pcf) 80.67 Initial Saturation 49.6%

Final Water Content 19.8% Specific Gravity 2.7 X Assumed

Liquid Limit 32 Plastic Limit 18 Plasticity Index 14

Classification CL



OLSSON ASSOCIATES

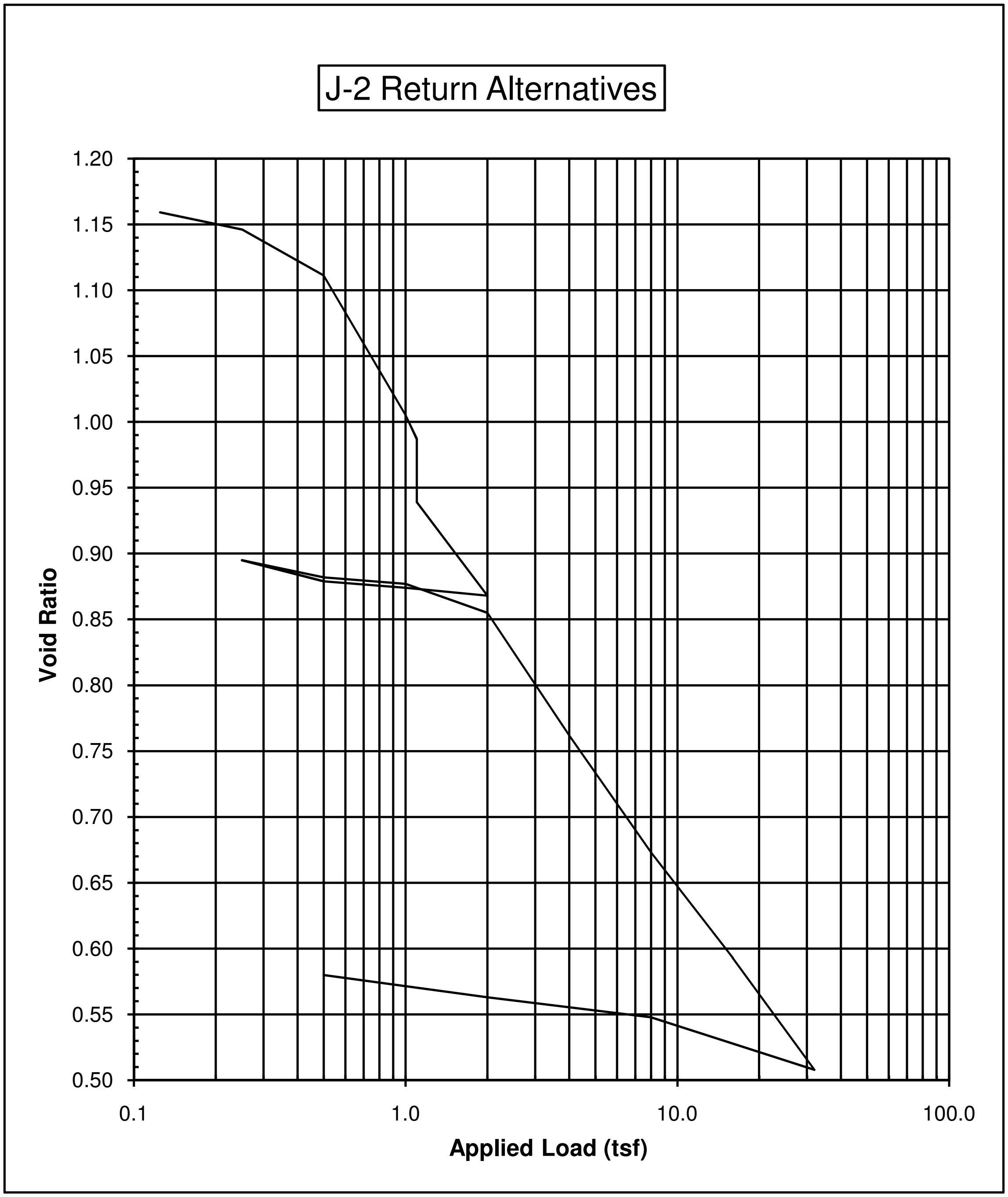
Project CNPPID Reregulating Reservoir Feasibiltiy Sudy

Location Phelps & Gosper County, Nebraska - Area 2

Job No. A09-1460 Date: 06/11/10

COLLAPSE / CONSOLIDATION TEST

Drill Hole No.	B-7C	Sample No.	U-1 (1-2.5')		
Sample Description	Alluvium: Yellowish brown , Lean clay				
Initial Water Content	21.4%	Dry Unit Weight (pcf)	77.41	Initial Saturation	49.0%
Final Water Content	20.1%	Specific Gravity	2.7	X	Assumed
Liquid Limit	31	Plastic Limit	21	Plasticity Index	10
Classification	CL				



Project	CNPPID Re-Regulating Reservoir Feasibiltiy Sudy		
Location	Phelps & Gosper County, Nebraska - Area 2		
Job No.	A09-1460	Date:	06/14/10

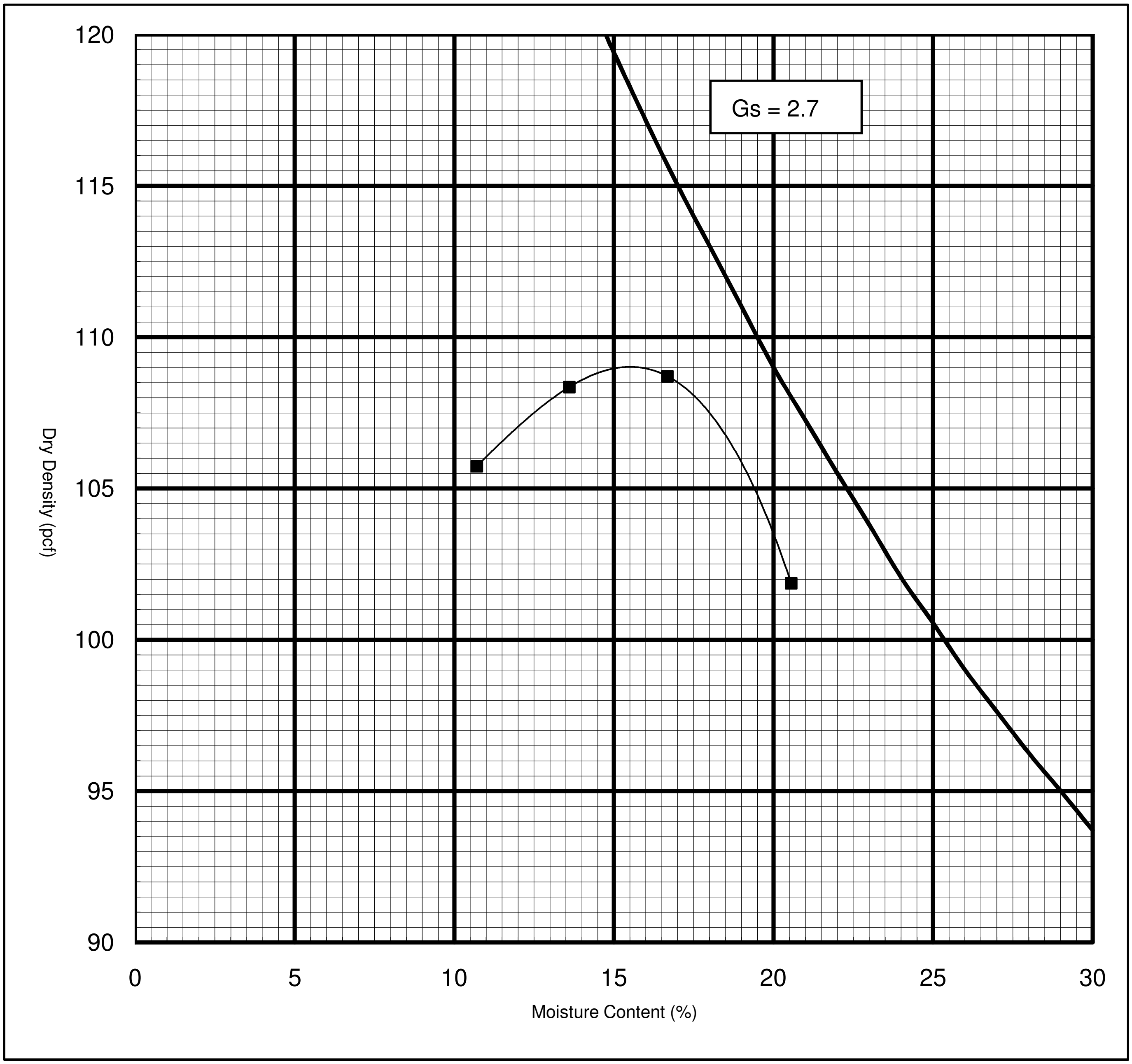
OLSSON ASSOCIATES

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-4B (0-1')

Sample Description: Alluvial Sandy Topsoil: Yellowish brown, Clayey sand

Liquid Limit	N/A	Plastic Limit	N/A	Plasticity Index	N/A	Classification	SC
Type of Test	D-698	Maximum Dry Density	109.0 pcf			Optimum Moisture Content	15.5%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

