APPENDIX A

PROJECT DESCRIPTION

Appendix A1

Concept Design for Wastewater Disposal

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Technical Memorandum

Date: July 28th, 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**

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

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1) Introduction

This technical memorandum is provided as Appendix A1 to the Environment Act Proposal submission for the Keeyask Infrastructure Project.

The North Access Road Start Up Camp is located at approximately km 177 north on PR280 (refer to Figure 1). The life of the start up camp is anticipated to be 2 to 3 years, with an occupancy ranging between approximately 125 (max) and 50 (min) persons, depending upon construction activities at the time.

2) Site Layout

Facilities at the start up camp will include the following (refer to Figure 2):

- Accommodation units, with washrooms and laundry facilities
- Offices and stores
- Kitchen and Dining Hall
- Fire Truck/Ambulance Garage
- Generator
- Electrified parking stalls
- Water Treatment Plant (WTP) with water storage tanks
- Groundwater well

Furthermore, a gatehouse will also be built to control access to the North Access Road. As the gatehouse will be in service beyond the life of the camp, it is proposed that this building is served by a small pump out tank.

3) Alternatives Considered

At the outset of the design stage, the relative merits of various options for the disposal of wastewater from the start up camp were considered, as shown in the table below. The concept of greywater and blackwater separation was also considered.

Alternative	Description
A0	Black water trucked to Split Lake lagoon (currently overloaded – included for comparison only)
A1	Black water trucked to Split Lake lagoon with upgrades
A2	Truck All Sewage to Split Lake lagoon with upgrades
B1	Black water trucked to Gillam WWTP
B2	All sewage trucked to Gillam WWTP
C1	Black water trucked to Thompson WWTP
C2	All sewage trucked to Thompson WWTP
D	All sewage to on-site mechanical WWTP with drain field
E	All sewage to septic tank with drain field
F	Lagoon with discharge route

The analysis included a comparison of technical issues, potential for disruption (weather/freezing), training requirements, schedule risks and Class D cost estimates.

The preferred option was Alternative E, as it presented the lowest lifecycle cost, low potential for disruption and limited training requirements. As such, a concept design for an engineered drain field was prepared, as shown in the attached calculations.

4) Design Criteria

The principal reference for field design criteria is The Environment Act Regulation 83/2003 "Onsite Wastewater Management Systems".

5) Geotechnical Investigation

The field investigation at the proposed location for the Start Up Camp drain field was completed on July 21 and 22, 2009 by Jared Baldwin, EIT and Geoff Nolette, CET of AECOM. A total of six test holes were drilled at the locations shown on the Test Hole location plan (Figure 2). Test Holes 09-01, 09-02, 09-03 and 09-04 were drilled in the general vicinity of the proposed drain field. Test Holes 09-05 and 09-06 were drilled between the proposed water well and the drain field locations. The test holes were drilled using a 50mm diameter hand auger to depths ranging from 1.4 to 3 m. The test hole depths were limited by drilling conditions such as wet sand or very stiff clay. Representative soil samples were collected and returned to AECOM's Soils Testing Laboratory for further testing.

Standpipe piezometers were installed in Test holes 09-01, 09-02 and 09-04. Water levels were measured in the piezometers and falling head tests were subsequently performed to provide data that can be used to estimate the hydraulic conductivity of the soils. A draft copy of the test hole logs is attached, including the details of the piezometer installations. The logs will be finalized once the soils testing work is completed.

In general, a thin layer of organics (0.15 to 0.35m thick) was encountered at surface and was typically wet. The organics was underlain by clay in all test holes. A layer of sand ranging in thickness from 1.3 to 1.6m was encountered below the clay in Test Holes 09-01, 09-02, 09-04, a thin layer of sand

(0.2m thick) was encountered in Test Hole 09-05. The water levels measured in the piezometers approximately 12 hours after installation were 2.9m, 1.7m and 1.96m for Test Holes 09-01, 09-02 and 09-04, respectively. As such, static water levels closest to the proposed field site, indicated groundwater flow would be towards the north. The design will be progressed further once the falling head test data is reduced and the soils testing results are available.

In summary, it appears that the site may be suitable for the use of a disposal field, possibly with areas of local excavation of the clay layer, and site grading to ensure minimum separation between the base of the system and groundwater table.

Further geotechnical investigation is proposed to take place over summer 2009, to assist in the detailed design of both the wastewater disposal field and the start up camp facilities. This investigation will comprise the use of a drill rig and will include additional percolation tests.

6) Hydraulic Loading

A consumption figure of 320 LPCD has been assumed, based on information collected from Wuskwatim camp between 2008 and 2009. Therefore, the total flow anticipated is 55,000 litres per day (a conservative estimate), which includes both domestic use and backwash from the water treatment plant (estimated at 15%), plus contingency allowance.

7) Organic Loading

Whilst organic loading is not considered in the design criteria, the maximum organic loading is anticipated to be approximately 9.5 kg BOD per day (based on 75g BOD per person per day). It should be noted that wastewater discharge from the kitchen would first pass through a grease trap.

8) Concept Design

The concept for wastewater disposal comprises the use of two prefabricated septic tanks (with sedimentation and control chambers, and an access manhole). Each would be fitted with small submersible pumps (on a duty/standby arrangement) and a forcemain discharging into a disposal field. Sludge would be removed from the septic tank at periodic intervals via vacuum truck, and transported to a licensed facility for disposal. This concept has also been used previously at other Manitoba Hydro facilities, including Radisson and Henday converter stations.

The Regulations refer to 3 types of system, namely;

1. Trench type disposal field (using wastewater effluent chambers)
2. Trench type disposal field (using perforated distribution pipe)
3. Total area field (using either pipe/aggregate or chamber system, either on grade or aboveground)

The choice of system will be refined as further site information becomes available. However, for the purposes of the concept design, a "Type 1" system, comprising "Infiltrator" units with Quick-4 High Capacity Chambers, has been assumed. It is understood from the manufacturer that there are a number of other installations in Manitoba, and similar work camps in Alberta. The use of a chamber style trench disposal field allows for higher flows than with a perforated distribution pipe and aggregate filled trench due to larger surface area and storage capacity.

The multiple trench field would comprise two header pipes, each connected to a series of perforated plastic chambers located in parallel shallow trenches, with a minimum of 2m separation (as shown in Figure 3).

Wastewater shall be discharged into the chambers via small diameter pressure pipe. The pipe may be either suspended via straps or supported on stools within the chamber. An application rate of approximately 11.7 litres/m^2/day has been assumed, which is anticipated to be conservative, based on the geotechnical information gathered to date.

As currently proposed, a distance of approximately 300m separation would be maintained between the discharge field and the groundwater well. This separation shall be further reviewed prior to the commencement of well drilling.

Pipe materials, diameters, orifice sizes and spacing will be confirmed during detailed design. The use of pump controls will also be reviewed during detailed design, to allow alternate dosing of the fields.

Fencing shall be installed around the field to prevent vehicular traffic loading. A method for the control of surface drainage will be considered during detailed design, and may include perimeter ditching to avoid additional hydraulic load being added to the drainage field.

9) Protection from Freezing

Depth of cover, vegetation planting requirements and methods for snow capture will be further reviewed during detailed design. However, it is anticipated that there will always be warm effluent being pumped into the field, which should provide sufficient heat to avoid freezing.

