

APPENDIX 8:

SOUTH WINNIPEG RECREATION CAMPUS

SWRC LONG-TERM GROUNDWATER MONITORING JAN-2025

January 22, 2025

City of Winnipeg
Municipal Accommodations
Assets and Project Management
3rd Floor, 65 Gary Street
Winnipeg, Manitoba R3C 4K4

Attention: Tracy Stople
Project Manager

Re: South Winnipeg Recreation Campus – Geotechnical Services
Long-Term Groundwater Monitoring

1.0 BACKGROUND

KGS Group has previously completed a two-phase geotechnical investigation at the site of the proposed South Winnipeg Recreation Campus to be located approximately 425 m southwest of the intersection of Bison Drive and Frontier Trail, in the City of Winnipeg, Manitoba. The scope of services of the previously completed two-phase geotechnical investigation is summarized below.

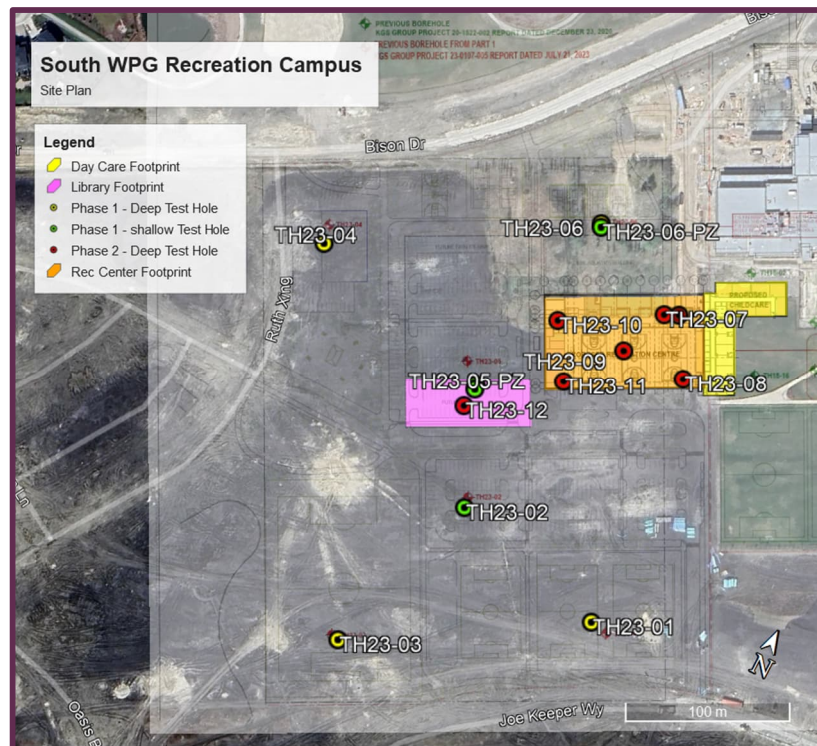
- **Phase 1: General Investigation** – A geotechnical drilling investigation consisting of six (6) test holes across the project site ranging in depth from 6.1 to 17.2 m, and the installation of six (6) standpipe piezometers, four (4) of which were screened within the lower silt till and two (2) screened within the upper lean clay (CL). In-field rising head hydraulic conductivity tests were completed for the upper lean clay (CL) and lower silt till layers, and laboratory hydraulic conductivity tests were completed on undisturbed samples of the high plasticity fat clay (CH) layer. The hydraulic conductivity tests results were then used to estimate the volume of water anticipated to accumulate within surface excavations (pool/basement/crawlspace). Preliminary recommendation for foundations and site preparation we also provided as part of this phase. The findings of the general investigation were summarized within our report titled “South Winnipeg Recreation Campus – Geotechnical Engineering Report” and dated July 21, 2023.
- **Phase 2: Detailed Investigation** – Included a review of 2018 and 2020 test holes from the adjacent school site to the west. A geotechnical drilling investigation consisting of six (6) test holes advanced to refusal at depths ranging from 15.3 m to 16.0 m within the footprint of the proposed recreation center and library building. Test Holes could not be advanced within the proposed childcare facility as the footprint of that

portion of the building extends on to the adjacent school property, and drill rig access was limited by existing fencing. Installation of three (3) vibrating wire piezometers to monitor the groundwater level in each of the three (3) soil types identified during Phase 1 including, lean clay (CL), fat clay (CH), and silt till. The Phase 2 report included an updated estimate on the maximum volume of groundwater seepage expected to collect within surface excavations based on the maximum lean clay (CL) thickness encountered within the Phase 2 test holes, as well as, finalized foundation design and site preparation recommendations, and other recommendations related to the construction of the proposed buildings. The findings of the Phase 2 investigation are summarized with our report titled “South Winnipeg Recreation Campus – Phase 2 Geotechnical Engineering Report”, dated March 19, 2024.

Following review of the Phase 2 geotechnical report, the City of Winnipeg (CoW) requested a proposal to provide long-term groundwater monitoring and a refined estimate of seepage volume. It is understood that groundwater seepage into surface excavations and basements on other CoW owned buildings has become a difficult and problematic issue for the CoW. A seepage volume estimation will help CoW define the requirements for temporary and permanent dewatering.

A site plan indicating the location of the test holes completed as part of the Phase 1 and 2 investigations is provided below.

FIGURE 1: PHASE 1 AND 2 TEST HOLE LOCATION PLAN



2.0 SEEPAGE VOLUME ESTIMATION

2.1 Hydraulic Conductivity Testing

As discussed in detail within the Phase 1 and Phase 2 geotechnical reports, in-field and laboratory tests were completed to estimate the hydraulic conductivity of the three (3) soil types encountered across the project site. Rising head hydraulic conductivity tests were completed in the field utilizing the installed standpipes to estimate the hydraulic conductivity of the upper lean clay (CL) and lower silt till materials. The hydraulic conductivity of the fat clay layer (CH) was determined in the laboratory using a flexible wall permeameter and collected Shelby tube samples. The results of the completed hydraulic conductivity testing, and the assumed values used for seepage volume estimation are summarized in the table below.

TABLE 1: SUMMARY OF COMPLETED HYDRAULIC CONDUCTIVITY TESTING

Testing Method	Soil Type	Test Hole ID	Estimated Hydraulic Conductivity, k (cm/sec)
In-Field Rising Head ASTM D4044 /D4044M-15	Clay (CL)	TH23-05-PZ	9.5×10^{-6}
		TH23-06-PZ	1.6×10^{-5}
	Assumed hydraulic conductivity for Lean Clay (CL) 1×10^{-5} cm/sec		
	Silt Till	TH23-01	1.2×10^{-4}
		TH23-03	2.6×10^{-4}
		TH23-04	1.2×10^{-4}
		TH23-06	4.4×10^{-6}
	Assumed hydraulic conductivity for Silt Till 1×10^{-4} cm/sec		
Laboratory Flexible Wall Permeameter ASTM D5084	Clay (CH)	TH23-01	1.5×10^{-8}
		TH23-05	6.3×10^{-9}
	Assumed hydraulic conductivity for Fat Clay (CH) 1×10^{-8} cm/sec		

Based on the results above, the hydraulic conductivity is greatest for silt till materials. However, as surface excavations are anticipated to be limited to a depth 3.0 m below existing ground surface, the silt till is not anticipated to be encountered during excavations. Therefore, surface excavations which encounter a greater thickness of lean clay (CL) materials are anticipated to accumulate the most groundwater.

2.2 Review of Test Hole Logs

As discussed above, surface excavations which encounter lean clay (CL) materials are anticipated to collect the most groundwater seepage, therefore a review of the previously completed test hole logs is essential to determine where the lean clay (CL) is anticipated to be encountered. The Phase 1 and Phase 2 test hole logs (TH23-01 to TH23-12) with laboratory testing results are provided in Appendix A for reference.

As shown in Figure 1 above, test holes were not completed within the footprint of the proposed daycare facility during Phase 1 or Phase 2 investigations. Therefore, KGS Group will utilize some of the previously completed test holes from the adjacent school property to help to define the soil profile around the daycare. Based on test hole locations indicated on Figure 2, test holes TH23-07 to TH23-11 can be used to approximate the soil profile near the recreation center and test holes TH18-02 and TH20-23 will be used to approximate the soil profile at the daycare facility. The test hole logs for TH18-02 and TH20-23 are provided in Appendix B for reference.

