Appendix C

Geotechnical Soil Testing Data

Table C-1
Laboratory Soil Testing Results
Groundwater Assessment Report
UMore Mining Area
Dakota County, Minnesota

Sample Boring/Well ID	Depth (feet bgs)	Unit Description	USCS Symbol	Particle Size						Particle Size Distribution			Porosity (%)	Permeameter Test Conducted	Hydraulic Conductivity[1] (feet/day)
				% Gravel		% Sand			% Fines	% Gravel >5mm	% Sand 5 > and <0.75 mm	% Fines <0.75 mm			
				Coarse	Fine	Coarse	Medium	Fine							
A6-Pilot	130	Outwash	SP	0	4	4	26	63	3	4	93	3	36.3	Constant-Head	4.5 (H)
A6-Pilot	158	Outwash	GP-GM	50	7	5	15	17	6	57	37	6	NA	NA	NA
C2-Pilot	104	Outwash	SP-SM/SM	0	2	1	4	82	11	2	87	11	NA	NA	NA
C2-Pilot	158	Outwash	SP-SM	0	5	11	45	33	6	5	89	6	33.0	Constant Head	2.1 (H)
E1-Pilot	155	Outwash	SP-SM	0	5	9	47	31	8	5	87	8	30.5	Constant Head	0.43 (H)
MW-B1-001	65	Outwash	SP	0	0	0	6	90	4	0	96	4	NA	NA	NA
MW-A3-003	75	Outwash	SP	0	0	1	11	84	4	0	96	4	NA	NA	NA
MW-D3-007	60	Outwash	SP	0	18	18	37	25	2	18	80	2	NA	NA	NA
MW-E2-009	68	Outwash	SP	0	0	0	8	89	3	0	97	3	NA	NA	NA
MW-E4-010	65	Outwash	SP	1	8	14	29	47	1	9	90	1	NA	NA	NA
MW-C7-004	88	Outwash w/ ML lenses	SM	1	7	8	35	33	16	8	76	16	NA	NA	NA
MW-A3-003	81	ML in Outwash	CL/CL-ML	0	0	0	1	1	98	0	2	98	41.3	Falling Head	0.013 (V)
MW-B1-001	73-74	ML in Outwash	ML	0	0	0	0	33	67	0	33	67	NA	NA	NA
MW-C7-004	86-88	ML in Outwash	CL-ML	0	0	0	2	12	86	0	14	86	NA	NA	NA
C2-Pilot	120	Diamicton	CL	0	1	1	12	30	56	1	43	56	29.6	Falling Head	3.4E-4 (V)
E1-Pilot	103	Diamicton	CL	0	0	0	6	18	76	0	24	76	30.7	Falling Head	1.0E-5 (V)
MW-E2-209	113	Diamicton	CL	1	2	1	8	23	65	3	32	65	31.7	Falling Head	6.8E-5 (V)
MW-C4-311	70	Diamicton	CL	0	2	2	7	28	61	2	37	61	22.1	Falling Head	1.4E-4 (V)
B2-Pilot	86-88	Diamicton	CL	0	2	2	11	25	60	2	38	60	NA	NA	NA
E1-Pilot	126-127	Diamicton	SC	0	0	2	15	39	44	0	56	44	NA	NA	NA
MW-E2-305	70	St. Peter Sandstone	SM	0	0	0	1	34	65	0	35	65	31.0	Falling Head	0.21 (H)
MW-D5-308	65	St. Peter Sandstone	SM	0	12	3	5	41	39	12	49	39	NA	NA	NA

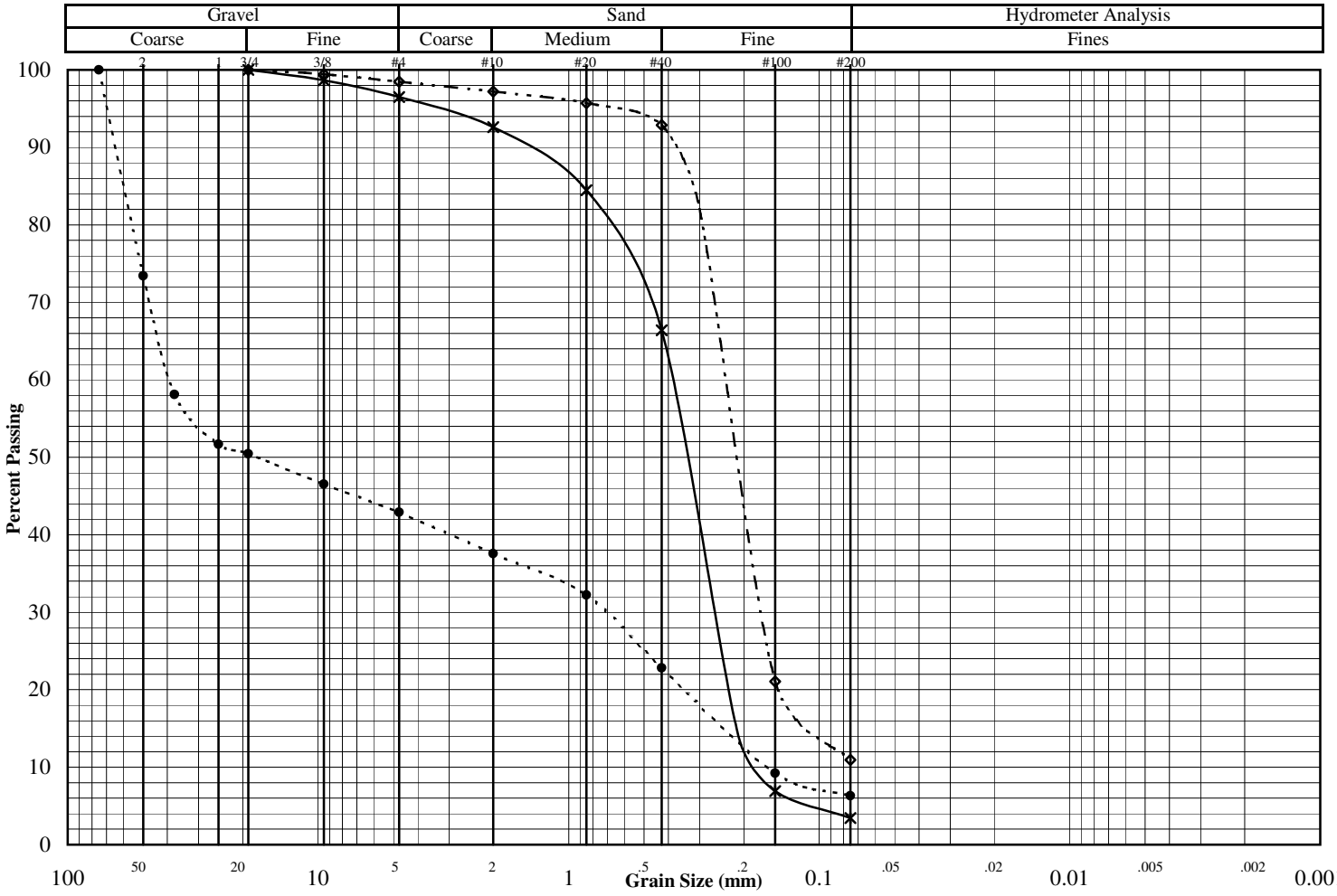
Notes:
[1] Outwash and St. Peter Sandstone samples were re-packed in the laboratory
(V) - Indicates vertical hydraulic conductivity is approximated
(H) - Indicates horizontal hydraulic conductivity is approximated
NA - Not applicable. Particle size analysis only.
mm - millimeter
cm/s - centimeters per second
bgs - below ground surface
ML -silt
SP - poorly graded sand
SM - silty sand
CL - lean clay
SC - clayey sand

Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/13/09
Reported To:	Barr Engineering Company	Report Date:	3/3/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	A6-Pilot		130	Rotosonic	Sand w/a trace of gravel, fine to medium grained (SP)
●	A6-Pilot		158	Rotosonic	Gravel w/sand and silt (GP-GM)
◇	C2-Pilot		104	Rotosonic	Sand w/silt (SP-SM/SM)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity	0.363		
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	1885.1	2456.5	739.6
2"		73.4	
1.5"		58.1	
1"		51.7	
3/4"	100.0	50.4	100.0
3/8"	98.7	46.5	99.4
#4	96.5	42.9	98.5
#10	92.6	37.6	97.2
#20	84.5	32.2	95.7
#40	66.4	22.8	92.9
#100	6.9	9.2	21.1
#200	3.5	6.3	11.0

	*	●	◇
D_{60}	0.37	39	0.23
D_{30}	0.22	0.70	0.17
D_{10}	0.16	0.16	0.069
C_U	2.31	243.75	3.33
C_C	0.82	0.08	1.82

Remarks:

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SOIL ENGINEERING TESTING, INC.

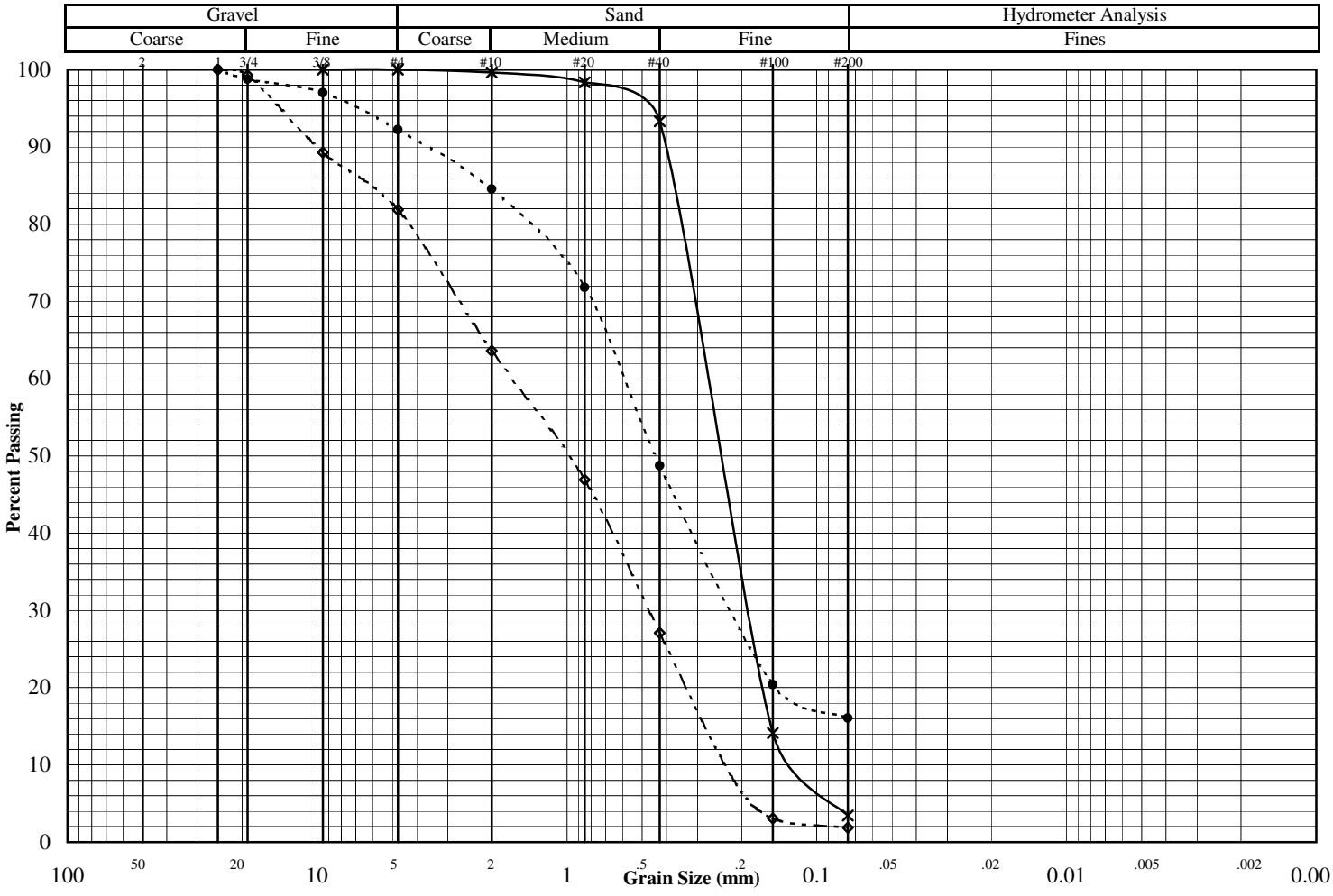
Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/13/09
Reported To:	Barr Engineering Company	Report Date:	3/3/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	MW-B1-001		65	Rotosonic	Sand, fine grained (SP)
●	MW-C7-004		88	Rotosonic	Silty Sand w/a little gravel (SM)
◇	MW-D3-007		60	Rotosonic	Sand w/gravel, medium grained (SP)