Job Number: A09-1466

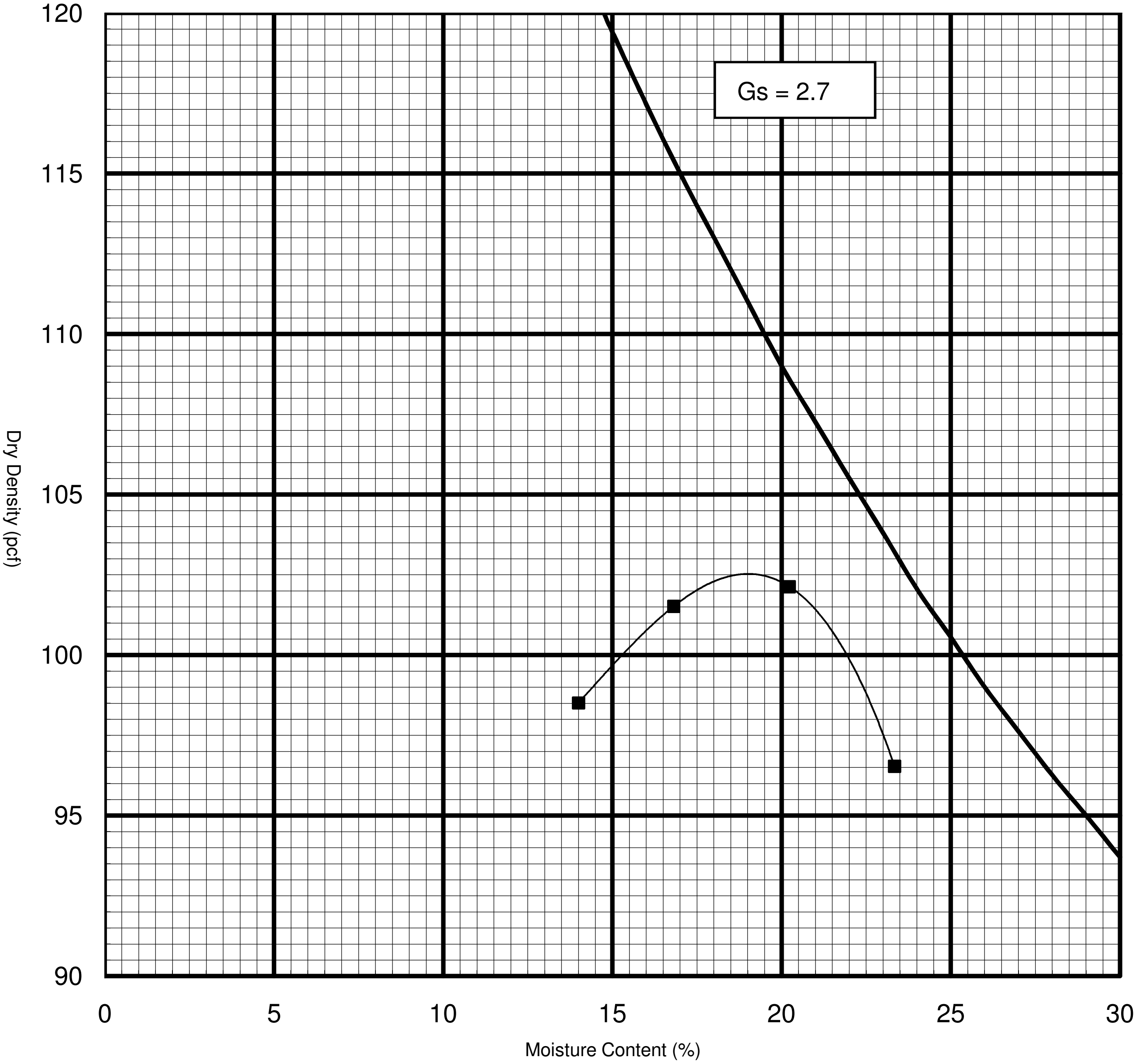
Date: 06/02/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-7C (0-1.5')

Sample Description: Topsoil: Brown, Lean clay

Liquid Limit	32	Plastic Limit	18	Plasticity Index	14	Classification	CL
Type of Test	D-698	Maximum Dry Density	102.5 pcf			Optimum Moisture Content	19.1%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

Job Number: A09-1466

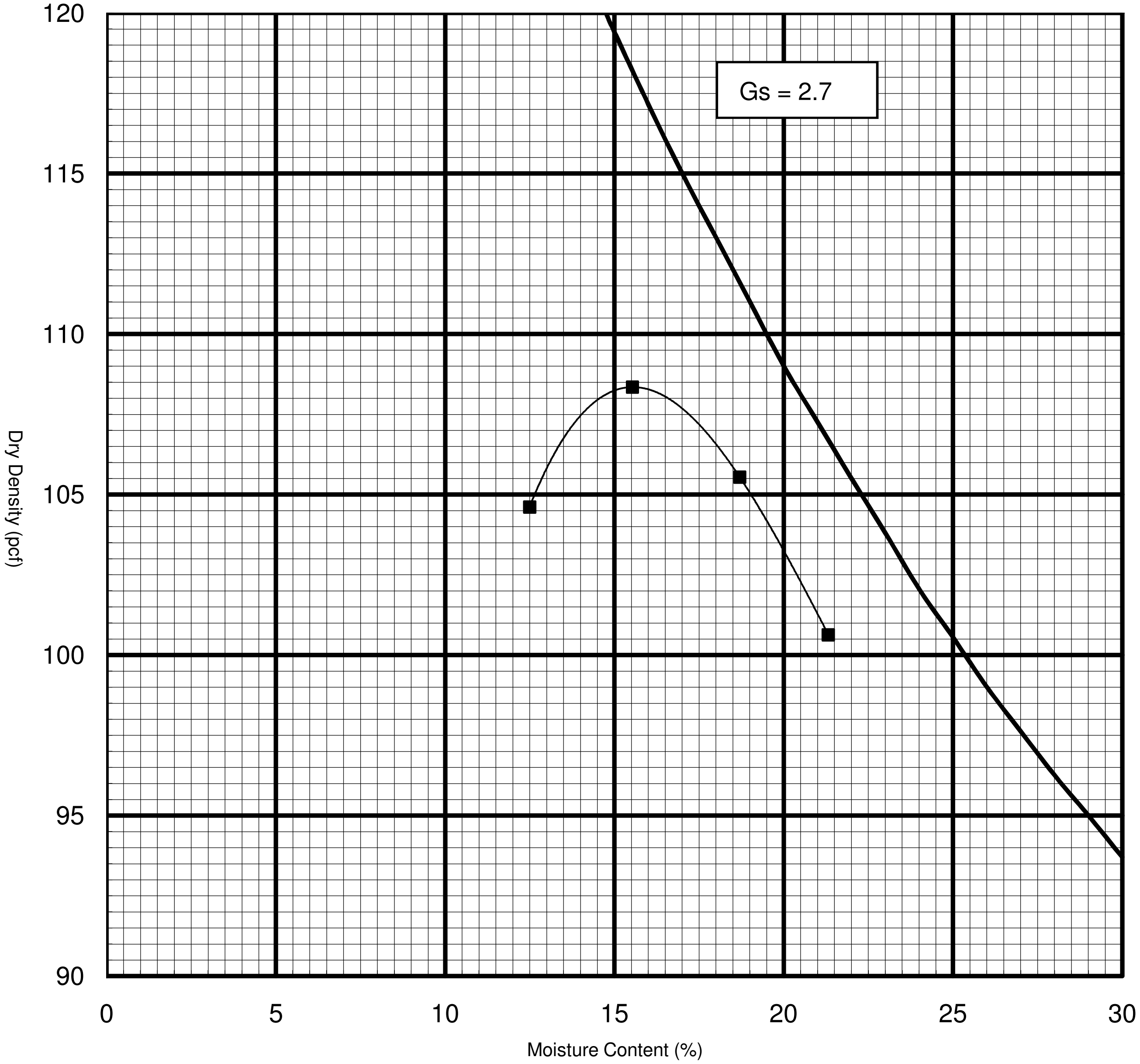
Date: 06/01/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-8B (3-8')

Sample Description: Alluvium: Yellowish brown, Sandy lean clay

Liquid Limit	24	Plastic Limit	18	Plasticity Index	6	Classification	CL/ML
Type of Test	D-698	Maximum Dry Density	108.4 pcf	Optimum Moisture Content	15.6%		



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nerbaska - Area 2

Job Number: A09-1466

Date: 06/01/10

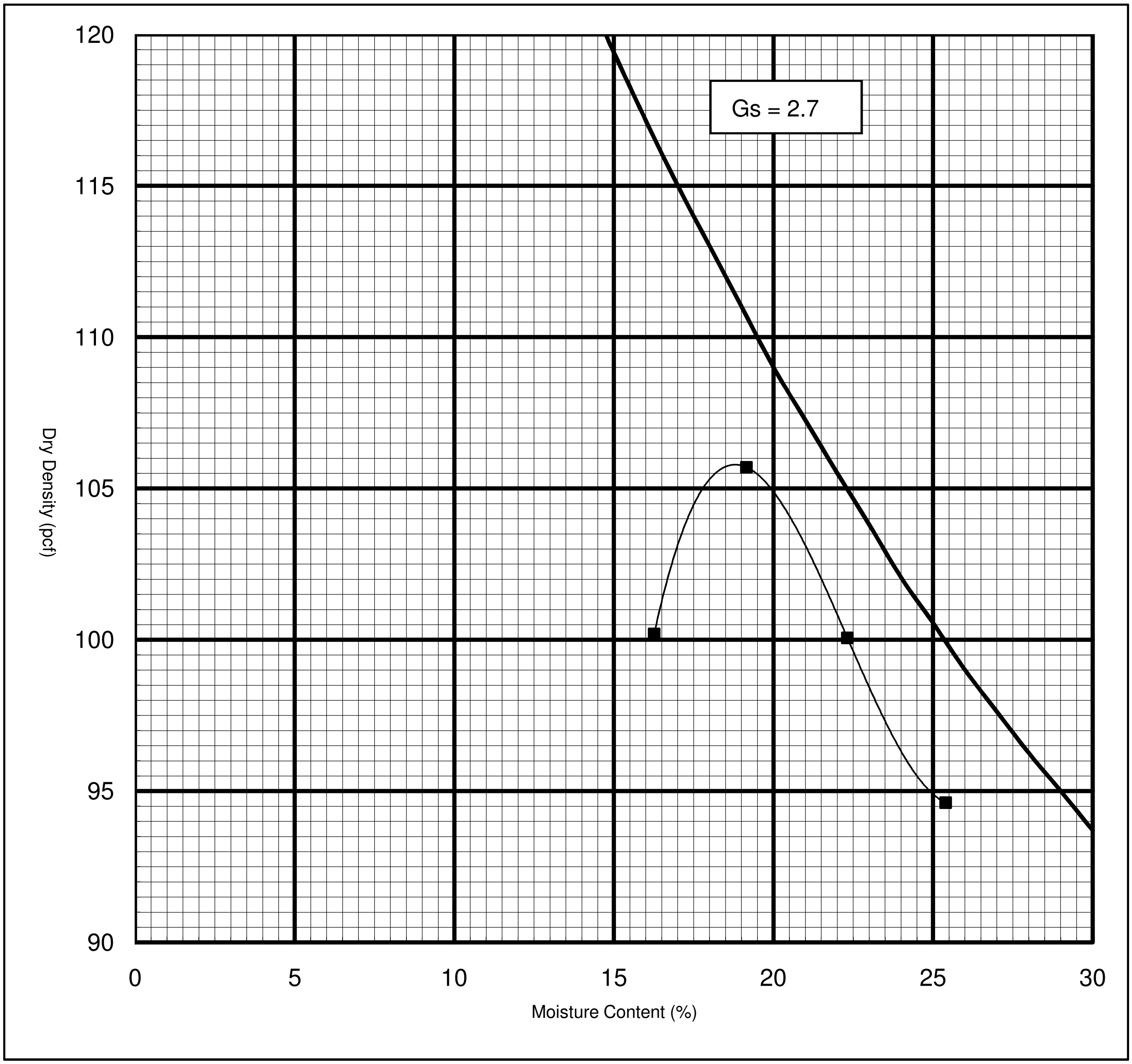
MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-11 (1-4.5')

