Geotechnical Survey and Utilities Capacity Study

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EXECUTIVE SUMMARY

The geotechnical investigation was conducted to provide foundation recommendations for a future greenhouse and header house at the Morden Research Centre. A total of eight (8) testholes were drilled on the project site on November 15, 2012. The general soil stratigraphy at the site, as interpreted from the testhole logs, consists of topsoil, silty clay, sand, silt, and clay to the depths explored in the testholes. Based on the soil and groundwater conditions encountered at the testhole locations, timber or precast concrete friction piles could be used to support the structures.

The assessment of the suitability of the existing mechanical infrastructure is limited due to the lack of exact data on the utility requirements of the proposed building and renovations. However, water and sewer appear to be adequate for typical new construction. A limiting factor of the adequacy depends in part on the size and depth of the new building as well as internal process requirements. The natural gas service pressure to the site needs to be increased or a new line from the main to the new building must be installed.

The electrical service to the site appears to be adequate; however, serving power to a new building at the proposed site would require an upgrade to the existing nearby transformer TR#1 or a new dedicated pad mounted transformer be provided. The emergency electrical service to the site appears to be adequate for the current needs. Serving power to a new building at the proposed site would require an upgrade of the existing generator diesel unit or new dedicated diesel generator unit be provided. The incoming telephone services to the facility are sufficient. Additional telephone lines to the new building at the proposed site would have to be coordinated with MTS. The existing fire alarm control panel is a conventional system and has limited zones of initiating devices. Provision of a fire alarm system to the new building would require upgrading the existing fire alarm control panel or a new stand alone addressable panel located in the new building and interconnected to the existing system.

1 PROJECT DESCRIPTION

1.1 General

1.1.1 Services and Scope

Public Works and Government Services Canada (PWGSC) retained the services of Stantec Consulting Ltd., which offered a multi-disciplinary team of specialists required for this project. Services included the provision of a geotechnical report and land topographical and underground surveys in a defined area allocated for a future building. Mechanical and electrical utility service capacity reviews of the site were also required to help determine the possible need for utility and infrastructure upgrades.

1.2 Background Information

AAFC is proposing to design and construct the following:

.1 A new greenhouse / header house

The project is intended to identify action items for site upgrades to allow for the relocation of the Cereal Research Centre in Winnipeg to the Morden Research Centre and to accommodate a laboratory modification to Building #72. The laboratory project will include provisions for new freezers.

2 SITE STUDIES

2.1 Geotechnical Investigation

2.1.1 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted on November 15, 2012 under the supervision of our geotechnical field personnel. Drilling services were provided by Kletke Environmental Drilling Ltd. Eight (8) testholes were drilled to a depth of 10 m at the locations shown on the Testhole Location Plan provided in Appendix B.

Representative soil samples were obtained directly from the auger flights at depths ranging from 0.3 to 1.5 m. The soil samples were visually classified in the field and returned to Stantec's soils laboratory for additional examination and testing. Upon completion of drilling, the testholes were examined for evidence of sloughing and groundwater seepage. A stand pipe was installed in Testhole TH 04 during the geotechnical field investigation. The testholes were backfilled with auger cuttings upon completion of the site investigation.

2.1.2 Laboratory Testing

Water content tests were conducted on the soil samples recovered from the testholes and the results are shown in the testhole logs provided in Appendix C. Selected soil samples were tested for the following:

.1 particle size (ASTM D422)
.2 Atterberg limits (ASTM D4318)
.3 water-soluble sulfate in soil (CSA A23.2-3B)
.4 water-soluble chloride in soil (AAHSTO T291)
.5 pH of soil (ASTM D4972)
.6 standard Proctor (ASTM D698)
.7 California Bearing Ratio (ASTM D1883)

The test results for particle size, Atterberg limits, water-soluble sulfate, water-soluble chloride, pH, standard proctor and CBR are summarized in Tables 1-3.

Table 1 - Particle Size and Atterberg Limits Test Data

Testhole no.	Sample Depth (m)	Soil Type	Particle Size				Atterberg Limits		
			Gravel (%) 75 to 4.75 mm	Sand (%) <4.75 to 0.075 mm	Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index
TH 04	0.8	Silty Clay	0.1	6.9	30.4	62.6	65	23	42
TH 04	2.3	Silty Clay	0	9.7	31.8	58.5	55	23	32
TH 04	4.6	Sand	6.9	75.0	9.1	9.0	nonplastic		

Table 2 - Sulphate Content, Chloride Content, and pH Test Data

Testhole no.	Sample Depth (m)	Soil Type	Water-Soluble Sulphate Content (%)	Water-Soluble Chloride Content (mg/kg)	pH
TH 04	0.3	Silty Clay	0.38	10	7.9
TH 04	3.0	Silty Clay	0.56	11	8.3
TH 04	7.6	Clay	0.07	41	8.7

Table 3 - Standard Proctor and CBR Test Data

Testhole no.	Sample Depth (m)	Soil Type	Maximum Dry Density (kg/m3)	Optimum Moisture Content (%)	CBR Soaked (%)
Composite Sample	0.0 - 0.8	Silty Clay	1477	25.5	2.1

Note: Composite sample obtained from silty clay samples from Testholes TH 01, TH 03, and TH 04.

The laboratory test reports are provided in Appendix D.

2.1.3 Soil Profile

The typical soil stratigraphy at the Morden Research Center site, as interpreted from the testhole logs, consists of topsoil, silty clay, sand, silt and clay to the depths explored in the testholes. Granular fill was found below the topsoil in Testhole TH 06. A description of the soil types is provided below.

.1Topsoil: Topsoil was encountered at the surface of all testholes. The thickness of the topsoil was approximately 0.1 m.

.2 Granular Fill: Granular fill was encountered below the topsoil in Testhole TH 06. The granular fill extended to a depth of 1.2 m. The granular fill was brown, loose, moist and of low plasticity with some clay and trace fine to coarse gravel. The thickness of the granular fill was approximately 1.1 m. Water contents of the granular fill ranged from 7 to 12%.

.3 Silty Clay: Silty clay was typically encountered below the topsoil. The silty clay extended to depths ranging from 1.6 to 3.7 m. The silty clay was black to grey, soft to firm, moist and of high plasticity with trace organics, trace fine sand and trace gravel. Water contents of the silty clay ranged from 19 to 41%.

.4 Sand: Sand was typically encountered below the silty clay. Sand was also encountered below clay in Testhole TH 06. The sand extended to depths ranging from 4.6 to 5.5 m. The sand was tan, loose to dense, and moist, with trace coarse gravel, trace silt and trace clay. Water contents of the sand ranged from 12 to 34%.

.5 Silt: Silt was typically encountered below the sand. The silt extended to depths ranging from 5.9 to 7.0 m. Silt was not encountered in Testhole TH 02. The silt was grey to tan, compact and moist with trace clay. Water contents of the silt ranged from 20 to 29%.

.6 Clay: Clay was typically encountered below the silt. Clay was also encountered below the sand in testhole TH 02. The clay extended to the maximum depths explored in the testholes. The clay was grey, soft to firm, moist and of high plasticity with trace to some silt. Water contents of the clay ranged from 22 to 59%.

2.3 Groundwater

Groundwater conditions were observed immediately after completion of drilling of the testholes. Minor to moderate groundwater seepage and sloughing was observed in the sand layers in the testholes at depths between 3.0 to 4.7 m. All observations of groundwater conditions are shown in the testhole logs provided in Appendix C. It should be noted that only short-term seepage and sloughing conditions were observed in the testholes. Groundwater levels will normally fluctuate during the year and will be dependent on precipitation and surface drainage. Groundwater seepage and soil sloughing should be expected from the sand and silt layer encountered in the testholes during periods of snow melt and heavy precipitation.

A standpipe piezometer was installed in Testhole TH 04 to a depth of 5.6 m and was slotted from 3.0 to 5.6 m. The water level in the standpipe piezometer on November 24, 2012, 9 days after completion of drilling, was 3.1 m below existing grade.

2.4 Geotechnical Considerations

Based on our current understanding of the proposed development and the results of our geotechnical investigation, the primary geotechnical concerns on the project site are:

.1 groundwater seepage and sloughing in the sand layer, and

.2 high volume change potential of high plasticity silty clay soil.

These issues will be discussed in the following section.

2.5 Design Recommendations and Comments

2.5.1 Foundations

Based upon the soil and groundwater conditions encountered at the testhole locations, the proposed greenhouse and header house may be supported on timber or precast concrete friction piles. Other foundation options considered for the proposed greenhouse and header house included shallow footings, cast-in-place concrete friction piles, and precast concrete end-bearing piles. Shallow footings are not considered suitable for this project due to anticipated poor foundation performance related to volume change within the high plasticity silty clay. Cast-in-place concrete piles are not considered suitable for this project due to groundwater seepage and sloughing conditions in the sand layer. Precast concrete end-bearing piles are not considered suitable for this project as refusal depth was not established during our field investigation.

In accordance with the 2010 National Building Code of Canada (NBCC), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS).

The Ultimate Limit States case is primarily concerned with collapse mechanisms for the structure and hence, safety. For foundation design, ultimate limit states consist of:

.1 Exceeding the load-carrying capacity of the foundation
.2 Sliding
.3 Uplift
.4 Large deformation of foundation, leading to an ultimate limit state being induced in the .5 superstructure or building
.5 Overturning, and
.6 Loss of overall stability

The factored resistance at the ULS is the ultimate geotechnical resistance multiplied by the appropriate resistance factor.

The Serviceability Limit States (SLS) case considers mechanisms that restrict or constrain the intended use or occupancy of the structure. They are typically associated with movements that interrupt or hinder the purpose of the structure. For foundation design, serviceability limit states can be categorized as:

.1 Excessive movements, and

.2 Unacceptable vibrations

The SLS case is addressed by determining the maximum available resistance to keep the foundation under service loads within tolerable limits as provided by the structural engineer. Un-factored permanent and transitory loads are used for calculating total deformation in non-cohesive soils. Permanent loads and appropriate portions of transitory loads are used for the initial and time-dependent final deformations of cohesive soils. Therefore, the foundation loads and serviceability tolerances have to be known to properly determine the SLS resistance values. In cases where tolerable movements are not provided by the structural engineer, the tolerable limit of total settlement for foundations subject to compression is assumed to be 25 mm.

2.5.2 Timber Piles

A foundation system suitable to support the proposed lightly-loaded structures is a system of driven timber piles. These units, when driven to a depth of 10 m with a hammer capable of delivering a minimum rated energy of 40 KJ per blow, may be designed based on the factored shaft friction resistance values shown in Table 4.

Table 4 - ULS Design Values for Timber Piles

Depth Range below Grade	Factored Shaft Friction
0 m to 1.5 m	0 kPa
1.5 m to 10 m	increases linearly from 6 kPa at 1.5 m to 24 kPa at 10 m

For friction piles, less than 15 mm of settlement is required to mobilize skin friction and consequently, the SLS case does not govern pile design. Although higher pile capacities will be achieved for pile lengths greater than 10 m, soil conditions below a depth of 10 m were not evaluated during our site investigation. Our office should be contacted if pile lengths greater than 10 m are being considered for the proposed structures. The structural engineer must check the properties of the timber pile and confirm that the structural capacity of the pile is not exceeded.

Due to the presence of silty clay at a shallow depth and the potential for soil drying and shrinkage near the ground surface, the frictional support should be excluded in the calculation of the pile capacity as follows:

.1 For piles inside heated buildings (not perimeter piles), the depth to ignore for frictional support should be the upper 1.5 m below the adjacent ground surface
.2 For perimeter piles, the depth to ignore for frictional support should be the upper 2.5 m below the adjacent ground surface

The contribution from end bearing should be ignored in pile capacity calculations. Pile spacing should not be less than 3 pile diameters, measured center to center. Pile heave for piles within 5 pile diameters should be monitored and redriving done where pile heave occurs. Timber piles are subject to decay above the zone of saturation and must therefore be treated with a wood preservative. Pre-boring to a depth of approximately 2 m should be considered for all driven piles to enhance pile alignment and to limit vibrations for existing structures. The prebored hole diameter should be slightly larger than the nominal pile diameter. All piles should be driven continuously to their required depth once driving is initiated. If pile groups are required for the proposed greenhouse and header house, we should be contacted to review the requirement for a group reduction factor.