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	1624.0	1608.8	1882.7
2"			
1.5"			
1"		100.0	100.0
3/4"		98.8	99.3
3/8"	100.0	97.0	89.3
#4	100.0	92.2	81.9
#10	99.6	84.5	63.6
#20	98.3	71.8	46.9
#40	93.3	48.7	27.1
#100	14.1	20.4	3.1
#200	3.4	16.1	1.9

	*	●	◇
D_{60}	0.27	0.59	1.7
D_{30}	0.18	0.21	0.47
D_{10}	0.13	0.03	0.21
C_U	2.08	19.67	8.10
C_C	0.92	2.49	0.62

Remarks:

The D10 value for MW-C7-004 @ 88' is projected based on the values at the #100 sieve and the #200 sieve

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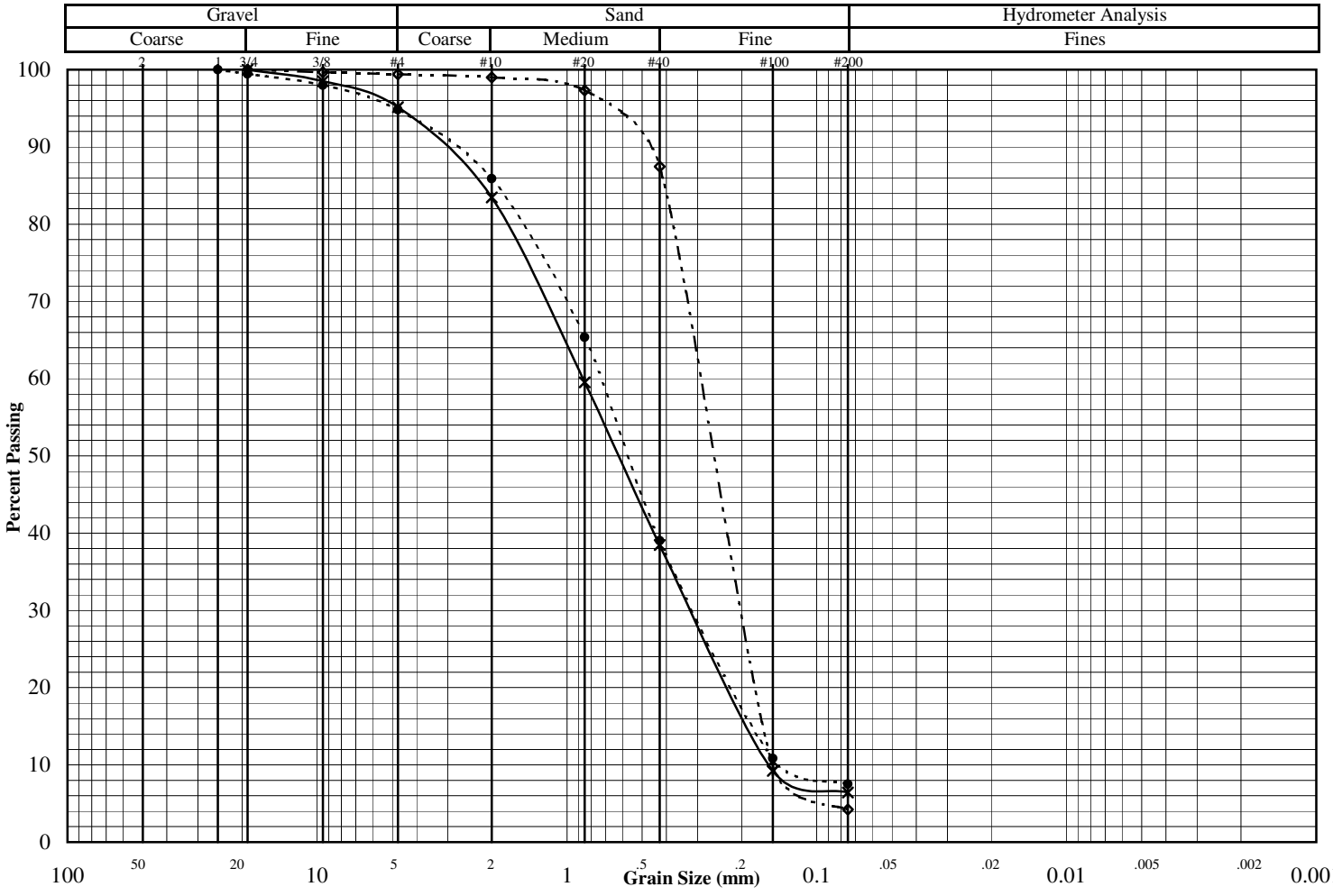
Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/13/09
Reported To:	Barr Engineering Company	Report Date:	3/3/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	C2-Pilot		158	Rotosonic	Sand w/silt and a little gravel (SP-SM)
●	E1-Pilot		155	Rotosonic	Sand w/silt and a little gravel (SP-SM)
◇	MW-A3-003		75	Rotosonic	Sand, fine grained (SP)