Sample Description: Alluvium: Yellowish brown, Lean clay

Liquid Limit 28 Plastic Limit 20 Plasticity Index 8 Classification CL

Type of Test D-698 Maximum Dry Density 105.7 pcf Optimum Moisture Content 18.8%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

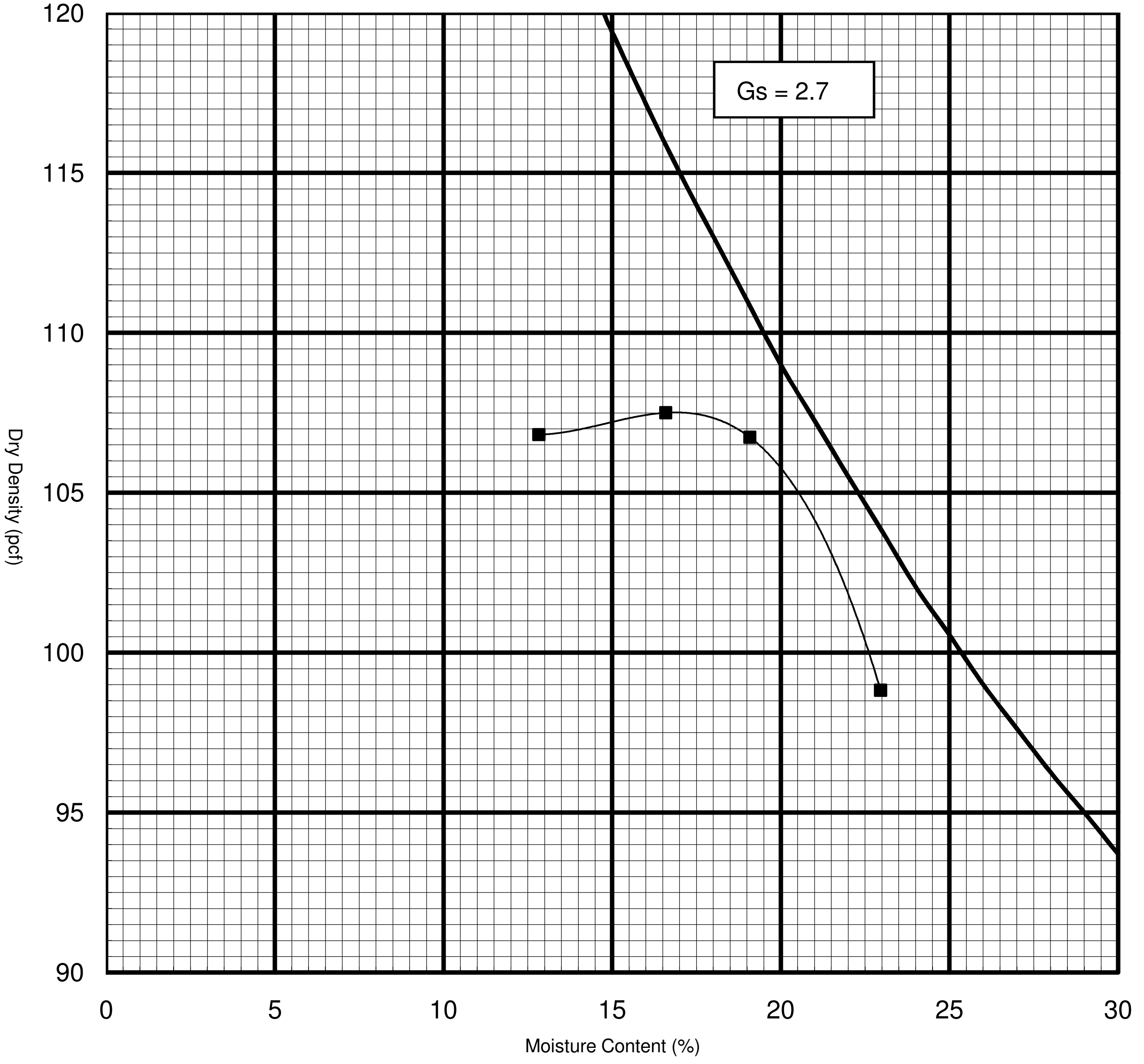
Job Number: A09-1466 Date: 06/01/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-12 (3-7.5')

Sample Description: Alluvium: Very dark grayish brown, Silty lean clay with sand

Liquid Limit	29	Plastic Limit	24	Plasticity Index	5	Classification	CL/ML
Type of Test	D-698	Maximum Dry Density	107.6 pcf	Optimum Moisture Content	16.9%		



Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

Job Number: A09-1466 Date: 06/01/10

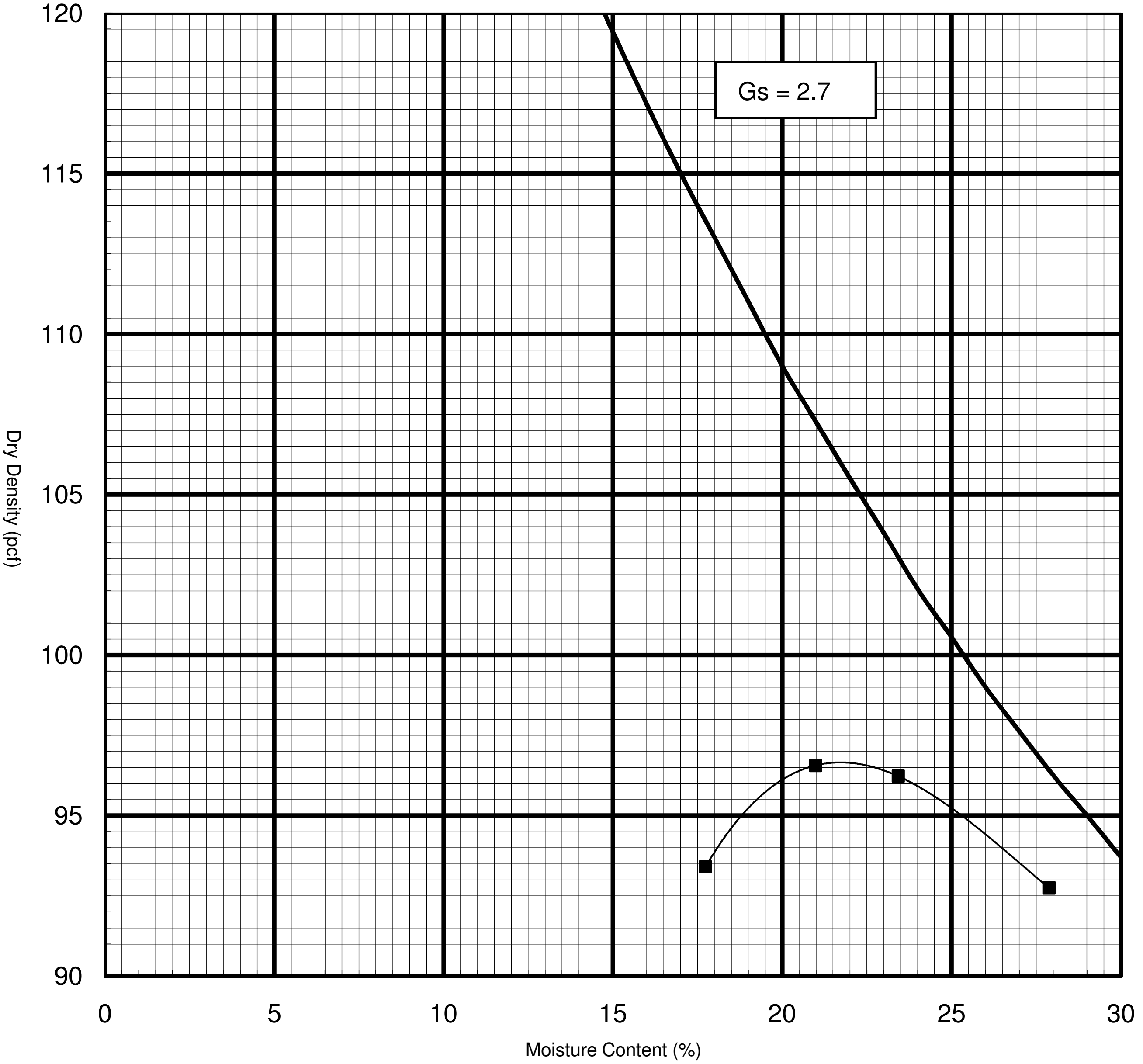
MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Bulk Sample: B-16 (1-6.0')

Sample Description: Alluvium: Very dark brown, Lean clay

Liquid Limit 39 Plastic Limit 18 Plasticity Index 22 Classification CL

Type of Test D-698 Maximum Dry Density 96.6 pcf Optimum Moisture Content 21.4%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