A minimum void space of 150 mm should be provided beneath all structural elements to accommodate potential heave of the high plasticity silty clay. To ensure that the piles achieve their design capacities, full time inspection by qualified geotechnical personnel is recommended during pile installation.

2.5.3 Precast Concrete Piles

A foundation system suitable to support the proposed lightly-loaded structures is a system of driven precast concrete friction piles. These units, when driven to a depth of 10 m with a hammer capable of delivering a minimum rated energy of 40 KJ per blow, may be designed based on the factored shaft friction resistance values shown in Table 5.

Table 5 - ULS Design Values for Precast Concrete Piles

Depth Range below Grade	Factored Shaft Friction
0 m to 1.5 m	0
1.5 m to 10 m	increases linearly from 3 kPa at 1.5 m to 13 kPa at 10 m

For friction piles, less than 15 mm of settlement is required to mobilize skin friction and consequently, the SLS case does not govern pile design. Although higher pile capacities will be achieved for pile lengths greater than 10 m, soil conditions below a depth of 10 m were not evaluated during our site investigation. Our office should be contacted if pile lengths greater than 10 m are being considered for the proposed structures.

Due to the presence of silty clay at a shallow depth and the potential for soil drying and shrinkage near the ground surface, the frictional support should be excluded in the calculation of the pile capacity as follows:

.1 For piles inside heated buildings (not perimeter piles), the depth to ignore for frictional support should be the upper 1.5 m below the adjacent ground surface

.2 For perimeter piles, the depth to ignore for frictional support should be the upper 2.5 m below the adjacent ground surface

The contribution from end bearing should be ignored in pile capacity calculations. Pile spacing should not be less than 3 pile diameters, measured center to center. Pile heave for piles within 5 pile diameters should be monitored and redriving done where pile heave occurs. Pre-boring to a depth of approximately 2 m should be considered for all driven piles to enhance pile alignment and to limit vibrations for existing structures. The prebored hole diameter should be slightly larger than the nominal pile diameter. All piles should be driven continuously to their required depth once driving is initiated. If pile groups are required for the proposed greenhouse and header house, we should be contacted to review the requirement for a group reduction factor.

A minimum void space of 150 mm should be provided beneath all structural elements to accommodate potential heave of the high plasticity silty clay. To ensure that the piles achieve their design capacities, full time inspection by qualified geotechnical personnel is recommended during pile installation.

2.5.4 Floor Slab

Due to the presence of high plasticity silty clay at this site, the potential exists for heave of a soil-supported floor slab. Soil moisture contents will typically increase after construction, which causes swelling of clay soils. The magnitude of heave for soil-supported floor slabs is typically in the range of 20 to 50 mm, but can be as high as 100 mm. Heave is generally higher on sites where trees are removed prior

to construction or in areas where leaking water supply or sewer lines or poor drainage lead to increased moisture contents in the silty clay soil after construction. Based upon the soil conditions encountered on the project site, the maximum heave of a soil-supported floor slab is estimated to be in the range of 35 to 50 mm. To minimize potential heave of a soil-supported floor slab, measures must be taken to prevent drying of the subgrade soils during construction. The magnitude of slab heave can be reduced by removal of the high plasticity silty clay soils near the ground surface and replacement with granular fill. Removal of the expansive clay soils to a depth of 0.75 m and replacement with granular fill will reduce the maximum predicted slab heave to 10 to 15 mm. Construction of a soil-supported floor slab should proceed as follows:

.1 Remove topsoil
.2 Proof roll exposed silty clay subgrade to identify areas with low strength soils.
.3 Excavate low strength soils identified during proof rolling and replace with granular sub-base material.
.4 Place and compact granular sub-base, as required, to raise the existing grade to achieve the design elevation for the floor slab
.5 Place and compact granular base course

The minimum thickness of granular base course beneath the concrete floor slab should be 150 mm. All granular fill materials should be placed in 150 mm thick lifts and compacted to at least 100% of Standard Proctor Density.

The granular base and sub-base materials for floor slab construction should comply with the requirements for Manitoba Infrastructure and Transportation Class A and Class C Base Course respectively. The requirements for the granular fill materials are shown in Table 6.

Table 6 - Granular Fill Requirements for Floor Slab

Sieve Size	Base Course	Sub-Base
37.5 mm		100%
25 mm		85 to 100%
19 mm	100%	—
16 mm	80 to 100%	—
4.75 mm	45 to 70%	25 to 80%
2.00 mm	25 to 55%	—
425	15 to 30%	15 to 40%
75	8 to 15%	8 to 18%
Crush content	35% min.	15% min.
Shale content	12% max.	15% max.
LA abrasion	35% max.	40% max.

Sieve analysis and compaction testing of the granular fill material should be conducted to ensure that the materials and compaction comply with the design specifications.

2.5.5 Drainage

All roof downspouts should be directed away from the greenhouse and header house and the ground surface should be graded to promote drainage away from the foundations. Final site grading should ensure that all surface runoff is directed away from the greenhouse and header house using a minimum gradient of 2%. To compensate for potential settlement of backfill materials adjacent to the greenhouse and header house, the grade should be increased to 10% for the first 2 m from the buildings. A clay cap should be provided at the ground surface to minimize water infiltration adjacent to the structures.

2.5.6 Foundation Concrete

Based on the water-soluble sulfate test results, and our experience in Morden, the class of exposure for concrete in contact with clay soil at the Morden Research Centre is considered to be severe (S-2 in CSA A23.1-09 Table 3). The requirements for concrete exposed to severe sulfate attack are provided in Table 7.

Table 7 - Foundation Concrete Requirements

Parameter	Design Requirement
class of exposure	S-2
compressive strength	32 MPa at 56 days
air content	4 to 7%
water-to-cementing materials ratio	0.45 max.
cement	Type HS or HSb

Concrete in contact with native soils should meet the above requirements.

2.5.7 Concrete Sidewalks

Silty clay was typically encountered at a shallow depth in the testholes drilled on the project site. Silty clay is considered to be a highly frost-susceptible soil and therefore, measures must be taken to prevent frost-related movements of exterior slabs at building entrances. Frost heave of exterior concrete slabs in front of building entrances is a common problem in Manitoba. Unprotected sidewalks dowelled into the grade beam often tip up due to rotation around the dowel connection, resulting in cracking of the sidewalk and blocking of entrance doors. Unprotected sidewalks that are not dowelled into the grade beam may heave adjacent to the exterior wall resulting in blocking of entrance doors and crushing of exterior wall facing with insufficient clearance above the exterior slab. The magnitude of heave is dependent upon several factors including the soil type, soil moisture content, climatic conditions, and heat loss from the structure. Due to the many factors that play a role in frost heave, the magnitude of heave is very difficult to predict. Maximum heave in the range of 40 to 60 mm has been observed for exterior concrete slabs at building entrances with similar soil conditions.

The use of a slab warming system is recommended to prevent frost penetration below exterior concrete slabs at building entrances. This system may also be used to melt snow and ice that might otherwise accumulate on the surface of the concrete slab at the building entrances. Other options that may be considered to prevent frost heave of exterior concrete slabs are the use of rigid insulation or construction of a structural slab at the building entrances. The exterior slabs should be sloped away from the building and the exterior slab/building interface should be sealed to prevent seepage of surface runoff into the subgrade soils. In areas where frost protection is not provided, the exterior wall facing should not project beyond the face of the grade beam or there should be adequate clearance to accommodate frost heave of the exterior concrete slab.

2.6 Site Seismic Classification

Table 4.1.8.4.A. in the National Building Code of Canada (NBCC) presents Soil Site Class Definitions based on various criteria, including the shear wave velocity, standard penetration resistance and undrained shear strength. The table provides correlations for Soil Site Classes C, D, and E with various ranges of standard penetration resistance and undrained shear strength to be calculated for the top 30 m of the subsurface materials at a site. Based on our review of the undrained shear strength test data for this project and our knowledge of the soil conditions in the general site vicinity, it is our judgment that the project site can be classified as Soil Site Class E for seismic design considerations. It should be noted that the Province of Manitoba has repealed the seismic classification requirement from the National Building Code and consequently, there is no current requirement to incorporate seismic design into this project.

3 SITE SURVEY

A survey of the site was conducted on November 5th, 2012. The results can be seen on the survey drawing shown in Appendix E1. This site drawing was used to create a mechanical and electrical utility service drawing which can be seen in Appendix E2.

The survey was limited to an area surrounding the proposed location of the new greenhouse building.

From the geophysical survey, the EM data suggests that the "old building foundation" depth is greater than at least 0.5 m below grade and possibly as much as 1.0 m. The foundation width could not be deduced based on the scan data but, a 6-inch wide rectangular outline on the ground surface can be seen. Discussion with the site manager indicate the substructure of the demolished building belonged to an old greenhouse. Also, there is an electrical utility buried near the northwest corner of the building foundation so care should be taken at this location in the event any digging is to occur."

3.1 Mechanical Site Observations

3.1.1 General Information

This section of the report covers the mechanical utilities capacity study portion of the project. It is written in accordance with the terms of reference with the goal of determining the reserve capacity of the Centre and Building #72.

The recommendations pertaining to the suitability of current utilities to the new developments are limited due to the lack of exact data on the utility requirements of the proposed building and renovations. However, water and sewer systems appear to be adequate for new construction depending on the size and depth of the new building. Natural gas services may need to be increased depending on the needs of the building processes, in addition to the building heating requirements.

3.1.2 Sources of Information

Information used to describe and analyze existing systems included the following:

.1 Site Visits/Site Investigations
.2 Information requests
.3 Interviews
.4 Existing drawings

3.1.3 Water

Water supply for the Centre is provided by the City of Morden water utility. From the street, there is an incoming underground 150 mm (6") metered water main serving the fire protection and domestic water systems of the whole compound.

Like the existing system, it is anticipated that the biggest demand on the system will be the fire protection requirements of the new building. There are fire hydrants throughout the compound and there is one just east of the proposed location of a new greenhouse. This hydrant would most likely be served by a 150 mm (6") water main, which would be the recommended connection point for the future building. If this pipe is not 150 mm (6") and the fire protection system of the new building requires this size, there is a 150 mm (6") water main to the north west. It is highly likely that the current water distribution is sufficient for the new building.

With regards to any renovations to Building #72, there is adequate surplus capacity for the renovation. The building's main water service pipe is 150 mm (6"). There is also a current project that eliminates city water use for cooling, which has historically been the largest contributor to water consumption. The renovation as described indicates no major change in water demand, but if there are new substantial water loads, it recommended that the greenhouse/header house be connected to the main water service to make sure that there are no adverse effects on current plumbing fixtures and/or equipment.

There is convenience in having one water meter for the whole center, but it is not optimal where fire protection systems exist downstream of the meter. This type of installation for a water meter is not normally done. The fire protection system does not regularly consume water except for regular testing, leaks and perhaps accidental discharges. The operating cost for those flows does not justify changing the current configuration. However, if fire protection does get used then it does impact the systems. The water meter is substantially undersized (3"or 4"), which may not affect low demand flows but it will affect high demand flows like fire hydrants or standpipe use. Water consumption for the fixtures in the buildings can be seen in Table 8.

Table 8 - Water Fixture Unit (WFU)

Building	Current WFU Load	WFU Capacity Approx.
#50 Public Washrooms	85	90
#6 Special Crop's Office	40	151
#64 Seed Laboratory Bldg. I	53	88
#73 Maintenance shop	40	151
#72 Main Building	340	4000
Research Station	558	5000

With regards to service water, the system pressure is high. Currently, it is around 620 kPA (90 psi). This pressure is good if there is a tall building to supply, when certain equipment requires a higher pressure, or when we have undersized pipes (which is not the case here). When not needed, it does increase the potential for water consumption and increases the likelihood of leaks and breakage.

This high static system pressure is not a guarantee that system pressure is adequate for a fire protection system. If the new building requires a standpipe system it is almost certain that it will require a 150 mm (6") connection (which is available) and a fire pump. Water supply testing and hydraulic calculations of the new building will confirm this.

3.1.4 Storm and Sewer System

There is separate land drainage system for rain water serving the Centre. There will be changes to this system to accommodate the new building connection point or vehicle traffic flow. Putting a building on a grass area will increase run-off. However, the size of the new development is not enough to impact the existing system.