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity	0.330	0.305	
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	3242.5	2444.8	3178.4
2"			
1.5"			
1"		100.0	
3/4"	100.0	99.4	100.0
3/8"	98.5	98.0	99.7
#4	95.2	94.8	99.4
#10	83.5	85.9	99.0
#20	59.5	65.4	97.3
#40	38.5	39.0	87.5
#100	9.2	10.8	9.8
#200	6.4	7.5	4.2

	*	●	◇
D_{60}	0.87	0.71	0.29
D_{30}	0.31	0.31	0.20
D_{10}	0.16	0.15	0.16
C_U	5.44	4.73	1.81
C_C	0.69	0.90	0.86

Remarks:

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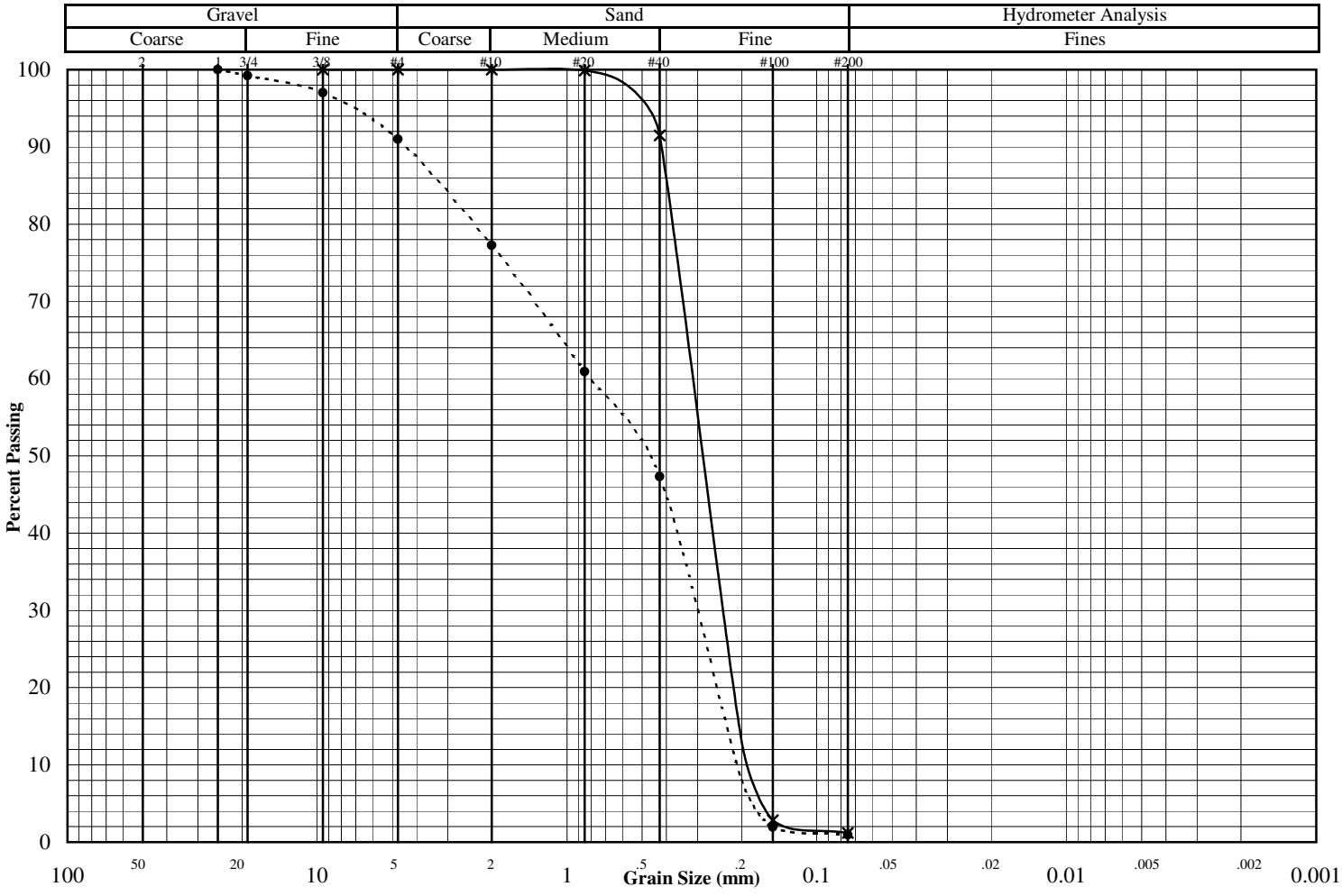
Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/13/09
Reported To:	Barr Engineering Company	Report Date:	3/3/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	MW-E2-009		68	Rotosonic	Sand, fine grained (SP)
●	MW-E4-010		65	Rotosonic	Sand w/a little gravel, fine to medium grained (SP)
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	852.3	1797.0	
2"			
1.5"			
1"		100.0	
3/4"		99.2	
3/8"	100.0	97.0	
#4	100.0	91.0	
#10	100.0	77.2	
#20	99.9	60.9	
#40	91.5	47.3	
#100	2.8	2.0	
#200	1.2	0.9	