FIGURE 2: TEST HOLE LOCATION FOR 2018 AND 2020 SCHOOL INVESTIGATIONS

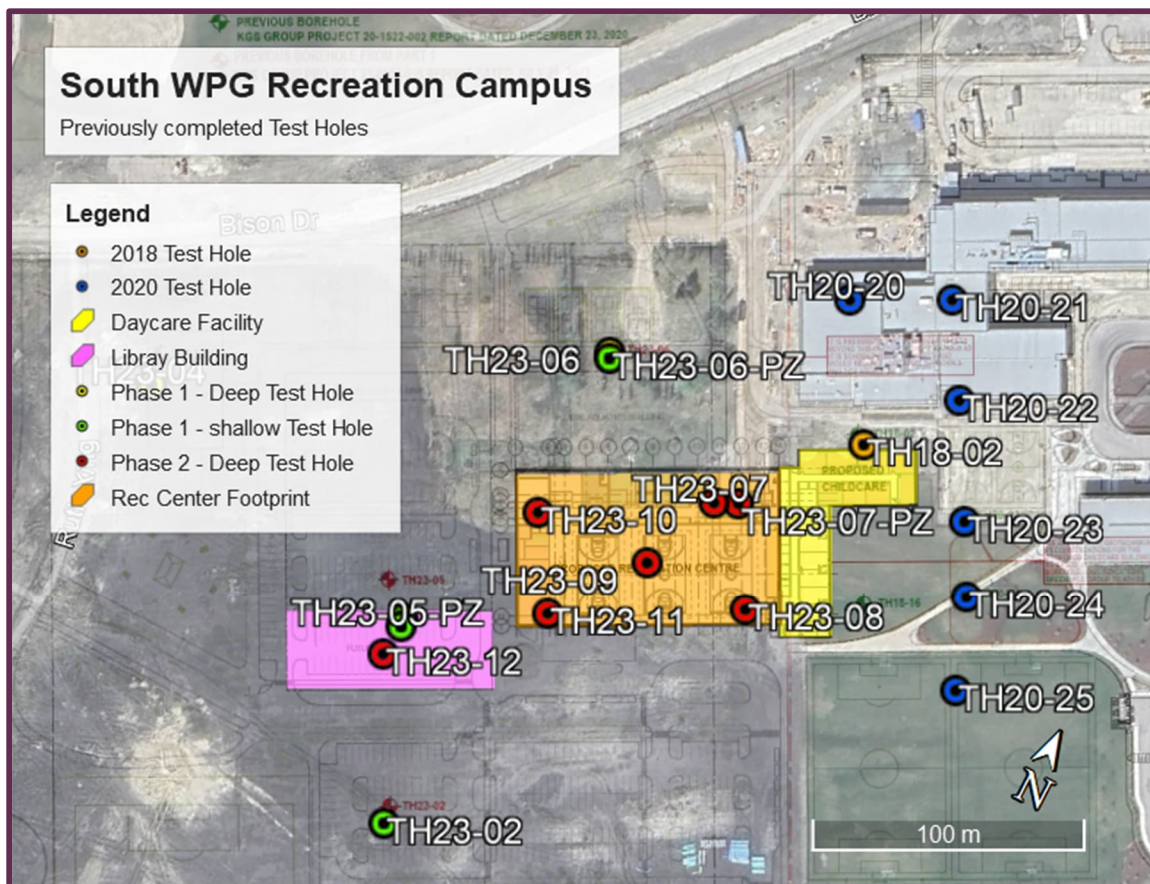


TABLE 2: SUMMARY OF SOIL PROFILE FROM ADJACENT TEST HOLE LOGS

Test Hole ID	Approximate Soil Layer Depth Interval (m)			Length of Excavation (m)	Excavation Area (m ²)	Colour as Indicated on Figure 3
	Lean Clay (CL)	Fat Clay (CH)	Silt Till			
TH23-07	0.0 – 0.6 and 1.5 to 4.3	0.6 to 1.5 and 4.3 to 14.0	14.0 to 15.3	57.5	1,400	Red
TH23-08	0.0 to 3.7	3.7 to 12.2	12.2 to 15.3	96.0	1,815	White
TH23-09	0.0 to 0.5	0.5 to 13.4	13.4 to 15.3	NA	700	Pink
TH23-10	0.0 to 1.2	1.2 to 13.1	13.1 to 15.3	82.0	1,400	Yellow
TH23-11	0.0 to 2.0	2.0 to 12.5	12.5 to 16.0	81.0	1,080	Teal
TH18-02	0.0 to 0.6	0.6 to 13.7	13.7 to 15.3	60.0	470	Orange
TH20-23	0.0 to 1.5	1.5 to 13.5	13.5 to 14.9	53.5	550	Blue

South WPG Recreation Campus
Excavation Soil Profile

Legend

- 2018 Deep Test Hole
- 2020 Deep Test Hole
- 2023 Deep Test Hole
- TH18-02
- TH20-23
- TH23-07
- TH23-08
- TH23-09
- TH23-10
- TH23-11

Map labels: TH23-10, TH23-07, TH23-09, TH23-08, TH23-11, TH18-02, TH20-23, TH18-02, TH23-02, TH23-03, TH23-04, TH23-05, TH23-06, TH23-07, TH23-08, TH23-09, TH23-10, TH23-11, TH23-12, TH23-13, TH23-14, TH23-15, TH23-16, TH23-17, TH23-18, TH23-19, TH23-20, TH23-21, TH23-22, TH23-23, TH23-24, TH23-25, TH23-26, TH23-27, TH23-28, TH23-29, TH23-30, TH23-31, TH23-32, TH23-33, TH23-34, TH23-35, TH23-36, TH23-37, TH23-38, TH23-39, TH23-40, TH23-41, TH23-42, TH23-43, TH23-44, TH23-45, TH23-46, TH23-47, TH23-48, TH23-49, TH23-50, TH23-51, TH23-52, TH23-53, TH23-54, TH23-55, TH23-56, TH23-57, TH23-58, TH23-59, TH23-60, TH23-61, TH23-62, TH23-63, TH23-64, TH23-65, TH23-66, TH23-67, TH23-68, TH23-69, TH23-70, TH23-71, TH23-72, TH23-73, TH23-74, TH23-75, TH23-76, TH23-77, TH23-78, TH23-79, TH23-80, TH23-81, TH23-82, TH23-83, TH23-84, TH23-85, TH23-86, TH23-87, TH23-88, TH23-89, TH23-90, TH23-91, TH23-92, TH23-93, TH23-94, TH23-95, TH23-96, TH23-97, TH23-98, TH23-99, TH23-100.

70 m

2.3 Groundwater Monitoring

As part of the long-term groundwater monitoring program, KGS Group installed a multi-channel data logger to collect two (2) daily readings from the three (3) previously installed vibrating wire piezometers. KGS Group then returned monthly to collect the data from the logger and to record the groundwater levels within the previously installed standpipe piezometers. Plots of the recorded groundwater readings from the vibrating wire piezometers are provided in Appendix C.

2.4 Seepage Volume Estimation

KGS Group has prepared the following seepage volume estimations based on the monthly average (Table 3) and monthly maximum (Table 4) groundwater water levels recorded during our ten (10) month observation period. The seepage volume estimation was based on an excavation depth of 3.0 m as well as the layer thickness from the test hole logs, side wall lengths, and excavation areas as indicated on Table 2.

TABLE 3: ESTIMATION OF AVERAGE MONTHLY SEEPAGE VOLUME

Month	Average Groundwater Elevation/Depth (m)			Estimated Monthly Average Seepage Volume (m ³ /day)
	Upper Lean Clay (CL)	Fat Clay (CH)	Silt Till	
March	230.8/2.2	227.4/5.4	227.5/5.3	32.9
April	231.3/1.7	227.5/5.3	227.5/5.3	33.8
May	232.4/0.6	227.9/4.9	228.0/4.8	36.4
June	232.7/0.3	229.1/3.7	229.1/3.7	37.5
July	232.7/0.3	229.2/3.6	229.2/3.6	37.5
August	232.2/0.8	228.5/4.3	228.6/4.2	35.9
September	231.7/1.3	228.1/4.7	228.2/4.6	34.6
October	231.4/1.6	228.0/4.8	228.1/4.7	34.0
November	231.3/1.7	227.8/5.0	227.9/4.9	33.8
December	231.6/1.4	227.9/4.9	227.9/4.9	34.4

TABLE 4: ESTIMATION OF MAXIMUM MONTHLY SEEPAGE VOLUME

Month	Maximum Groundwater Elevation/Depth (m)			Estimated Monthly Maximum Seepage Volume (m ³ /day)
	Upper Lean Clay (CL)	Fat Clay (CH)	Silt Till	
March	231.0/2.0	227.5/5.3	227.6/5.2	33.2
April	231.9/1.1	227.6/5.2	227.7/5.1	35.0
May	232.9/0.1	228.8/4.0	228.8/4.0	38.3
June	232.9/0.1	229.5/3.3	229.5/3.3	38.3
July	233.0/0.0	229.7/3.1	229.7/3.1	38.6
August	232.5/0.5	228.8/4.0	228.9/3.9	36.8
September	231.9/1.1	228.3/4.5	228.4/4.4	35.0
October	231.5/1.5	228.2/4.6	228.3/4.5	34.2
November	231.6/1.4	228.0/4.8	228.0/4.8	34.4
December	231.7/1.3	228.0/4.8	228.1/4.7	34.6

As anticipated, peak seepage volumes were greatest during the spring and summer months (May to July) and lowest during the fall and winter months (October to March). As shown above groundwater seepage volumes are anticipated to vary with seasonal changes in groundwater elevations.

2.5 Discussion

Based on the standpipe and vibrating wire piezometer data plots as provided in Appendix C, the vibrating wire piezometers installed within the fat clay (CH) and silt till layers have a strong correlation to one another. Water levels within these two layers are recorded at essentially the same elevation throughout the recording period and are generally within 0.1 m of each other. However, the readings from the standpipes installed within the silt till show water elevations 2 m to 3 m lower than the vibrating wire piezometer, indicating that a hydraulic connection between the fat clay (CH) and silt till layers must have been established during piezometer installation. The elevation of the groundwater recorded from these piezometers ranges from 227.4 to 229.7 m corresponding to a groundwater depth of 5.4 to 3.1 m below ground surface. In general, the groundwater levels within the fat clay (CH) and silt till layers were recorded to be lower than the assumed excavation depth of 3.0 m below ground surface and will not significantly contribute to the groundwater seepage accumulation within the excavation.