For the waste water system, the Centre is connected to the City's sewer system by a 250 mm (10") sewer pipe. There is a lift station near the front entrance of the Centre using two 850 L/min (225 gpm) submersible pumps. Currently, the estimated peak service water usage for the whole Centre is just over 380 L/min (100 gpm). This estimated peak water usage does not include the use of City water for direct cooling which is assumed to be removed. The difference between the lift station capacity and current peak usage indicates that there is a lot of extra capacity downstream of the system. The current anticipated drain load and system capacities for normal usage are shown in Table 9.

Table 9 - Drainage Fixture Unit (DFU)

Building	Current DFU Load	Approx. DFU Capacity
#50 Public Washrooms	52	700
#6 Special Crop's Office	22	180
#64 Seed Laboratory Bldg.	31	180
#73 Maintenance shop	25	180
#72 Main Building	139	2000
Research Station	269	2500

There is a sewer pipe serving Building #73, which is close to the proposed location of the future building. There appears to be ample depth of the existing sewer line available to tie into this manhole as there are other buildings further upstream connected to this manhole. However, if the new buildings will have a basement with washrooms or other equipment requiring drains, then the available depth should be reviewed further.

With regards to the renovation at Building #72, there is a 250 mm (10") sewer line serving the building with capacity that should be more than enough to handle future renovations.

3.1.5 Natural Gas Distribution

Gas is being distributed throughout the complex by a 50 mm (2”) gas main. There is one gas meter near the entrance gates. An interview with Hydro informed the study of the distribution pressure having been increased to 15 psi in 2009 from 10 psi. The gas pressure is lowered to 5 psi before it enters each building.

Summation of all gas burning equipment in the Centre (Table 10) shows that the current mainline is already carrying the maximum prescribed load. If the system pressure can be raised, the current size may meet the future loads. Hydro will decide if this is possible. Currently, they can’t make the decision until they know how much load will exactly be added. If this is not possible, a new line may be needed from the gas meter to the new building.

Table 10 – Natural Gas Load

Building	Current Load ft^3/h	Current ft^3/h Capacity
#72 Main Building		15,000
Boiler	6,000	
Boiler	6,000	
Boiler 2, 2a	3,000	
Steam Boiler	3,000	
Hot Water tank	400	
#73 Maintenance shop		3,000
Boiler	300	
Hot Water tank	40	
W-bay Heater	100	
Radiant Heater	60	
#64 Seed Laboratory Bldg.		500
Radiant Heater	60	
Radiant Heater	60	
Radiant Heater	60	
Radiant Heater	60	
Dryer	100	
#34 Dryer Bldg.		500
Dryer	100	
Site Estimated Total	19,340	1900

3.2 Electrical Site Observations

3.2.1 Summary

This section of the report covers the electrical utilities capacity study portion of the project. It is written in accordance with the terms of reference with the goal of determining the reserve capacity of the Centre and Building #72.

3.2.2 Sources of Information

Information used to describe and analyze existing systems included the following:

.1 Site Visits/Site Investigations
.2 Information requests
.3 Interviews
.4 Existing drawings

3.2.3 Power Distribution

Normal electrical service:

The electrical service for Morden Research Centre is provided and maintained by Manitoba Hydro through the high voltage line along Route 100.

The electrical service is metered by MB Hydro through a single meter and is located by the utility pole along Route 100. Based on utility data from the facility, for the last twelve months the maximum power consumption of the facility was 275 kW in the month of October 2011.

There are two incoming service entrances from Manitoba Hydro, both located on the west side of the property along Route 100.

After the utilities incoming service demarcation point, all equipment thereafter are customer owned.

The following transformer power consumption estimates are based on the connected building loads as determined from the electrical panels. The first service entrance serves customer transformer TR#1 750 kVA 25KV-347/600V transformer through an underground direct buried 3-1/0 25KV primary conductors and provides power to Buildings 69, 72 and 73. The transformer has a reached its 80% capacity, it has 20% spare left to accommodate another building.

The second service entrance serves customer transformers TR#2 – 300kVA 12470-120/208V; TR#3 – 50kVA 7200-120/208V and TR#4 – 50kVA 7200-120/208V through an underground direct buried 3-1/0KV primary conductors.

Transformer TR#2 provides power to Buildings #38, 39, 64, 67, and 75; TR#3 provides power to Buildings #6, 7, and 33; and TR#4 provides power to previously existing Building #51.

Transformer TR #2 has 20% spare capacity, transformer TR#3 has 20% spare capacity and transformer TR#4 has 100% spare capacity.

All of the customer-owned transformers, complete with their associated primary and secondary conductors, were installed in the year 2003 and appear to be in good condition.

The main distribution panel (MDP) in Building #72 is a 1600A 347/600V 3-phase 4-wire 22kA with a main breaker made by Westinghouse LSIG 1600A 600V 3-phase, and appears to be in good condition.

The panel in Building #72 currently supplies power to Building #73 and crosses the site of the proposed greenhouse/header house as can be seen in Appendix E.

Emergency electrical service:

The existing diesel generator set in the facility, located in Building #72, is 80kW with a system voltage of 600V. The manufacturer is Cummins and it appears to be in good condition. The unit is serving panels E-100, E-200, E-300, E-400, EA, MCC, and maintenance shop. It appears that, from the connected electrical loads based on panel directories, around 60% of the generator capacity has been utilized by these existing electrical panels. The standby unit has a 20% spare capacity for future load.

The existing automatic transfer switch is a Eaton Cutler-Hammer ATH series 600V 3-Phase 150A manufactured in December 2008, has limited expansion capacity and may not meet current code standards.

The generator unit has an existing day tank located in the same room.

3.2.4 Telecommunication

The telephone service in Morden Research Centre is provided by MTS through the pedestal along Route 100. That service has been extended to the facility and terminated in another pedestal located adjacent to transformer TR#1. The existing MTS service lines are routed underground from the pedestal. The cable present in this pedestal is a 50-pair cable and currently 8 are in use.

If required in the proposed new greenhouse and header house, telephone service may be provided through this same pedestal. There is capacity in the pedestal, but pending MTS requirements may have to extend from site entrance demark location or to suit MTS requirements.

AAFC are in the process of upgrading their incoming telephone system with voice over the internet.

Re-route existing underground cables and conduit runs in the area of the new building location.

3.2.5 Fire Alarm System

The existing fire alarm control panel for the facility is located in the electrical room in Building #72. The control panel is a Simplex 4002 conventional system with 28 alarm zones and two spare zones. There is a room to expand the system, however it is very difficult to obtain parts and an expansion most likely will require replacement of the panel.

4 MISCELLANEOUS TEST REPORTS

4.1 Fire Hydrant Test Report

Fire hydrant flow tests were conducted to establish existing water main flow rates and pressure.

Tests were performed by Deblo Industries Ltd. on November 5th, 2012 between the hours of 1:30pm and 3:00pm. The technician used a Hydropro 100 Diffuser flow measuring device manufactured by Pollard Water. The device did not contain a serial number.

The test locations, flow test results, and test equipment information can be seen in Appendix F. Each hydrant was opened for about five minutes to clear the line prior to taking flow measurements. Pressure measurements are recorded in pounds per square inch.

5 LIMITATIONS

5.1 Geotechnical, Mechanical, and Electrical Assessments

Professional judgments and recommendations are presented in this report. They are based on an evaluation of the technical information gathered during the site investigation. We do not guarantee the performance of the project in any respect other than that our engineering work and judgment rendered meet the standards and care of our profession.

Geotechnical testholes and associated test results may not represent potentially unfavourable subsurface conditions between the testholes. If during construction soil conditions are encountered that vary from those discussed in this report, we should be notified immediately in order that we may evaluate the impact, if any, on the recommendations provided in this report. The recommendations presented in this report are applicable only to this specific site. The data herein should not be used for other purposes.

The mechanical capacity assessments are limited to typical building construction and cannot guarantee adequate capacity for all possibilities. The designers of new buildings on site must exercise professional judgment based on the type and size of building to be constructed.

The electrical assessments comment on capacity but do not guarantee the quality of power.

APPENDIX A

SITE PHOTOGRAPHS

Photo 1 - Project site looking north from southwest corner

Photo 2 - Project site looking southwest from northeast corner

Photo 3 - Standpipe piezometer installed in Testhole TH 04

Photo 4 - Drilling Testhole TH 08

Photo 5 - Electrical main service entrance

Photo – 6 Telephone main service entrance

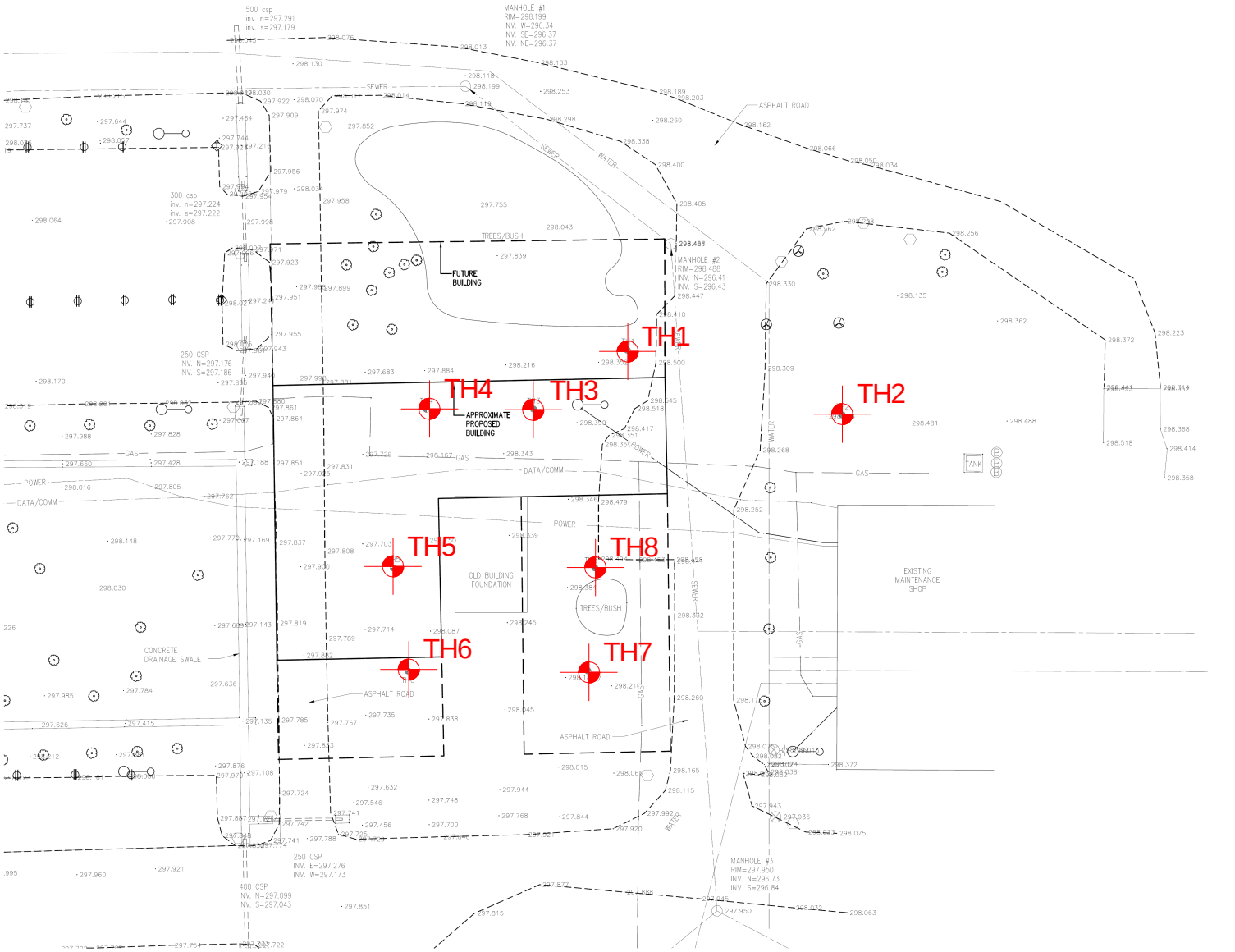
Photo – 7 Transformer TR#1 – 750Kva 12470-347/600V