	*	●	◇
D_{60}	0.30	0.81	
D_{30}	0.22	0.30	
D_{10}	0.19	0.20	
C_U	1.58	4.05	
C_C	0.85	0.56	

Remarks:

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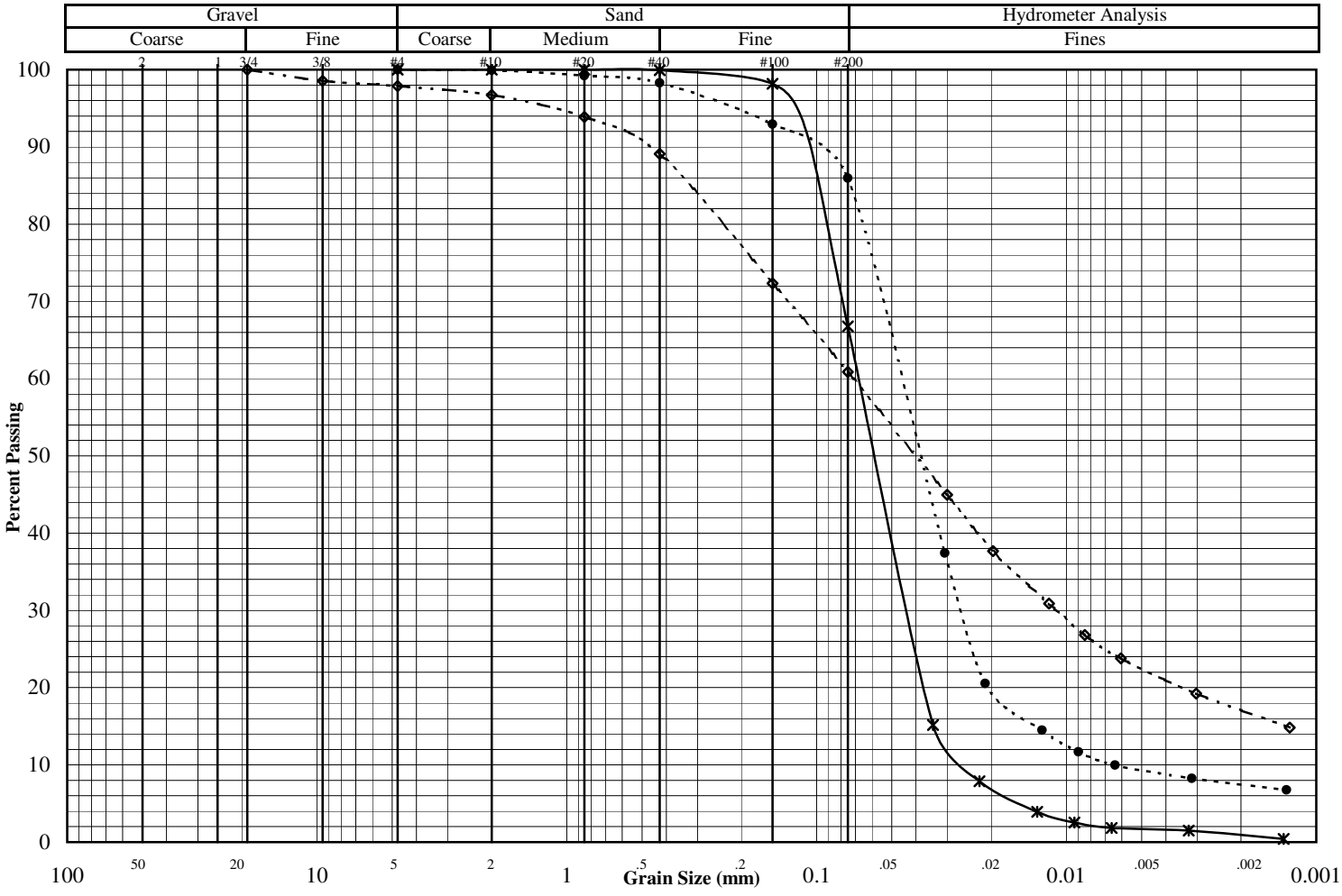
Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/16/09
Reported To:	Barr Engineering Company	Report Date:	2/20/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	MW-B1-001		73-74	Rotosonic	Sandy Silt (ML)
●	MW-C7-004		86-88	Rotosonic	Silty Clay (CL-ML)
◇	MW-C4-311		70	Rotosonic	Sandy Lean Clay w/a trace of Gravel (CL)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.67*	2.69*	2.69*
Porosity			0.211
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	235.9	349.4	660.2
2"			
1.5"			
1"			
3/4"			100.0
3/8"			98.5
#4	100.0	100.0	97.9
#10	100.0	99.9	96.7
#20	100.0	99.2	93.9
#40	99.9	98.3	89.1
#100	98.2	93.0	72.3
#200	66.8	86.0	60.9

	*	●	◇
D_{60}	0.069	0.045	0.07
D_{30}	0.043	0.027	0.011
D_{10}	0.028	0.0064	
C_U	2.46	7.03	
C_C	0.96	2.53	

Remarks:

* The D10 value for sample MW-C4-311 @ 70' is lower than 0.001

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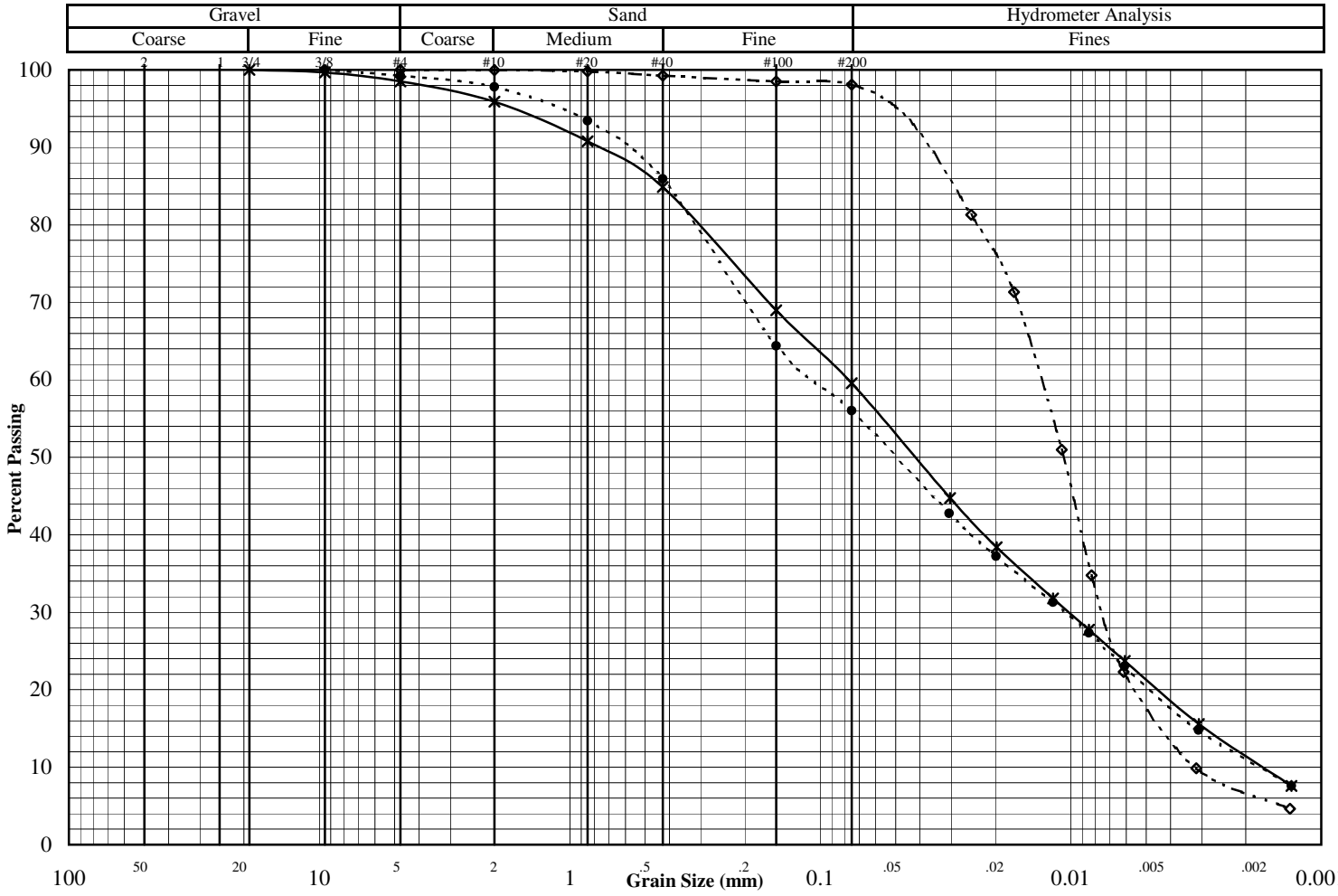
Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/17/09
Reported To:	Barr Engineering Company	Report Date:	3/3/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B2-Pilot		86-88	Rotosonic	Sandy Lean Clay (CL)
●	C2-Pilot		120	Rotosonic	Sandy Lean Clay (CL)
◇	MW-A3-003		81	Rotosonic	Lean Clay (CL/CL-ML)



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.69*	2.69*	2.69*
Porosity		0.296	0.413
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	736.1	186.5	208.4
2"			
1.5"			
1"			
3/4"	100.0		
3/8"	99.7	100.0	
#4	98.5	99.3	100.0
#10	95.9	97.8	100.0
#20	90.8	93.4	99.8
#40	84.9	85.9	99.2
#100	69.0	64.4	98.5
#200	59.6	56.0	98.1

	*	●	◇
D_{60}	0.076	0.11	0.0125
D_{30}	0.01	0.01	0.0077
D_{10}	0.0017	0.0017	0.0031
C_U	44.71	64.71	4.03
C_C	0.77	0.53	1.53

Remarks:

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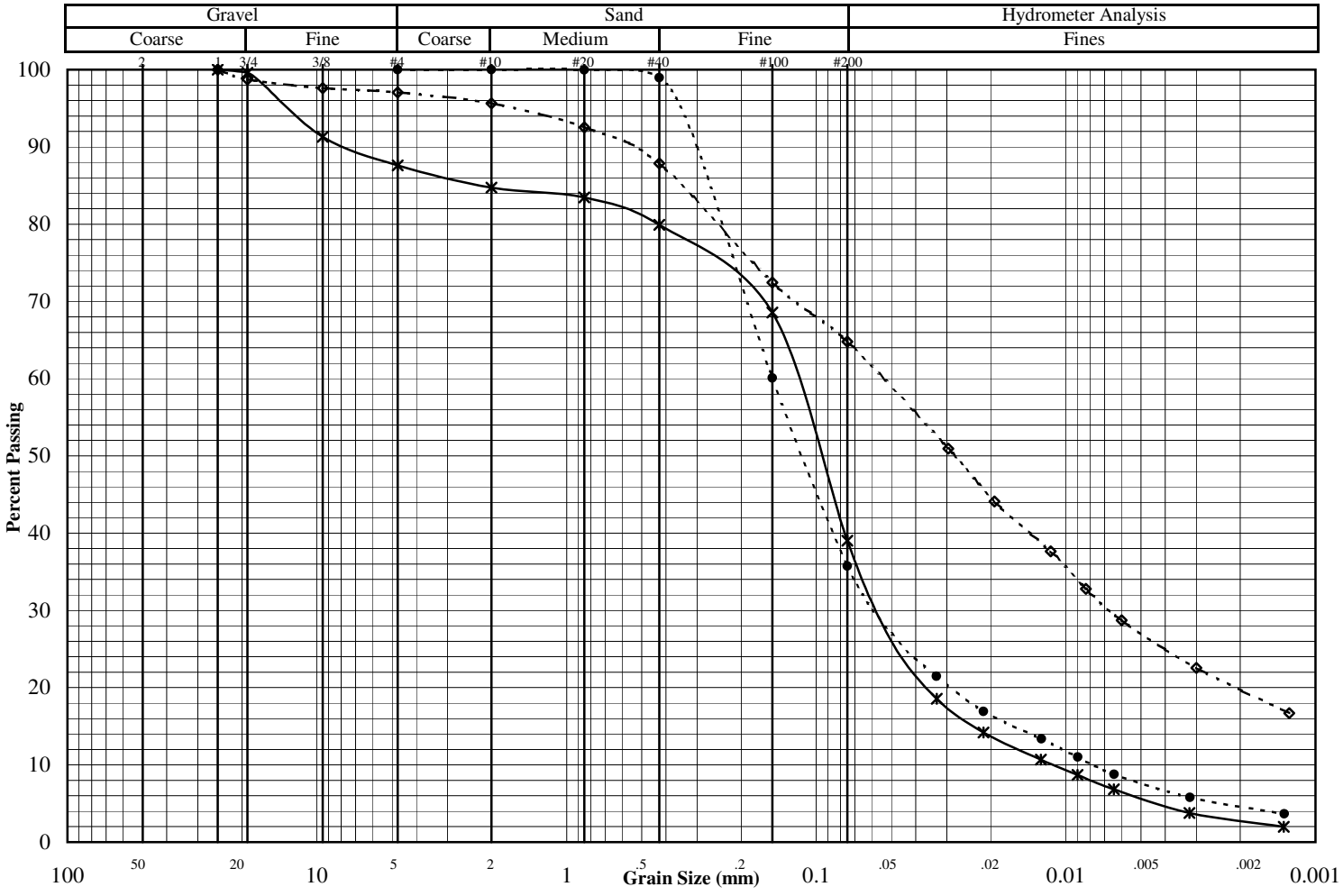
Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/16/09
Reported To:	Barr Engineering Company	Report Date:	2/20/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	MW-D5-308		65	Rotosonic	Silty Sand w/a little gravel (SM)
●	MW-E2-305		70	Rotosonic	Silty Sand (SM)
◇	MW-E2-209		113	Rotosonic	Sandy Lean Clay w/a trace of gravel (CL)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.69*
Porosity		0.310	0.317
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	2337.2	350.6	1718.7
2"			
1.5"			
1"	100.0		100.0
3/4"	99.6		98.7
3/8"	91.3		97.6
#4	87.6	100.0	97.0
#10	84.7	100.0	95.6
#20	83.5	100.0	92.5
#40	79.9	98.9	87.9
#100	68.6	60.1	72.5
#200	39.0	35.7	64.8

	*	●	◇
D_{60}	0.12	0.18	0.052
D_{30}	0.054	0.06	0.0069
D_{10}	0.011	0.008	
C_U	10.91	22.50	
C_C	2.21	2.50	

Remarks:

* The D10 value for sample MW-E3-209 @ 113' is lower than 0.001

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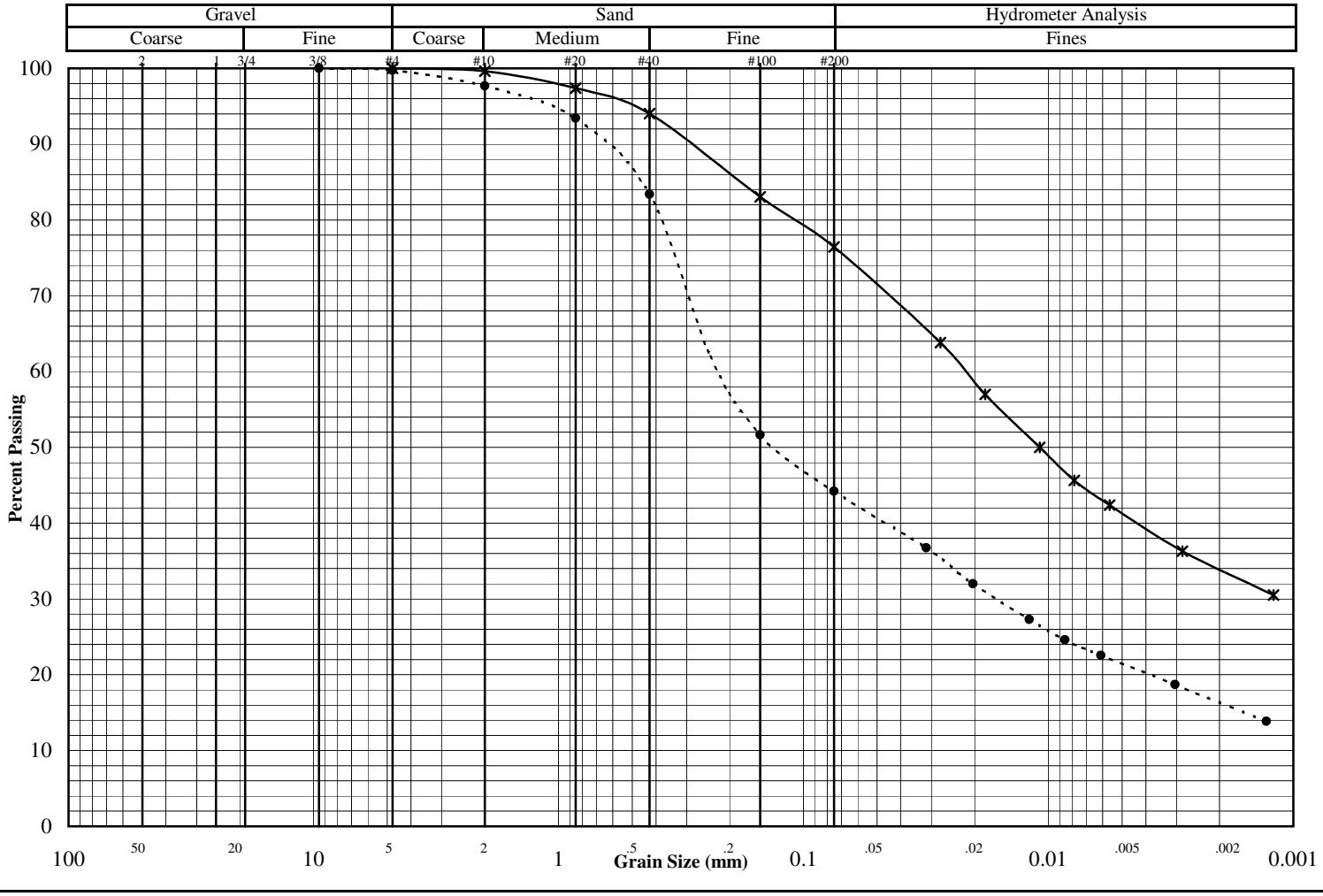
Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6872**

