

AECOM

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Technical Memorandum

Date: October 26th, 2009
To: Brian Beyak, P.Eng, Manitoba Hydro
From: Jamie Ellis, P.Eng, AECOM
Project Number: 0217-200-07 (3) [Hydro Ref: 243 981 0100]
Subject: **Keeyask Infrastructure Project – North Access Road Start Up Camp
Concept Design for Wastewater Disposal
Additional Information**

Distribution: Neil Klassen, C.E.T., AECOM
Bob Romanetz, P.Eng, AECOM

A technical memorandum relating to wastewater disposal from the North Access Road Start Up Camp (SUC) was previously included as Appendix A1 to the Environment Act Proposal submission for the Keeyask Infrastructure Project (dated July 28th, 2009). Revision 1 (dated October 2nd) was then submitted, including further information on the concept design, following the completion of additional fieldwork programs. This revision incorporates comments raised at a meeting between representatives from Manitoba Hydro, TetrES, AECOM and Manitoba Conservation, held on October 13th, 2009.

The basis for design and site tests included the following documents:

- Environment Act Regulation 83/2003 "Onsite Wastewater Management Systems".
- Supplementary Information for Onsite Wastewater Management System Installations, by Manitoba Conservation (dated July 2005, Revised January 2008)
- Guideline 2009-01E – Onsite Wastewater Disposal Field Decommissioning (dated September 2009)

Two geotechnical investigations have been completed to evaluate three potential sites for the SUC drain field. The first investigation was completed on July 21 and 22, 2009 by AECOM to evaluate the original proposed site located west of the SUC. A second geotechnical investigation was completed at these two locations on September 11 and 12, 2009 by Manitoba Hydro. Samples from the second program were submitted to AECOM's Materials Testing Laboratory to determine the moisture content and full gradation of the soils encountered. The test results and a summary table are also attached (Enclosure 2).

The upper 1.5 m of soil at Test Holes 09-13, 09-14 and 09-15 generally consists of a silt with trace to some sand and variable clay content (trace clay to clayey). Below this layer the soil has variable silt

and sand content (i.e. silt content ranges from about 11 to 85 percent and the sand ranges from about 7 to 88 percent) and the clay content is less than 10 percent.

Based on the Soil Texture Classification Triangle contained in the Supplementary Information, the majority of the soil samples tested for gradation correspond to a silt loam to a loamy sand given the low percentage of clay (i.e. less than 10 percent) and the range of silt and sand percentages. As can be seen from the summary table in Enclosure 2, whilst some samples did contain greater than 85% sand content, these are at least 1m below the base of the field, and TH09-13 is some 75m away from the west end of the field. Therefore, the wastewater application rate assumed in the concept design (12.72 litres/m²/day), is considered to be conservative and consistent with both sampling and percolation tests undertaken at the site to date.

A further review of the information suggested that the base of the field could be located 0.5m higher (at elevation 177.0 m) than previously assumed in the concept design drawings. However, the potential for further raising the base elevation of the field will be reviewed during detailed design, in conjunction with a review of cut/fill volumes.

The concept design referred to the use of a "Type 1" system, including "Infiltrator" units with "Quick-4 High Capacity" Chambers. Other similar proprietary systems (such as ADS ARC 24) shall be considered during the detailed design stage. This may result in minor modifications to trench length and sizing.

The regional groundwater system was not investigated as part of the geotechnical investigation undertaken to evaluate the subsurface conditions at the SUC and the potential drain field sites. However, based on the standpipe piezometers installed at the SUC and the September 19, 2009 monitoring data, the groundwater appears to be flowing in a north to north west direction. Definitive groundwater flow directions cannot be determined without installing more piezometers in and around the general area. It is expected that the groundwater table will generally follow the contours of the land. In the area of the drain field, it is anticipated that movement of water from the base of the drain field will flow radially outward and downward.

As shown in the figures which accompanied the Revision 1 submission, surface water flows radially from the proposed drain field area. Surface water from the start up camp pad will be routed to perimeter ditches, which will discharge into the south ditch of the North Access Road. As shown on Figures 4 and 5, areas beyond the top of the perimeter ditch should drain away from the field, such that additional hydraulic loading is avoided. Some localized grading beyond the top of ditch may be required to achieve this.

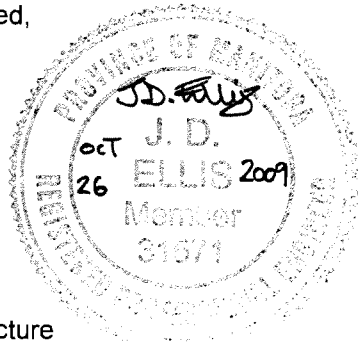
Upon closure of the camp, the wastewater system would be decommissioned in accordance with Guideline 2009-01E – Onsite Wastewater Disposal Field Decommissioning (dated September 2009). It is anticipated that the pipes would be plugged, surface features removed from the site, and that tanks would be removed from the site for future use.

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October 26th, 2009

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Respectfully submitted,



J. D. Ellis, P.Eng
Community Infrastructure
AECOM Canada Ltd.

Encs:

Revised Enclosure 2 from last submission (Laboratory testing data & summary table)

GRAIN SIZE DISTRIBUTION

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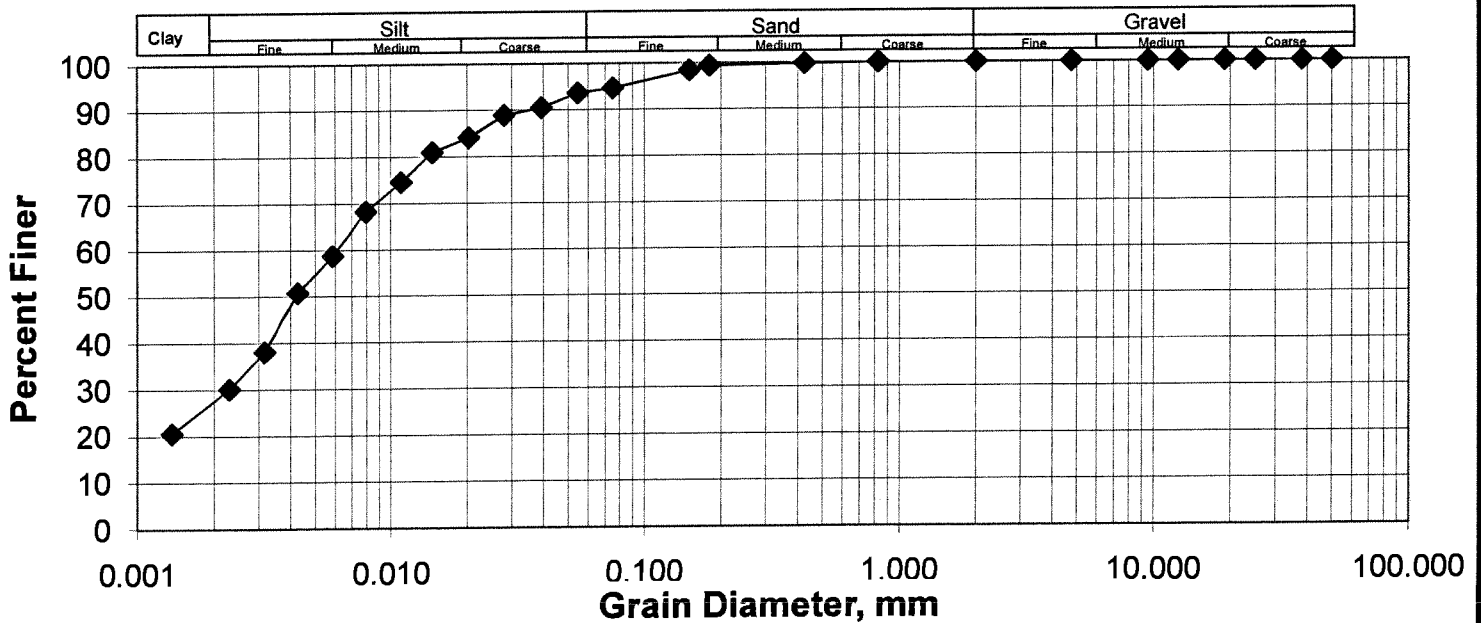
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 AECOM
 1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada
 tel (204) 284-0580 fax (204) 453-3646

Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-02
 Hole No. TH09-13
 Depth: 1.4-1.5 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	94.6
38.0	100.0	0.83	100.0	0.0545	93.6
25.0	100.0	0.43	99.8	0.0392	90.5
19.0	100.0	0.18	99.4	0.0279	88.9
12.5	100.0	0.15	98.4	0.0202	84.1
9.5	100.0	0.075	94.6	0.0145	80.9
4.75	100.0			0.0109	74.6
2.00	100.0			0.0080	68.2
				0.0059	58.7
				0.0043	50.8
				0.0032	38.1
				0.0023	30.1
				0.0014	20.6

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	66.8%
Sand	6.1%	Clay	27.1%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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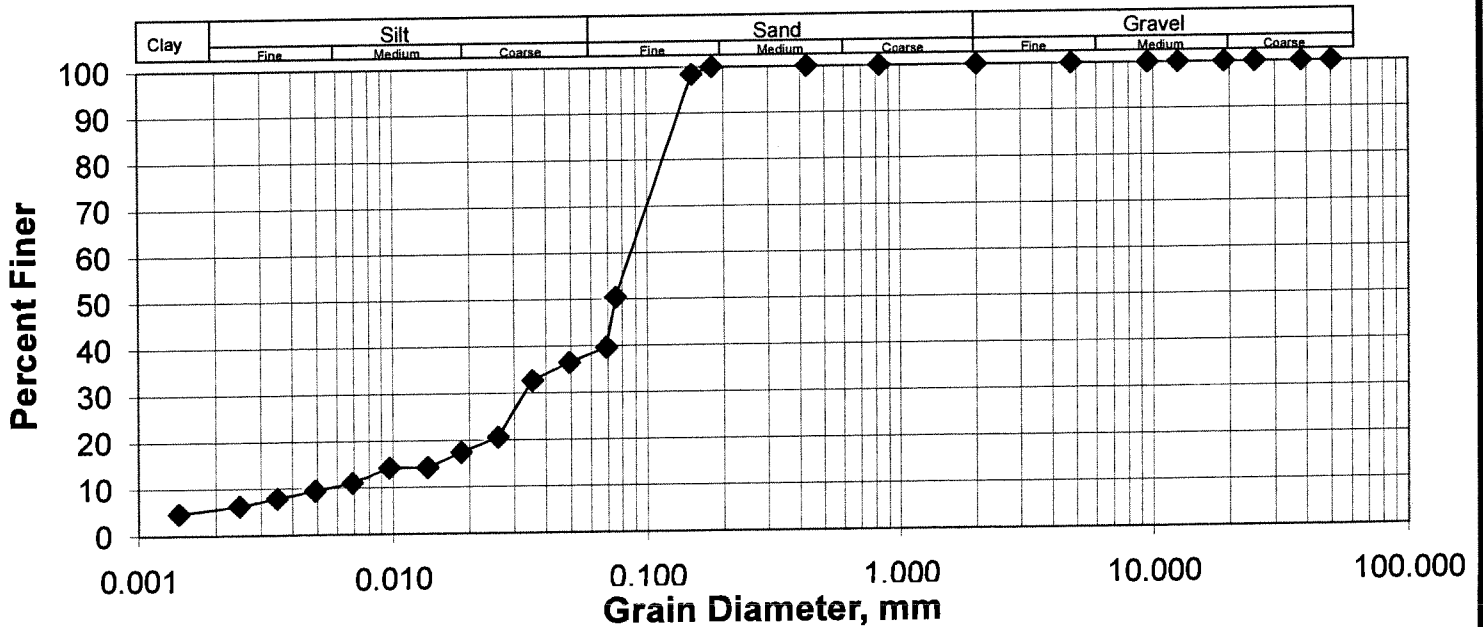
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Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-03
 Hole No. TH09-13
 Depth: 2.2-2.3 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	50.4
38.0	100.0	0.83	100.0	0.0688	39.6
25.0	100.0	0.43	100.0	0.0492	36.5
19.0	100.0	0.18	100.0	0.0352	32.7
12.5	100.0	0.15	98.4	0.0259	20.6
9.5	100.0	0.075	50.4	0.0185	17.4
4.75	100.0			0.0136	14.2
2.00	100.0			0.0096	14.2
				0.0069	11.1
				0.0049	9.5
				0.0035	7.9
				0.0025	6.3
				0.0014	4.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	32.6%
Sand	61.8%	Clay	5.6%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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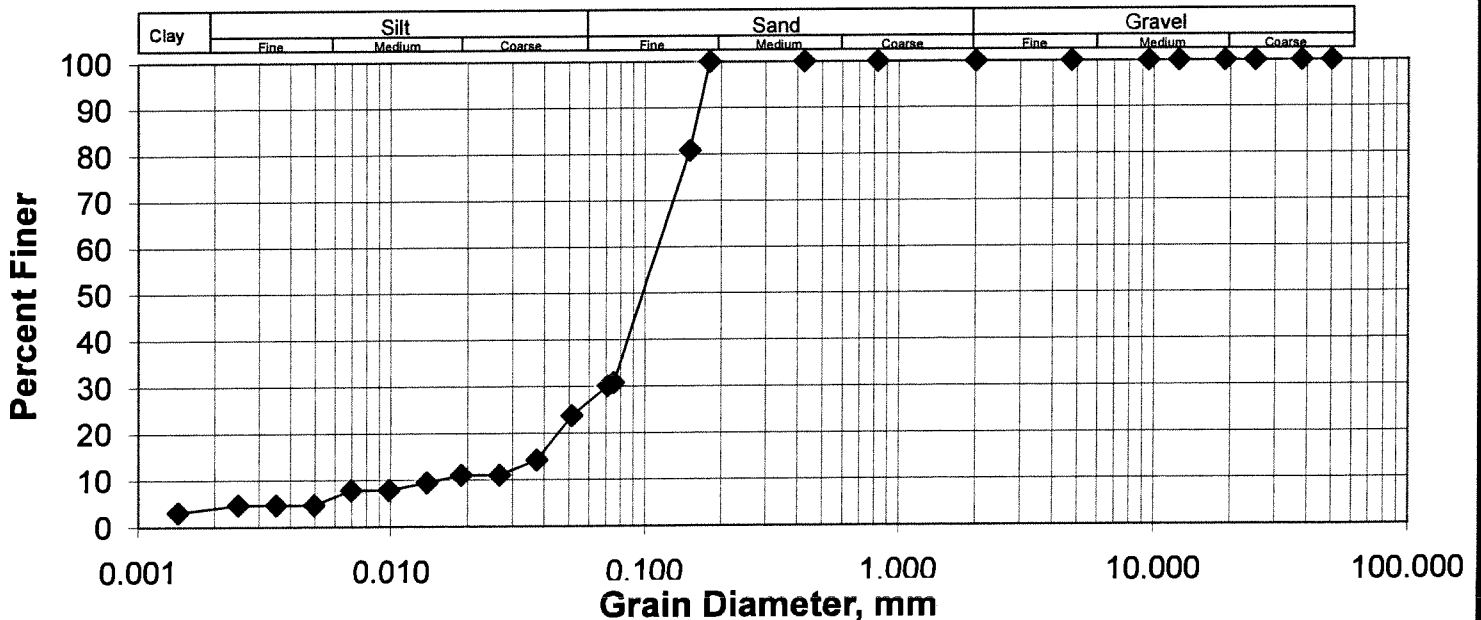
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 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-04
 Hole No. TH09-13
 Depth: 3.0-3.1 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	30.8
38.0	100.0	0.83	100.0	0.0710	30.1
25.0	100.0	0.43	100.0	0.0513	23.8
19.0	100.0	0.18	100.0	0.0373	14.2
12.5	100.0	0.15	80.8	0.0266	11.1
9.5	100.0	0.075	30.8	0.0188	11.1
4.75	100.0			0.0138	9.5
2.00	100.0			0.0098	7.9
				0.0069	7.9
				0.0049	4.7
				0.0035	4.7
				0.0025	4.7
				0.0014	3.1