Photo – 8 Transformer TR#2 – 300Kva 12470-347/600V

Photo – 9 Transformer TR#4 – 50Kva 7200-347/600V (Identical to transformer TR#3)

APPENDIX B

TESTHOLE LOCATION PLAN



THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project No. STA-1259	Drawn by: SB	Figure: 1	Testhole Location Plan Morden Research Centre Morden, Manitoba
Date: Feb. 26, 2013	Reviewed by: AP	Scale: NTS	

APPENDIX C

TESTHOLE LOGS AND CBR REPORT

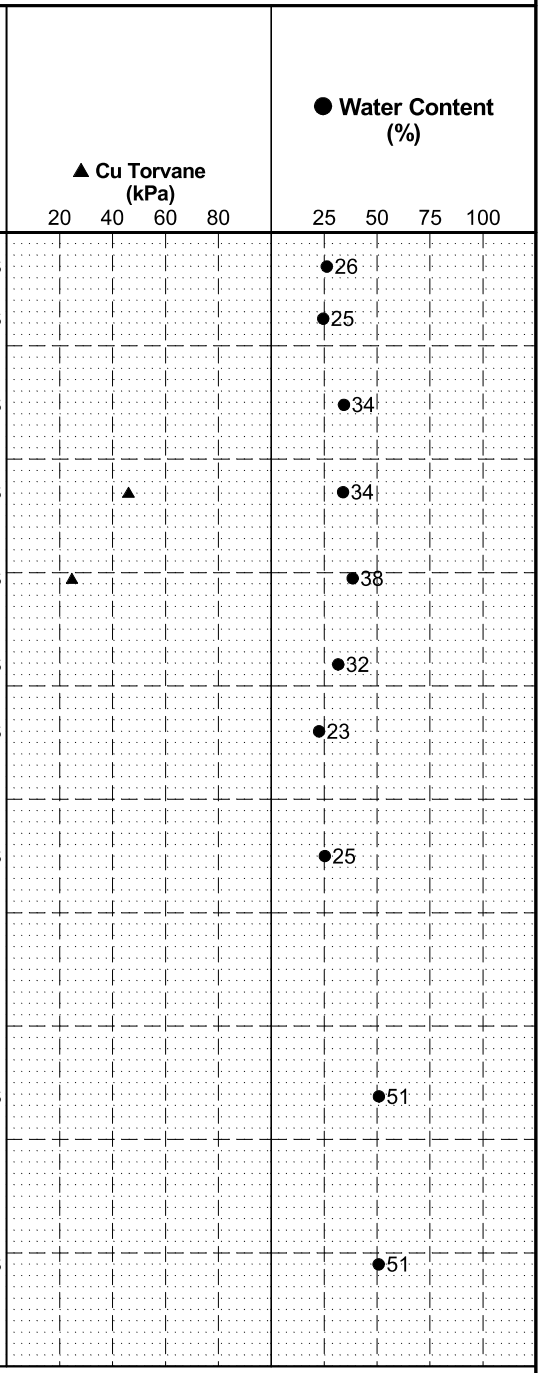
TESTHOLE TH 01

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566489 m E, 5448960 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.35 m

Depth (m)	Elevation (m)	Description	Sample Type
0.0	298.30	**Topsoil**	
		Silty Clay - black, firm, moist, high plasticity - trace organics to a depth of 0.8 m - brown below 1.5 m	BS
1.0			BS
2.0			BS
3.0	295.05		BS
		Sand - tan, compact, moist - trace clay	BS
4.0	293.75		BS
		Silt - tan, compact, moist - trace clay	BS
5.0			
6.0	291.95		
		Clay - grey, firm, moist, high plasticity - trace silt	BS
7.0			
8.0			
9.0			BS
10.0	288.35		
11.0			
12.0			



- Minor groundwater seepage was observed at a depth of 3.7 m.
- Groundwater level was observed at a depth of 3.7 m upon completion of drilling.
- Soil sloughing was observed in the sand layer at a depth of 3.4 m.
- Testhole terminated at a depth of 9.2 m.

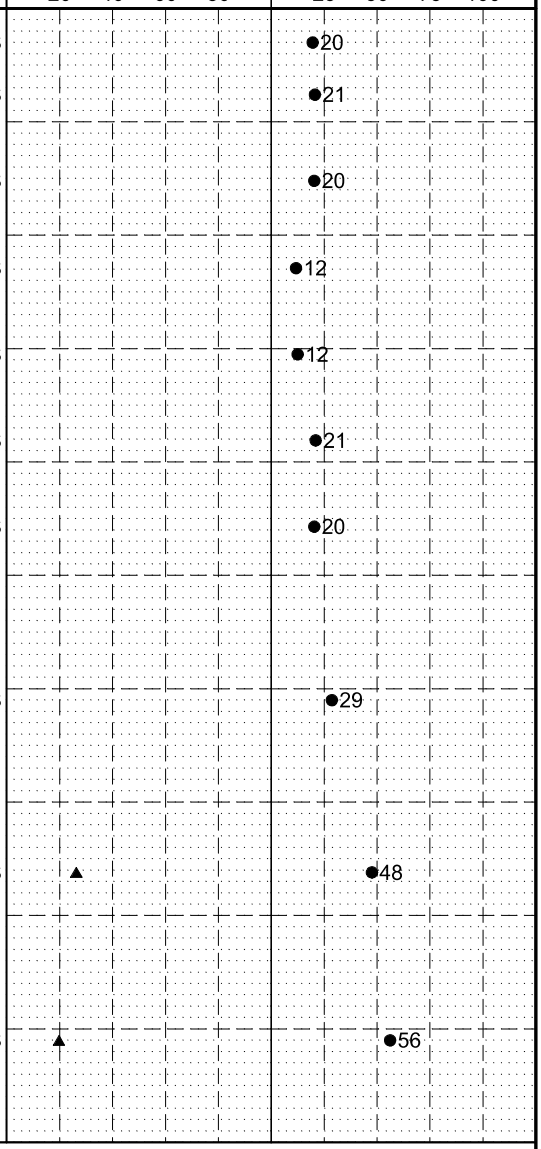
TESTHOLE TH 02

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566514 m E, 5448951 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.45 m

Depth (m)	Elevation (m)	Description	Sample Type
0.0	298.40	**Topsoil**	
		Silty Clay - black, firm, moist, high plasticity	BS
1.0			BS
	296.65		BS
2.0		**Sand** - tan, dense, moist, fine to coarse grained - trace coarse gravel below 3.0 m - trace clay below 3.5 m	BS
3.0			BS
4.0			BS
5.0	292.85		BS
6.0		**Clay** - grey, soft, moist, high plasticity - some silt between 5.6 m and 6.1 m	BS
7.0			
8.0			BS
9.0			BS
10.0	288.45		
11.0		• Minor groundwater seepage was observed at a depth of 3.7 m. • Groundwater level was observed at a depth of 3.7 m upon completion of drilling. • Soil sloughing was observed in the sand layer at a depth of 3.7 m. • Testhole terminated at a depth of 9.2 m.	
12.0			



TESTHOLE TH 03

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566477 m E, 5448952 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.32 m

Depth (m)	Elevation (m)	Description	Sample Type	▲ Cu Torvane (kPa)	● Water Content (%)
0.0	298.27	**Topsoil**			
		Silty Clay - black, firm, moist, high plasticity - trace organics to a depth of 0.8 m - brown below 1.2 m	BS		28
1.0			BS		24
			BS	▲	32
2.0			BS	▲	37
3.0			BS	▲	38
	294.52		BS	▲	29
4.0		**Sand** - tan, compact, moist - trace clay	BS		24
5.0	292.82		BS		21
		Silt - tan, compact, moist			
6.0	291.62		BS		29
7.0		**Clay** - grey, firm, moist, high plasticity			
			BS	▲	47
8.0					
9.0			BS	▲	35
10.0	288.32				
11.0					
12.0					

- Moderate groundwater seepage was observed at a depth of 3.8 m.
- Groundwater level was observed at a depth of 3.8 m upon completion of drilling.
- Soil sloughing was observed in the sand layer at a depth of 3.8 m.
- Testhole terminated at a depth of 9.2 m.

TESTHOLE TH 04

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566464 m E, 5448954 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.03 m

Depth (m)	Elevation (m)	Description	Sample Type	Particle Size Distribution: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	▲ Cu Torvane (kPa)	● Water Content (%)
0.0	297.98	**Topsoil**	BS						20
		Silty Clay - black, firm, moist, high plasticity - trace fine sand - trace organic to a depth of 0.8 m - brown, stiff, below 1.2 m - soft below 2.5 m	BS	0.1	6.9	30.4	62.6		24
1.0			BS					60	31
2.0			BS	0.0	9.7	31.8	58.5	60	38
3.0	294.63		BS					20	41
		Sand - tan, compact, moist - trace gravel - trace silt - trace clay	BS						34
4.0			BS	6.9	75.0	9.1	9.0		23
5.0	292.53								
		Silt - tan, compact, moist - trace clay	BS						24
6.0	291.33								
		Clay - grey, soft, moist, high plasticity - trace silt	BS					20	47
7.0									
8.0			BS					20	47
9.0	288.03								
10.0									
11.0									
12.0									

- Moderate groundwater seepage was observed at a depth of 3.4 m.
- Groundwater level was observed at a depth of 3.0 m upon completion of drilling.
- Soil sloughing was observed in the sand layer at a depth of 3.7 m.
- Testhole terminated at a depth of 9.2 m.
- Standpipe piezometer to a depth of 5.6 m, slotted between 3.0 and 5.6 m

TESTHOLE TH 05

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566458 m E, 5448934 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 297.70 m

Depth (m)	Elevation (m)	Description	Sample Type	▲ Cu Torvane (kPa) 20 40 60 80	● Water Content (%) 25 50 75 100
0.0	297.65	**Topsoil**			
		Silty Clay - black, firm, moist, high plasticity - trace organics to a depth of 0.8 m - grey below 0.8 m	BS		●28
1.0			BS		●26
			BS		●28
2.0			BS	▲	●40
3.0	294.70		BS	▲	●29
		Sand - tan, compact, moist - some fine to coarse gravel	BS		●20
4.0			BS		●23
5.0	292.50				
		Silt - tan, compact, moist - trace clay	BS		●22
6.0	291.00				
		Clay - grey, soft, moist, high plasticity	BS	▲	●52
7.0					
8.0			BS	▲	●46
9.0	287.70				
10.0		• Minor groundwater seepage was observed at a depth of 3.0 m. • Groundwater level was observed at a depth of 3.0 m upon completion of drilling. • Soil sloughing was observed in the sand layer at a depth of 3.0 m. • Testhole terminated at a depth of 9.2 m.			
11.0					
12.0					