Project:	UMA Hydro Assessment #23/190B 05.03	Test Date:	2/17/09
Reported To:	Barr Engineering Company	Report Date:	3/2/09

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	E1-Pilot		103	Rotosonic	Sandy Lean Clay (CL)
●	E1-Pilot		126-127	Rotosonic	Clayey Sand (SC)
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.71*	2.69*	
Porosity	0.307		
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	125.1	273.2	
2"			
1.5"			
1"			
3/4"			
3/8"		100.0	
#4	100.0	99.7	
#10	99.6	97.7	
#20	97.4	93.4	
#40	94.0	83.4	
#100	83.0	51.6	
#200	76.4	44.2	

	*	●	◇
D_{60}	0.021	0.21	
D_{30}	0.0012	0.017	
D_{10}			
C_U			
C_C			

Remarks:

* Not able to determine a D10 value for either of the samples

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Bloomington, Minnesota 55420-3436

Hydraulic Conductivity Test Data

Project: UMA Hydro Assessment #23/190B 05.03 Date: 2/26/2009

Reported To: Barr Engineering Company Job No.: 6872

Boring No.:	A6-Pilot	C2-Pilot	E1-Pilot				
Sample No.:							
Depth (ft)	130	158	155				
Location:							
Sample Type:	Bag	Bag	Bag				
Soil Type:	Sand w/a trace of gravel, fine to medium grained (SP)	Sand w/ Silt and a little Gravel (SP-SM)	Sand w/ Silt and a little Gravel (SP-SM)				
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:	0.363	0.330	0.305				
Ht. (in):	3.98	3.98	3.98				
Dia. (in):	2.89	2.89	2.89				
Dry Density (pcf):	106.5	112.0	116.2				
Water Content:	16.6%	12.5%	11.7%				
Test Type:	Constant	Constant	Constant				
Max Head (cm):	29.8	29.8	29.8				
Confining press. (Effective-psi):	None	None	None				
Trial No.:	6-10	6-10	8-12				
Water Temp °C:	20.2	21.2	21.6				
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.6×10^{-3}**	**7.3×10^{-4}**	**1.5×10^{-4}**				
K @ 20 °C (ft/min)	**3.2×10^{-3}**	**1.4×10^{-3}**	**3.0×10^{-4}**				
Notes:							

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Hydraulic Conductivity Test Data

Project: UMA Hydro Assessment #23/190B 05.03 Date: 2/26/2009

Reported To: Barr Engineering Company Job No.: 6872

Boring No.:	C2-Pilot	E1-Pilot	MW-A3-003	MW-C4-311	MW-E2-209	MW-E2-305	
Sample No.:							
Depth (ft)	120	103	81	70	113	70	
Location:							
Sample Type:	Rotosonic	Rotosonic	Rotosonic	Rotosonic	Rotosonic	Rotosonic	
Soil Type:	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Lean Clay (CL/CL-ML)	Sandy Lean Clay w/a trace of Gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Silty Sand (SM)	
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:	0.296	0.307	0.413	0.221	0.317	0.310	
Ht. (in):	2.96	1.97	2.96	1.70	2.22	2.96	
Dia. (in):	2.88	2.88	2.88	2.88	2.88	2.88	
Dry Density (pcf):	117.8	115.9	98.3	130.4	114.2	115.4	
Water Content:	12.0%	15.4%	27.0%	8.6%	15.8%	13.7%	
Test Type:	Falling	Falling	Falling	Falling	Falling	Falling	
Max Head (ft):	5.0	5.0	4.0	5.0	5.0	4.0	
Confining press. (Effective-psi):	3.0	3.0	3.0	3.0	3.0	3.0	
Trial No.:	10-14	18-22	13-17	6-10	6-10	20,24-27	
Water Temp °C:	20.0	20.0	20.0	20.0	20.0	20.0	
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.2×10^{-7}**	**3.7×10^{-9}**	**4.6×10^{-6}**	**5.0×10^{-8}**	**2.4×10^{-8}**	**7.3×10^{-5}**	
K @ 20 °C (ft/min)	**2.4×10^{-7}**	**7.3×10^{-9}**	**9.0×10^{-6}**	**9.9×10^{-8}**	**4.7×10^{-8}**	**1.4×10^{-5}**	
Notes:							