Job Number: A09-1466

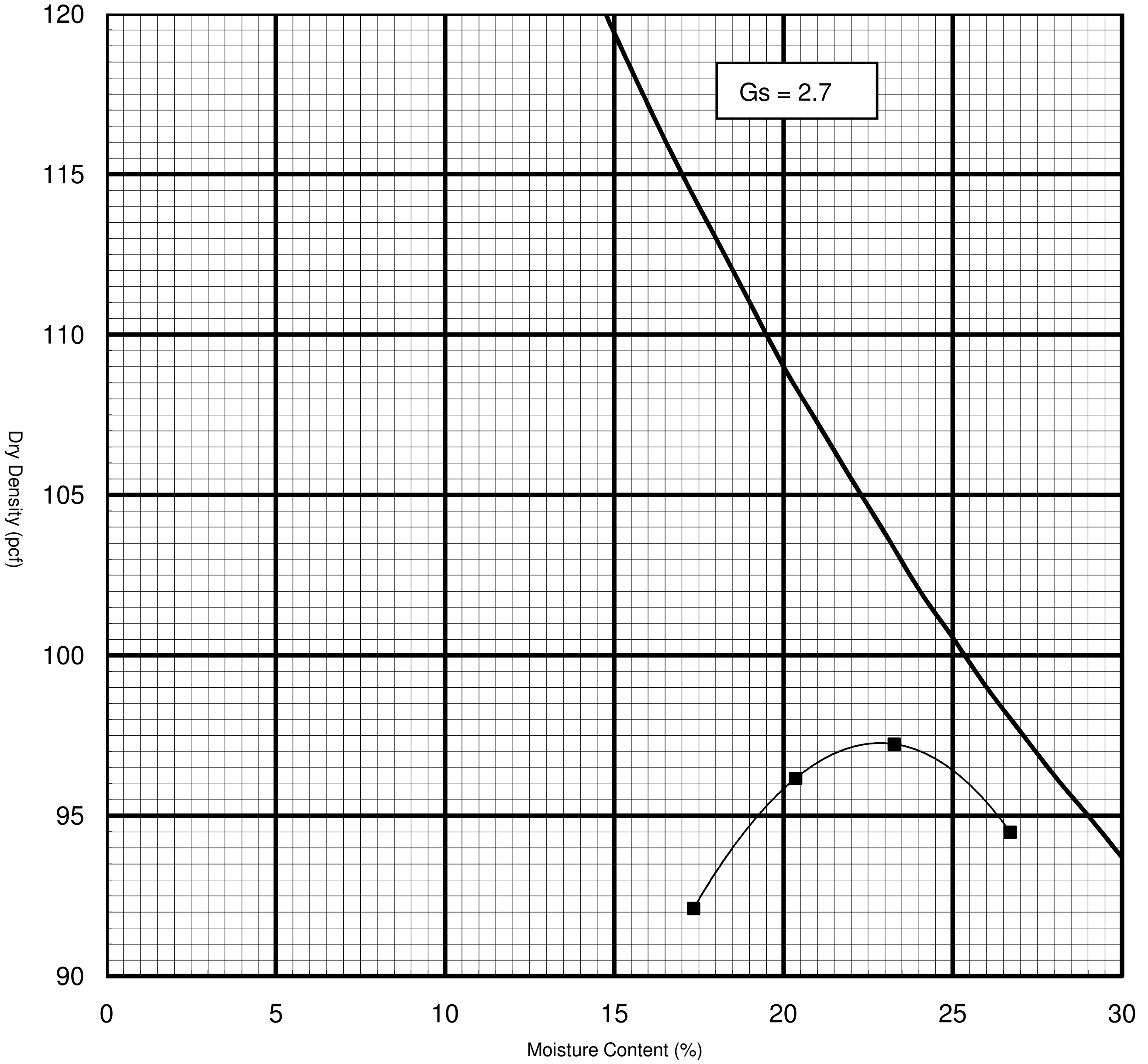
Date: 06/01/10

MOISTURE - DENSITY RELATIONSHIP

Sample Identification: Composite Bulk Sample: B-17 & B-15 (2-4.0')

Sample Description: Alluvium: Yellowish brown, Lean clay

Liquid Limit	43	Plastic Limit	20	Plasticity Index	23	Classification	CL
Type of Test	D-698	Maximum Dry Density	97.3 pcf			Optimum Moisture Content	22.9%



OLSSON ASSOCIATES

Project: CNPPID Reregulating Reservoir

Location: Phelps & Gosper County, Nebraska - Area 2

Job Number: A09-1466

Date: 06/03/10

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2
Job Number: A09-1466
Date: 05/28/10
Sample Identification: B-6C (13-14.5'), B-7C (9-11.5'), B-6C (14.5-16')
Sample Description: Alluvium: Dark brown, Lean clay

INDEX TEST DATA

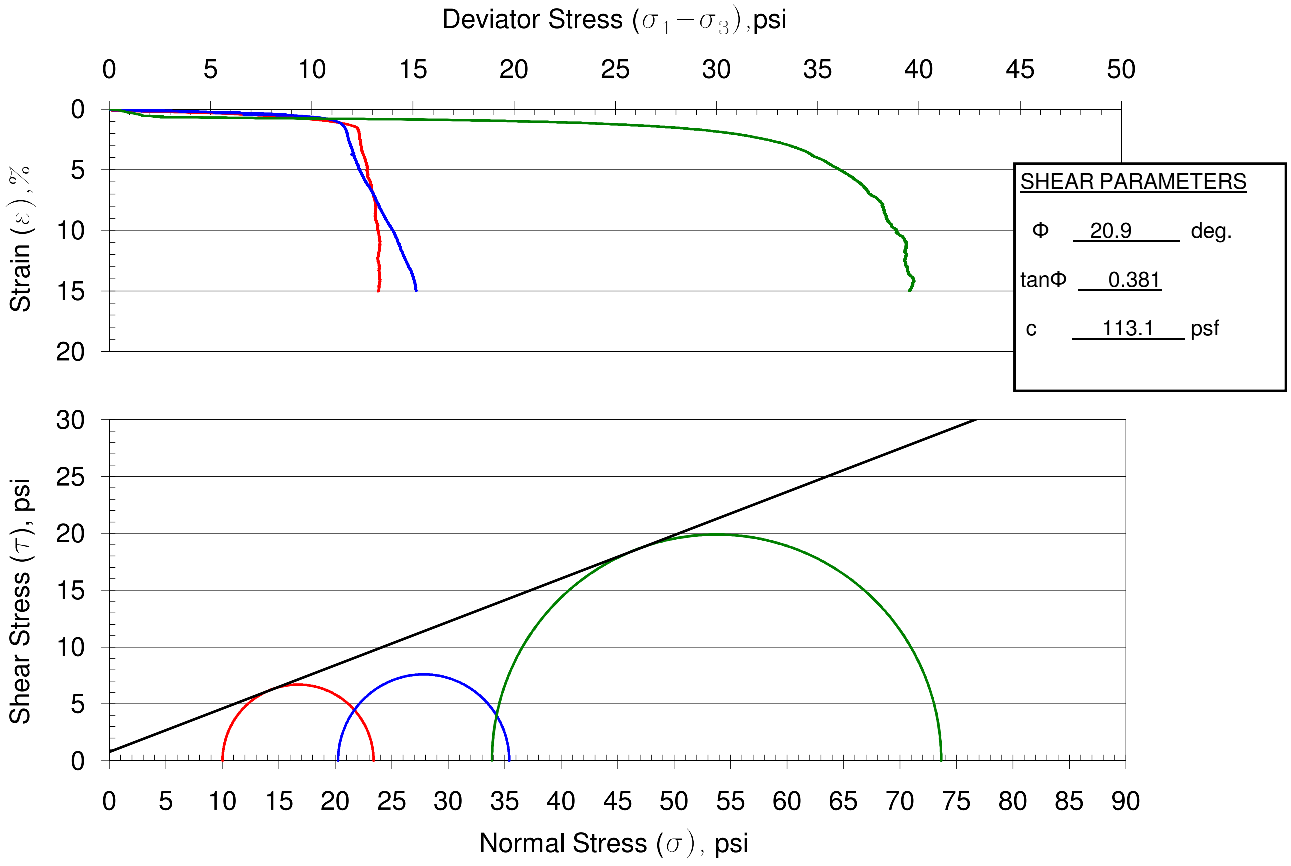
USCS Lean clay (CL); LL N/A; PI N/A;
%FINER (mm): 0.002 N/A; 0.005 N/A; 0.074 (#200) N/A
G_s (-#4) ______ G_s (+#4) ______
Standard: γ_d MAX. ______ pcf ______ w_{opt} ______ %
Modified: γ_d MAX. ______ pcf ______ w_{opt} ______ %

SPECIMEN DATA

HEIGHT 6.014"; DIAMETER 2.852"
MATERIALS TESTED PASSED____ SIEVE
METHOD OF PREPARATION: In-situ
MOLDING MOISTURE ______ %
MOLDED AT ______ % OF γ_d MAX

TYPE OF TEST	
UU	
CU	
CU'	☒
CD	

DRY DENSITY		B PARAMETER	MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1-\sigma_3$ (psi)	AXIAL STRAIN AT FAILURE ε (%)
INITIAL pcf ☒ g/cc	CONSOLIDATED pcf ☒ g/cc		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
88.8	89.3	0.98	30.0	90.3	32.8	22.4	10.0	13.4	14.1
89.0	94.1	0.95	14.9	45.0	29.3	28.7	20.2	15.2	15.0
94.7	97.8	0.97	24.8	85.9	26.8	26.5	33.9	39.8	14.2



SHEAR PARAMETERS

Φ 20.9 deg.