The vibrating wire piezometer installed within the upper lean clay (CL) layer in test hole TH23-07 recorded groundwater depths much closer to the surface, ranging in elevation from 230.7 to 233.0 m, and corresponding

to a groundwater depth of 0.0 to 2.3 m below ground surface. Based on the assumed excavation depth of 3.0 m below existing grade, groundwater seepage from the upper lean clay (CL) should be expected year-round. Groundwater elevations recorded from the standpipe piezometers installed within the lean clay (CL) are in general agreement with the readings from the vibrating wire piezometer, confirming accurate representation of the groundwater levels within the lean clay (CL).

As shown on the lean clay (CL) standpipe and vibrating wire piezometer plots, rain events (as indicated by the blue data point) result in a near immediate increase in groundwater levels measured within the lean clay (CL) layer. This indicates that the lean clay layer (CL) is strongly connected with surface water and indicates possible perched groundwater conditions. As shown on the plots for the fat clay (CH) and silt till layers, rain events do also trigger an increase of groundwater levels in these layers, however, their response appears to lag by approximately 1 or 2 days.

3.0 RECOMMENDATIONS

3.1 Groundwater Seepage Control

KGS Group recommends implementing one (1) of the following alternatives to help to limit the groundwater seepage into temporary or permanent excavations.

- Alternative 1: Excavate and remove the entire lean clay (CL) layer from across the project site and replace with compacted fat clay (CH) materials. The fat clay (CH) materials have a significantly lower hydraulic conductivity than the lean clay (CL), therefore replacing lean clay (CL) with fat clay (CH) will reduce the overall groundwater seepage volume.
- Alternative 2: Provide a minimum 1 m thick compacted fat clay (CH) capping layer across the project site. Capping the lean clay (CL) materials will limit water infiltration from the surface and will allow surface water to runoff towards ditches or other drainage infrastructure.
- Alternative 3: Install a cut-off trench around the perimeter of the proposed below grade structures. The cut off trench should be constructed approximately 5 m off-set from the perimeter of the excavation, be at least 1 m in width to accommodate construction equipment, and should extend the full depth of the lean clay (CL) layer. The cut off trench should be backfilled with compacted fat clay (CH) materials. Protrusions through the cut-off trench for connections or utilities should also be backfilled with fat clay (CH).

In addition to the alternatives provided above, it is recommended that all lean clay (CL) materials encountered at the base of the excavation be replaced with compacted fat clay (CH).

Regardless of which alternative is selected, the finished ground surface of the project site should be graded to promote drainage away from the building and below grade elements. Discharge from roof down spouts or sump pits should not be allowed to be accumulated adjacent to the structure and should be provided with sufficient extensions to direct water away from the structure. Additionally, drainage conditions around the structure should be inspected at least once per year following spring melts or a major rain event.

3.2 Temporary Excavations

To maintain safe working conditions and a stable base for construction, water should not be allowed to accumulate within the excavation. A dewatering system consisting of a series of perimeter trenches and sump pumps located at the base of the excavation can likely control the seepage by pumping the water out of the excavation and discharging away from the limits of construction. The rate of seepage is expected to decrease as pumping operations continue.

Open excavation side slopes should be covered to prevent from drying or saturation and surface runoff should be directed away from excavations. Surcharge loads such as soil stockpiles, equipment, etc. should be kept a minimum of 1 m or a distance equal to the depth of excavation away from the edge of excavation, whichever is greater.

If a deep excavation with a shoring system is considered, KGS Group recommends that an excavation and shoring plan should be prepared and submitted by a registered Professional Engineer who is skilled in these designs.

3.3 Surface and Subsurface Drainage

A permanent subdrain system should be installed around the exterior of below grade walls. Subdrains should be constructed with a perforated weeping tile wrapped with a filter sock and backfilled with drain rock (clean pea gravel or clean crushed rock), placed in a trench directing flows to sump pit. It is recommended that the sum pit be a minimum of 0.8 x 0.8 m (2.5 x 2.5 ft) in plan area and have a seal cover suitable support the weight of an adult. Water should be pumped from within the sump pit using suitable piping material with a minimum inside diameter of 30 mm, discharge piping should be equipped with a check valve to prevent backflow into the sump pit and should be graded to prevent freezing water from developing within the system. Installation of subsurface drainage should be in accordance with locally accepted practices and should conform to City of Winnipeg By-law No. 4555/87 Section 23. As discussed within our Phase 1 and Phase 2 geotechnical reports the maximum depth of frost penetration at this site is estimated to be 2.5 m below final ground surface elevation.

The final ground elevation around the perimeter of the structures should be sloped a minimum 2% to promote positive drainage away from the perimeter of all structures and to protect against surface water ponding. Roadways, parking lots, unloading areas and landscaping within a zone of approximately 2 m of the exterior perimeter of any structure should be sloped at a minimum gradient of 5% to compensate for future loss of grade that may result from potential settlement. Downspouts should be positively directed away from structures and beyond the backfill zone.

3.4 Buoyancy Effects

Any structures constructed below the ground surface should consider the effects of buoyancy and may require additional measures to counter act buoyancy. Buoyancy forces will impose uplift pressures on below grade structures located below the groundwater level and should be considered during the structural design. Forces can be calculated by multiplying the unit weight of water by the volume of the structure below the groundwater table.

Buoyancy forces can be resisted by the mass of the structure itself and/or by extending the base mat/slab beyond the chamber walls. In the latter case, the mass of the soil directly and vertically above the extended foundation slab and outside the foundations walls is utilized to counter-act buoyancy forces.

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for the City of Winnipeg in accordance with the agreement between KGS Group and the City of Winnipeg (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by the City of Winnipeg. Unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

Third Party Use of Report

Any use a third party makes of this report or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

Geotechnical Investigation Statement of Limitations

The geotechnical investigation findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions found at and within the depth of the test holes drilled by KGS Group at the site at the time of drilling. If conditions encountered during construction appear to be different from those shown by the test holes drilled by KGS Group or if the assumptions stated herein are not in keeping with the design, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

Prepared By:

Approved By:

Trevor Schellenberg, P.Eng.
Geotechnical Engineer

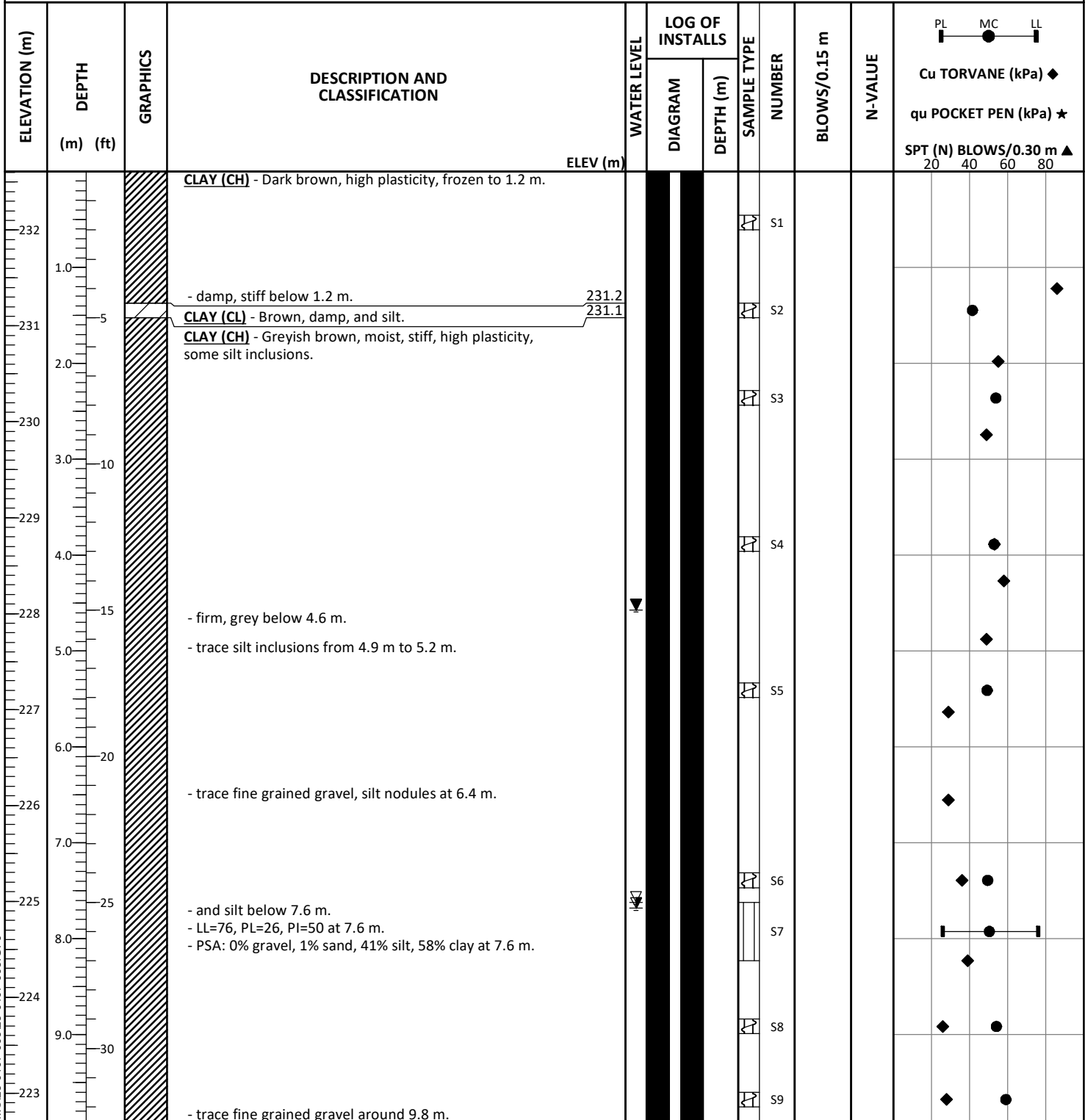
Tony Ng, P.Eng. P.E., P.G.
Geotechnical Specialist Advisor