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	22.6%
Sand	73.4%	Clay	4.0%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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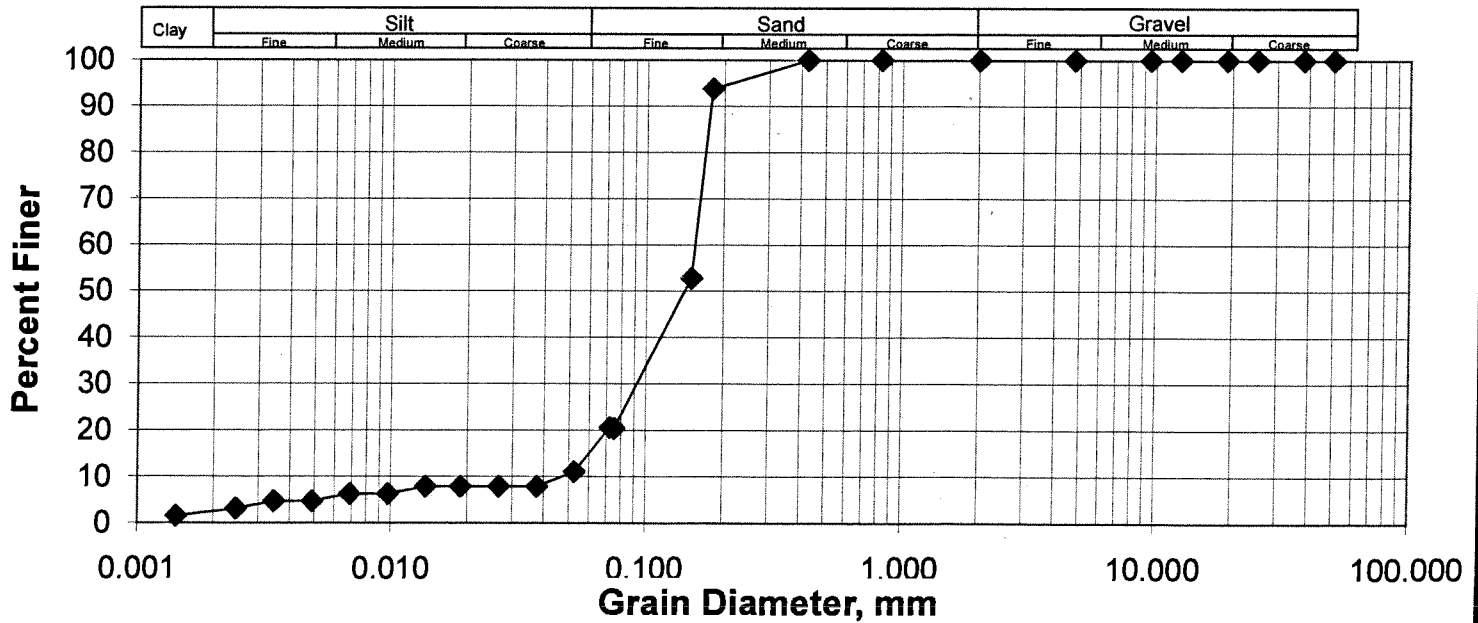
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Job No.: 0217-200-07-03
 Client: Manitoba Hydro
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 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-05
 Hole No. TH09-13
 Depth: 3.7-3.8 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	20.4
38.0	100.0	0.83	100.0	0.0721	20.6
25.0	100.0	0.43	100.0	0.0525	11.1
19.0	100.0	0.18	93.8	0.0374	7.9
12.5	100.0	0.15	52.8	0.0265	7.9
9.5	100.0	0.075	20.4	0.0187	7.9
4.75	100.0			0.0137	7.9
2.00	100.0			0.0097	6.3
				0.0069	6.3
				0.0049	4.7
				0.0034	4.7
				0.0024	3.1
				0.0014	1.5

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	12.3%
Sand	85.3%	Clay	2.4%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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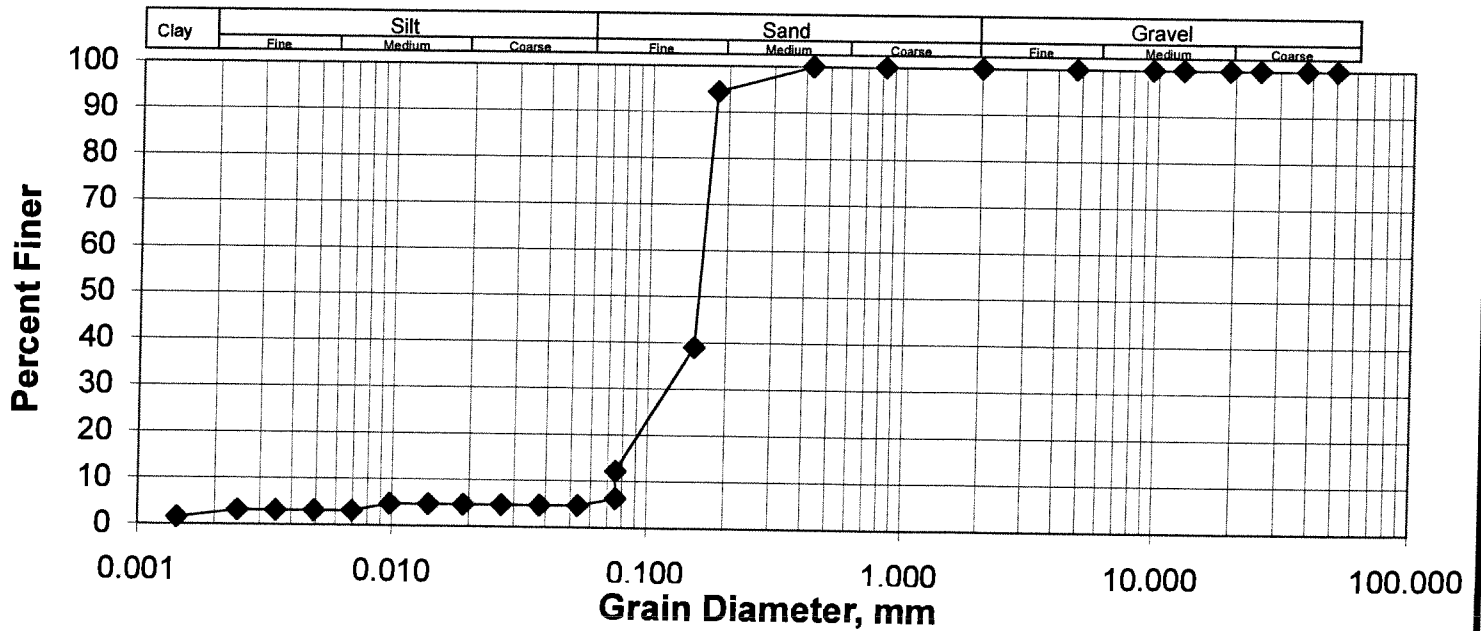
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Job No.: 0217-200-07-03
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 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-06
 Hole No. TH09-13
 Depth: 4.5-4.6 m
 Date Sampled:
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	12.2
38.0	100.0	0.83	100.0	0.0752	6.3
25.0	100.0	0.43	100.0	0.0534	4.7
19.0	100.0	0.18	94.4	0.0378	4.7
12.5	100.0	0.15	39.0	0.0267	4.7
9.5	100.0	0.075	12.2	0.0189	4.7
4.75	100.0			0.0138	4.7
2.00	100.0			0.0098	4.7
				0.0069	3.1
				0.0049	3.1
				0.0035	3.1
				0.0024	3.1
				0.0014	1.5