10) Proposed Operation, Maintenance and Monitoring

Features such as inspection ports (to confirm the field is not saturated) and cleanout ports shall be included during the detailed design stage, along with an outline program for O&M and monitoring.

In the event of a system failure, it is anticipated that a trucked system would be initiated, whilst repairs are carried out. The septic tanks will be sized appropriately to accommodate hauling of waste water off site in the case of an emergency.

11) Decommissioning

Upon decommissioning of the wastewater system, it is anticipated that the pipes would be plugged and surface features removed from the site.

Respectfully submitted,

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

PROVINCE OF MANITOBA
J.D.Ellis
J. D.
ELLIS
28 July 2009
Member
31571
REGISTERED PROFESSIONAL ENGINEER

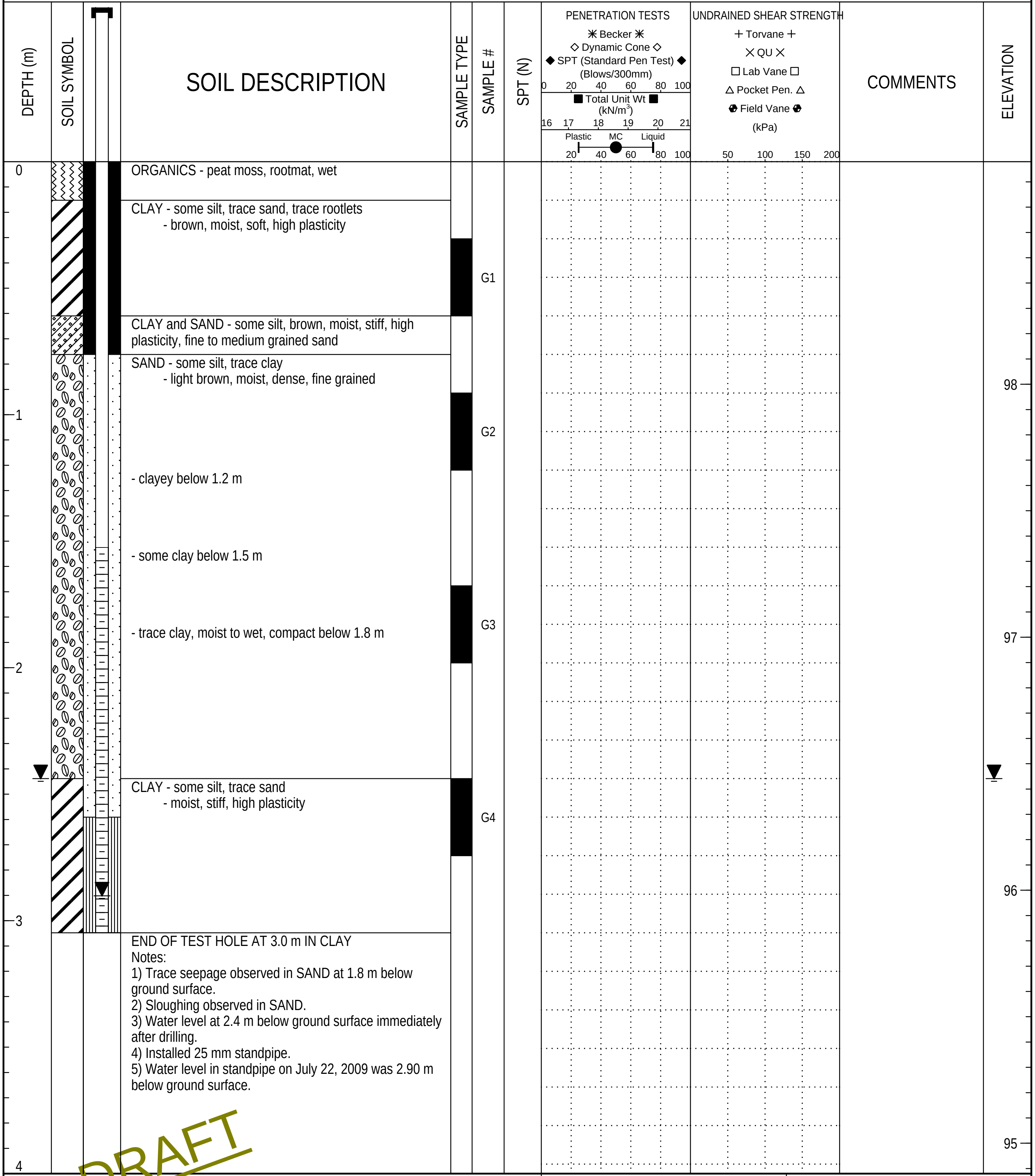
Encs:

1. Test hole logs
2. Calculations
3. Figure 1 – Location Plan
4. Figure 2 – Borehole Location Plan
5. Figure 3 – Proposed Drain Field Layout

PROJECT: Keeyask Generating Station Infrastructure
CLIENT: Manitoba Hydro
TESTHOLE NO: TH-09-01
LOCATION: Start-Up Camp, UTM 15 V, E - 343543, N - 6255132
PROJECT NO.: 0217-200-07
CONTRACTOR:
METHOD: 50 mm Hand Auger
ELEVATION (m): 98.88

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ▨ NO RECOVERY ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁙ GRAVEL ▥ SLOUGH ⁙ GROUT ▨ CUTTINGS ⁙ SAND



SOIL DESCRIPTION

ORGANICS - peat moss, rootmat, wet

CLAY - some silt, trace sand, trace rootlets
- brown, moist, soft, high plasticity

CLAY and SAND - some silt, brown, moist, stiff, high plasticity, fine to medium grained sand

SAND - some silt, trace clay
- light brown, moist, dense, fine grained

- clayey below 1.2 m

- some clay below 1.5 m

- trace clay, moist to wet, compact below 1.8 m

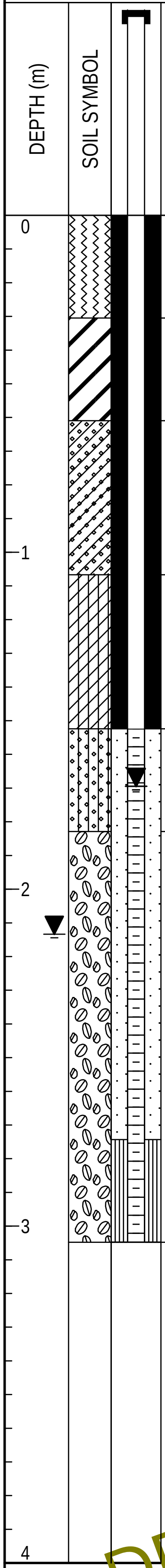
CLAY - some silt, trace sand
- moist, stiff, high plasticity

END OF TEST HOLE AT 3.0 m IN CLAY
Notes:
1) Trace seepage observed in SAND at 1.8 m below ground surface.
2) Sloughing observed in SAND.
3) Water level at 2.4 m below ground surface immediately after drilling.
4) Installed 25 mm standpipe.
5) Water level in standpipe on July 22, 2009 was 2.90 m below ground surface.