TS/cs
Attached

APPENDIX A

Phase 1 and 2 Test Hole Logs

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT LOCATION	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	232.61 m
DESCRIPTION	SE corner of property, ~300 m South of Cadboro Road	TOC STICK-UP / ELEV.	1.07 m / 233.68 m (Standpipe)
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer	START DATE	4-11-2023
METHOD(S)	0.0 m to 16.9 m: 125 mm ø SSA	UTM (m)	N 5,517,488.85 E 630,644.05 Zone 14



WATER LEVELS	During Drilling/Digging	7.62 m	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
	Upon Completion	4.57 m		
	Remeasured/Static	7.68 m on 12-16-2023		
			APPROVED T. SCHELLENBERG	DATE 4-28-2023

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80			
					DIAGRAM	DEPTH (m)								
222	35		- trace till, trace sand from 10.7 m to 12.2 m.											
221	40		- soft below 11.1 m. - trace coarse grained gravel from 11.3 m to 11.4 m.					S10						
220	45		- light grey below 11.9 m.					S11						
219	50		SILT TILL - Light grey, damp to moist, dense, some fine to medium grained sand, some coarse grained gravel.					S12						
218	55		- very dense, some fine to medium grained gravel below 13.7 m.					S13	8 11 50/ 140mm	+100				>>▲
217	60		- some to with clay below 14.6 m. - LL=26, PL=13, PI=13 at 14.6 m. - PSA: 7% gravel, 28% sand, 43% silt, 22% clay at 14.6 m. - poor recovery, trace clay at 15.2 m.					S14						
216	65							S15	33 50/ 80mm	+100				>>▲
215	70							S16						
214	75							S17	50/ 110mm	+100				>>▲
213	80		Notes: 1. End of test hole at 16.9 m. 2. Test hole remained open to 16.9 m upon completion of drilling/digging. 3. Test hole backfilled with bentonite chips. An approximate 13.4 m of bentonite seal at surface. 4. Protective well cover installed at surface.											
212	85													
211	90													

WATER LEVELS

▽ During Drilling/Digging 7.62 m
 ▽ Upon Completion 4.57 m
 ▽ Remeasured/Static 7.68 m on 12-16-2023

CONTRACTOR
Paddock Drilling

APPROVED
T. SCHELLENBERG

INSPECTOR
H. SABHARWAL

DATE
4-28-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	232.69 m
LOCATION	Winnipeg, Manitoba	START DATE	4-11-2023
DESCRIPTION	Near middle of property, ~200 m South of Cadboro Road	UTM (m)	N 5,517,512
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer		E 630,543 Zone 14
METHOD(S)	0.0 m to 6.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
			ELEV (m)					
232	1.0		CLAY (CH) - Dark brown, trace fine to medium grained sand, trace silt nodules, frozen to 1.2 m.					
	5		- damp, stiff below 1.2 m.			S1		
231	2.0		CLAY (CL) - Brown, damp to moist, stiff, and silt.			S2		
			230.9					
			CLAY (CH) - Brown, damp to moist, firm, high plasticity, oxide nodules.					
			- gypsum inclusions below 2.1 m.			S3		
230	3.0		- oxidation below 3.0 m.					
	10					S4		
229	4.0		- trace fine grained sand at 4.3 m.			S5		
	15		- dark grey below 4.6 m.					
228	5.0		- trace silt inclusions, trace sand around 5.3 m.			S6	100	
	20					S7		
227	6.0							
226	7.0		Notes: 1. End of test hole at 6.1 m. 2. Test hole remained open to 6.1 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings.					
225	25							
224	8.0							
223	9.0							
	30							

WATER LEVELS	▽ During Drilling/Digging	Dry	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
	▼ Upon Completion	Dry		
			APPROVED T. SCHELLENBERG	DATE 4-28-2023

PROJECT NO.	23-0107-005
SURFACE ELEV.	232.83 m
TOC STICK-UP / ELEV.	1.00 m / 233.83 m (Standpipe)
START DATE	4-11-2023
UTM (m)	N 5,517,405.86
	E 630,514.07 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲			
				ELEV (m)								20	40	60	80
			CLAY (CL) - Light brown, and silt, frozen.	232.5											
			CLAY (CH) - Brown, high plasticity, trace silt, frozen to 1.07 m.					S1							
			- damp to moist, stiff below 1.1 m.					S2							
			- some silt from 1.5 m to 1.7 m.					S3							
			- trace gypsum, trace silt nodules below 1.7 m.					S4							
			- some silt, firm from 2.4 m to 2.5 m.					S5							
			- molted brown/grey below 3.0 m.					S6							
			- trace oxidation pockets from 3.7 m to 4.0 m.					S7							
			- firm below 4.0 m.					S8							
			- no gypsum below 4.6 m.					S9	100						
			- grey below 6.1 m.												
			- trace fine grained gravel below 7.6 m.												
			- slight increase in silt nodules, trace coarse grained sand below 9.1 m.												
WATER LEVELS				During Drilling/Digging	12.80 m	CONTRACTOR				INSPECTOR					
				Upon Completion	6.71 m	Paddock Drilling				C. FRIESEN					
				Remeasured/Static	7.91 m on 12-16-2023	APPROVED				DATE					
						T. SCHELLENBERG				4-28-2023					

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL		
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	232.85 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	0.98 m / 233.83 m (Standpipe)
DESCRIPTION	NE corner of property, ~50 m South of Cadboro Road	START DATE	4-12-2023
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer	UTM (m)	N 5,517,612.58
METHOD(S)	0.0 m to 13.7 m: 125 mm ø SSA - switched due to Sand Blowout 13.7 m to 16.8 m: 150 mm ø HSA		E 630,391.72 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80			
					DIAGRAM	DEPTH (m)									
			ELEV (m)												
			CLAY (CH) - Light brown, trace sand, frozen to 0.91 m.					S1							
232	1.0		- damp, stiff below 0.9 m.					S2							
			CLAY (CL) - Light brownish grey, dry, soft, some sand, and silt.												
	5		CLAY (CH) - Light brown, damp to moist, stiff, high plasticity, trace silt.					S3							
231	2.0		- moderate oxidation, trace silt nodules from 2.1 m to 2.3 m.					S4							
			- trace gypsum around 2.4 m.					S5							
	10		- firm below 2.7 m.					S6							
230	3.0							S7							
			- oxide nodules, trace silt at 4.1 m.					S8							
229	4.0							S9							
	15		- grey below 5.5 m.					S10							
228	5.0														
	20		- dark grey, some silt nodules below 6.1 m.												
227	6.0														
	25														
226	7.0														
	30														
225	8.0														
224	9.0														
223			- soft below 9.4 m.												

WATER LEVELS	▽ During Drilling/Digging	Dry	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
	▽ Upon Completion	Dry		
	▽ Remeasured/Static	7.84 m on 12-16-2023	APPROVED T. SCHELLENBERG	DATE 4-28-2023

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL							
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80							
222 11.0 221 12.0 220 13.0 219 14.0 218 15.0 217 16.0 216 17.0 215 18.0 214 19.0 213 20.0 212 21.0 70	35 40 45 50 55 60 65 70		- trace fine grained gravel , moist at 9.9 m. - increasing silt nodules below 10.1 m.	219.9			S11												
						S12	100												
			- firm, silt till clump from 11.3 m to 11.4 m.																
			- trace fine to medium grained gravel at 11.9 m.				S13												
							S14												
							S15												
							S17	100	8 50/ -90mm	+100						>>▲			
							S16												
						14.94	S18												
						15.24	S20	100	25 32 50/ 80mm	+100						>>▲			
						16.76	S21	38	41 48 50/ 130mm	+100						>>▲			
				215.7		17.20													
			Notes: 1. End of test hole at 17.2 m. 2. Test hole remained open to 17.2 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips. An approximate 7.3 m of bentonite seal at surface. 4. Protective well cover installed at surface.																