GRAIN SIZE DISTRIBUTION CURVE



** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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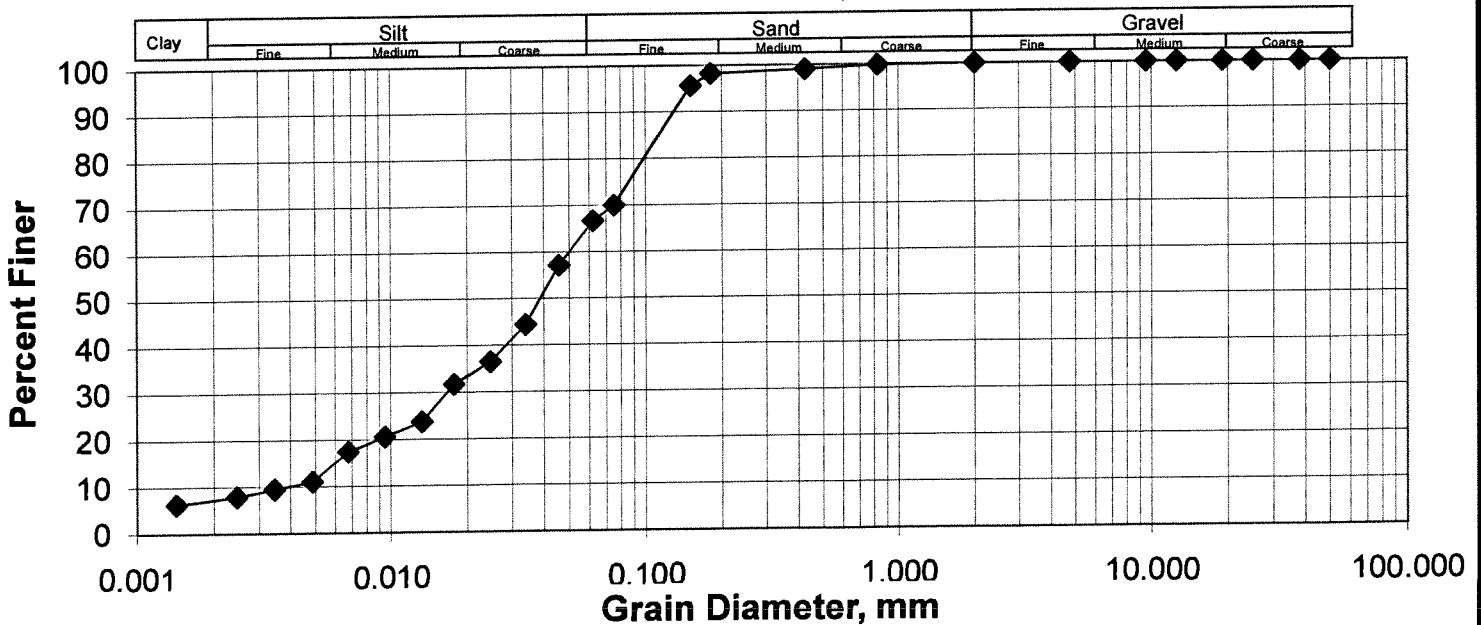
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 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-02
 Hole No. TH09-14
 Depth: 1.4-1.5 m
 Date Sampled:
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	70.0
38.0	100.0	0.83	99.8	0.0620	66.6
25.0	100.0	0.43	99.0	0.0456	57.1
19.0	100.0	0.18	98.2	0.0338	44.4
12.5	100.0	0.15	95.6	0.0246	36.5
9.5	100.0	0.075	70.0	0.0177	31.7
4.75	100.0			0.0132	23.8
2.00	100.0			0.0094	20.6
				0.0067	17.4
				0.0049	11.1
				0.0035	9.5
				0.0025	7.9
				0.0014	6.3

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	58.3%
Sand	34.5%	Clay	7.2%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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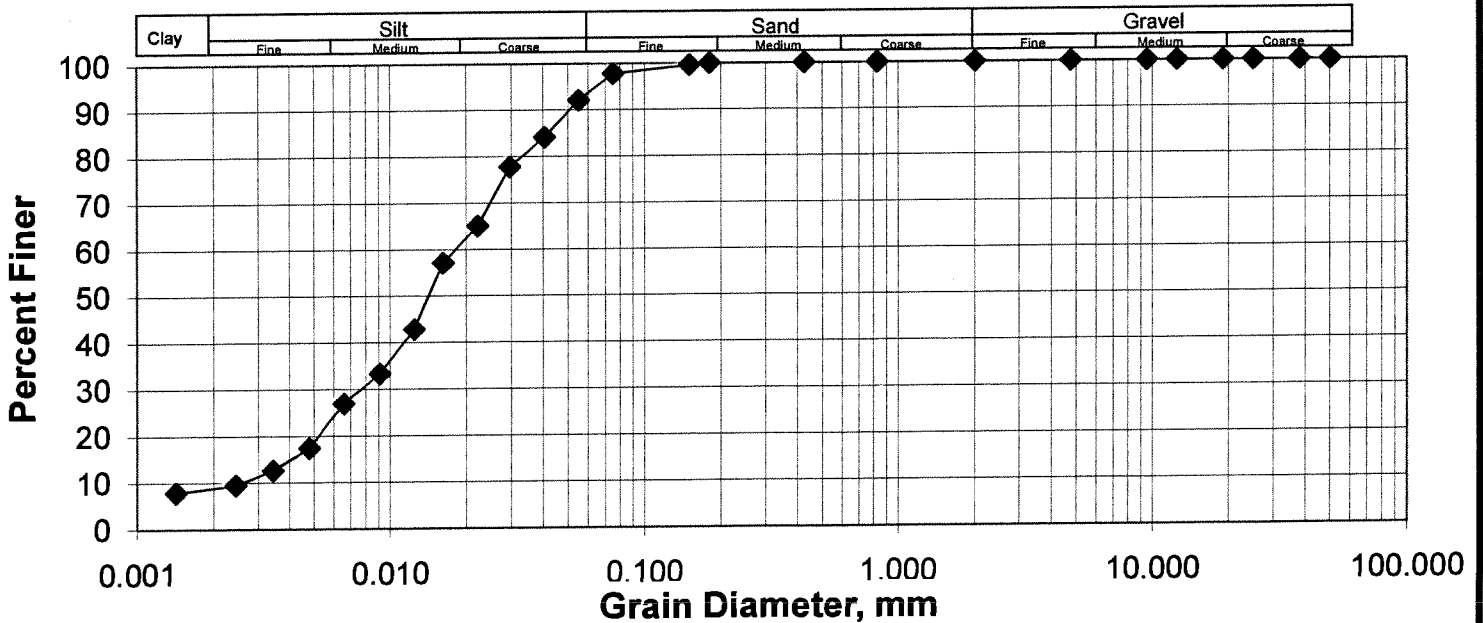
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 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-03
 Hole No. TH09-14
 Depth: 2.2-2.3 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	97.8
38.0	100.0	0.83	100.0	0.0549	92.1
25.0	100.0	0.43	100.0	0.0405	84.1
19.0	100.0	0.18	100.0	0.0295	77.8
12.5	100.0	0.15	99.6	0.0221	65.1
9.5	100.0	0.075	97.8	0.0161	57.1
4.75	100.0			0.0124	42.8
2.00	100.0			0.0091	33.3
				0.0066	26.9
				0.0048	17.4
				0.0034	12.6
				0.0024	9.5
				0.0014	7.9