tanΦ 0.381

c 113.1 psf

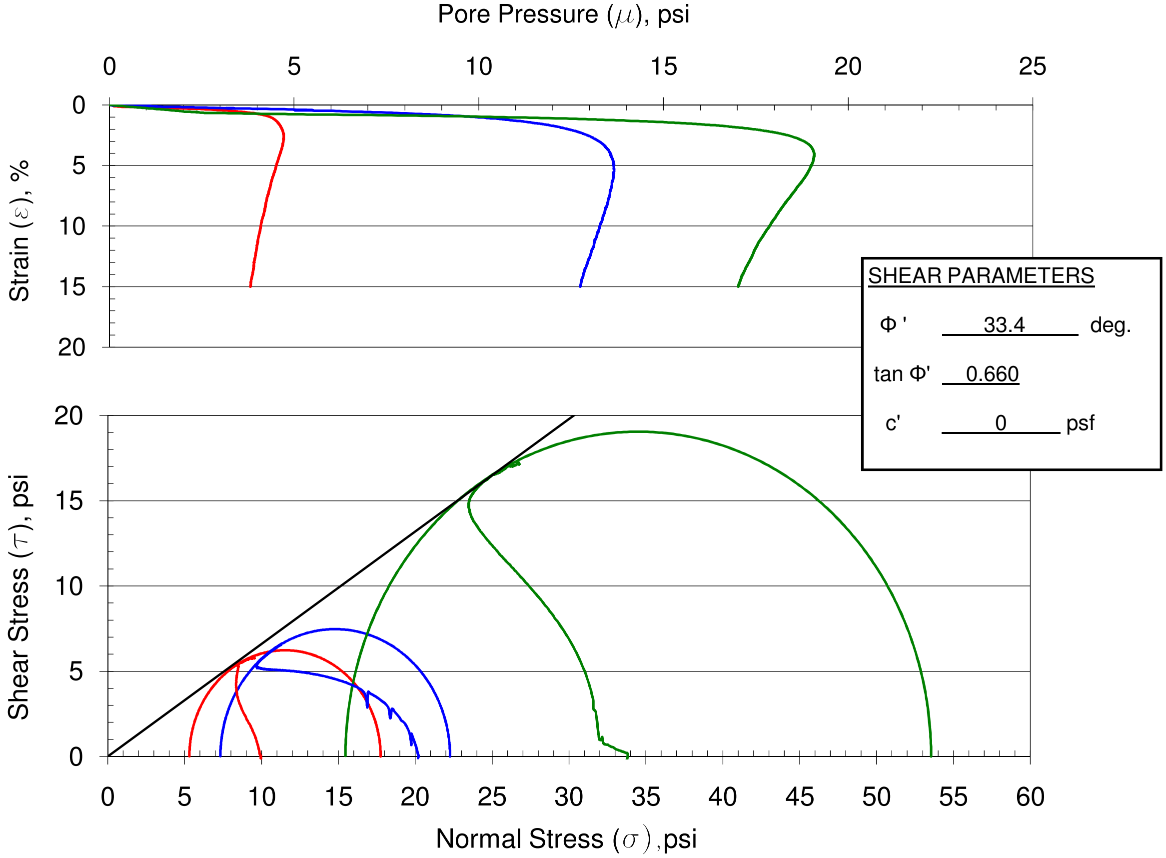
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2	Job Number: A09-1466	Date: 05/28/10
Sample Identification: B-6C (13-14.5'), B-7C (9-11.5'), B-6C (14.5-16')	Sample Description: Alluvium: Dark brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM PRINCIPAL EFFECTIVE STRESS RATIO	AXIAL STRAIN AT FAILURE ε (%)
10.0	4.7	5.3	12.4	$\left(\frac{\sigma_1'}{\sigma_3'}\right)_{max}$	2.8
20.2	12.9	7.3	14.9		13.4
33.9	18.4	15.5	38.1		7.6



SHEAR PARAMETERS

Φ ' 33.4 deg.

tan Φ' 0.660

c' 0 psf

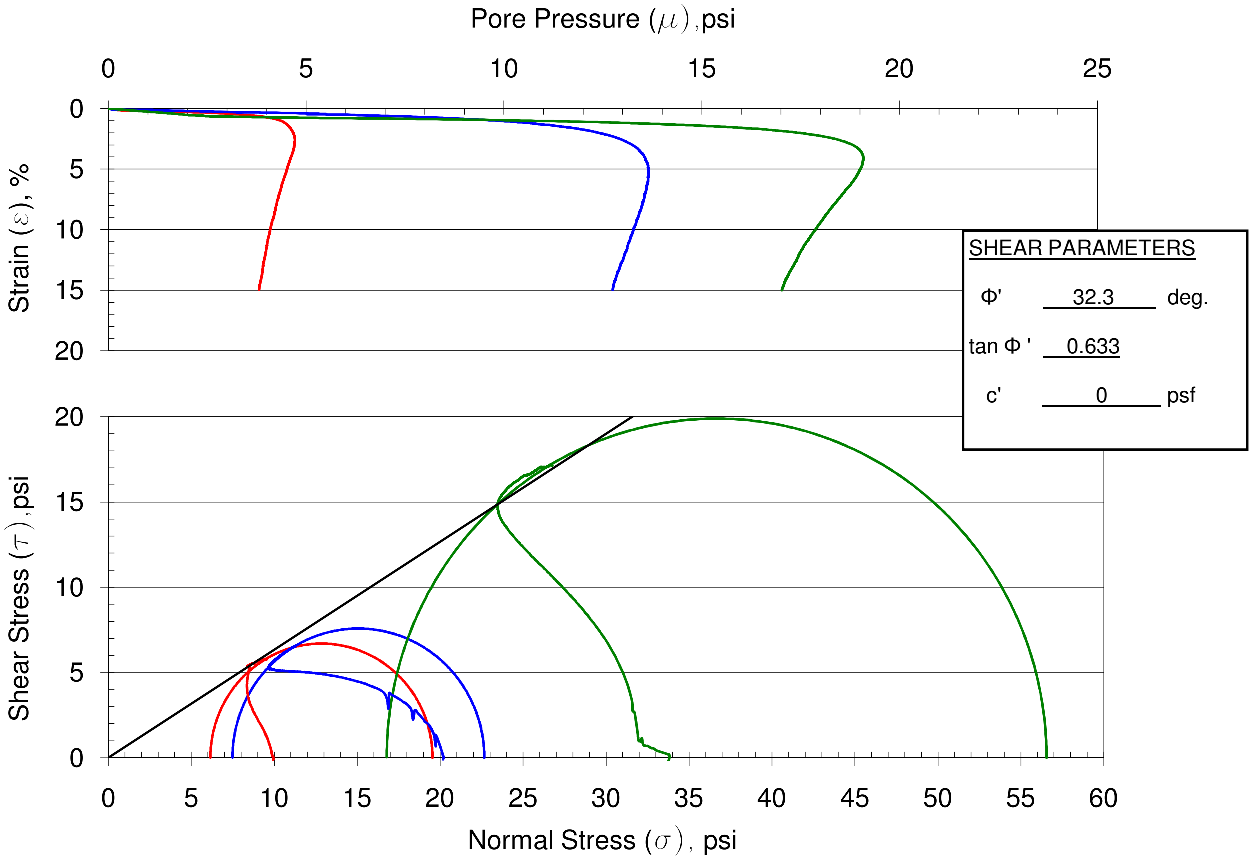
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2	Job Number: A09-1466	Date: 05/28/10
Sample Identification: B-6C (13-14.5'), B-7C (9-11.5'), B-6C (14.5-16')	Sample Description: Alluvium: Dark brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM DEVIATOR STRESS	AXIAL STRAIN AT FAILURE ε (%)
10.0	3.9	6.2	13.4	$(\sigma_1 - \sigma_3)_{max}$	14.1
20.2	12.7	7.5	15.2		15.0
33.9	17.1	16.8	39.8		14.2



SHEAR PARAMETERS

Φ' 32.3 deg.

tan Φ ' 0.633

c' 0 psf

REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2

Job Number: A09-1466

Date: 07/19/10

Sample Identification: Composite Bulk: B-15 (2-4'), B-17 (2-4')

Sample Description: Alluvium: Dark brown, Lean clay

INDEX TEST DATA

USCS Lean clay (CL); LL 43 ; PI 23 ;

%FINER (mm): 0.002 36%; 0.005 39%;

0.074 (#200) 96.3%

G_s (-#4) ______ G_s (+#4) ______

Standard: γ_d MAX. 97.3 pcf w_{opt} 22.90%

Modified: γ_d MAX. pcf w_{opt} %

SPECIMEN DATA

HEIGHT______"; DIAMETER ______"

MATERIALS TESTED PASSED____ SIEVE

METHOD OF PREPARATION:

MOLDING MOISTURE 22.90%

MOLDED AT 95% OF γ_d MAX

TYPE OF TEST

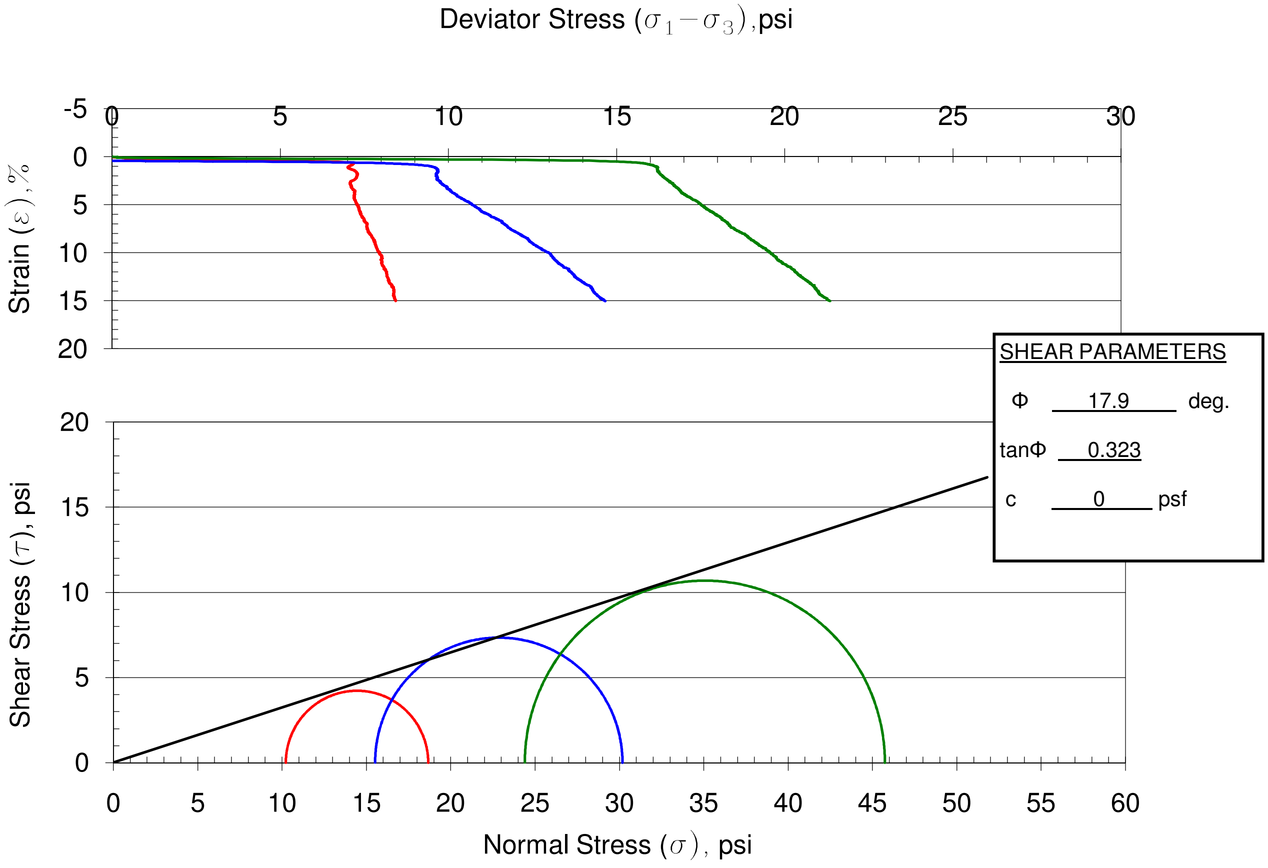
UU ☐

CU ☐

CU' ☒

CD ☐

DRY DENSITY		B PARAMETER	MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE ε (%)
INITIAL pcf ☒ g/cc	CONSOLIDATED pcf ☒ g/cc		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
92.7	99.9	0.95	24.6	81.0	30.3	170.0	10.2	8.4	14.9
93.2	95.9	0.95	27.0	90.0	28.0	288.0	15.5	14.7	15.0
91.2	96.5	0.95	24.4	77.6	27.6	191.0	24.4	21.4	15.0



SHEAR PARAMETERS

Φ 17.9 deg.

tanΦ 0.323

c 0 psf

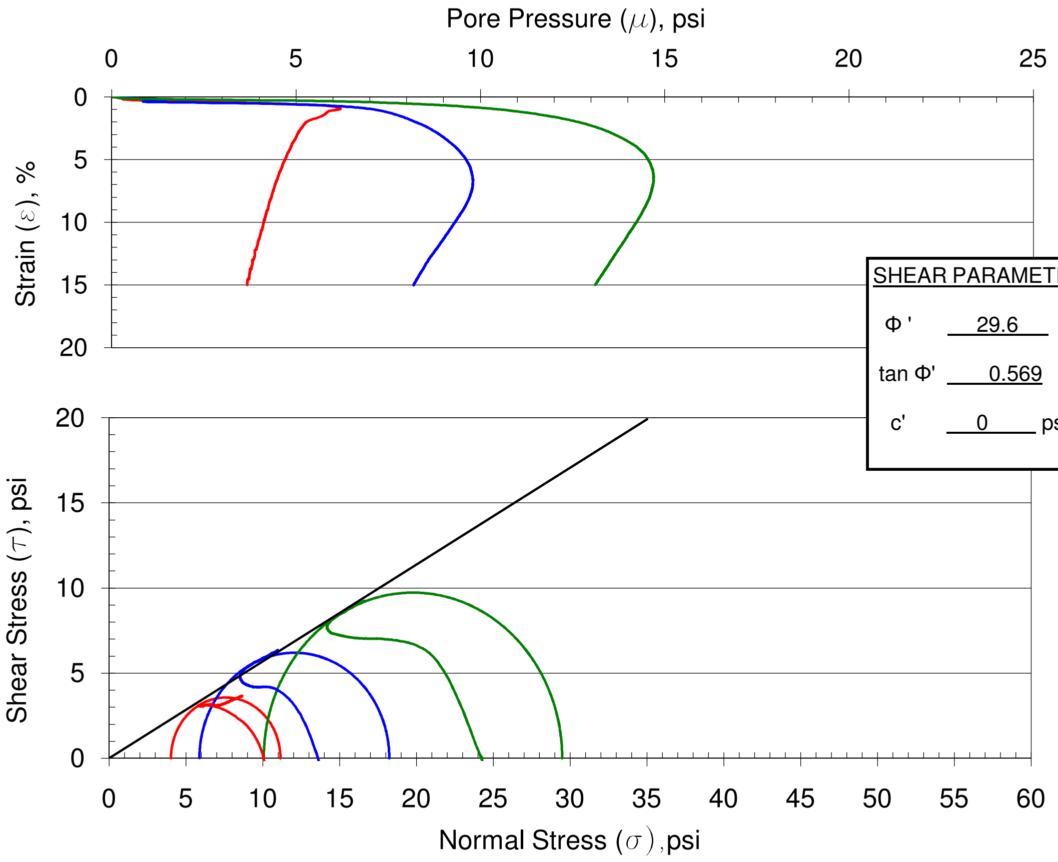
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2	Job Number: A09-1466	Date: 07/19/10
Sample Identification: Composite Bulk: B-15 (2-4'), B-17 (2-4')	Sample Description: Alluvium: Dark brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM PRINCIPAL EFFECTIVE STRESS RATIO	AXIAL STRAIN AT FAILURE ε (%)
10.2	6.2	4.0	7.1	$\left(\frac{\sigma_1'}{\sigma_3'}\right)_{max}$	0.9
15.5	9.6	5.9	12.4		8.5
24.4	14.3	10.1	19.4		9.6



SHEAR PARAMETERS

Φ ' 29.6 deg.

tan Φ' 0.569

c' 0 psf

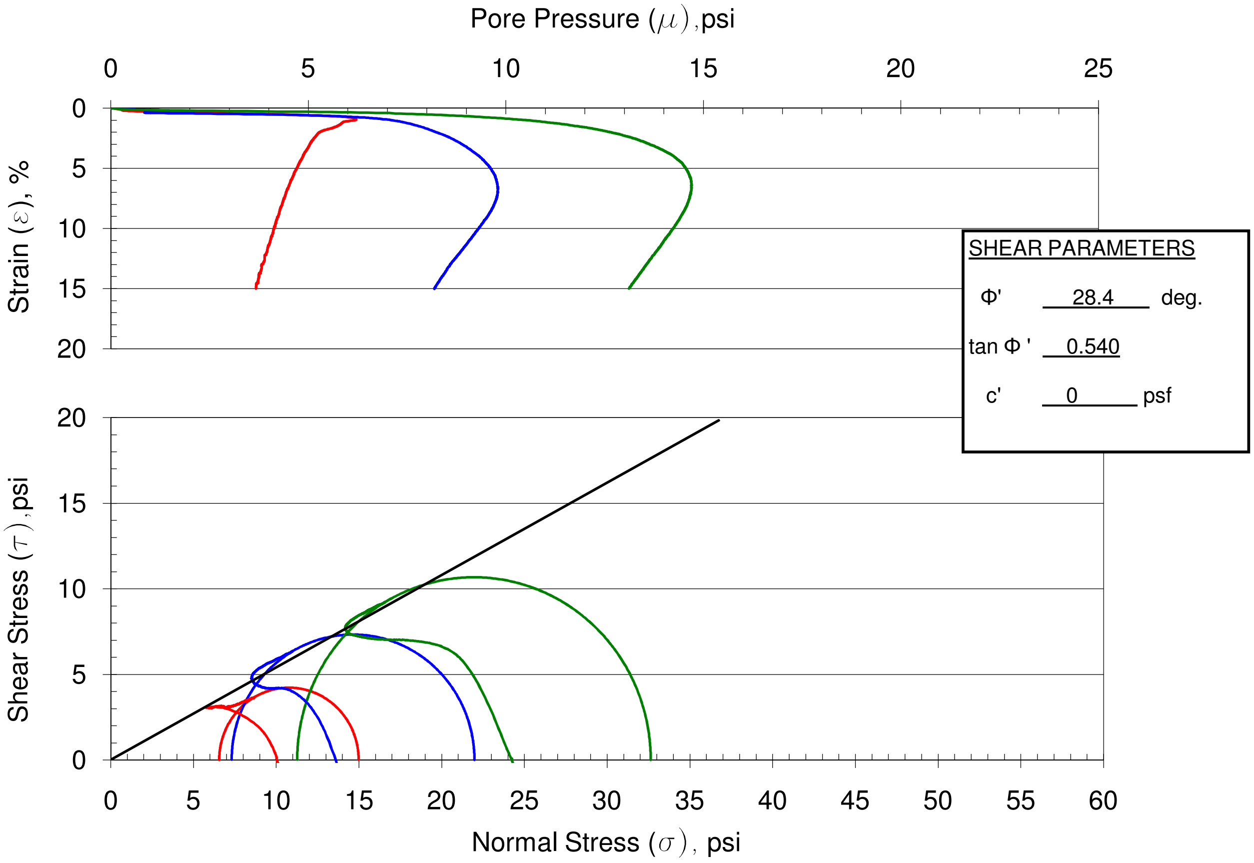
REMARKS

OLSSON ASSOCIATES

TRIXIAL SHEAR TEST

Project: CNPPID Reregulating Reservoir Feasibility Study - Area 2	Job Number: A09-1466	Date: 07/19/10
Sample Identification: Composite Bulk: B-15 (2-4'), B-17 (2-4')	Sample Description: Alluvium: Dark brown, Lean clay	