WATER LEVELS	▽ During Drilling/Digging	Dry	CONTRACTOR	INSPECTOR
	▼ Upon Completion	Dry	Paddock Drilling	H. SABHARWAL
	▼ Remeasured/Static	7.84 m on 12-16-2023	APPROVED T. SCHELLENBERG	DATE 4-28-2023

WATER LEVELS

▽ During Drilling/Digging
 ▽ Upon Completion
 ▽ Remeasured/Static

Dry
 Dry
 7.84 m on 12-16-2023

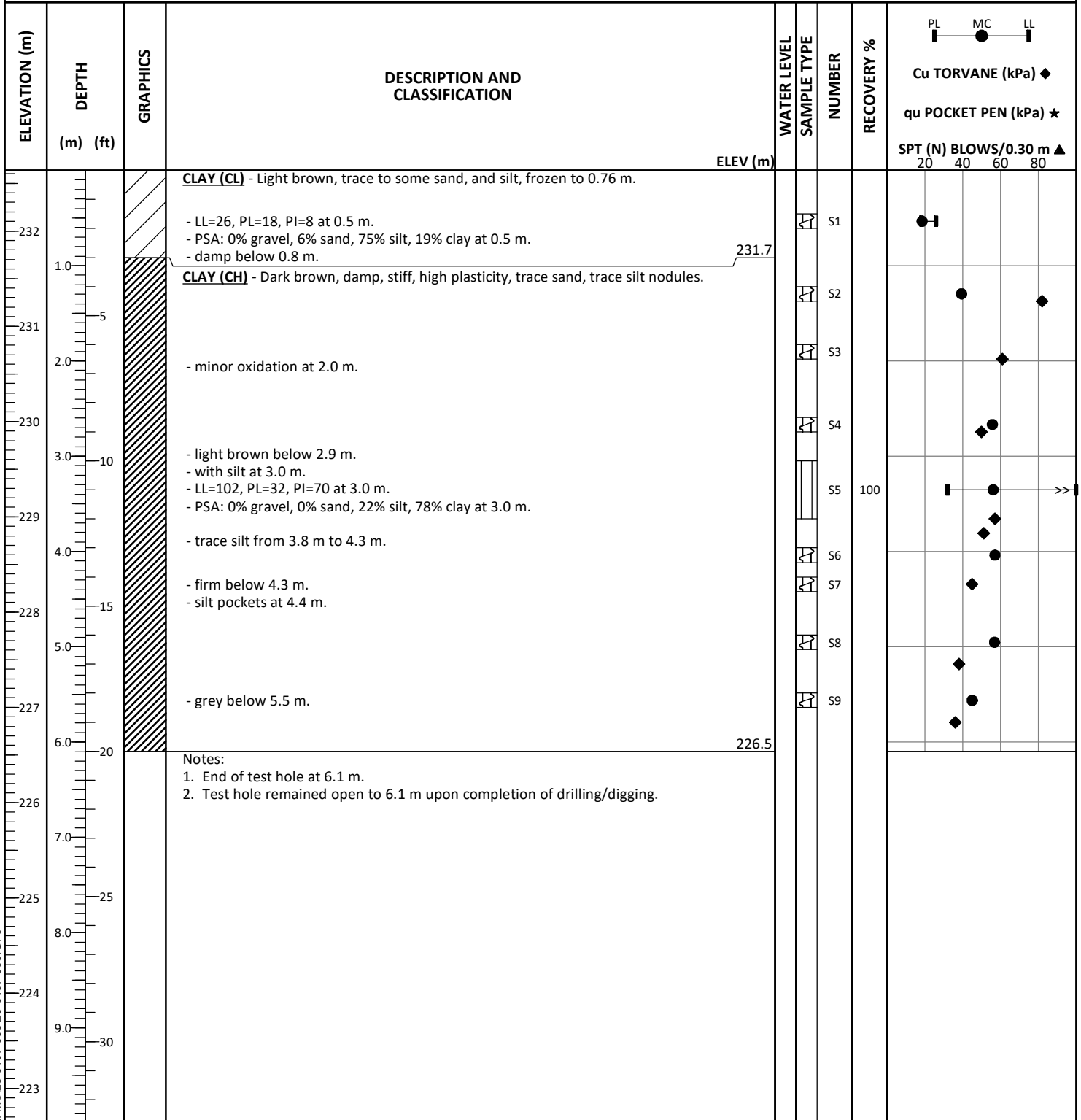
CONTRACTOR
 Paddock Drilling

APPROVED
 T. SCHELLENBERG

INSPECTOR
 H. SABHARWAL

DATE
 4-28-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	232.64 m
LOCATION	Winnipeg, Manitoba	START DATE	4-12-2023
DESCRIPTION	Near middle of property, ~125 m South of Cadboro Road	UTM (m)	N 5,517,581.79
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer		E 630,513.25 Zone 14
METHOD(S)	0.0 m to 6.1 m: 125 mm ø SSA		



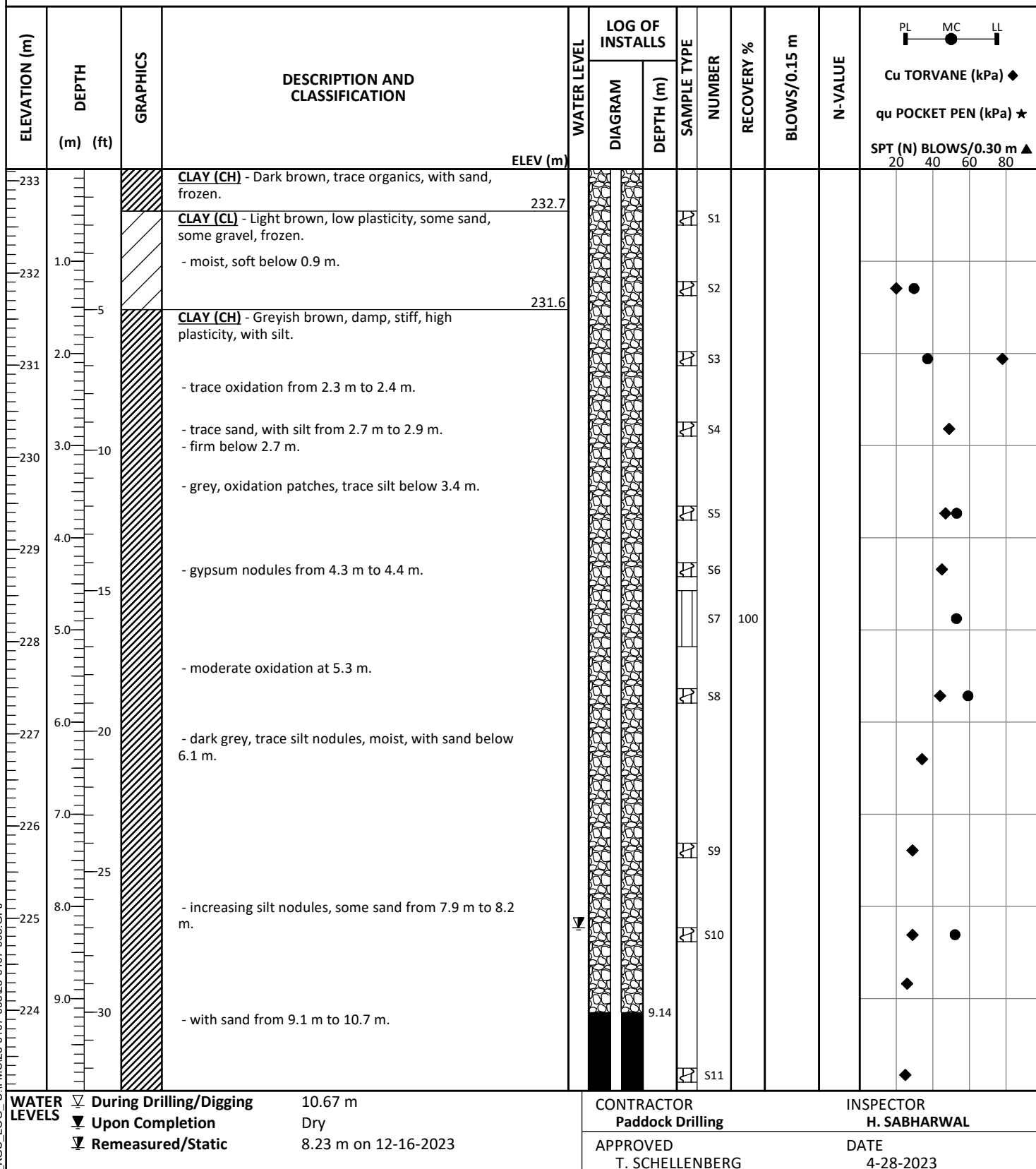
WATER LEVELS ▽ During Drilling/Digging ▼ Upon Completion	Dry Dry	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
		APPROVED T. SCHELLENBERG	DATE 4-28-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	232.64 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	0.91 m / 233.55 m (Standpipe)
DESCRIPTION	3 m south of test hole TH23-05	START DATE	4-12-2023
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer	UTM (m)	N 5,517,578.79
METHOD(S)	0.0 m to 0.9 m: 125 mm ø SSA		E 630,514.25 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL					
					DIAGRAM	DEPTH (m)			Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80					
			ELEV (m)											
			CLAY (CL) - Light brown, trace to some sand, and silt, frozen to 0.76 m.											
			- damp below 0.8 m.	231.7										
			Notes: 1. End of test hole at 0.9 m. 2. Test hole remained open to 0.9 m upon completion of drilling/digging. 3. Test hole backfilled with bentonite chips. An approximate 0.3 m of bentonite seal at surface. 4. Protective well cover installed at surface.											