LOGGED BY: Jared Baldwin
COMPLETION DEPTH: 3.05 m
REVIEWED BY: Gil Robinson
COMPLETION DATE: 21/7/09
PROJECT ENGINEER: Gil Robinson

PROJECT: Keeyask Generating Station Infrastructure
CLIENT: Manitoba Hydro
TESTHOLE NO: TH-09-02
LOCATION: Start-Up Camp, UTM 15 V, E - 343493, N - 6255034
PROJECT NO.: 0217-200-07
CONTRACTOR:
METHOD: 50 mm Hand Auger
ELEVATION (m): 99.03

SAMPLE TYPE	■ GRAB	▥ SHELBY TUBE	☒ SPLIT SPOON	☰ BULK	◪ NO RECOVERY	▌CORE
BACKFILL TYPE	■ BENTONITE	⁘ GRAVEL	▥ SLOUGH	⁘ GROUT	◪ CUTTINGS	⁘ SAND



SOIL DESCRIPTION

ORGANICS - peat moss, rootmat, wet

CLAY - silty, trace sand, trace organics
- grey, moist, firm, high plasticity

- brown below 0.5 m

CLAY and SAND - silty
- light brown, moist, stiff, high plasticity, fine grained sand

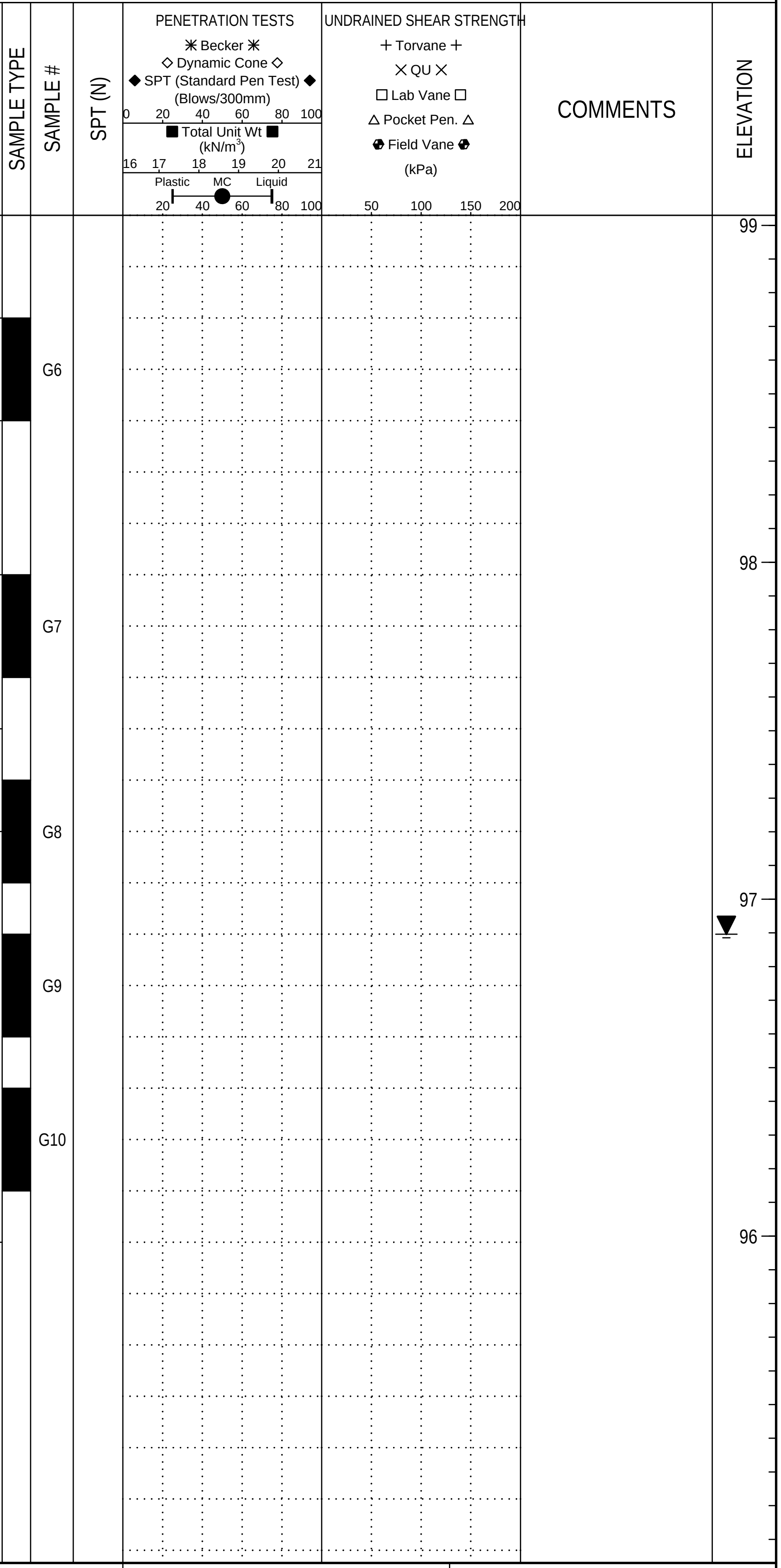
CLAY and SILT - sandy
- light brown, moist, firm to stiff, intermediate to high plasticity

SILT and SAND - clayey
- brown, moist, stiff, intermediate plasticity, fine grained sand

SAND - some clay, some silt
- light brown, moist to wet, compact to dense, fine and medium grained

- trace clay below 2.4 m

END OF TEST HOLE AT 3.0 m IN SAND
Notes:
1) Trace seepage observed in SILT and SAND at 1.5 m below ground surface.
2) Sloughing observed in SAND.
3) Water level at 2.1 m below ground surface immediately after drilling.
4) Installed 25 mm standpipe.
5) Water level in standpipe on July 22, 2009 was 1.69 m below ground surface.



LOGGED BY: Jared Baldwin
REVIEWED BY: Gil Robinson
PROJECT ENGINEER: Gil Robinson
COMPLETION DEPTH: 3.05 m
COMPLETION DATE: 21/7/09

PROJECT: Keeyask Generating Station Infrastructure	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-09-03
LOCATION: Start-Up Camp, UTM 15 V, E - 343491, N - 6254972		PROJECT NO.: 0217-200-07
CONTRACTOR:	METHOD: 50 mm Hand Auger	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▐ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ● Field Vane ● (kPa) 50 100 150 200	COMMENTS	DEPTH
0		ORGANICS - peat moss, rootmat, wet							
		CLAY - silty, some sand - light brown, frozen to 0.9 m							
		- some ice inclusions (<2 mm dia.) between 0.6 and 0.9 m.	■	G11					
1		- moist, firm, intermediate to high plasticity below 0.9 m							1
		- brown, high plasticity below 1.2 m							
			■	G12					
2									2
		- trace silt inclusions (<5 mm dia.), stiff below 2.1 m	■	G13					
			■	G14					
3									3
		END OF TEST HOLE AT 3.0 m IN CLAY Notes: 1) Seepage observed from ORGANICS. 2) No sloughing observed. 3) Water level at 2.1 m below ground surface immediately after drilling from seepage in ORGANICS. 4) Backfilled test hole with auger cuttings.							
4									

LOGGED BY: Jared Baldwin	COMPLETION DEPTH: 3.05 m
REVIEWED BY: Gil Robinson	COMPLETION DATE: 21/7/09
PROJECT ENGINEER: Gil Robinson	Page 1 of 1