GRAIN SIZE DISTRIBUTION CURVE



Gravel 0.0% Silt 84.7%
 Sand 6.5% Clay 8.8%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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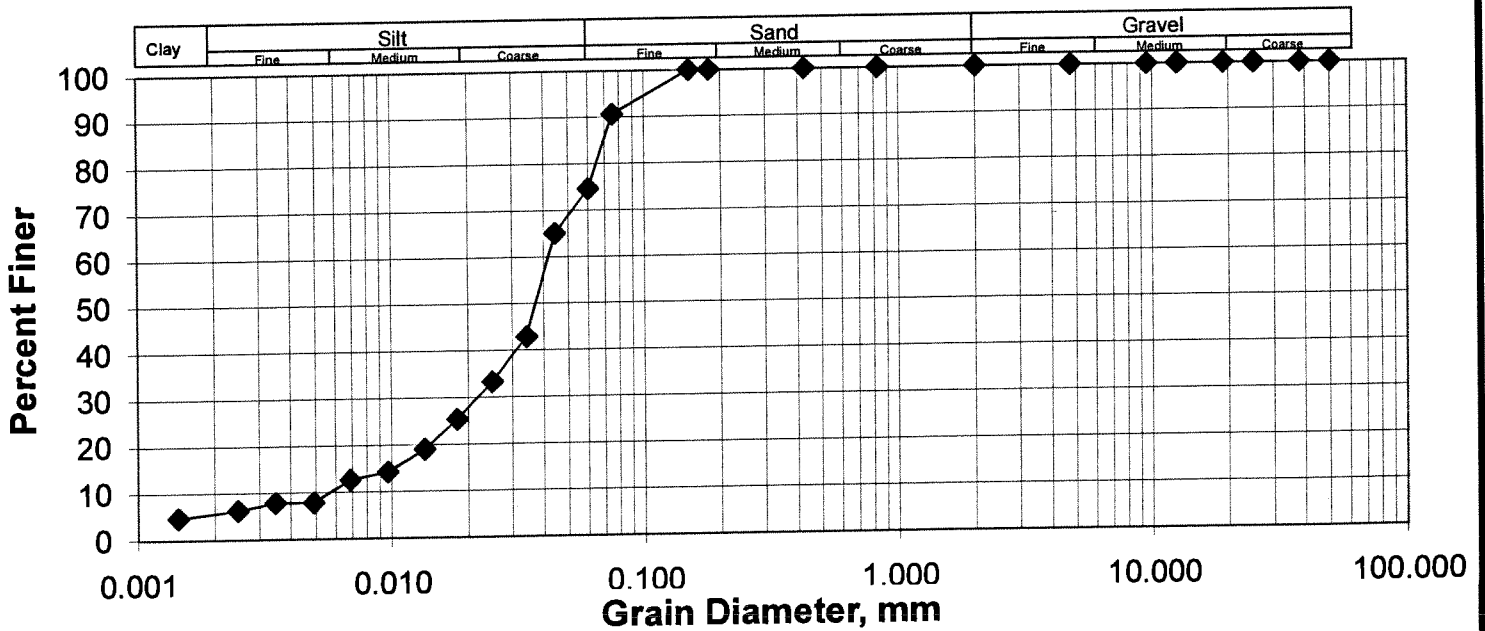
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Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-04
 Hole No. TH09-14
 Depth: 3.0-3.1 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	90.6
38.0	100.0	0.83	100.0	0.0599	74.6
25.0	100.0	0.43	100.0	0.0442	65.1
19.0	100.0	0.18	100.0	0.0340	42.8
12.5	100.0	0.15	100.0	0.0249	33.3
9.5	100.0	0.075	90.6	0.0180	25.3
4.75	100.0			0.0134	19.0
2.00	100.0			0.0096	14.2
				0.0068	12.6
				0.0049	7.9
				0.0035	7.9
				0.0025	6.3
				0.0014	4.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	69.1%
Sand	25.3%	Clay	5.6%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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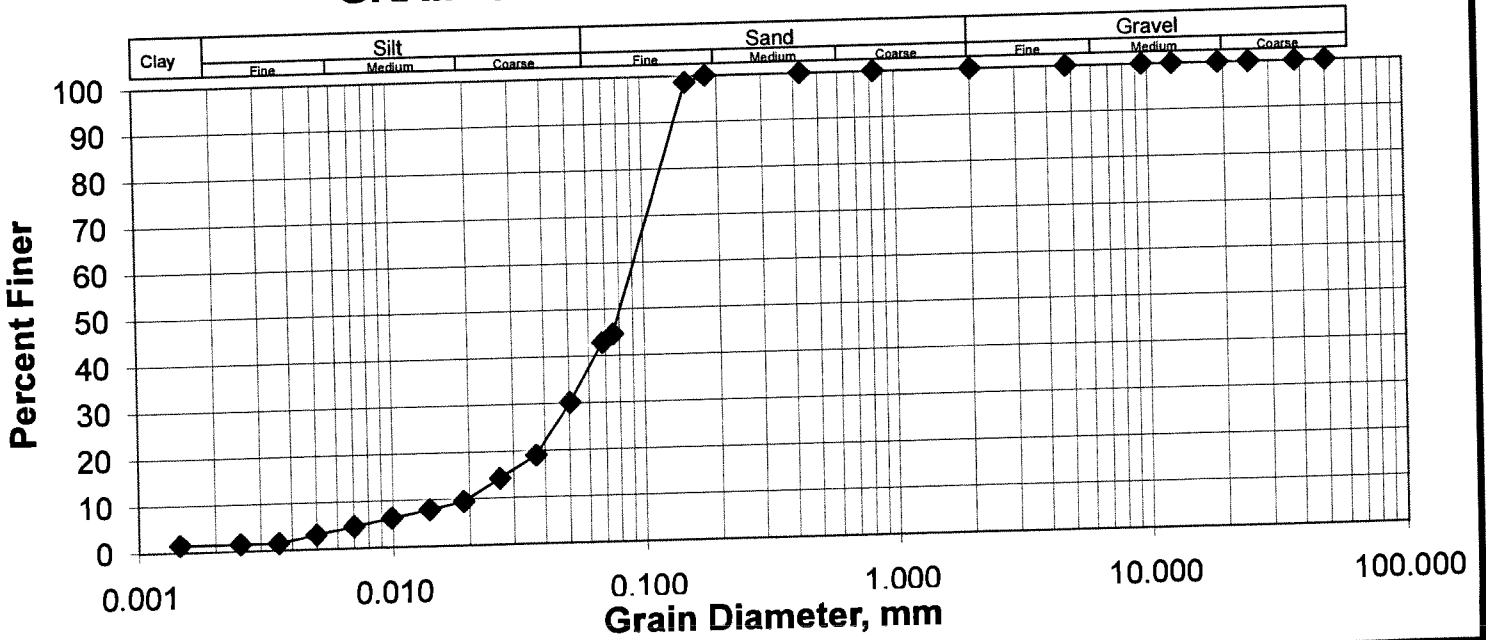
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 Tested By: LK

Sample No. ES-05
 Hole No. TH09-14
 Depth: 3.7-3.8 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	44.6
38.0	100.0	0.83	100.0	0.0680	42.8
25.0	100.0	0.43	100.0	0.0502	30.1
19.0	100.0	0.18	100.0	0.0368	19.0
12.5	100.0	0.15	98.6	0.0264	14.2
9.5	100.0	0.075	44.6	0.0189	9.5
4.75	100.0			0.0139	7.9
2.00	100.0			0.0099	6.3
				0.0070	4.7
				0.0050	3.1
				0.0035	1.5
				0.0025	1.5
				0.0014	1.5