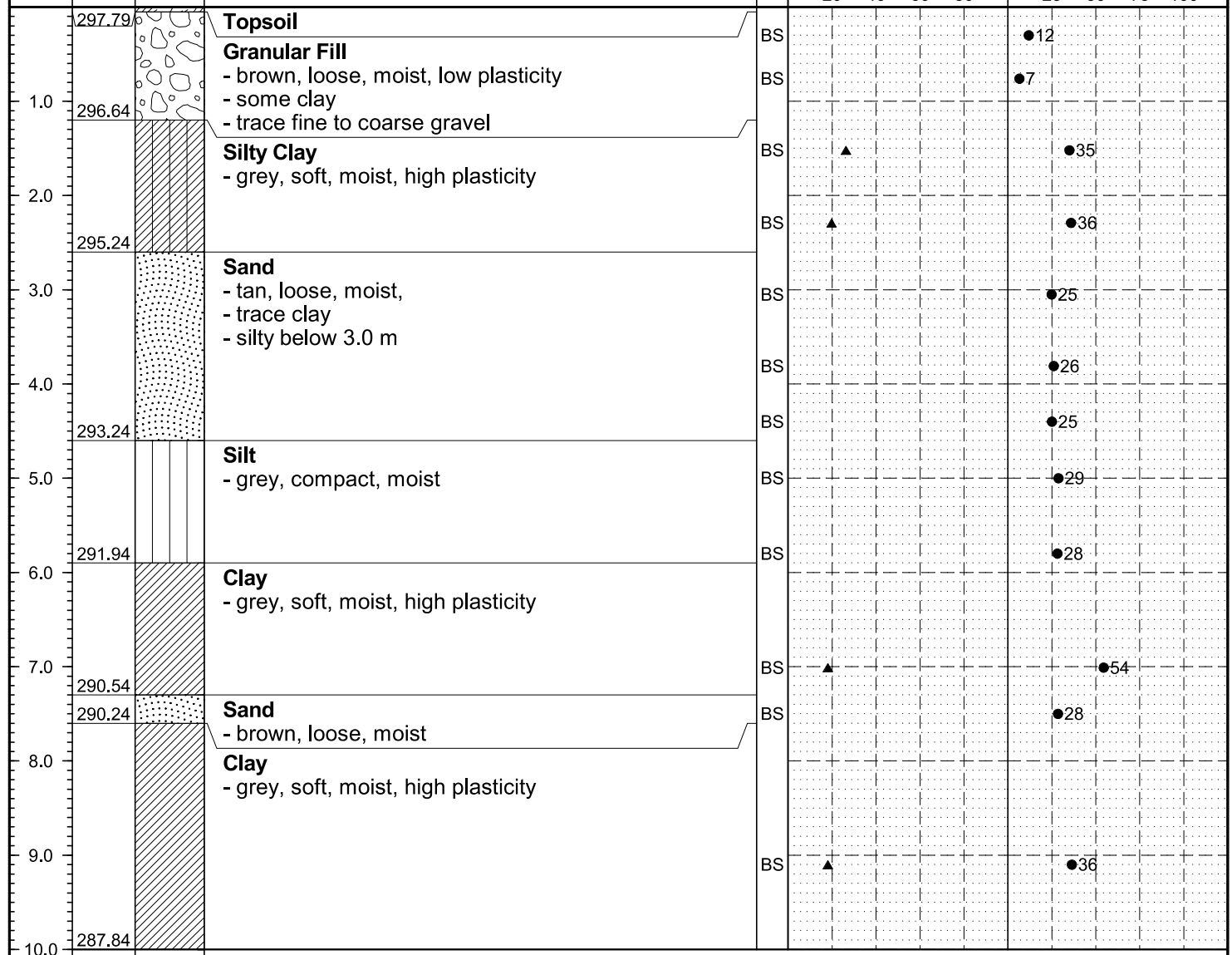
TESTHOLE TH 06

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566461 m E, 5448919 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 297.84 m

Depth (m)	Elevation (m)	Description	Sample Type
0.0	297.79	**Topsoil**	
		Granular Fill - brown, loose, moist, low plasticity - some clay - trace fine to coarse gravel	BS BS
1.0	296.64		
		Silty Clay - grey, soft, moist, high plasticity	BS BS
2.0	295.24		
		Sand - tan, loose, moist, - trace clay - silty below 3.0 m	BS BS BS
3.0			
4.0	293.24		
		Silt - grey, compact, moist	BS BS
5.0	291.94		
		Clay - grey, soft, moist, high plasticity	BS
6.0			
7.0	290.54		
	290.24	**Sand** - brown, loose, moist	BS
		Clay - grey, soft, moist, high plasticity	
8.0			
9.0			BS
10.0	287.84		
11.0			
12.0			



- Minor groundwater seepage was observed at a depth of 3.0 m.
- Groundwater level was observed at a depth of 3.0 m upon completion of drilling.
- Soil sloughing was observed in the sand layer at a depth of 3.0 m.
- Testhole terminated at a depth of 9.2 m.

TESTHOLE TH 07

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566484 m E, 5448921 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.18 m

Depth (m)	Elevation (m)	Description	Sample Type	▲ Cu Torvane (kPa)	● Water Content (%)
0.0	298.13	**Topsoil**			
		Silty Clay - black, firm, moist, high plasticity - trace organics to a depth of 1.1 m - brown, below 1.1 m	BS		●23
1.0			BS		●26
	296.68		BS		●33
		Sand - tan, compact, moist, fine grained - trace silt - trace clay - medium to coarse grained below 3.0 m	BS		●21
2.0			BS		●12
3.0			BS		●27
4.0			BS		●32
5.0	292.98				
		Silt - tan, compact, moist - trace clay	BS		●24
6.0	291.78				
		Clay - grey, soft, moist, high plasticity	BS	▲	●58
7.0					
8.0			BS	▲	●48
9.0					
10.0	288.18				
11.0		• Minor groundwater seepage was observed at a depth of 3.3 m. • Groundwater level was observed at a depth of 3.3 m upon completion of drilling. • Soil sloughing was observed in the sand layer at a depth of 3.3 m. • Testhole terminated at a depth of 9.2 m.			
12.0					

TESTHOLE TH 08

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

Project Name: Morden Research Centre
Project Location: Morden, Manitoba
Client: Public Works and Government Services Canada
Drilling Contractor: Kletke Enviro Drilling Ltd.
Drilling Method: 125 mm Solid Stem Auger
UTM Coordinates: 14U 566483 m E, 5448936 m N

Date Drilled: November 15, 2012
Depth of Testhole: 10.0 m
Logged by: Trevor Schellenberg
Reviewed by: German Leal
Testhole Elevation: 298.49 m

Depth (m)	Elevation (m)	Description	Sample Type	▲ Cu Torvane (kPa)	● Water Content (%)
0.0	298.44	**Topsoil**			
		Silty Clay - black, firm, moist, high plasticity - trace organics to a depth of 0.8 m - brown below 0.8 m - sandy below 3.0 m	BS		●19
1.0			BS		●24
			BS		●25
2.0			BS		●32
3.0			BS		●29
	294.79		BS		●31
4.0		**Sand** - tan, compact, moist - trace clay between 3.7 m and 4.3 m	BS		●25
5.0	292.99		BS		●22
		Silt - tan, compact, moist - trace clay	BS		●24
6.0					
7.0	291.49	**Clay** - grey, soft, moist, high plasticity	BS	▲	●59
8.0					
9.0			BS	▲	●49
10.0	288.49				
11.0		• Moderate groundwater seepage was observed at a depth of 3.7 m. • Groundwater level was observed at a depth of 3.7 m upon completion of drilling. • Soil sloughing was observed in the sand layer at a depth of 4.7 m. • Testhole terminated at a depth of 9.2 m.			
12.0					

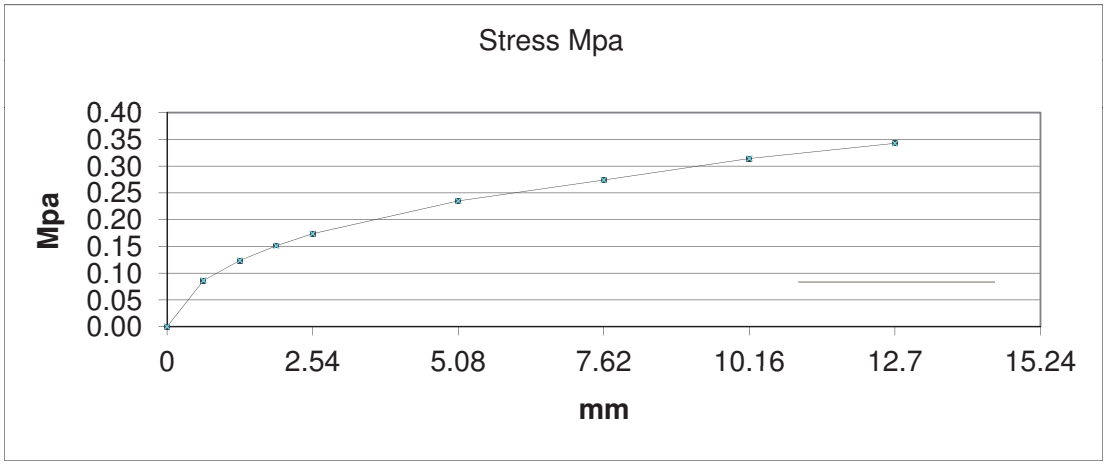
CBR Report

(ASTM D 1883)

Client:	The National Test Labs	Sample ID:	Road Subgrade 0 to 3'
Project:	Morden Research Center		
Date:	09 January 2013	Test Date:	02 January 2013
Sample Received:	28 December 2012	AMEC ID:	WX10300-10
Attention:	Mr. German Leal		

Compaction Method:	ASTM D698	**Moisture as compacted:**		28.60%
Soaked:	Yes	**Moisture Top 25.4mm after loading:**		29.70%
Percent Swell:	0.63%	**Dry Density before testing:**		1471 kg/m3
Bearing Ratio (Soaked):	2.54 pen top	2.19%	**Sample ID:**	CBR
	5.08 pen top	2.28%		
	12.7 pen top	1.91%		

Time Interval Seconds	Penetration MM	Dial Reading	Force Newtons	Stress Mpa
0	0	0	0	0.00
43	0.635	125	167	0.09
76	1.270	183	240	0.12
107	1.905	224	293	0.15
138	2.540	257	337	0.17
251	5.080	347	456	0.23
362	7.620	405	531	0.27
474	10.160	468	610	0.31
584	12.700	511	665	0.34



Comments:

AMEC Environment & Infrastructure

Per _____

Contact: Trevor Gluck, P. Eng.
Manager; Technical Services

APPENDIX D

LABORATORY TEST REPORTS

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

PWGSC
Western Region
167 Lombard Avenue
Winnipeg, Manitoba
R3C 2Z1

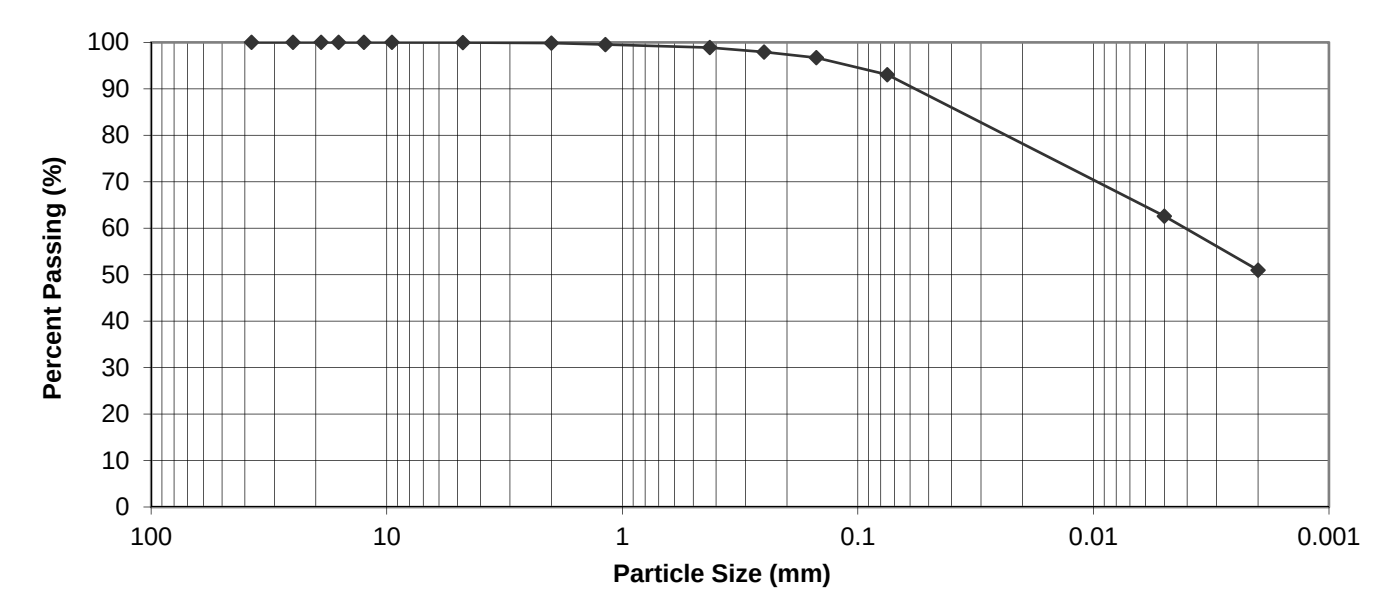
PROJECT: Morden Research Centre

Attention: Steve Miville

PROJECT NO.: STA-1259

SAMPLED BY: Trevor Schellenberg
SAMPLE ID: TH4 at 0.8 m

DATE RECEIVED: November 22, 2012
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	99.9
2.00 mm	99.8