LOG OF TEST HOLE DRAFT 0217-200-07 - TEST HOLE LOGS.GPJ UMA WINN.GDT 24/7/09

PROJECT: Keeyask Generating Station Infrastructure
CLIENT: Manitoba Hydro
TESTHOLE NO: TH-09-04
LOCATION: Start-Up Camp, UTM 15 V, E - 343558, N - 6255055
PROJECT NO.: 0217-200-07
CONTRACTOR:
METHOD: 50 mm Hand Auger
ELEVATION (m): 99.33

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◩ NO RECOVERY ▮ CORE
BACKFILL TYPE ■ BENTONITE ⁘ GRAVEL ▥ SLOUGH ⁘ GROUT ◩ CUTTINGS ⁘ SAND

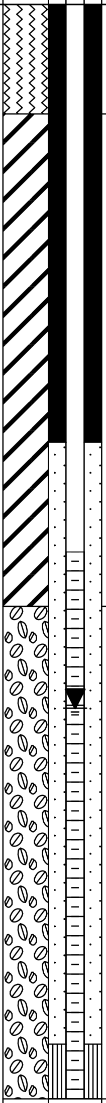
DEPTH (m) | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE # | SPT (N)

PENETRATION TESTS
✳ Becker ✳
◇ Dynamic Cone ◇
◆ SPT (Standard Pen Test) ◆
(Blows/300mm)
0 20 40 60 80 100
■ Total Unit Wt ■
(kN/m^3)
16 17 18 19 20 21
Plastic MC Liquid
20 40 60 80 100

UNDRAINED SHEAR STRENGTH
+ Torvane +
× QU ×
☐ Lab Vane ☐
△ Pocket Pen. △
Field Vane
(kPa)
50 100 150 200

COMMENTS

ELEVATION



DEPTH (m)	SOIL DESCRIPTION	SAMPLE #	ELEVATION
0	ORGANICS - peat moss, rootmat, wet		
	CLAY - silty, trace to some sand - brown, frozen to 1.1 m		99
	- trace ice inclusions (<1 mm dia.) between 0.6 and 1.1 m	G15	
1	- moist, firm, high plasticity below 1.1 m		
	- stiff below 1.4 m	G16	98
	SAND - silty, some clay - light brown, moist to wet, compact to dense, fine grained		
2		G17	
	- clayey below 2.4 m		97
	- some clay below 2.7 m	G18	
3	END OF TEST HOLE AT 3.0 m IN SAND		
			96
4			

Notes:
1) Seepage observed from ORGANICS.
2) Sloughing observed in SAND.
3) Water level at 0.2 m below ground surface immediately after drilling from seepage in ORGANICS.
4) Installed 25 mm standpipe.
5) Water level in standpipe on July 22, 2009 was 1.96 m below ground surface.

AECOM

LOGGED BY: Jared Baldwin
COMPLETION DEPTH: 3.05 m
REVIEWED BY: Gil Robinson
COMPLETION DATE: 21/7/09
PROJECT ENGINEER: Gil Robinson

PROJECT: Keeyask Generating Station Infrastructure
CLIENT: Manitoba Hydro
TESTHOLE NO: TH-09-05
LOCATION: Start-Up Camp, UTM 15 V, E - 343701, N - 6254939
PROJECT NO.: 0217-200-07
CONTRACTOR:
METHOD: 50 mm Hand Auger
ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

PENETRATION TESTS
✳ Becker ✳
◇ Dynamic Cone ◇
◆ SPT (Standard Pen Test) ◆
(Blows/300mm)
0 20 40 60 80 100
■ Total Unit Wt ■
(kN/m^3)
16 17 18 19 20 21
Plastic MC Liquid
20 40 60 80 100

UNDRAINED SHEAR STRENGTH
+ Torvane +
× QU ×
☐ Lab Vane ☐
△ Pocket Pen. △
● Field Vane ●
(kPa)
50 100 150 200

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	DEPTH
0	ORGANICS - peat moss, rootmat, wet					
	CLAY - silty, trace sand, trace rootlets - brown, moist, firm to stiff, high plasticity	■	G19			
	- sandy, soft, intermediate plasticity below 0.9 m					
1		■	G20			1
	- trace sand, very stiff, high plasticity					
	SAND - some silt, trace clay, dry to moist, dense to very dense, fine grained	■	G21			
	CLAY - silty, trace sand, brown, dry to moist, very stiff, high plasticity					
2						2
3						3
4						

END OF TEST HOLE AT 1.7 m IN CLAY
Notes:
1. Hand auger refusal at 1.7 m below ground surface.
2. No seepage or sloughing observed.
3. Backfilled test hole with auger cuttings.

LOGGED BY: Jared Baldwin
REVIEWED BY: Gil Robinson
PROJECT ENGINEER: Gil Robinson
COMPLETION DEPTH: 1.68 m
COMPLETION DATE: 22/7/09

PROJECT: Keeyask Generating Station Infrastructure	CLIENT: Manitoba Hydro	TESTHOLE NO: TH-09-06
LOCATION: Start-Up Camp, UTM 15 V, E - 343616, N - 6254945		PROJECT NO.: 0217-200-07
CONTRACTOR:	METHOD: 50 mm Hand Auger	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ◧ CORE

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + ✕ QU ✕ ☐ Lab Vane ☐ △ Pocket Pen. △ ● Field Vane ● (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	DEPTH
0		ORGANICS - peat moss, rootmat, wet					
		CLAY - silty, trace sand, trace rootlets - brown, moist, firm to stiff, high plasticity					
1		- some sand, soft below 0.9 m					1
		- trace sand, very stiff, high plasticity					
		END OF TEST HOLE AT 1.4 m IN CLAY Notes: 1. Hand auger refusal at 1.4 m below ground surface. 2. No seepage or sloughing observed. 3. Backfilled test hole with auger cuttings.					
2							2
3							3
4							

AECOM

LOGGED BY: Jared Baldwin	COMPLETION DEPTH: 1.52 m
REVIEWED BY: Gil Robinson	COMPLETION DATE: 22/7/09
PROJECT ENGINEER: Gil Robinson	Page 1 of 1

Ref **Notes:** **Output**

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Design Constraints **A1**

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Multiple Trench System (Chamber) **A3**

Total Area Field (Aggregate) **A4**

Total Area Field (Chamber) **A5**

Summary **A6**

Introduction

These calculations are required to determine the required size of a drain field for the Keeyask Generating Station start-up camp.

The drain field will dispose of both grey and septic water from the start-up camp using a two cell septage tank, pump and drain field.