GRAIN SIZE DISTRIBUTION CURVE



Gravel 0.0% Silt 35.6%
 Sand 62.9% Clay 1.5%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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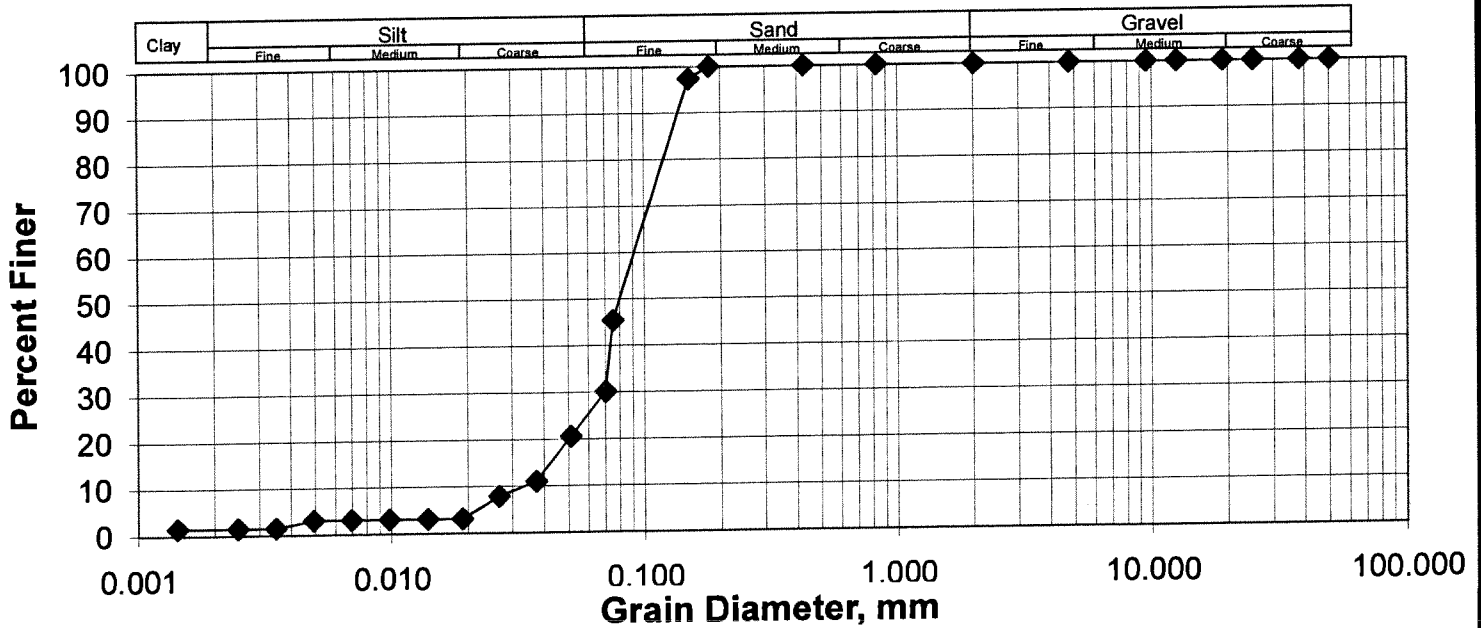
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 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-06
 Hole No. TH09-14
 Depth: 4.5-4.6 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	45.4
38.0	100.0	0.83	100.0	0.0700	30.1
25.0	100.0	0.43	100.0	0.0510	20.6
19.0	100.0	0.18	100.0	0.0371	11.1
12.5	100.0	0.15	97.4	0.0265	7.9
9.5	100.0	0.075	45.4	0.0190	3.1
4.75	100.0			0.0139	3.1
2.00	100.0			0.0098	3.1
				0.0069	3.1
				0.0049	3.1
				0.0035	1.5
				0.0025	1.5
				0.0014	1.5

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	23.6%
Sand	74.9%	Clay	1.5%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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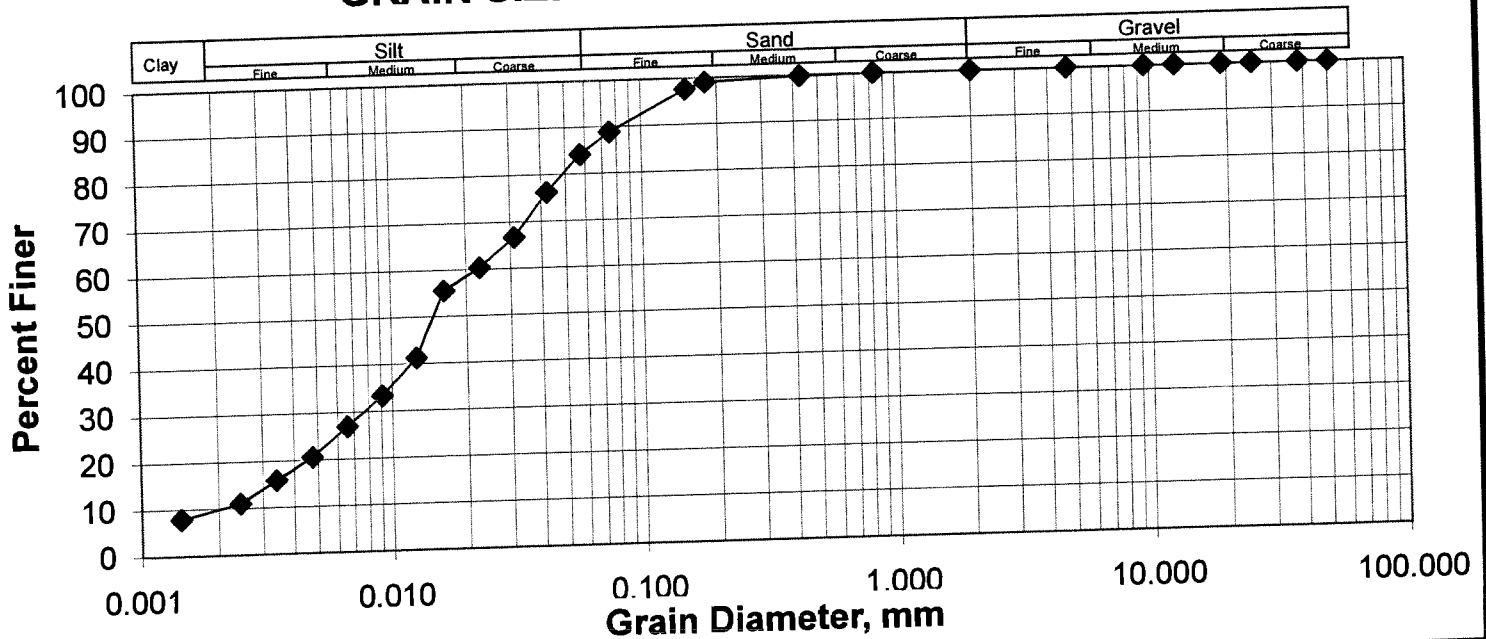
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 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 19-Oct-09
 Tested By: LK

Sample No. ES-02
 Hole No. TH09-15
 Depth: 1.4-1.5 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	88.8
38.0	100.0	0.83	100.0	0.0572	84.1
25.0	100.0	0.43	99.8	0.0421	76.2
19.0	100.0	0.18	99.0	0.0310	66.6
12.5	100.0	0.15	97.6	0.0225	60.3
9.5	100.0	0.075	88.8	0.0162	55.5
4.75	100.0			0.0125	41.2
2.00	100.0			0.0091	33.3
				0.0066	26.9
				0.0047	20.6
				0.0034	15.8
				0.0024	11.1
				0.0014	7.9

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	75.1%
Sand	15.2%	Clay	9.7%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

AECOM

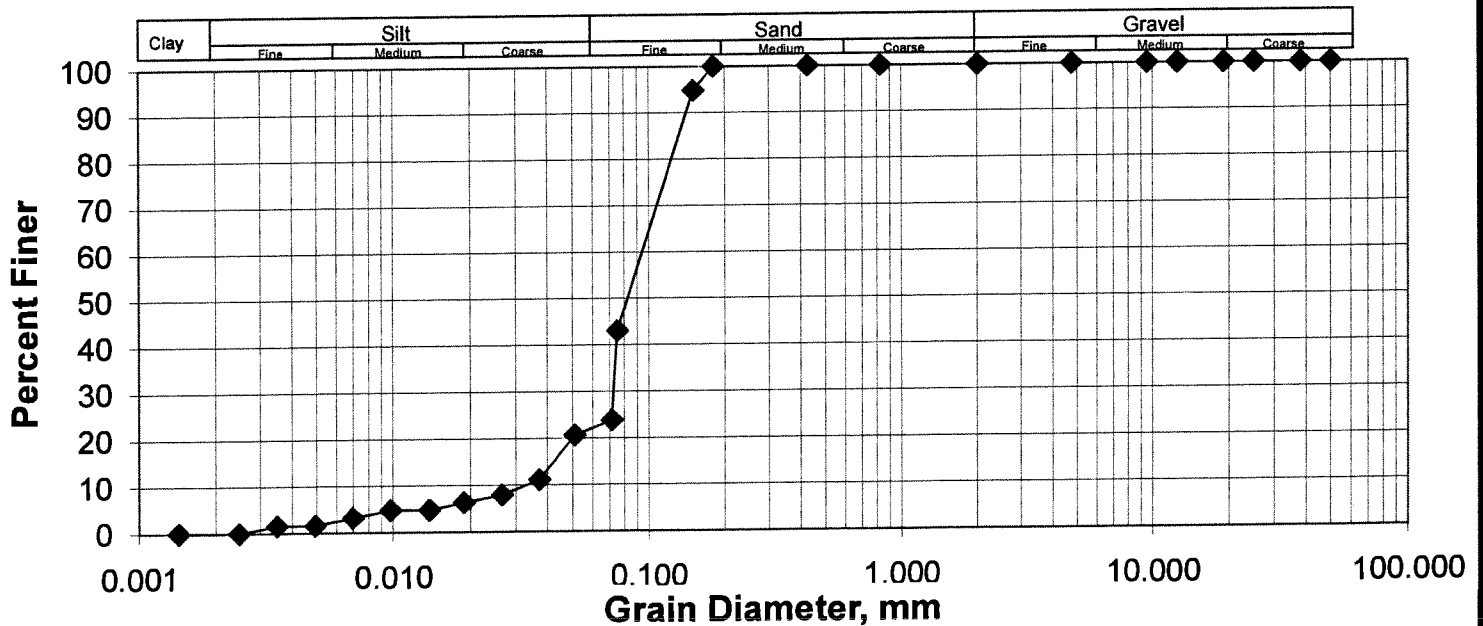
MATERIALS LABORATORY
 AECOM
 1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada
 tel (204) 284-0580 fax (204) 453-3646

Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-03
 Hole No. TH09-15
 Depth: 2.2-2.3 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	43.0
38.0	100.0	0.83	100.0	0.0714	23.8
25.0	100.0	0.43	100.0	0.0510	20.6
19.0	100.0	0.18	100.0	0.0371	11.1
12.5	100.0	0.15	94.8	0.0265	7.9
9.5	100.0	0.075	43.0	0.0188	6.4
4.75	100.0			0.0138	4.8
2.00	100.0			0.0098	4.8
				0.0069	3.2
				0.0049	1.6
				0.0035	1.6
				0.0025	0.0
				0.0014	0.0

GRAIN SIZE DISTRIBUTION CURVE



Gravel 0.0% Silt 22.0%
 Sand 78.0% Clay 0.0%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

AECOM

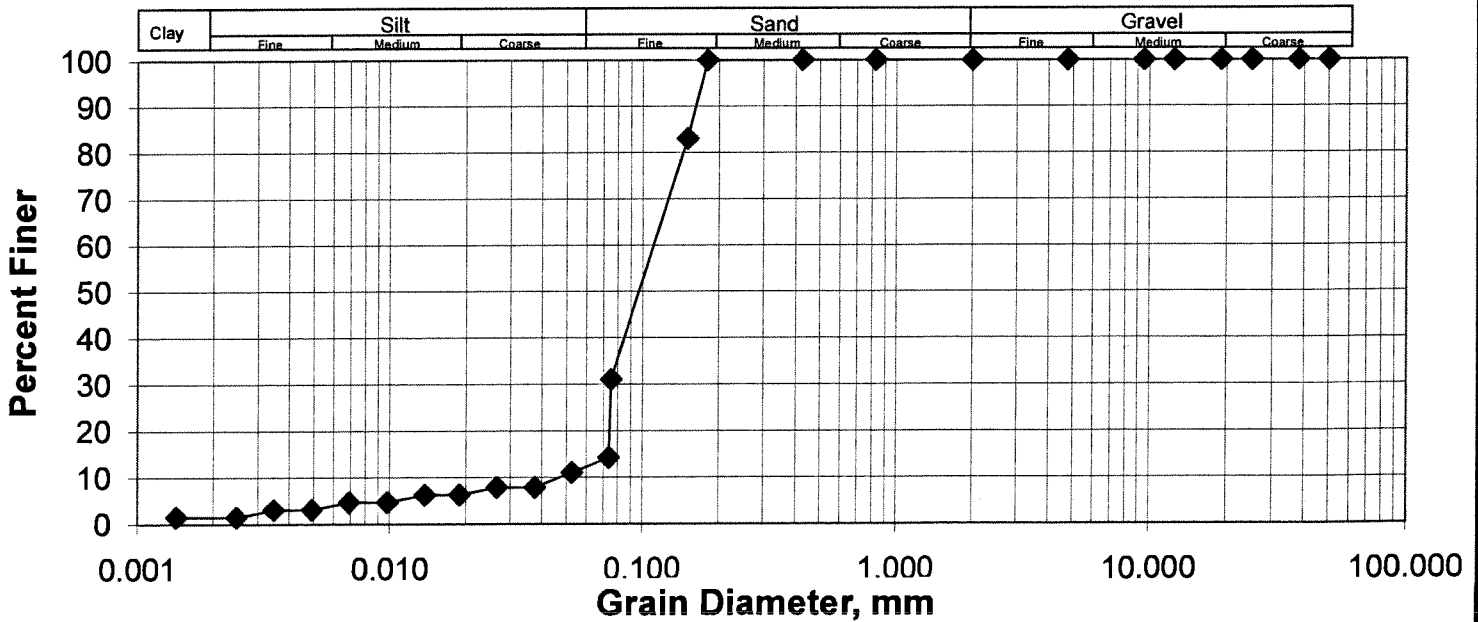
MATERIALS LABORATORY
 AECOM
 1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada
 tel (204) 284-0580 fax (204) 453-3646

Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-04
 Hole No. TH09-15
 Depth: 3.0-3.1 m
 Date Sampled: _____
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	31.0
38.0	100.0	0.83	100.0	0.0735	14.2
25.0	100.0	0.43	100.0	0.0525	11.1
19.0	100.0	0.18	100.0	0.0374	7.9
12.5	100.0	0.15	83.0	0.0265	7.9
9.5	100.0	0.075	31.0	0.0188	6.3
4.75	100.0			0.0137	6.3
2.00	100.0			0.0098	4.7
				0.0069	4.7
				0.0049	3.1
				0.0035	3.1
				0.0025	1.5
				0.0014	1.5

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	10.7%
Sand	87.8%	Clay	1.5%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

AECOM

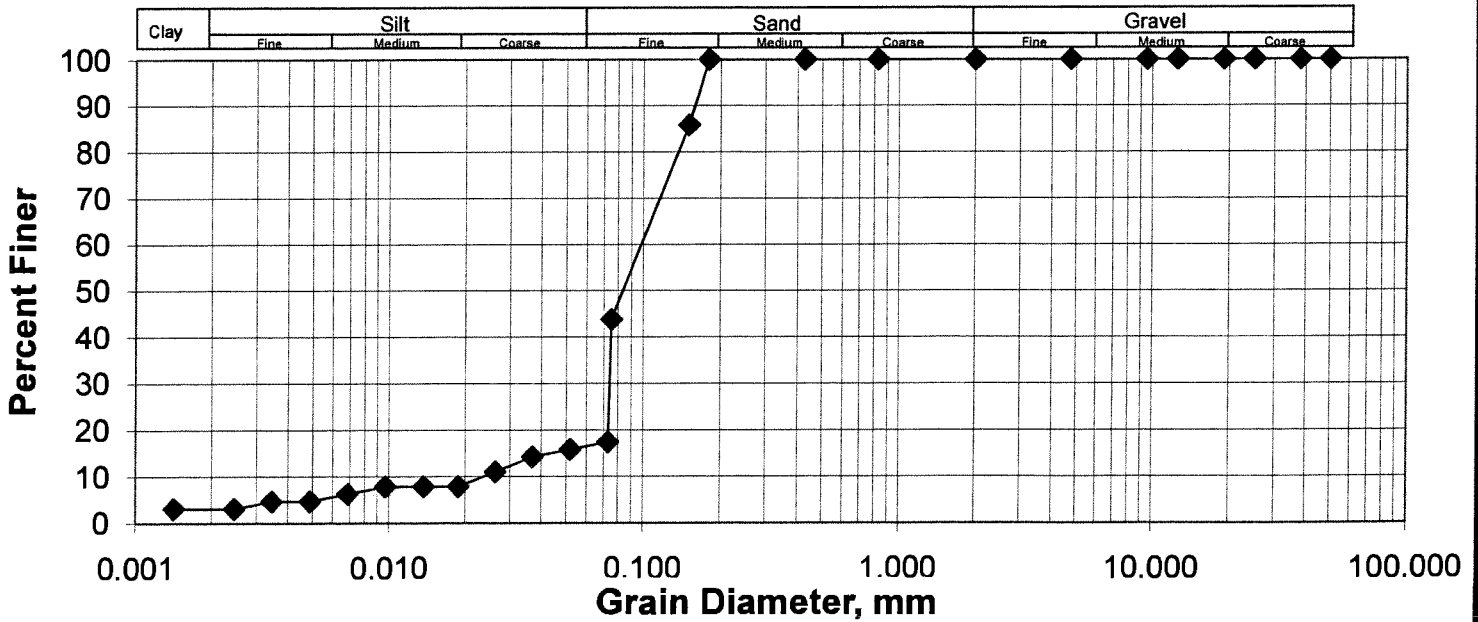
MATERIALS LABORATORY
 AECOM
 1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada
 tel (204) 284-0580 fax (204) 453-3646

Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-05
 Hole No. TH09-15
 Depth: 3.7-3.8 m
 Date Sampled:
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	43.8
38.0	100.0	0.83	100.0	0.0728	17.4
25.0	100.0	0.43	100.0	0.0518	15.8
19.0	100.0	0.18	100.0	0.0368	14.2
12.5	100.0	0.15	85.8	0.0262	11.1
9.5	100.0	0.075	43.8	0.0187	7.9
4.75	100.0			0.0137	7.9
2.00	100.0			0.0097	7.9
				0.0069	6.3
				0.0049	4.7
				0.0034	4.7
				0.0024	3.1
				0.0014	3.1

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	13.3%
Sand	83.6%	Clay	3.1%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

AECOM

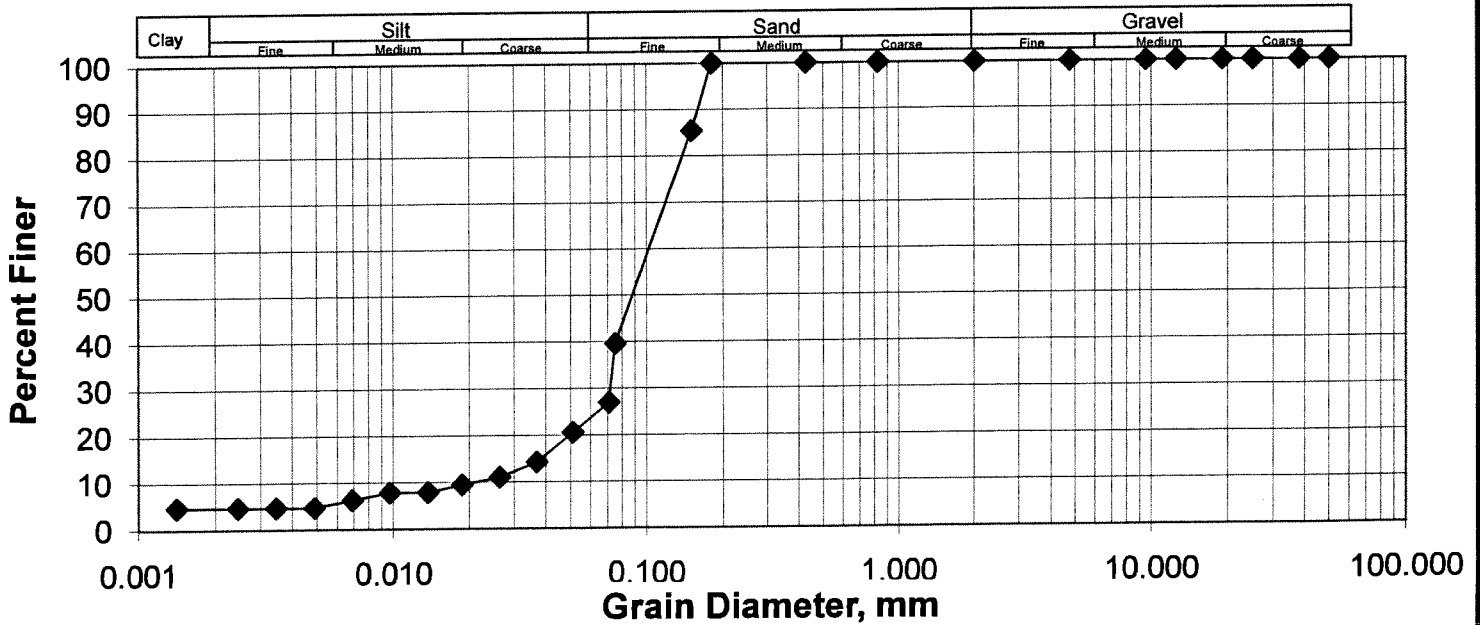
MATERIALS LABORATORY
 AECOM
 1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada
 tel (204) 284-0580 fax (204) 453-3646

Job No.: 0217-200-07-03
 Client: Manitoba Hydro
 Project: Keeyask Generating Station - Infrastructure
 Date Tested: 21-Oct-09
 Tested By: LK

Sample No. ES-06
 Hole No. TH09-15
 Depth: 4.5-4.6 m
 Date Sampled:
 Sampled By: Manitoba Hydro

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	39.6
38.0	100.0	0.83	100.0	0.0707	26.9
25.0	100.0	0.43	100.0	0.0510	20.6
19.0	100.0	0.18	100.0	0.0368	14.2
12.5	100.0	0.15	85.4	0.0262	11.1
9.5	100.0	0.075	39.6	0.0186	9.5
4.75	100.0			0.0137	7.9
2.00	100.0			0.0097	7.9
				0.0069	6.3
				0.0049	4.7
				0.0034	4.7
				0.0024	4.7
				0.0014	4.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	18.8%
Sand	76.5%	Clay	4.7%

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

Job No: 0217-200-07
 Client: Manitoba Hydro
 Title: Summary of samples taken in proposed drain field area
 By/Chkd: JDE/GR
 Date: October 26th, 2009

Gradation Test Results (AECOM)												
TH	Approx Location	Sample #	Depth from	Depth to	Laboratory Description	% Sand	% Silt	% Clay	Ground Level at TH	EL of top of sample	Field base EL (base of trenches)	Diff sample to field base EL (-ve = above)
09-13	75 m West of drain field	ES-01	0.7	0.8	Not tested for gradation, too shallow			-	179.25	178.55	177.00	-1.55
		ES-02	1.4	1.5	Clayey Silt, trace sand	6.1	66.8	27.1		177.85		-0.85
		ES-03	2.2	2.3	Sand and silt, trace clay	61.8	32.6	5.6		177.05		-0.05
		ES-04	3	3.1	Silty sand, trace clay	73.4	22.6	4		176.25		0.75
		ES-05	3.7	3.8	Sand, some silt, trace clay	85.3	12.3	2.4		175.55		1.45
		ES-06	4.5	4.6	Sand, trace silt, trace clay	94.8	2.8	2.4		174.75		2.25
09-14	West end of drain field	ES-01	0.7	0.8	Not tested for gradation, too shallow				179.73	179.03	177.00	-2.03
		ES-02	1.4	1.5	Silt and sand, trace clay	34.5	58.3	7.2		178.33		-1.33
		ES-03	2.2	2.3	Silt, trace fine sand, trace clay	6.5	84.7	8.8		177.53		-0.53
		ES-04	3	3.1	Sandy silt, trace clay	25.3	69.1	5.6		176.73		0.27
		ES-05	3.7	3.8	Sand and silt, trace clay	62.9	35.6	1.5		176.03		0.97
		ES-06	4.5	4.6	Silty sand, trace clay	74.9	23.6	1.5		175.23		1.77
09-15	East end of drain field	ES-01	0.7	0.8	Not tested for gradation, too shallow				179.01	178.31	177.00	-1.31
		ES-02	1.4	1.5	Silt, some sand, trace clay	15.2	75.1	9.7		177.61		-0.61
		ES-03	2.2	2.3	Silty sand	78	22	0		176.81		0.19
		ES-04	3	3.1	Sand, some silt, trace clay	87.8	10.7	1.5		176.01		0.99
		ES-05	3.7	3.8	Sand, some silt, trace clay	83.6	13.3	3.1		175.31		1.69
		ES-06	4.5	4.6	Sand, some silt, trace clay	76.5	18.8	4.7		174.51		2.49