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.5
0.425 mm	98.9
0.250 mm	97.9
0.150 mm	96.7
0.075 mm	93.0
0.005 mm	62.6
0.002 mm	51.0
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.1	0.1	0.9	5.9	30.4	62.6	NT*

NT* Sample not tested for colloids

November 28, 2012

REVIEWED BY: Trevor Schellenberg, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

PWGSC
Western Region
167 Lombard Avenue
Winnipeg, Manitoba
R3C 2Z1

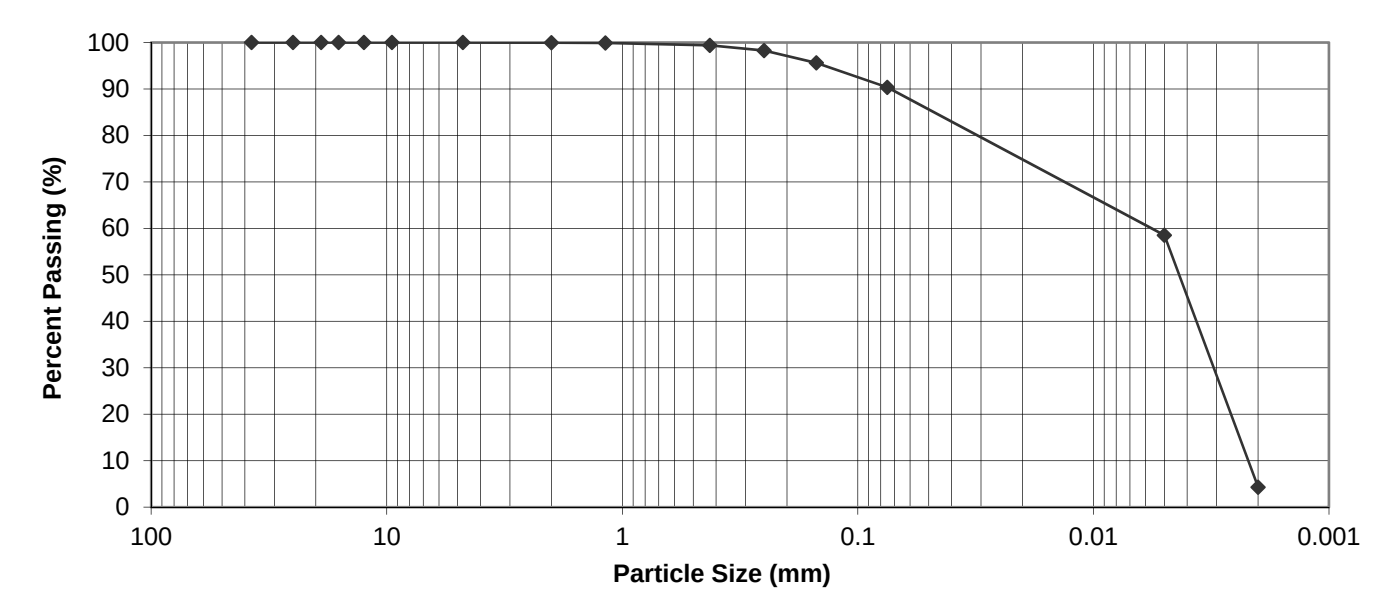
PROJECT: Morden Research Centre

Attention: Steve Miville

PROJECT NO.: STA-1259

SAMPLED BY: Trevor Schellenberg
SAMPLE ID: TH4 at 2.3 m

DATE RECEIVED: November 22, 2012
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	99.9

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.4
0.250 mm	98.3
0.150 mm	95.6
0.075 mm	90.3
0.005 mm	58.5
0.002 mm	4.3
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.1	0.5	9.1	31.8	58.5	NT*

NT* Sample not tested for colloids

November 28, 2012

REVIEWED BY: Trevor Schellenberg, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

PWGSC
Western Region
167 Lombard Avenue
Winnipeg, Manitoba
R3C 2Z1

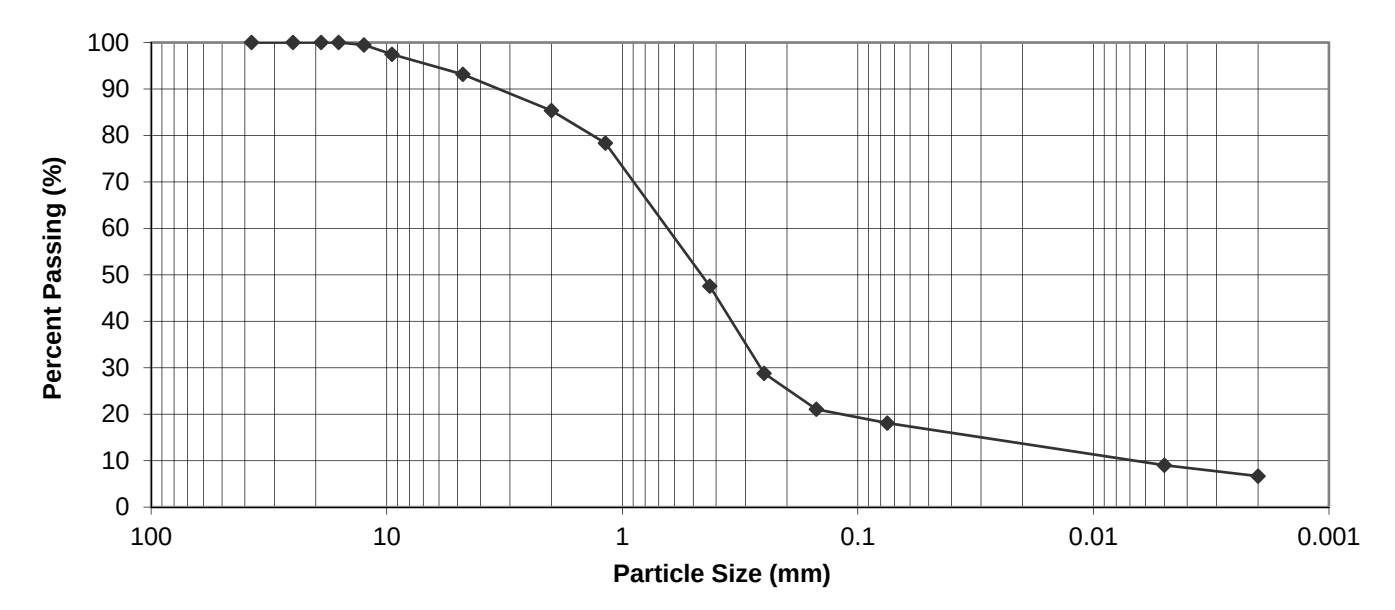
PROJECT: Morden Research Centre

Attention: Steve Miville

PROJECT NO.: STA-1259

SAMPLED BY: Trevor Schellenberg
SAMPLE ID: TH4 at 4.6 m

DATE RECEIVED: November 22, 2012
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	99.5
9.50 mm	97.4
4.75 mm	93.1
2.00 mm	85.3

PARTICLE SIZE	PERCENT PASSING
1.18 mm	78.3
0.425 mm	47.5
0.250 mm	28.8
0.150 mm	21.1
0.075 mm	18.1
0.005 mm	9.0
0.002 mm	6.7
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
6.9	7.8	37.8	29.4	9.1	9.0	NT*

NT* Sample not tested for colloids

November 28, 2012

REVIEWED BY: Trevor Schellenberg, B.Sc., EIT

CERTIFICATE OF ANALYSIS

CLIENT	**National Testing Laboratories Ltd.**		
	199 Henlow Bay		
	Winnipeg MB	TEL	(204) 488-6999
	R3Y 1G4	FAX	(204) 488-6947
ATTENTION	**German Leal**		

RECEIVED / TEMP	Nov-29-12 12:03 / NA	**WORK ORDER**	2111457
REPORTED	Dec-04-12	**PROJECT**	STA-1259
COC #(s)	40837.5581	**PROJECT INFO**	Morden Research Centre

General Comments:

CARO Analytical Services employs methods which are based on those found in "Standard Methods for the Examination of Water and Wastewater", 21st Edition, 2005, published by the American Public Health Association (APHA); US EPA protocols found in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846", 3rd Edition; protocols published by the British Columbia Ministry of Environment (BCMOE); and/or CCME Canada-wide Standard Reference methods.

Methods not described in these publications are conducted according to procedures accepted by appropriate regulatory agencies, and/or are done in accordance with recognized professional standards using accepted testing methodologies and quality control efforts except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

- All solids results are reported on a dry weight basis unless otherwise noted
- Units: mg/kg = milligrams per kilogram, equivalent to parts per million (ppm)
  mg/L = milligrams per litre, equivalent to parts per million (ppm)
  ug/L = micrograms per litre, equivalent to parts per billion (ppb)
  ug/g = micrograms per gram, equivalent to parts per million (ppm)
  ug/m3 = micrograms per cubic meter of air
- "RDL" Reported detection limit
- "<" Less than reported detection limit
- "AO" Aesthetic objective
- "MAC" Maximum acceptable concentration (health-related guideline)
- "LAB" RMD = Richmond location, KEL = Kelowna location, EDM = Edmonton location, SUB = Subcontracted

Please contact CARO if more information is needed or to provide feedback on our services.

CARO Analytical Services

Final Review Per: **Cecil Chiu, B.Sc., PChem**
Inorganics Coordinator, Richmond

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

SAMPLE DATA

CLIENT	National Testing Laboratories Ltd.	**WORK ORDER #**	2111457
PROJECT	STA-1259	**REPORTED**	Dec-04-12

TP 4 @ 0.3 m (2111457-01) Matrix: Soil Sampled: Nov-29-12 12:03

Analyte	Result	RDL	Units	Prepared	Analyzed	Notes
General Parameters						
Sulfate, Water Soluble	**0.38**	0.05	%	Nov-29-12	Dec-04-12	
pH	**7.9**	0.1	pH units	Dec-01-12	Dec-01-12	
Chloride, Water Soluble	**10**	10	mg/kg dry	Nov-30-12	Dec-03-12	

TP 4 @ 3.0 m (2111457-02) Matrix: Soil Sampled: Nov-29-12 12:03

Analyte	Result	RDL	Units	Prepared	Analyzed	Notes
General Parameters						
Sulfate, Water Soluble	**0.56**	0.05	%	Nov-29-12	Dec-04-12	
pH	**8.3**	0.1	pH units	Dec-01-12	Dec-01-12	
Chloride, Water Soluble	**11**	10	mg/kg dry	Nov-30-12	Dec-03-12	

TP 4 @ 7.6 m (2111457-03) Matrix: Soil Sampled: Nov-29-12 12:03

Analyte	Result	RDL	Units	Prepared	Analyzed	Notes
General Parameters						
Sulfate, Water Soluble	**0.07**	0.05	%	Nov-29-12	Dec-04-12	
pH	**8.7**	0.1	pH units	Dec-01-12	Dec-01-12	
Chloride, Water Soluble	**41**	10	mg/kg dry	Nov-30-12	Dec-03-12	

ANALYSIS / REPORT INFORMATION

CLIENT	National Testing Laboratories Ltd.	**WORK ORDER #**	2111457
PROJECT	STA-1259	**REPORTED**	Dec-04-12

Analysis Description	**Method Reference(s)** (* = modified from)		**LAB**
	Preparation	**Analysis**	
Sulfate (CSA A23.2)	N/A	CSA A23.2-2B	RMD
pH in Concrete (ASTM D4972)	N/A	ASTM D4972	RMD
Chloride, Water Soluble (AASHTO)	N/A	AASHTO T291-94	RMD

QUALITY CONTROL DATA

CLIENT	National Testing Laboratories Ltd.	**WORK ORDER #**	2111457
PROJECT	STA-1259	**REPORTED**	Dec-04-12

The following section reports quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with quality control samples that ensure your data is of the highest quality. Common QC types include:

- Method Blank (Blk): Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment

- Duplicate (Dup): Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.

- Blank Spike (BS): A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).