Design Constraints

Ref			
	Camp popluation	125	
	Per capita water consumption	320	LCPD
	Total daily effluent flow (Accounts for WTP Backwash)	55000	L/Day
1	Application rate (Selcted as a "worst case" for sizing)	11.74	L/m^2/Day

References:

1 Enviroment Act (E125 - R.M. 83/2003), Table (Wastewater Effluent Application Rates for Trench-type and Total Area Disposal Fields)

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99 Commerce Drive
Winnipeg, MB R3P OY7
Canada

CLIENT: MANITOBA HYDRO
PROJECT: KEEYASK GENERATING STATION
STARTUP CAMP
PROJECT NO: 0217-200-07

DATE: 7/27/2009
DESIGNED BY: ADAM BRAUN
CHECKED BY: JAMIE ELLIS

Ref	**Notes:**			**Output**
	Trench System using a Traditional Pipe and Aggregate			
	Camp population	125		
	Water consumption	320	LPCD	
	Percent of water discharged through system	100%		
	Daily Volume (Q)	55000	L	
1	Application Rate	11.74	L/m^2/Day	
	(Based on assumption of clay soil in area)			
	Trench Geometry			
2	Trench width (W)	1.00	m	
	(Maximum allowed width)			
3	Trench Depth	1.00	m	
	(Maximum allowed depth)			
4	Height of distribution pipe above trench bottom (H)	0.6	m	
	(1m deep trench - (0.3 m earth cover + 0.1 m stone cover))			
5	Area of trench per linear meter (A)	1.300	m^2/Linear m	
	$\boxed{LengthofTrench = \frac{DailyEffluentFlow}{(ApplicationRate) \times (ApplicationArea)}}$			
	Length of trench required	3603.72	m	
	Field Geometry			
6	Length of laterals	18	m	
	(Maximum length of laterals)			
	# of laterals required	201		
7	Spacing	2	m	
	(Minimum distance between trenches)			
	Total width of field (assume one large area)	601.00	m	
	Total field area	10818.00	m^2	
	References:			
	1 Environment Act (E125 - R.M. 83/2003), Table (Wastewater Effluent Application Rates for Trench-type and Total Area Disposal Fields)			
	2 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(3)			
	3 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(3)			
	4 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(4)			
	5 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(4)			
	6 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(4)			
	7 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(3)			

Ref	**Notes:**			**Output**
	Trench System using a Chamber Design			
	Camp population	125		
	Water consumption	320	LPCD	
	Percent of water discharged through system	100%		
	Daily Volume (Q)	55000	L	
1	Application Rate	11.74	L/m^2/Day	
	(Based on assumption of clay soil in area)			
2	Open Area Multiplier	1.5		
	Trench Geometry			
3	Trench width (W)	0.86	m	
	(Width of Infiltrator Systems Quick4 High Capacity Chambers)			
4	Area of trench per linear meter (A)	1.463	m^2/Linear m	
	(Area of Infiltrator Systems Quick4 High Capacity Chambers)			

$$\boxed{LengthofTrench = \frac{DailyEffluentFlow}{(ApplicationRate)\times(ApplicationArea)\times(OpenAreaMultiplier\,)}}$$

	Length of trench required	2134.81	m	
	Field Geometry			
5	Length of laterals	30	m	
	(Maximum length of laterals)			
	# of laterals required	72		
6	Spacing	2	m	
	(Minimum distance between trenches)			
	Total width of field (assume one large area)	204.21	m	
	Total field area	6126.24	m^2	

References:

1 Environment Act (E125 - R.M. 83/2003), Table (Wastewater Effluent Application Rates for Trench-type and Total Area Disposal Fields)
2 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(5)
3 Design and Installation Manual for Quick4 Chambers in Manitoba, Page 5
4 Design and Installation Manual for Quick4 Chambers in Manitoba, Page 9
5 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(5)
6 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(3)

Ref	**Notes:**			**Output**
	Total Area Field Using Pipe and Aggregate			
	Camp population	125		
	Water consumption	320	LPCD	
	Percent of water discharged through system	100%		
	Daily Volume (Q)	55000	L	
1	Application Rate	11.74	L/m^2/Day	
	(Based on assumption of clay soil in area)			
2	Safety Factor	2		
	(Safety factor for pipe and aggregate systems)			
	$\boxed{AreaofField = \frac{(DailyEffluentFlow)\times(SafetyFactor)}{ApplicationRate}}$			
	Area of field required	9369.68	m^2	
	Field Geometry			
	Assumed width of field	30	m	
	Length of field	312.32	m	

References:

1 Environment Act (E125 - R.M. 83/2003), Table (Wastewater Effluent Application Rates for Trench-type and Total Area Disposal Fields)

2 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(6)

AECOM
99 Commerce Drive
Winnipeg, MB   R3P OY7
Canada

CLIENT: MANITOBA HYDRO
PROJECT: KEEYASK GENERATING STATION
STARTUP CAMP
PROJECT NO: 0217-200-07

DATE: 7/27/2009
DESIGNED BY: ADAM BRAUN
CHECKED BY: JAMIE ELLIS

Ref	**Notes:**			**Output**
	Total Area Field Using a Chamber Design			
	Camp population	125		
	Water consumption	320	LPCD	
	Percent of water discharged through system	100%		
	Daily Volume (Q)	55000	L	
1	Application Rate	11.74	L/m^2/Day	
	(Based on assumption of clay soil in area)			
2	Safety Factor	1.5		
	(Safety factor for chamber systems)			
	$\boxed{AreaofField = \frac{(DailyEffluentFlow)\times(SafetyFactor)}{ApplicationRate}}$			
	Area of field required	7027.26	m^2	
	Field Geometry			
	Assumed width of field	30	m	
	Length of field	234.24	m	

References:
1 Environment Act (E125 - R.M. 83/2003), Table (Wastewater Effluent Application Rates for Trench-type and Total Area Disposal Fields)
2 Environment Act (E125 - R.M. 83/2003), Schedule A, Section 2(6)

Ref **Notes:** **Output**

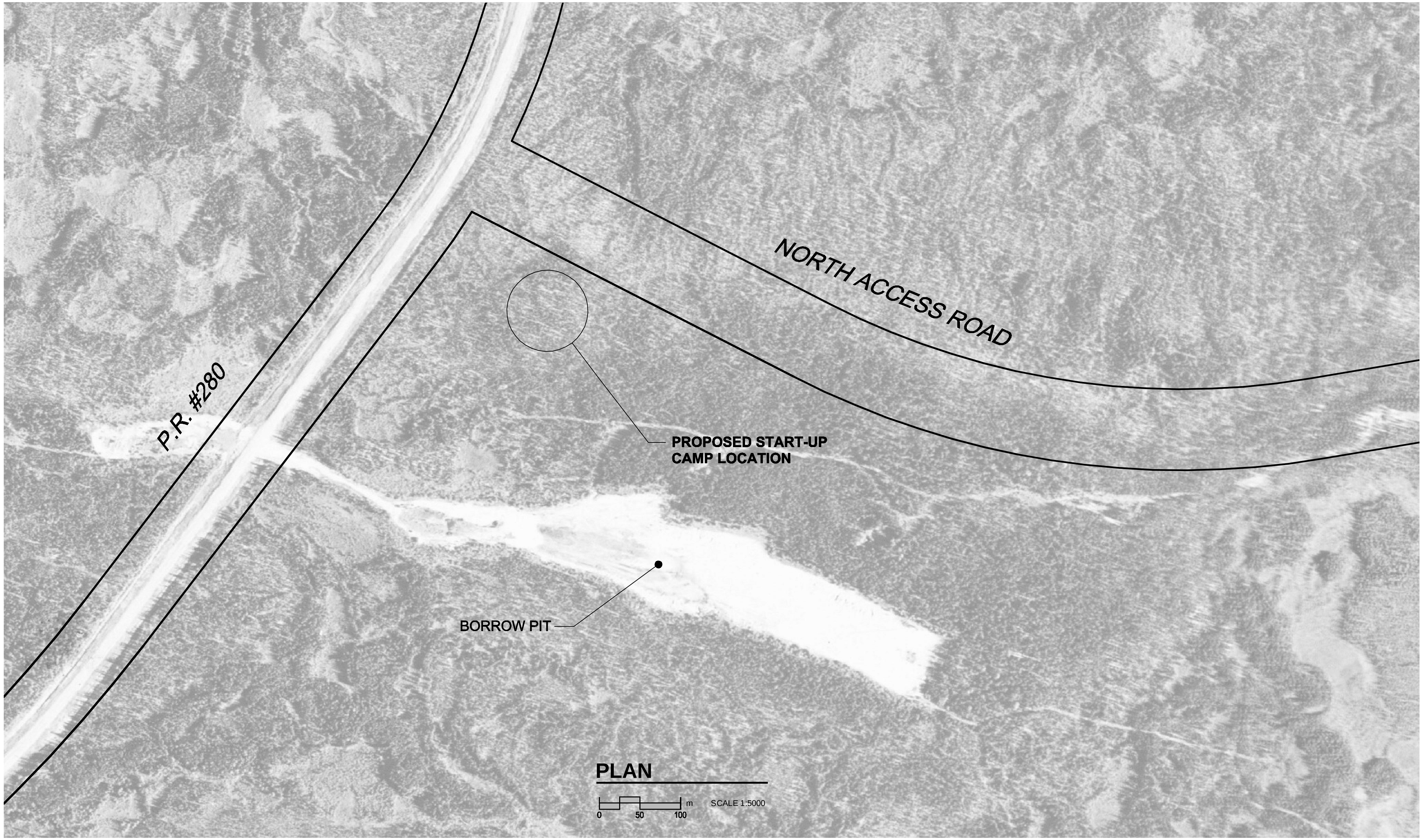
Summary:

Total field areas:

Pipe and aggregate trench system	**10,818**	m^2
Chamber trench system	$\boxed{\mathbf{6,126}}$	m^2
Pipe and aggregate total area field	**9,370**	m^2
Chamber total area field	**7,027**	m^2

Therefore:

Chamber trench system will cover the least amount of total area



Keeyask Generating Station - Infrastructure Eng
North Access Road Startup Camp - 243981-0100

AECOM

LOCATION PLAN
Figure 1

ISS/REV: A
AECOM FILE NAME: 0217-200-07_01-C-F001_RX.dwg   Saved By: berardk   PLOT: 7/27/2009 12:20:27 PM   B SIZE 11" x 17" (279.4mm x 431.8mm)

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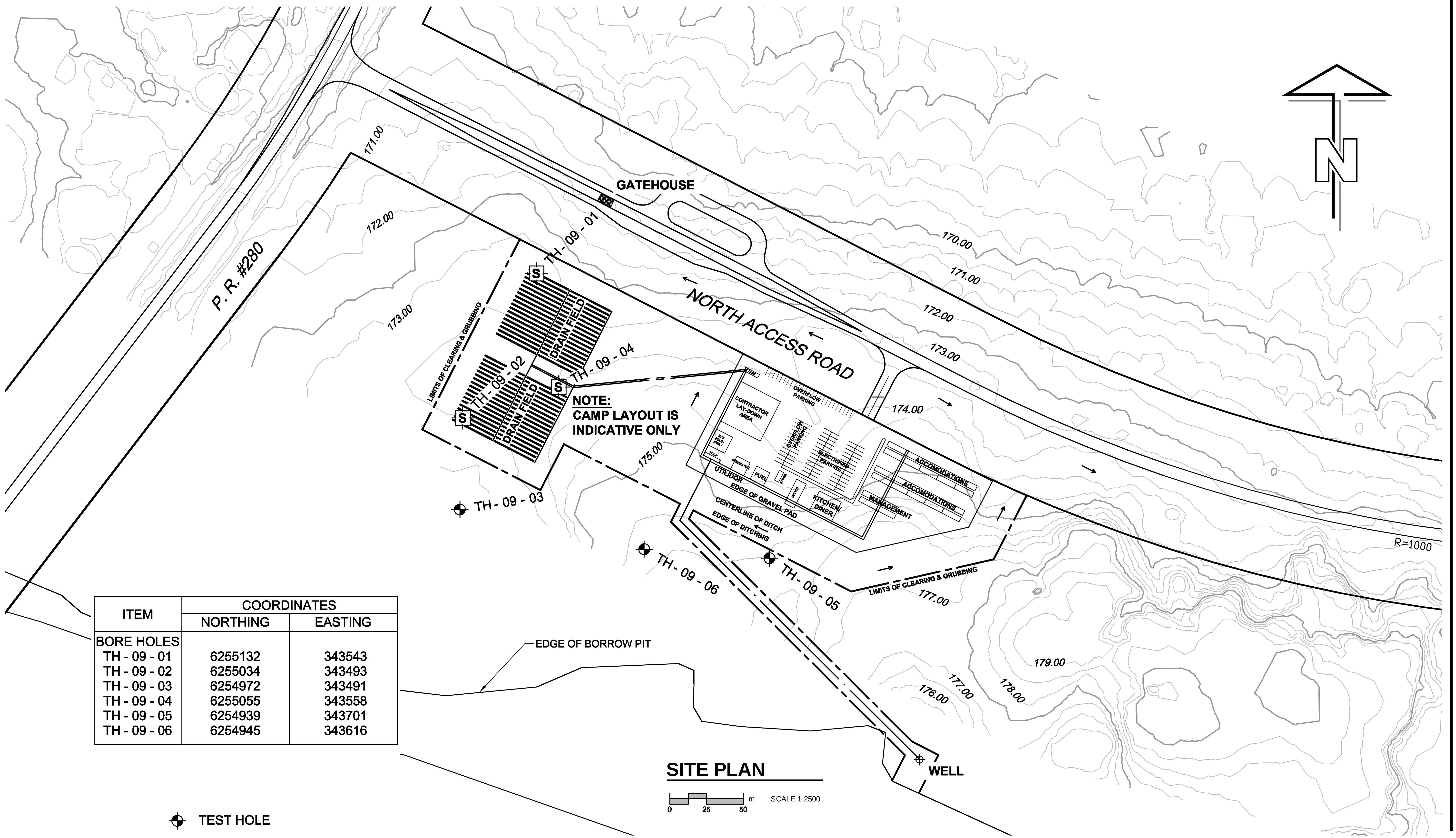

NOTE:
CAMP LAYOUT IS INDICATIVE ONLY

ITEM	COORDINATES	
	NORTHING	EASTING
BORE HOLES		
TH - 09 - 01	6255132	343543
TH - 09 - 02	6255034	343493
TH - 09 - 03	6254972	343491
TH - 09 - 04	6255055	343558
TH - 09 - 05	6254939	343701
TH - 09 - 06	6254945	343616