WATER LEVELS ▽ During Drilling/Digging ▽ Upon Completion ▽ Remeasured/Static	Dry Dry on 12-16-2023 Dry	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
		APPROVED T. SCHELLENBERG	DATE 4-28-2023

PROJECT NO.	23-0107-005
SURFACE ELEV.	233.13 m
TOC STICK-UP / ELEV.	1.12 m / 234.24 m (Standpipe)
START DATE	4-13-2023
UTM (m)	N 5,517,703.35
	E 630,533.45 Zone 14



ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80		
					DIAGRAM	DEPTH (m)								
223			- soft below 10.4 m.					S12						
222														
221				220.9				S13	100	0 2 3	5			
220			SILT TILL - Light grey, damp to moist, loose, some fine to medium grained sand, some coarse grained gravel.			13.11 13.41								
219			- dense below 13.7 m.					S14	100	18 16 24	40			
218								S15	67	7 16 32	48			
217														
216			- very dense at 16.5 m.	216.5		16.46 16.59		S16	80	50/ 130mm	+100			>>▲
215			Notes: 1. End of test hole at 16.6 m. 2. Refusal encountered in silt till at a depth of 16.5 m. 3. Test hole remained open to 16.6 m upon completion of drilling/digging. 4. Test hole backfilled with auger cuttings and bentonite chips. An approximate 4.0 m of bentonite seal at surface. 5. Protective well cover installed at surface.											
214														
213														
212														

WATER LEVELS

▽ During Drilling/Digging
 ▽ Upon Completion
 ▽ Remeasured/Static

10.67 m
 Dry
 8.23 m on 12-16-2023

CONTRACTOR
 Paddock Drilling

APPROVED
 T. SCHELLENBERG

INSPECTOR
 H. SABHARWAL

DATE
 4-28-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 1 General Investigation	SURFACE ELEV.	233.11 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	1.01 m / 234.13 m (Standpipe)
DESCRIPTION	2 m north of test hole TH23-06	START DATE	4-14-2023
DRILL RIG / HAMMER	Mobile B57 Track Mounted Drill Rig with Auto-Hammer	UTM (m)	N 5,517,701
METHOD(S)	0.0 m to 0.9 m: 125 mm ø SSA		E 630,534.08 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
					DIAGRAM	DEPTH (m)			
233			CLAY (CH) - Dark brown, trace organics, with sand, frozen.	232.7		0.30			
			CLAY (CL) - Light brown, low plasticity, some sand, some gravel, frozen.	232.2		0.91			
232	1.0		Notes: 1. End of test hole at 0.9 m. 2. Test hole remained open to 0.9 m upon completion of drilling/digging. 3. Test hole backfilled with bentonite chips. An approximate 0.3 m of bentonite seal at surface. 4. Protective well cover installed at surface.						
	5								
	2.0								
231									
	10								
230									
	15								
229									
	20								
228									
	25								
227									
	30								
226									
225									
224									

WATER LEVELS	☐ During Drilling/Digging ☒ Upon Completion ☐ Remeasured/Static	Dry Dry on 12-16-2023 Dry	CONTRACTOR Paddock Drilling	INSPECTOR H. SABHARWAL
			APPROVED T. SCHELLENBERG	DATE 4-28-2023

KEY TO SYMBOLS

LITHOLOGIC SYMBOLS



Clay (CH, high plasticity)



Clay (CL, low plasticity)



Silt Till



Topsoil

SAMPLER SYMBOLS



Auger Grab



Shelby Tube



SPT Split Spoon

WELL CONSTRUCTION SYMBOLS



Slough



Standpipe (bentonite)



Standpipe (cuttings)



Standpipe (filter sand)



Screen (filter sand)

ABBREVIATIONS

LL - Liquid Limit
 PL - Plastic Limit
 PI - Plastic Index
 MC - Moisture Content
 DD - Dry Density
 NP - Non-Plastic
 -200 - Percent Passing No. 200 Sieve
 TV - Torvane (kPa)
 PP - Pocket Penetrometer (kPa)
 PSA - Particle Size Analysis
 TOC - Top Of Casing

PN - Pneumatic Piezometer
 VW - Vibrating Wire Piezometer
 PID - Photoionization Detector
 ppm - Parts Per Million
 Water Level During Drilling
 Water Level Upon Completion of Drilling
 Water Level Remeasured/Static

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 2 Detailed Investigation	SURFACE ELEV.	232.99 m
LOCATION	Winnipeg, Manitoba	START DATE	11-27-2023
DESCRIPTION	NE Corner Recreation Centre Building	UTM (m)	N 5,517,674
DRILL RIG / HAMMER	Acker MP5 Track Mounted Drill Rig with Safety Drop Hammer		E 630,594 Zone 14
METHOD(S)	0.0 m to 15.3 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲
										20 40 60 80
			TOPSOIL - 152 mm, Black, damp, non-plastic, some rootlets, frozen. ELEV (m) 232.8							
			CLAY (CL) - Light brown, damp, low plasticity, and silt, frozen. 232.4			S1				
			CLAY (CH) - Brown, damp, high plasticity, silty, frozen.							
232	1.0		- firm below 1.0 m.			S2				
	5									
			CLAY (CL) - Brown, damp, firm, low plasticity, and silt. 231.5							
231	2.0					S3				
						S4				
230	3.0		- wet below 3.0 m.			S5				
						S6				
229	4.0					S7				
			CLAY (CH) - Grey, moist, firm, high plasticity, trace to some silt. 228.7							
	15									
228	5.0					S8				
227	6.0									
	20									
226	7.0					S9				
225	8.0					S10				
224	9.0		- trace fine gravel below 9.1 m.							
	30									

WATER LEVELS ▽ During Drilling/Digging 3.05 m ▼ Upon Completion 14.63 m	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR J.Loewen
	APPROVED T. SCHELLENBERG	DATE 12-14-2023

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆			qu POCKET PEN (kPa) ★			SPT (N) BLOWS/0.30 m ▲		
										20	40	60	80	20	40	60	80	
222	11.0		- soft below 11.3 m.			S11												
221	12.0					S12												
220	13.0					S13												
219	14.0		- till transition below 12.2 m.															
218	15.0					S14												
217	16.0		SILT TILL - Grey, wet, very dense, trace medium gravel, fine-grained to coarse-grained sand, some clay.			S15	75	50/ 40mm	+100									
216	17.0																	
215	18.0																	
214	19.0																	
213	20.0																	
212	21.0																	
	70																	

Notes:

- End of test hole at 15.3 m.
- Refusal encountered on boulder or bedrock at a depth of 15.3 m.
- Test hole remained open to 15.3 m upon completion of drilling/digging.
- Test hole backfilled with bentonite chips.

WATER LEVELS

During Drilling/Digging	3.05 m
Upon Completion	14.63 m

CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR J.Loewen
APPROVED T. SCHELLENBERG	DATE 12-14-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT LOCATION	South Winnipeg Rec. Campus - Phase 2 Detailed Investigation	SURFACE ELEV.	233.03 m
DESCRIPTION	NE Corner of Recreation Centre Building	START DATE	11-28-2023
DRILL RIG / HAMMER	Acker MP5 Track Mounted Drill Rig with Safety Drop Hammer	UTM (m)	N 5,517,677.59
METHOD(S)	0.0 m to 4.6 m: 125 mm Ø SSA		E 630,601.69 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80			
					DIAGRAM	DEPTH (m)						
			ELEV (m)									
			<u>TOPSOIL</u> - 152 mm, Black, damp, non-plastic, some rootlets, frozen. 232.9									
			<u>CLAY (CL)</u> - Light brown, damp, low plasticity, and silt, frozen. 232.4									
232	1.0		<u>CLAY (CH)</u> - Brown, damp, high plasticity, silty, frozen. 231.5									
	5		<u>CLAY (CL)</u> - Brown, damp, firm, low plasticity, and silt. 231.5									
231	2.0											
	10		- wet below 3.0 m.									
230	3.0											
	15											
229	4.0		<u>CLAY (CH)</u> - Grey, moist, firm, high plasticity, trace to some silt. 228.8									
	15		228.5									
228	5.0		Notes: 1. End of test hole at 4.6 m. 2. Test hole remained open to 4.6 m upon completion of drilling/digging. 3. Grout mix consisted of 13 part cement, 10 part bentonite, 77 part water. 4. Protective well cover installed at surface. 5. VW176043 water level on Dec 15, 2025 @ 1.48 m.									
227	6.0											
	20											
226	7.0											
	25											
225	8.0											
	30											
224	9.0											

WATER LEVELS	▽ During Drilling/Digging	3.05 m	CONTRACTOR	INSPECTOR
	▼ Upon Completion	4.20 m	Maple Leaf Drilling Ltd.	J.Loewen
			APPROVED	DATE
		T. SCHELLENBERG	12-14-2023	

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 2 Detailed Investigation	SURFACE ELEV.	232.95 m
LOCATION	Winnipeg, Manitoba	START DATE	11-27-2023
DESCRIPTION	SE Corner of Recreation Centre Building	UTM (m)	N 5,517,644.38
DRILL RIG / HAMMER	Acker MP5 Track Mounted Drill Rig with Safety Drop Hammer		E 630,622.8 Zone 14
METHOD(S)	0.0 m to 15.3 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
			ELEV (m) 232.8 TOPSOIL - 204 mm, Black, damp, non-plastic, some rootlets, frozen.							
			CLAY (CL) - Brown, damp, low plasticity, and silt, frozen.			S1				
232	1.0					S2				
	5		- firm below 1.5 m.			S3				◆
231	2.0									
	10					S4				
230	3.0									
	15					S5				
229	4.0		ELEV (m) 229.3 CLAY (CH) - Brown, moist to wet, firm, high plasticity, trace to some silt.			S6				◆
	15		- grey below 4.6 m.			S7				◆
228	5.0					S8				
	20					S9				◆
227	6.0									
	25		- soft below 7.0 m.			S10				◆
226	7.0									
	30		- trace fine to medium sand below 7.6 m.			S11				◆
225	8.0									
224	9.0									
223										