MINOR PRINCIPAL STRESS σ_3 (psi)	PORE PRESSURE μ, (psi)	EFFECTIVE MINOR PRINCIPAL STRESS σ_3' (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA MAXIMUM DEVIATOR STRESS	AXIAL STRAIN AT FAILURE ε (%)
10.2	3.7	6.5	8.4	$(\sigma_1 - \sigma_3)_{max}$	14.9
15.5	8.2	7.3	14.7		15.0
24.4	13.1	11.3	21.4		15.0



SHEAR PARAMETERS

Φ' 28.4 deg.

tan Φ ' 0.540

c' 0 psf

REMARKS

Harris
Laboratories
A Division of AgSource Cooperative Services

300 Speedway Circle, Suite 2
Lincoln, NE 68502

Tel: (402) 476-0300
Fax: (402) 476-0302

SOIL ANALYSIS

Submitted By:	6850221
Olsson Associates **3800 South 6th Street** **Lincoln, NE 68502**	

Submitted For:
J-2 AREAS 1 AND 2

Date Received	Date Reported	Samples Stored Until	Laboratory Sample #'s
28-May-2010	**1-Jun-2010**	**12-Jun-2010**	**AC11876 - AC11882**

Information Sheet Number: **022178**

REPORT OF ANALYTICAL RESULTS

Client Sample Identification	Analysis	Result
B-7BULK Area 2	Organic Matter %	1.7
B-4BULK Area 2	Organic Matter %	1.6
B-11BULK Area 2	Organic Matter %	1.2
5C Area 2	Organic Matter %	2.4
B4A1SURF Area 1	Organic Matter %	0.8
B4A2SURF Area 2	Organic Matter %	1.1
B15SURF Area 1	Organic Matter %	1.2

APPENDIX H

PLATTE RIVER HEC-RAS MEMORANDUM

OLSSON
ASSOCIATES

MEMO

☐ Overnight
☐ Regular Mail
☐ Hand Delivery
☒ Other: e-mail_____

TO: Eric Dove
PHONE: 417.890.8802
FROM: Carter Hubbard
RE: Platte River HEC-RAS Model
DATE: 07/23/10
PROJECT #: 009-1466
PHASE: 110, 110 001

NOTES:

I have received the comments and review questions regarding the Platte River floodplain modeling developed from the HEC-RAS 1-D sediment transport model. The comments were provided by Steve Smith and Beorn Courtney via e-mail. I have copied the comments and attached my responses below. I hope this help describe the revisions that were made to the model. The corresponding files have been sent via a separate e-mail. If any further information or explanation is required, please let me know.

1. Based on Carter's description, I'm assuming he made ineffective flow areas smaller, to allow a greater portion of the channel to actively convey flood flows? Or did he lower the elevation of the ineffective flow areas?

Changes made to each cross section are noted in the description section of the cross section data editor. A description of changes and the reasoning is provided for each cross section where changes were made. The .g02 file is the final geometry file created. If you scroll through the cross sections using the HEC-RAS cross section data editor, you should be able to read the description field to determine the changes, if any, at each cross section. If you open plan file .p01 (original RAS model from HDR/TT, corresponds to .g01 geometry file) and .p02 (revised model containing my changes, corresponds to .g01 geometry file) at the same time and check the "compare geometry" option, RAS will plot both the original and revised cross sections for direct comparison.

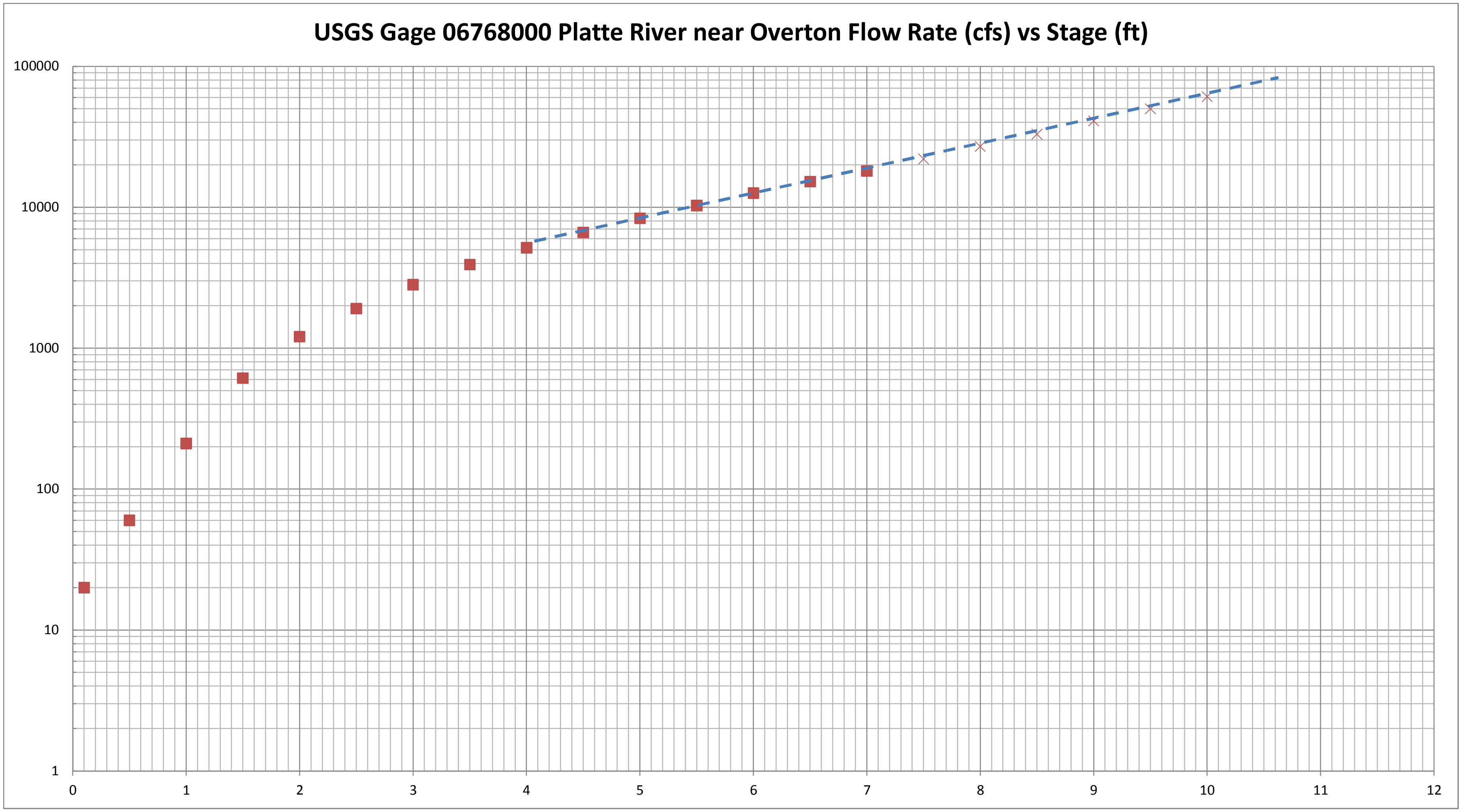
2. How did Olsson resolve the issue of the 50/50 flow split at Overton gage, where HDR had assumed 50% of Overton flow comes from the north channel of Jeffries Island and the other 50% from the J2 channel? I'm assuming you replaced that low-flow assumption with actual input flow values instead?

We input an initial flow split assumption of 60/40 into the .f02 flow file (corresponds to .p02 plan file and .g02 geometry file), where 60% of flow is diverted to J-2 from Main 1, either through the bridges under Hwy 283 and County Road 433, or overflows from Main 1 to J-2 downstream from County Road 433. The remaining 40% of flow stays in the main channel. We allowed HEC-RAS to optimize the balance of flows between the J-2 channel and the main channel. We ran the RAS model with the optimization routines activated one time. We then took the computed flow rates for each reach and manually input the computed flow rates back into the .f02 flow file, overwriting the flow values we initially input. Once the flow rates were overwritten, we reran the RAS model using the overwritten flows and without the optimization routines activated. This final run, corresponding to the attached .p02, .f02, and .g02 files, represents the optimized flow split between the various reaches.

3. What type (if any) calibration was done for the peak flows? I realize that stage-discharge curves are rarely available for such high flows, but am curious if Carter had any historical data to shoot at?

Eric Dove provided the flow versus stage data based on a statistical analysis of historical data from USGS Gage 06768000 (see attached spreadsheet). Flow data from the gage only included flows up to approximately 20,000 cfs. The 100-year flood event on this reach of the Platte is approximately 45,970 cfs (based on statiscal analysis of gage data provided by Eric Dove and summarized in the attached Word document). For flows greater than 20,000 cfs, I estimated stage by extrapolating from a semi-log plot of flow vs. stage (see attached spreadsheet).

Additional notes are provided in the description field on the HEC-RAS project page (main interface window) of the model.