SITE PLAN

⊕ TEST HOLE

[S] STANDPIPE

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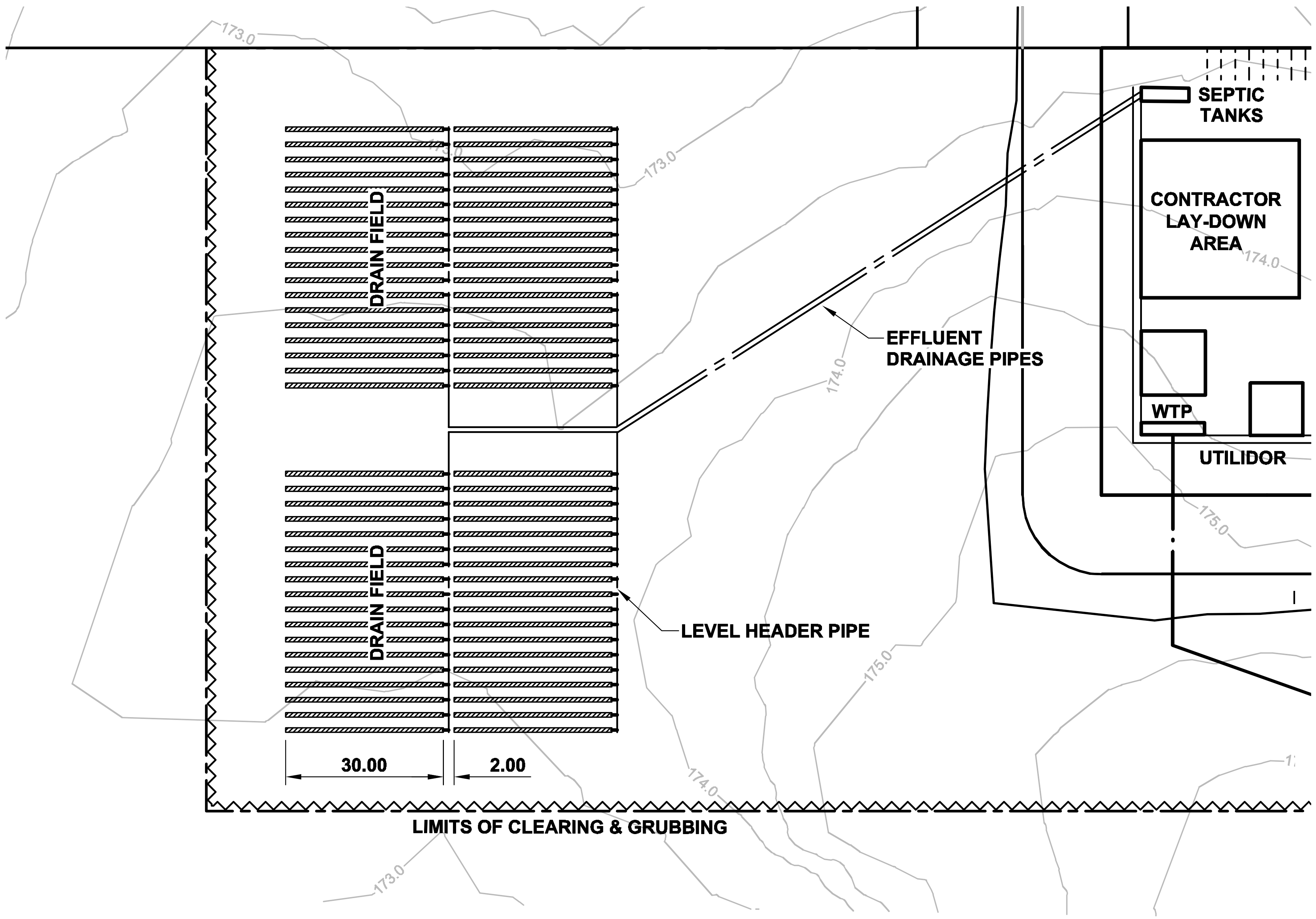
AECOM

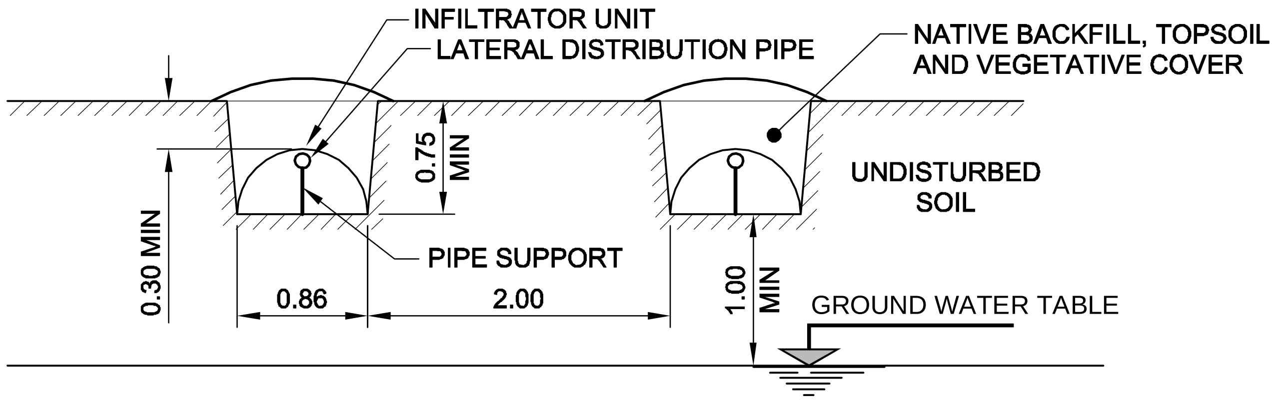
TEST HOLE LOCATION PLAN

Figure 2



PLAN

SCALE 1:1000



TYPICAL SECTION THROUGH FIELD

SCALE 1:50

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PLOT: 7/27/2009 12:29:08 PM

Saved By: berardk

AECOM FILE NAME: 0217-200-07_01-C-F003_RX.dwg

ISS/REV: A

AECOM

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PROPOSED DRAIN FIELD LAYOUT

Figure 3

Appendix A2

Analysis of Alternatives

ROAD

Alignment of the proposed road involved a scoping process from selection of a preferred corridor based on a regional analysis to selection of a preferred alignment within the preferred corridor.

The regional analysis involved gathering information on the physiography, topography, geology, soils, and broad environmental constraints. Technical feasibility, life-cycle costs, distance to borrow sources and environmental factors were used in the analysis. The Gull Esker provided technical and cost benefits for a corridor and appeared to avoid sensitive areas.

Once a preferred corridor was selected, work began on selecting a preferred alignment within the corridor. There will be a 100-m right-of-way (ROW) for the road and the centreline will vary within the 100-m ROW zone. The selection process generally followed five steps.

The first step in this process involved the establishment of the North Access Road Route Selection Committee in July 2005 (described further in Section 4.1.1. of the main report), comprised of members of Manitoba Hydro and their consultants, along with representatives from the local potentially affected First Nation communities of Fox Lake Cree Nation, Tataskweyak Cree Nation, York Factory First Nation, War Lake Cree Nation and Manitoba Infrastructure and Transportation.

The second step involved the assessment of alternative routes based on a benefit/cost analysis and aerial photograph interpretation. In this analysis, two alternatives were developed along a common roadway alignment while a third alternative was developed along a different roadway alignment. Efforts were made to follow an existing winter trail route which already had received some disturbance.

The third step in the process involved field studies to evaluate the alternative alignments. Manitoba Hydro conducted a field program in the winter of 2007-08 for the purpose of collecting data for use in the detailed design stage of the proposed road. The field program involved analyses of the preferred road options using input from technical specialists (including over-flights and ground-based environmental investigations for potential routes) and consultation with the North Access Road Route Selection Committee. In addition, the Committee members were given the opportunity to fly over the proposed route and if necessary, suggest alternative alignments.