WATER LEVELS

▽ During Drilling/Digging	3.35 m
▼ Upon Completion	14.63 m

CONTRACTOR	INSPECTOR
Maple Leaf Drilling Ltd.	J.Loewen
APPROVED	DATE
T. SCHELLENBERG	12-14-2023

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲
										20 40 60 80
222	11.0									
221	12.0									
220	13.0									
219	14.0									
218	15.0		SILT TILL - Grey, moist to wet, very dense, trace medium gravel, fine-grained to coarse-grained sand, some clay.							
217	16.0		Notes: 1. End of test hole at 15.3 m. 2. Refusal encountered in silt till at a depth of 15.3 m. 3. Test hole remained open to 15.3 m upon completion of drilling/digging. 4. Test hole backfilled with bentonite chips.							
216	17.0									
215	18.0									
214	19.0									
213	20.0									
212	21.0									
	70									

WATER LEVELS

▽ During Drilling/Digging 3.35 m

▼ Upon Completion 14.63 m

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
J.Loewen

APPROVED
T. SCHELLENBERG

DATE
12-14-2023

PROJECT NO.	23-0107-005
SURFACE ELEV.	232.77 m
START DATE	11-28-2023
UTM (m)	N 5,517,642.93
	E 630,582.47 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL						
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲	20	40	60	80
			ELEV (m) TOPSOIL - 204 mm, Black, damp, non-plastic, frozen, some rootlets. CLAY (CL) - Light brown, damp to moist, low plasticity, and silt, some topsoil, frozen. CLAY (CH) - Grey, moist, high plasticity, frozen, some silt, trace fine-grained sand.															
			232.6															
			232.3															
								</										

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲					
					DIAGRAM	DEPTH (m)											
222	35		- trace medium sand and fine gravel below 10.7 m.					S10									
221	40																
220	45																
219	45		SILT TILL - Grey, moist, dense, trace medium gravel, fine-grained to coarse-grained sand, some clay. - very dense, dry below 13.7 m.	219.4				S11									
218	50																
217	55																
216	60							S12									
215	65							S13									
214	70							S14	60	35 30 50/ 100mm	+100					>>▲	
213	75							S15	100	50/ 50mm	+100					>>▲	
212	80																
211	85																
Notes: 1. End of test hole at 15.3 m. 2. Refusal encountered in silt till at a depth of 15.3 m. 3. Test hole remained open to 15.3 m upon completion of drilling/digging. 4. Test hole backfilled with bentonite chips. 5. Grout mix consisted of 13 part cement, 10 part bentonite, 77 part water. 6. Protective well cover installed at surface. 7. VW175851 water level on Dec 15, 2023 @ 5.28 m. 8. VW176039 water level on Dec 15, 2023 @ 6.65 m.																	

WATER LEVELS

▽ During Drilling/Digging

▼ Upon Completion

None Encountered

Dry

CONTRACTOR

Maple Leaf Drilling Ltd.

APPROVED

T. SCHELLENBERG

INSPECTOR

J.Loewen

DATE

12-14-2023

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 2 Detailed Investigation	SURFACE ELEV.	233.06 m
LOCATION	Winnipeg, Manitoba	START DATE	11-28-2023
DESCRIPTION	NW Corner of Recreation Centre Building	UTM (m)	N 5,517,639.69
DRILL RIG / HAMMER	Acker MP5 Track Mounted Drill Rig with Safety Drop Hammer		E 630,538.9 Zone 14
METHOD(S)	0.0 m to 15.3 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
233			TOPSOIL - 610 mm, Black, damp, non-plastic, trace rootlets, frozen.							
	1.0		CLAY (CL) - Light brown, damp, low plasticity, and silt, frozen.			S1				
232			- Silt below 0.9 m.							
	5		CLAY (CH) - Brown, damp, stiff, high plasticity, trace to some silt trace to some silt, frozen.			S2				
			- stiff below 1.5 m.							
231	2.0					S3				
230	3.0		- grey below 3.0 m.			S4				
229	4.0					S5				
228	5.0					S6				
227	6.0					S7				
226	7.0					S8				
225	8.0					S9				
224	9.0					S10				

WATER LEVELS ▽ During Drilling/Digging None Encountered
 ▽ Upon Completion Dry

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
J.Loewen

APPROVED
T. SCHELLENBERG

DATE
12-14-2023

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲	
223											
	35		- trace medium sand, trace fine gravel below 10.7 m.		S11						
222	11.0										
	40				S12						
221	12.0										
	45										
220	13.0										
	45		SILT TILL - Grey, damp, very dense, trace medium gravel, fine-grained to coarse-grained sand, some clay.		S13		75	21 34 46	80		
219	14.0										
	50				S14						
218	15.0				S15		100	50/ 50mm	+100		
			Notes: 1. End of test hole at 15.3 m. 2. Refusal encountered in silt till at a depth of 15.3 m. 3. Test hole remained open to 15.3 m upon completion of drilling/digging. 4. Test hole backfilled with bentonite chips.							>>▲	
217	16.0										
	55										
216	17.0										
	60										
215	18.0										
	65										
214	19.0										
	70										
213	20.0										
212	21.0										
	70										
WATER LEVELS ▽ During Drilling/Digging ▼ Upon Completion				None Encountered Dry		CONTRACTOR Maple Leaf Drilling Ltd.				INSPECTOR J.Loewen	
				APPROVED T. SCHELLENBERG				DATE 12-14-2023			

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	23-0107-005
PROJECT	South Winnipeg Rec. Campus - Phase 2 Detailed Investigation	SURFACE ELEV.	232.71 m
LOCATION	Winnipeg, Manitoba	START DATE	11-29-2023
DESCRIPTION	SW Corner of proposed Recreation Centre Building	UTM (m)	N 5,517,608.4
DRILL RIG / HAMMER	Acker MP5 Track Mounted Drill Rig with Safety Drop Hammer		E 630,559.66 Zone 14
METHOD(S)	0.0 m to 16.0 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
			ELEV (m)							
			TOPSOIL - 610 mm, Black, damp, non-plastic, with rootlets, frozen.							
232	1.0		CLAY (CL) - Black, damp, low plasticity, and silt, frozen. - brown below 0.7 m.		S1					
	5		- stiff below 1.4 m.		S2					
231	2.0		CLAY (CH) - Brown, damp, stiff, high plasticity, trace to some silt.		S3					
	10		- grey below 3.0 m.		S4					
230	3.0				S5					
	15				S6					
229	4.0				S7					
	20				S8					
228	5.0									
	25		- firm below 7.6 m.		S9					
227	6.0									
	30				S10					
226	7.0									
225	8.0									
224	9.0									
223										

WATER LEVELS ▽ During Drilling/Digging None Encountered
 ▽ Upon Completion Dry

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
J.Loewen

APPROVED
T. SCHELLENBERG

DATE
12-14-2023

KGS LOG U:\FMS\23-0107-005\23-0107-005.GPJ

PROJECT NO.	23-0107-005
SURFACE ELEV.	232.64 m
START DATE	11-29-2023
UTM (m)	N 5,517,566.81
	E 630,513.68 Zone 14

ELEVATION (m)		DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL				Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲
(m)	(ft)	(m)	(ft)									20	40	60	80			

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
222	35					S11				
221	40		- soft, silt till transition below 12.2 m.			S12				
220	45									
219	45		SILT TILL - Grey, damp, dense, trace medium gravel, fine-grained to coarse-grained sand, some clay.			S13				
218	50		- very dense below 13.7 m.			S14	77	26 45 50/ 90mm	+100	>>▲
217	55					S15				
216	60					S16	100	50 50/ 20mm	+100	>>▲
215	65		Notes: 1. End of test hole at 15.5 m. 2. Refusal encountered on boulder or bedrock at a depth of 15.5 m. 3. Test hole caved to 15.2 m upon completion of drilling/digging. 4. Test hole backfilled with bentonite chips.							