USGS Gage 06768000 Platte River near Overton Flow Rate (cfs) vs Stage (ft)
100000
10000
1000
100
10
1
0
1
2
3
4
5
6
7
8
9
10
11
12

Here is the report output for Platte River – Overton Annual Peak Flow:

```
------------------------------
Bulletin 17B Frequency Analysis
   14 Oct 2009   03:20 PM
------------------------------


--- Input Data ---

Analysis Name: Platte River - Overton, NE, Annual Peak Flow
Description:

Data Set Name: PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK
DSS File Name: F:\Projects\009-1466\HEC-SSP\J-2_Return\J-2_Return.dss
DSS Pathname: /PLATTE RIVER/OVERTON, NEBR./FLOW-ANNUAL PEAK/01jan1900/IR-CENTURY/USGS/

Report File Name: F:\Projects\009-1466\HEC-SSP\J-2_Return\Bulletin17bResults\Platte_River_-
_Overton,_NE,_Annual_Peak_Flow\Platte_River_-_Overton,_NE,_Annual_Peak_Flow.rpt
XML File Name: F:\Projects\009-1466\HEC-SSP\J-2_Return\Bulletin17bResults\Platte_River_-
_Overton,_NE,_Annual_Peak_Flow\Platte_River_-_Overton,_NE,_Annual_Peak_Flow.xml

Start Date:
End Date:

Skew Option: Use Station Skew
Regional Skew: 0.0
Regional Skew MSE: 0.0

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
 Based on 91 events, 10 percent outlier test value K(N) = 2.984

        0 low outlier(s) identified below test value of 727.6
```

```
----------------------
<< High Outlier Test >>
----------------------
 Based on 91 events, 10 percent outlier test value K(N) = 2.984

    0 high outlier(s) identified above test value of 59,309.81




--- Final Results ---

<< Plotting Positions >>
PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK
-----------------------------------------------------------------
|    Events Analyzed      |          Ordered Events          |
|                FLOW  |        Water       FLOW  Weibull  |
| Day Mon Year        CFS  |  Rank     Year        CFS  Plot Pos |
|--------------------------|-------------------------------------|
|  29 May 1915     19,600  |    1      1935     37,600    1.09   |
|  24 May 1916      5,200  |    2      1921     37,000    2.17   |
|  02 Jun 1917     29,300  |    3      1917     29,300    3.26   |
|  10 Oct 1918      9,000  |    4      1928     23,000    4.35   |
|  18 May 1920     21,500  |    5      1983     22,900    5.43   |
|  14 Jun 1921     37,000  |    6      1923     22,000    6.52   |
|  23 May 1922      9,400  |    7      1920     21,500    7.61   |
|  17 Jun 1923     22,000  |    8      1915     19,600    8.70   |
|  20 Jun 1926     15,500  |    9      1973     19,100    9.78   |
|  19 Apr 1927     12,800  |   10      1929     19,000   10.87   |
|  12 Jun 1928     23,000  |   11      1947     18,700   11.96   |
|  07 Jun 1929     19,000  |   12      1971     15,700   13.04   |
|  13 May 1930      9,940  |   13      1984     15,600   14.13   |
|  04 Apr 1931     10,600  |   14      1926     15,500   15.22   |
|  18 Mar 1932      6,120  |   15      1942     15,200   16.30   |
|  23 Apr 1933      8,440  |   16      1949     15,100   17.39   |
|  01 Feb 1934      5,210  |   17      1980     14,600   18.48   |
|  05 Jun 1935     37,600  |   18      1965     14,600   19.57   |
|  05 Mar 1936      6,100  |   19      1995     14,500   20.65   |
|  20 Mar 1937      7,050  |   20      1927     12,800   21.74   |
|  28 Feb 1938      7,680  |   21      1999     12,200   22.83   |
|  18 Mar 1939      9,660  |   22      2008     11,200   23.91   |
|  02 Mar 1940      8,940  |   23      1997     11,000   25.00   |
|  16 Mar 1941      2,330  |   24      1931     10,600   26.09   |
|  10 May 1942     15,200  |   25      1930      9,940   27.17   |
|  12 Apr 1943      3,860  |   26      1939      9,660   28.26   |
|  12 May 1944      4,070  |   27      1922      9,400   29.35   |
|  11 Jun 1945      5,530  |   28      1919      9,000   30.43   |
```

```
|  16 Mar 1946       3,490  |   29      1940       8,940   31.52    |
|  23 Jun 1947      18,700  |   30      1974       8,810   32.61    |
|  23 Jun 1948       5,990  |   31      1970       8,660   33.70    |
|  24 Jun 1949      15,100  |   32      1933       8,440   34.78    |
|  14 Nov 1949       3,210  |   33      1938       7,680   35.87    |
|  18 May 1951       7,550  |   34      1986       7,590   36.96    |
|  27 Mar 1952       5,710  |   35      1979       7,580   38.04    |
|  09 Jan 1953       4,640  |   36      1951       7,550   39.13    |
|  06 Nov 1953       2,930  |   37      1957       7,530   40.22    |
|  10 Mar 1955       2,370  |   38      1969       7,260   41.30    |
|  31 Mar 1956       1,970  |   39      1985       7,160   42.39    |
|  25 May 1957       7,530  |   40      1962       7,100   43.48    |
|  26 May 1958       5,800  |   41      1937       7,050   44.57    |
|  29 Mar 1959       2,960  |   42      1960       6,950   45.65    |
|  24 Mar 1960       6,950  |   43      1987       6,890   46.74    |
|  19 Jun 1961       3,490  |   44      1996       6,300   47.83    |
|  09 Jun 1962       7,100  |   45      1932       6,120   48.91    |
|  15 Feb 1963       3,020  |   46      1967       6,100   50.00    |
|  07 Apr 1964       2,360  |   47      1936       6,100   51.09    |
|  26 Jun 1965      14,600  |   48      1998       6,070   52.17    |
|  02 Mar 1966       3,410  |   49      1948       5,990   53.26    |
|  08 Jul 1967       6,100  |   50      1977       5,890   54.35    |
|  22 Feb 1968       2,550  |   51      1958       5,800   55.43    |
|  30 Jun 1969       7,260  |   52      1952       5,710   56.52    |
|  26 Jun 1970       8,660  |   53      1945       5,530   57.61    |
|  13 Jun 1971      15,700  |   54      1975       5,500   58.70    |
|  14 May 1972       4,750  |   55      1934       5,210   59.78    |
|  15 May 1973      19,100  |   56      1916       5,200   60.87    |
|  21 Mar 1974       8,810  |   57      1988       4,990   61.96    |
|  21 Jun 1975       5,500  |   58      1993       4,930   63.04    |
|  11 Apr 1976       2,860  |   59      1972       4,750   64.13    |
|  22 May 1977       5,890  |   60      1953       4,640   65.22    |
|  15 Mar 1978       3,600  |   61      1991       4,590   66.30    |
|  28 Jun 1979       7,580  |   62      2000       4,480   67.39    |
|  25 May 1980      14,600  |   63      2007       4,420   68.48    |
|  28 Jul 1981       3,730  |   64      1989       4,090   69.57    |
|  09 Mar 1982       2,520  |   65      1944       4,070   70.65    |
|  28 Jun 1983      22,900  |   66      1943       3,860   71.74    |
|  13 Jun 1984      15,600  |   67      1981       3,730   72.83    |
|  23 Feb 1985       7,160  |   68      1978       3,600   73.91    |
|  18 Jun 1986       7,590  |   69      1961       3,490   75.00    |
|  31 May 1987       6,890  |   70      1946       3,490   76.09    |
|  24 Feb 1988       4,990  |   71      1966       3,410   77.17    |
|  27 Jun 1989       4,090  |   72      1992       3,230   78.26    |
|  15 Aug 1990       3,200  |   73      1950       3,210   79.35    |
|  24 May 1991       4,590  |   74      1990       3,200   80.43    |
|  28 Aug 1992       3,230  |   75      2001       3,160   81.52    |
|  09 Mar 1993       4,930  |   76      1963       3,020   82.61    |
```

```
|  04 Mar 1994      2,900  |   77      1959      2,960   83.70   |
|  15 Jun 1995     14,500  |   78      1954      2,930   84.78   |
|  23 Sep 1996      6,300  |   79      1994      2,900   85.87   |
|  19 Jun 1997     11,000  |   80      1976      2,860   86.96   |
|  04 Apr 1998      6,070  |   81      1968      2,550   88.04   |
|  19 Aug 1999     12,200  |   82      1982      2,520   89.13   |
|  01 Oct 1999      4,480  |   83      1955      2,370   90.22   |
|  21 Oct 2000      3,160  |   84      1964      2,360   91.30   |
|  10 Apr 2002      2,060  |   85      1941      2,330   92.39   |
|  17 Apr 2003      2,010  |   86      2006      2,180   93.48   |
|  01 Mar 2004      2,140  |   87      2004      2,140   94.57   |
|  05 Jun 2005      2,120  |   88      2005      2,120   95.65   |
|  30 Mar 2006      2,180  |   89      2002      2,060   96.74   |
|  02 Jun 2007      4,420  |   90      2003      2,010   97.83   |
|  25 May 2008     11,200  |   91      1956      1,970   98.91   |
|--------------------------|-------------------------------------|
```

```
<< Skew Weighting >>
--------------------------------------------------------------
Based on 91 events, mean-square error of station skew =   0.076
Mean-square error of regional skew =                       0
--------------------------------------------------------------
```

```
<< Frequency Curve >>
PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK
------------------------------------------------------------------
|  Computed    Expected   |  Percent   |    Confidence Limits    |
|    Curve   Probability  |   Chance   |      0.05       0.95    |
|       FLOW, CFS         | Exceedance |       FLOW, CFS         |
|-------------------------|------------|-------------------------|
|     74,015     81,104   |    0.2     |    106,566     55,350   |
|     55,226     59,109   |    0.5     |     76,574     42,503   |
|     43,640     45,970   |    1.0     |     58,741     34,350   |
|     33,955     35,281   |    2.0     |     44,318     27,353   |
|     23,593     24,142   |    5.0     |     29,512     19,613   |
|     17,283     17,530   |   10.0     |     20,911     14,712   |
|     12,037     12,123   |   20.0     |     14,096     10,471   |
|      6,306      6,306   |   50.0     |      7,164      5,544   |
|      3,501      3,481   |   80.0     |      4,029      2,984   |
|      2,632      2,605   |   90.0     |      3,080      2,186   |
|      2,103      2,070   |   95.0     |      2,502      1,707   |
|      1,418      1,376   |   99.0     |      1,743      1,101   |
|-------------------------|------------|-------------------------|
```

```
<< Systematic Statistics >>
PLATTE RIVER-OVERTON, NEBR.-FLOW-ANNUAL PEAK
---------------------------------------------------------------
|       Log Transform:       |                          |
|         FLOW, CFS          |      Number of Events        |
|------------------------------|-------------------------------|
|  Mean             3.8175  |  Historic Events         0  |
|  Standard Dev       0.3202  |  High Outliers         0     |
|  Station Skew       0.3333  |  Low Outliers          0     |
|  Regional Skew      0.0000  |  Zero Events           0     |
|  Weighted Skew      0.0000  |  Missing Events        0     |
|  Adopted Skew       0.3333  |  Systematic Events       91  |
|-------------------------------|-------------------------------|
```