The fourth step in the process involved the development of constraint mapping on aspects such as fisheries, heritage resources potential, bird nesting and/or concentration areas, rare or uncommon habitat, wetlands and organic soils with excessive ice, potential bear dens, caribou calving, enduring physical features, etc., as well as maps of local First Nations' sensitivities such as resource harvesting trails and traplines. The output was used to identify environmental sensitivities within the proposed route alignments and to establish mitigation measures and/or alignment adjustments for protection of identified environmental considerations.

An analysis of the constraint mapping allowed for alignment adjustments to avoid sensitive areas. Integrated with the previous analyses, the process enabled the selection of a preferred alignment based on the following factors:

- Minimizing potential adverse effects to the environment;
- Remaining cost-effective and provide good technical potential for a safe route design; and
- Minimizing construction schedule risks.

A final step in the process was a series of public meetings in local First Nation communities (Bird, Gillam and Ilford) to present the road and gather feedback on the preferred route alignment. This is described in Section 4.1.1 of the main text.

The preferred alignment allows for borrow material for the road to be obtained from within the ROW instead of distant borrow pits. There is an existing borrow pit near the junction of PR 280 and the road, which may be used along with material from the G-3 deposit, but overall, material for the road will be taken from within the 100-m ROW.

START-UP CAMP WASTEWATER TREATMENT

As described in the Concept Design (Appendix A1), a range of alternatives was considered for sanitary wastewater disposal at the start-up camp, including hauling black water or sewage to Split Lake, Gillam or Thompson, a mechanical treatment plant, a holding tank with a drain or septic field, and a sewage lagoon. The alternatives were evaluated from monetary and non-monetary aspects, such as potential for disruption (bad weather, freezing conditions) and training requirements.

The wastewater lagoon at Split Lake is already overloaded. Hauling wastewater to Gillam or Thompson presents risk due to inclement weather, would be costly, and consume a large amount of fuel. A mechanical plant would require trained operators and an adsorption field, as there is no adequate receiving stream nearly the site.

A wastewater lagoon would be feasible but is high in cost. The septic tank/field option was identified as the preferred alternative for reasons of cost, relatively low risk, and reliability. Preliminary information on site conditions indicates that the soil is likely suitable for a disposal field and, accordingly, the septic tank/field option is planned. Further geotechnical investigations are underway to confirm the suitability of the soil conditions. In the event that this information does not confirm the appropriateness of this option, the alternatives of a mechanical plant with an adsorption field or hauling of the wastewater to Gillam will be proposed.

START-UP CAMP

The presence of an existing disturbed area near the beginning of the proposed road corridor provided the basis for selecting the start-up camp location. Conditions that favoured this location included distance from PR 280, raised elevation, presence of treed buffer area, proximity to a potential potable water source, and site drainage away from water source. A location away from PR 280, but close enough to allow ready access to this existing road was a major factor in site selection.

MAIN CAMP (PHASE ONE)

The location of the main camp for the proposed Keeyask GS project was determined relative to the location of the GS facilities, and considered access to the site and suitability of site conditions. Distance from the GS site was considered to be a critical factor in location. Favourable conditions also included relatively level land surface, foundation type, site drainage, avoidance of wetlands, proximity of granular sources, potable water supply and waste disposal opportunities.

STREAM CROSSING

Three main alternatives were considered for the crossing at Looking Back Creek. The alternatives included a multi-plate culvert, a bridge with abutments and a clear-span bridge. The preferred alternative was the clear-span bridge due to the minimal risk of adverse effects on fish and fish habitat, despite the comparatively higher cost. The selected crossing location was determined to be more favourable than upstream and downstream locations where the creek was either wider or not confined to a channel. No alternatives were considered for the crossing at the unnamed tributary, due to the low sensitivity of the site.

BORROW AREAS

Borrow areas, including granular sources, in the Local Study Area were identified from previous investigations by Manitoba Hydro along the Nelson River. From among the sources available, borrow areas for road construction, camp development and other infrastructure were selected based on their distance from the construction activity and characteristics of the borrow materials. From among a group that appeared to be economically feasible to use, environmental input was provided to determine sensitivities. In general it was decided to remain within the defined ROW as much as possible.

POTABLE WATER SUPPLY

Potable water supply alternatives for the start-up camp were to haul in water from Gillam or Thompson and to use local well water. Use of a proposed well in the vicinity of the start-up camp was preferred on the basis of cost, supply sustainability and environmental considerations.

Appendix A3

Contracts and Workforce Requirements

Table A.3-1 presents estimated peak Project workforce requirements by quarter and by occupation for the Project. These estimates could change when the Project is implemented depending on how the contractors choose to perform their work.

Table A.3-1 Estimated Keeyask Early Infrastructure Workforce Requirements by Occupations

Item	Labour	2009	2010				2011				2012		Quarterly Peak	Person Year
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2		
	NON-DESIGNATED TRADES (CONSTRUCTION, TRANSPORTATION AND INDUSTRIAL)													
1	Trade Helpers and Construction Labours	**7**	**7**	**7**	**7**	**10**	**8**	**15**	**21**	**18**	**14**	**12**	**21**	**25**
2	Driller / Blaster	**1**	**2**	**2**										**1**
3	Heavy Equipment Operator (excluding Crane Operators)	**8**	**10**	**21**	**21**	**30**	**20**	**22**	**23**	**10**	**5**	**3**	**23**	**35**
4	Teamster	**0**	**3**	**10**	**10**	**15**	**12**	**15**	**16**	**5**	**3**	**1**	**16**	**19**
	DESIGNATED TRADES (CONSTRUCTION, TRANSPORTATION AND INDUSTRIAL)													
5	Crane Operator	**0**	**0**					**1**	**1**	**1**	**1**	**1**	**1**	**1**
6	Mechanic	**1**	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**	**1**	**2**
7	Carpenter	**0**	**0**	**1**	**1**	**1**	**1**	**5**	**6**	**6**	**5**	**4**	**6**	**6**
8	Painter									**2**	**2**	**2**		**1**
9	Cement Mason									**2**		**2**		**1**
10	Roofer								**2**	**2**	**2**		**2**	**1**
11	Insulator								**2**	**2**	**2**		**2**	**1**
12	Iron Worker (excluding Reinforcing Workers)	**0**	**0**											**0**
13	Electrician			**1**	**1**	**1**	**1**	**2**	**4**	**4**	**4**	**3**	**4**	**5**
14	Plumber			**1**	**1**	**1**	**1**	**2**	**3**	**3**	**3**	**3**	**3**	**4**
15	Pipefitter							**2**	**2**	**2**	**2**		**2**	**2**
	CONSTRUCTION SUPPORT AND SERVICE TRADES													
16	Technical (Surveyors and Drafting)							**4**	**4**	**4**	**4**	**2**	**4**	**4**
17	Catering and Janitorial	**0**	**2**	**2**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**19**
18	Security				**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**9**
19	First Aid				**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**9**
20	Employee Retention Support				**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**4**
	CONTRACTOR SUPERVISORY													
21	Project Superintendent	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**4**	**2**	**2**	**1**	**4**	**6**
	MANITOBA HYDRO SITE STAFF													
22	**Manitoba Hydro Site Staff**	**2**	**4**	**8**	**15**	**15**	**15**	**15**	**15**	**15**	**13**	**3**	**15**	**30**
	Infrastructure Project Estimated Workforce	**22**	**33**	**56**	**80**	**98**	**82**	**109**	**126**	**101**	**85**	**60**	**126**	**184**