- Standard Reference Material (SRM): A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested for.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	% REC	% REC Limits	% RPD	% RPD Limit	Notes
General Parameters, Batch B2K1118										
Blank (B2K1118-BLK1)				Prepared: Nov-29-12, Analyzed: Dec-04-12						
Sulfate, Water Soluble	< 0.05	0.05	%							
Blank (B2K1118-BLK2)				Prepared: Nov-29-12, Analyzed: Dec-04-12						
Sulfate, Water Soluble	< 0.05	0.05	%							
Duplicate (B2K1118-DUP2)	**Source: 2111457-02**			Prepared: Nov-29-12, Analyzed: Dec-04-12						
Sulfate, Water Soluble	0.56	0.05	%		0.56			< 1	25	
General Parameters, Batch B2K1146										
Blank (B2K1146-BLK1)				Prepared: Nov-30-12, Analyzed: Dec-03-12						
Chloride, Water Soluble	< 10	10	mg/kg dry							
LCS (B2K1146-BS1)				Prepared: Nov-30-12, Analyzed: Dec-03-12						
Chloride, Water Soluble	485	10	mg/kg dry	500		97	80-120			
General Parameters, Batch B2L0003										
Duplicate (B2L0003-DUP2)	**Source: 2111457-02**			Prepared: Dec-01-12, Analyzed: Dec-01-12						
pH	8.4	0.1	pH units		8.3			1	20	

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

MOISTURE - DENSITY RELATIONSHIP REPORT

TO

Public Works & Government Services Canada
100-167 Lombard Ave.
Winnipeg, MB
R3C 2Z1

ATTN: Steve Miville

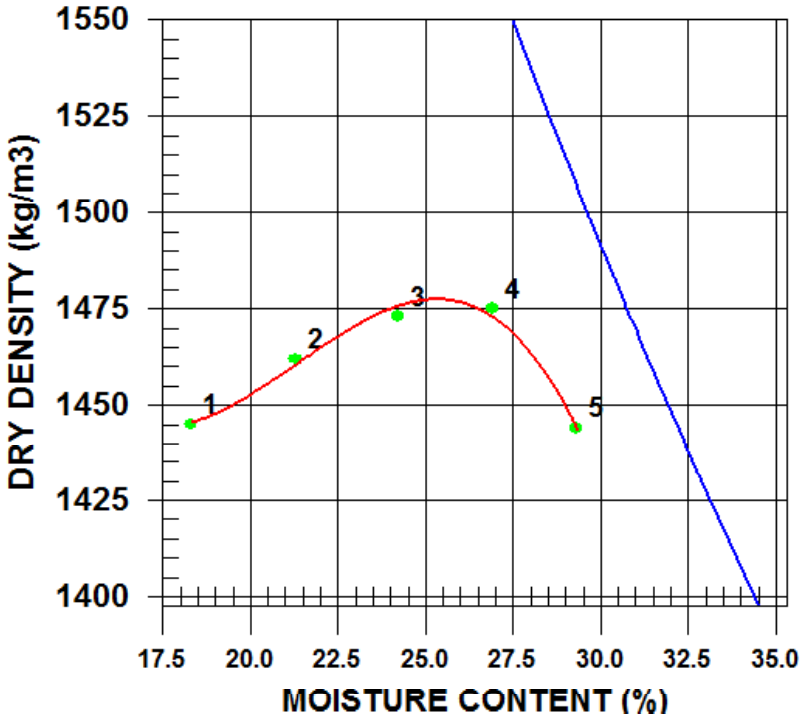
CLIENT Public Works & Government Services
C.C.

PROJECT Morden Research Centre

PROCTOR NO. 1

PROJECT NO. STA-1259

DATE SAMPLED	2012.Nov.15	DATE RECEIVED	2012.Nov.23
SAMPLED BY	T.Schellenberg	DATE TESTED	2012.Nov.27
MATERIAL IDENTIFICATION		COMPACTION STANDARD	Standard Proctor, ASTM D698
MATERIAL USE	Subgrade		
MAX. NOMINAL SIZE		COMPACTION PROCEDURE	A: 101.6mm Mold, Passing 4.75mm
MATERIAL TYPE	Clay		
SUPPLIER		OVERSIZE CORRECTION METHOD	None
SOURCE	Existing Material	RETAINED 4.75mm SCREEN	



TRIAL NUMBER	WET DENSITY (kg/m3)	DRY DENSITY (kg/m3)	MOISTURE CONTENT (%)
1	1710	1445	18.3
2	1773	1462	21.3
3	1829	1473	24.2
4	1872	1475	26.9
5	1867	1444	29.3

	MAXIMUM DRY DENSITY (kg/m3)	OPTIMUM MOISTURE CONTENT (%)
CALCULATED OVERSIZE CORRECTED	1477	25.5

COMMENTS
Material tested was identified as a composite sample of 0 to 0.8 m from testholes TH01, TH03 and TH04.

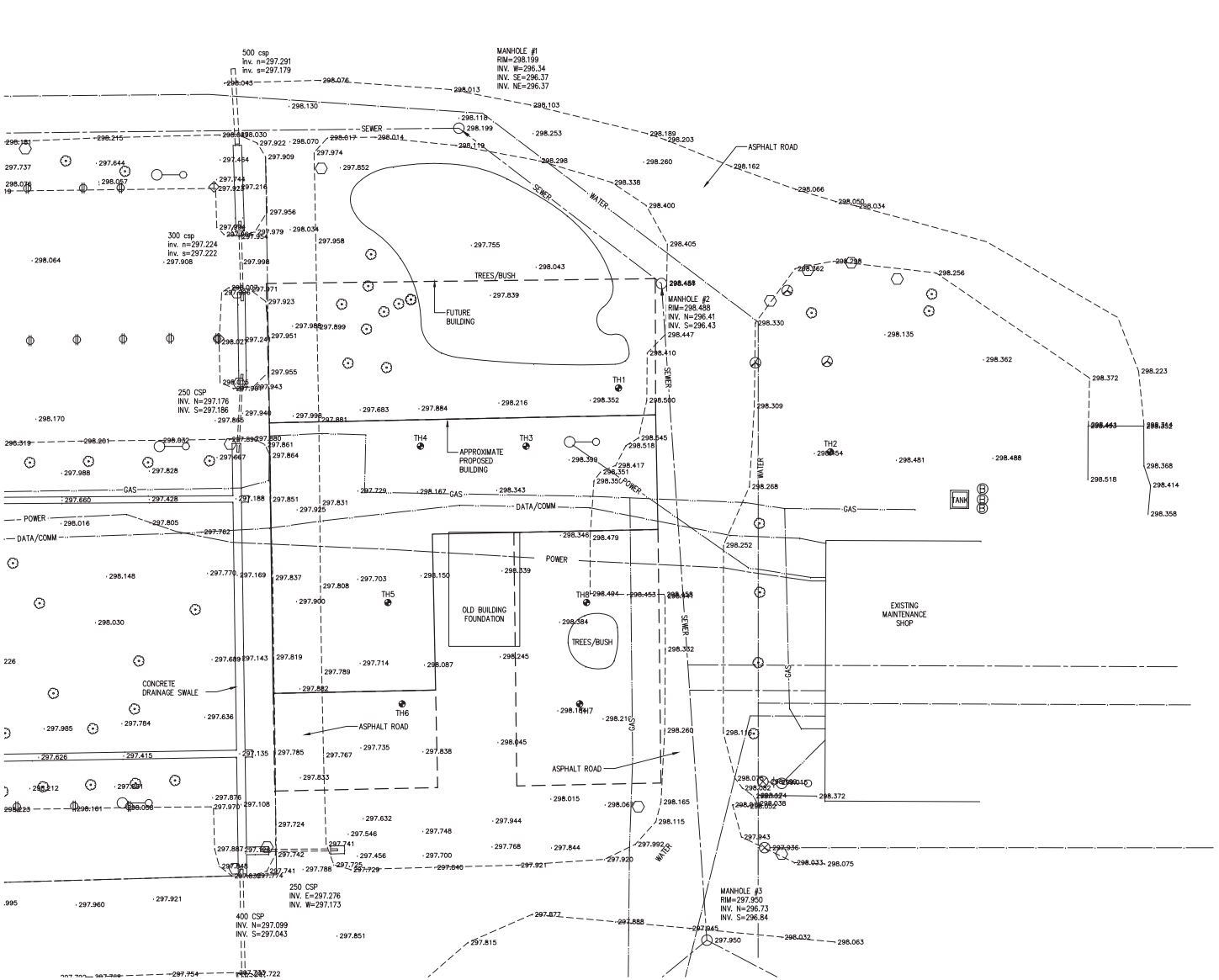
ACCREDITED MATERIALS TESTING LABORATORY
AASHTO R18

REVIEWED BY Jason Thompson, C.E.T.

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

APPENDIX E1

MORDEN RESEARCH CENTRE
SITE PLAN C-101



N

1:250 0 2500 7500 12500

0 10 20 30 40 50 60 70 80 90 100mm

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

PRELIMINARY
NOT FOR CONSTRUCTION

EXISTING	LEGEND
WATER	WATERMAIN
SEWER	WASTE WATER SEWER
GAS	GAS
POWER	HYDRO
DATA/COM	M.T.S.
	TREES
	TREE LINE
	SIGN
	MANHOLE
	HYDRANT
	VALVE
	LIGHT STAND
	CULVERT
	CONCRETE DRAINAGE SWALE
	ELECTRICAL PEDISTAL
31.334	ELEVATION
	TEST HOLE
	ROADWAY

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
1	REVISED BUILDING LOCATION	13/10/10

Client/client

AGRICULTURE AND AGRI-FOOD CANADA

Project title/Titre du projet
MORDEN, MB

MORDEN RESEARCH CENTRE
NEW GREENHOUSE AND
HEADER HOUSE BUILDING

Approved by/Approuvé par
BJR

Designed by/Concept par

Drawn by/Dessiné par
KR

PWGSC Project Manager/Administrateur de Projets TPSGC

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'ingénierie, TPSGC

Client/client

Drawing title/Titre du dessin
SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
C-101	1 OF 1	1

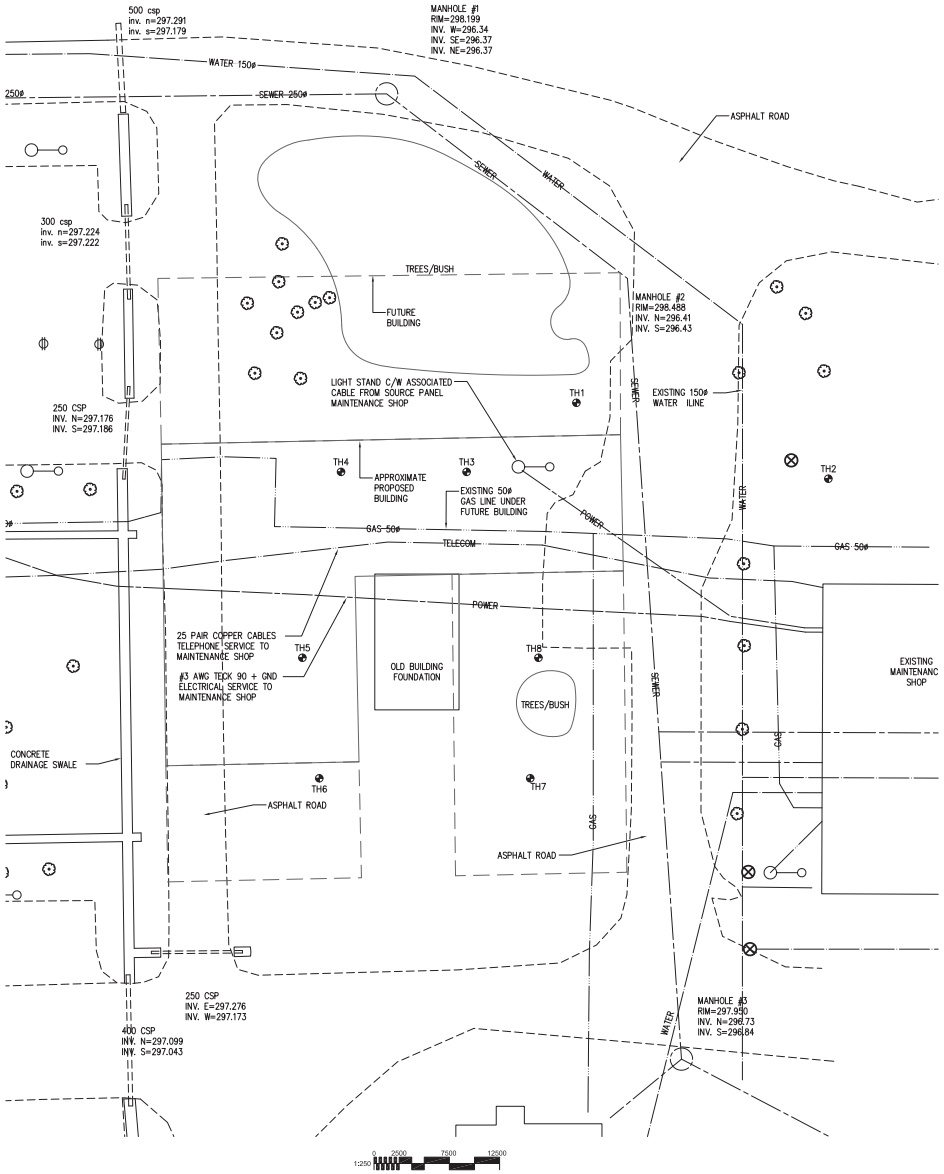
U:\1154\active\1154474501\0300_drawing\0302_sheet_files\02_civil\47450-101-xxx.dwg

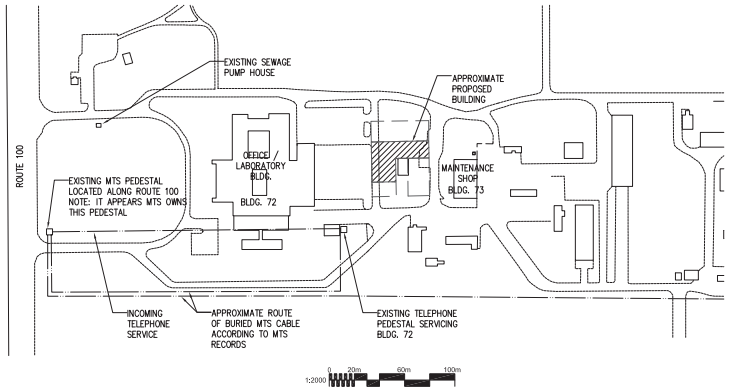
PWGSC – A1 – 841X594

47450 c-101-xxx

APPENDIX E2

MORDEN RESEARCH CENTRE
UTILITIES PLAN ME-101





N

EXISTING	LEGEND
WATER	WATERMAIN
SEWER	WASTE WATER SEWER
GAS	GAS
POWER	HYDRO
TELECOM	M.T.S.
	TREES
	TREE LINE
	SIGN
	MANHOLE
	HYDRANT
	VALVE
	LIGHT STAND
	CULVERT
	CONCRETE DRAINAGE SWALE
	ELECTRICAL PEDISTAL
31.334	ELEVATION
	TEST HOLE
	ROADWAY

DO NOT SCALE DRAWINGS

Revision/ Révision	Description/Description	Date/Date
1	REVISED BUDING LOCATION	13/02/19
0	ISSUED FOR INFORMATION	13/02/01

Client/client

AGRICULTURE AND AGRI-FOOD CANADA

Project title/Titre du projet

MORDEN, MB

MORDEN RESEARCH CENTRE NEW GREENHOUSE AND HEADER HOUSE BUILDING

Approved by/Approuve par
BH/ES

Designed by/Concept par

Drawn by/Dessine par
GV

PWGSC Project Manager/Administrateur de Projets TPSGC

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'ingénierie, TPSGC

Client/client

Drawing title/Titre du dessin

UTILITIES SITE PLAN

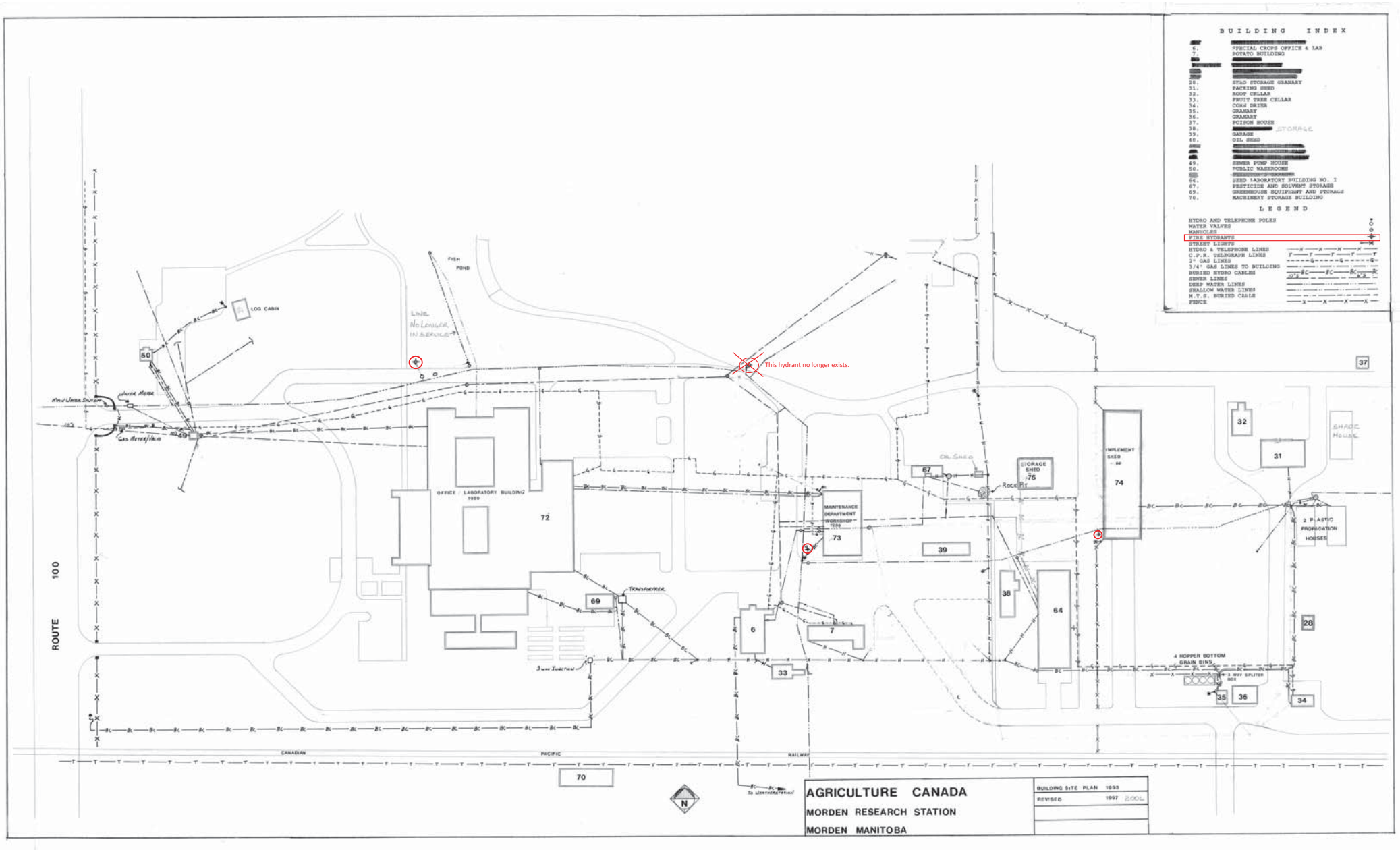
Project No./No. du projet	Sheet/Feuille	Revision no./ Le Révision no.
ME-101	1 OF 1	1

PWGSC – A1 – 841X594

47450c-101-M&E

APPENDIX F1

HYDRANT FLOW TEST MAP LOCATIONS


BUILDING INDEX
6. SPECIAL CROPS OFFICE & LAB
7. POTATO BUILDING
28. STAD STORAGE GRANARY
31. PACKING SHED
32. ROOT CELLAR
33. FRUIT TREE CELLAR
34. CORN DRIER
35. GRANARY
36. GRANARY
37. POISON HOUSE
38. STORAGE
39. GARAGE
40. OIL SHED
49. SEWER PUMP HOUSE
50. PUBLIC WASHROOMS
64. SEED LABORATORY BUILDING NO. 1
67. PESTICIDE AND SOLVENT STORAGE
69. GREENHOUSE EQUIPMENT AND STORAGE
70. MACHINERY STORAGE BUILDING
LEGEND
HYDRO AND TELEPHONE POLES
WATER VALVES
MANHOLES
FIRE HYDRANTS
STREET LIGHTS
HYDRO & TELEPHONE LINES
C.P.R. TELEGRAPH LINES
2" GAS LINES
3/4" GAS LINES TO BUILDING
BURIED HYDRO CABLES
SEWER LINES
DEEP WATER LINES
SHALLOW WATER LINES
M.T.S. BURIED CABLE
FENCE
FISH POND
LOG CABIN
LINE NO LONGER IN SERVICE
This hydrant no longer exists.
OFFICE - LABORATORY BUILDING 1969
72
MAINTENANCE DEPARTMENT WORKSHOP 1974
73
STORAGE SHED 75
74
IMPLEMENT SHED
OIL SHED
ROCK PIT
SHADE HOUSE
2 PLASTIC PROPAGATION HOUSES
4 HOPPER BOTTOM GRAIN BINS
3 WAY SPLITER BOX
TRANSFORMER
ROUTE 100
CANADIAN PACIFIC RAILWAY
N
AGRICULTURE CANADA
MORDEN RESEARCH STATION
MORDEN MANITOBA
BUILDING SITE PLAN 1993
REVISED 1997 2004

APPENDIX F2

HYDRANT FLOW TEST RESULTS

Supplying & Servicing the Water & Waste Industry
DEBLO Industries Ltd. Since 1989
557 Marjorie St.
Winnipeg, MB R3H 0S8
Fax: (204) 334-5588
Phone: (204) 334-4477
www.deblo.net
Email: kurtis1@mts.net tkonchuk@mts.net

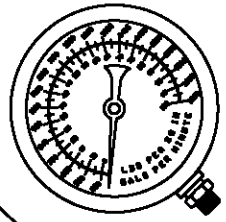
INSPECTED AT: AGRICULTURE CANADA
INSPECTED BY: KURTIS
CONTACT PERSON:
P.O. BRUCE HAUGH.
COMPLETION DATE: NOV 5, 2012
INVOICE#

#	LOCATION OF HYDRANT	MAKE OF HYRDRANT	FLOW TEST RESULTS						STATIC
1	BLDG #73	9658	RESIDUAL:	26					86.
			PITOT READING:	20					
			US/GPM:	750					
2	BLDG #74	MUELLER	RESIDUAL:	20					85
			PITOT READING:	15					
			US/GPM:	650					
3	N.W CORNER BLDG 72	9658	RESIDUAL:	35					89
			PITOT READING:	27					
			US/GPM:	880					
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						
			RESIDUAL:						
			PITOT READING:						
			US/GPM:						

APPENDIX F3

HYDRANT FLOW TEST EQUIPMENT

PRODUCT DATA SHEET



NOTE: Dual function Gauge
measures Pressure (0-100 psi)
and Flow (0-1680 gpm)

Liquid Filled Gauge
Part #HYD100

Snubber
Part #P675026

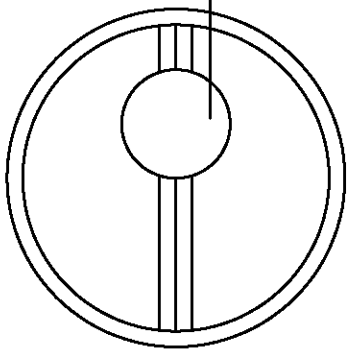
3-Way Ball Valve
Part #P675012

Inner Pitot Tube
Part #P675013

Diffuser Body
Part #HYDPROBODY

Swivel Adapter
Part #P67323AL 2-1/2"

Diffuser Baffle



FRONT END VIEW

REV	REVISION DESCRIPTION	DATE

PollardWater.com
200 Atlantic Avenue • New Hyde Park, NY 11040

TITLE: HYDPRO100 DIFFUSER

SIZE	DRAFTSMAN	DATE	APPROVAL	DATE	DRAWING NO.	REV
B	DMB	06/09/10			JGPS0002f	

SCALE	SUPERSEDES	SHEET
NTS	N/A	1 OF 1