WATER LEVELS
 ▽ During Drilling/Digging 13.72 m
 ▼ Upon Completion 13.72 m

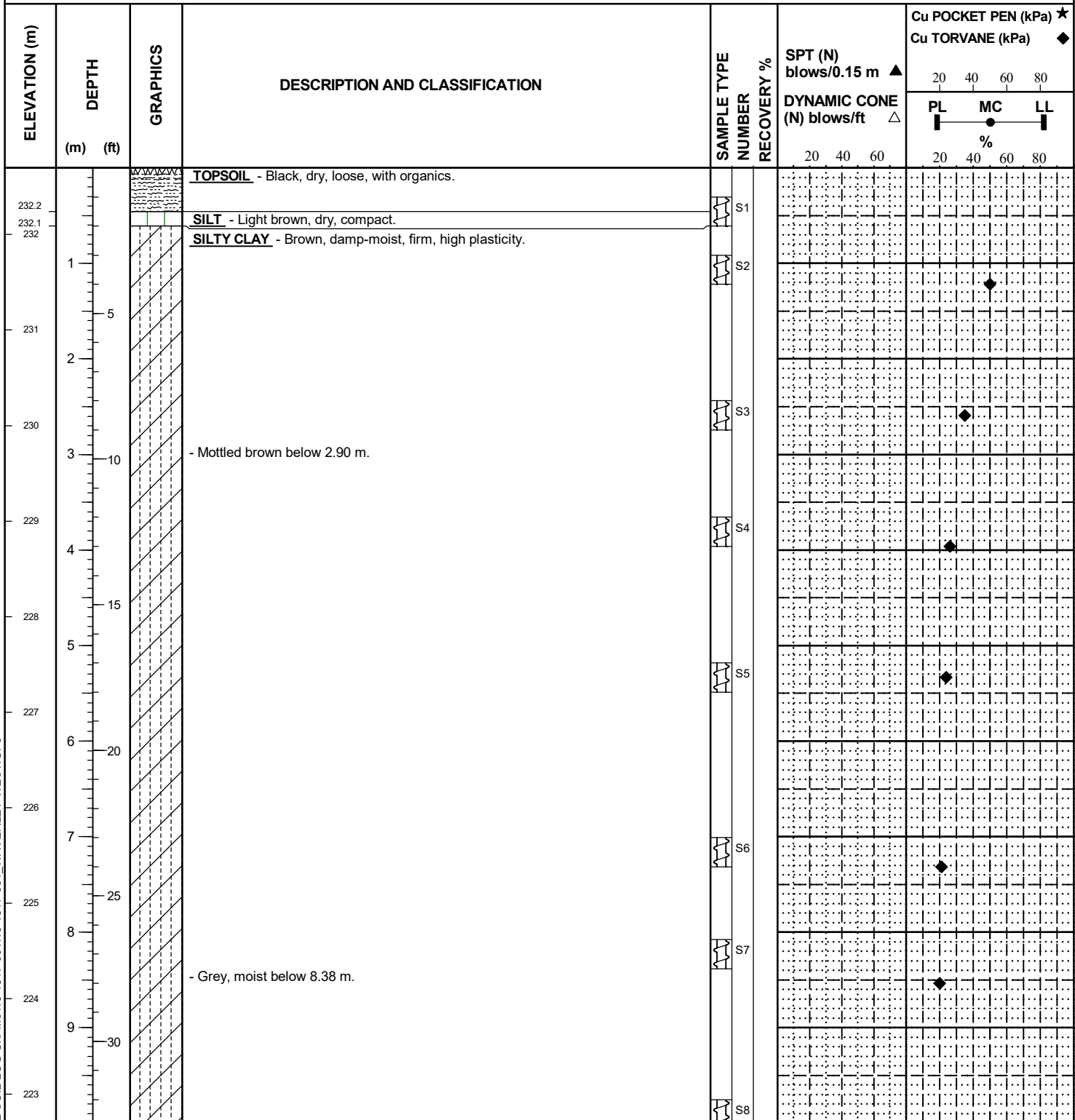
CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR J.Loewen
APPROVED T. SCHELLENBERG	DATE 12-14-2023

APPENDIX B

2018 and 2023 Test Hole Logs

CLIENT
PROJECT Waverley West School Geo. Investigation
SITE 2 Design-Build Schools in Waverley West
LOCATION Cadboro Road - South Lot
DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. 18-1517-001
GROUND ELEV. 232.70
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED 10/26/2018
UTM (m) N 5,517,718
E 630,631



SAMPLE TYPE ☒ Auger Grab ☒ Split Spoon

CONTRACTOR
Paddock Drilling Ltd.

INSPECTOR
J. WONG

APPROVED
D. ANDERSON

DATE
2/12/19

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★	Cu TORVANE (kPa) ◆
	(m)	(ft)								20 40 60 80	PL MC LL
222	35	11									
221	40	12			S9						
220	45	13		- Increase in fine to coarse grained gravel below 12.80 m.	S10						
219.9	45	14		SILT TILL - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.	S11						
218	50	15			S12						
217.4	50	15		- 50 blows for 3.5" in the first SPT set.	S13	15					
217				POWER AUGER REFUSAL AT 15.33 m							
216	55	16		Notes: 1. Hole open to 13.24 m below grade after completion of drilling. 2. Water was at observed at 11.15 m after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.							
215	60	17									
214	65	18									
213	70	19									
212											
211											

- Increase in fine to coarse grained gravel below 12.80 m.

SILT TILL - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.

- 50 blows for 3.5" in the first SPT set.

POWER AUGER REFUSAL AT 15.33 m

Notes:

- Hole open to 13.24 m below grade after completion of drilling.
- Water was at observed at 11.15 m after completion of drilling.
- Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ☒ Auger Grab ☐ Split Spoon

CONTRACTOR
Paddock Drilling Ltd.

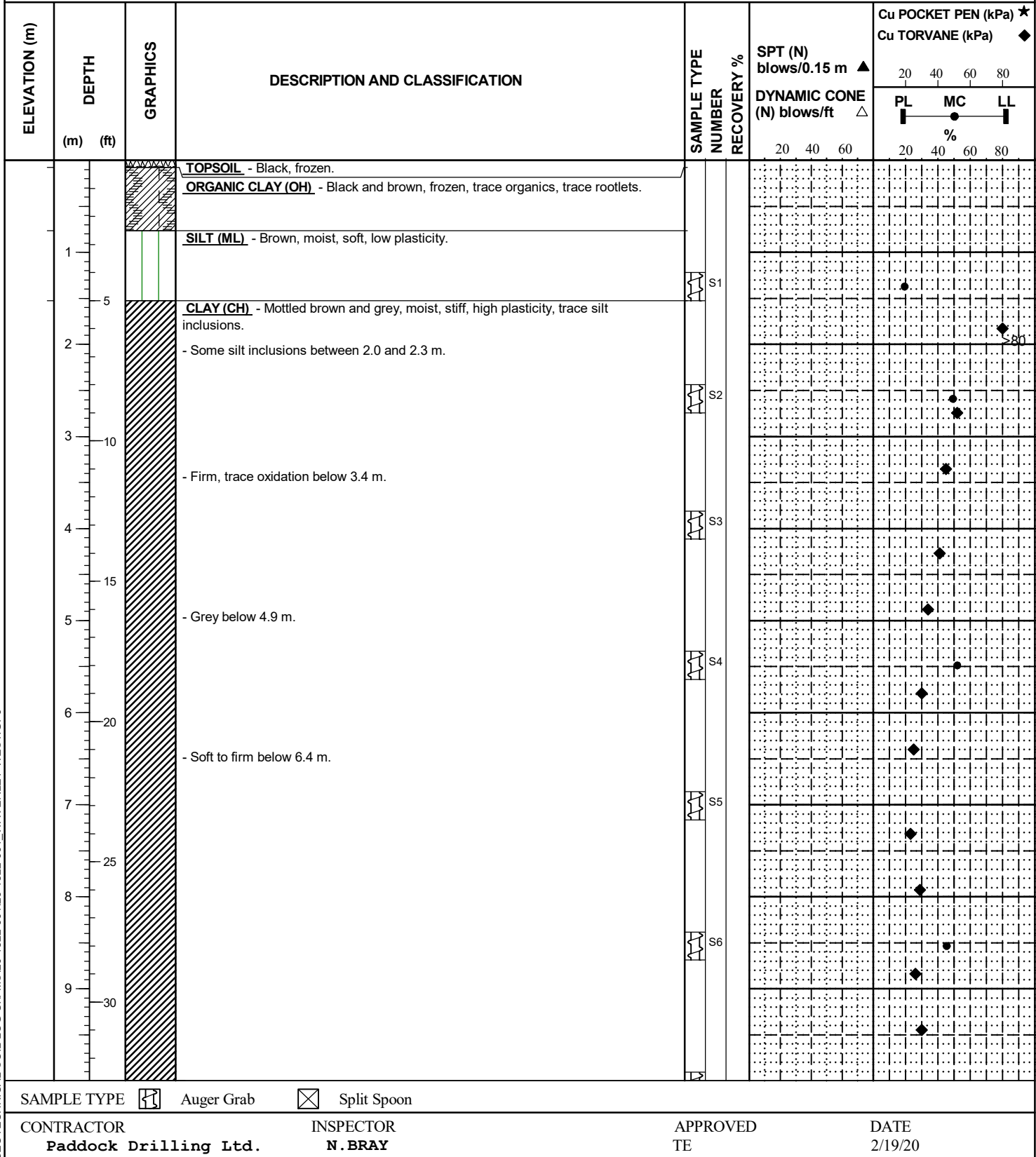
INSPECTOR
J. WONG

APPROVED
D. ANDERSON

DATE
2/12/19

CLIENT PEMBINA TRAILS SCHOOL DIVISION
PROJECT Waverley West School Geo. Investigation - Extra Services
SITE Waverley West, Cadboro Rd.
LOCATION South End Lot, Southeast/Central Daycare
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. 20-1522-001
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 1/21/2020
UTM (m) N 5,517,711
 E 630,677



ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆
					20 40 60	20 40 60 80 PL MC LL %
	35		- Soft below 10.4 m.	S7		
11						
	40			S8		
12						
	45		- Increased silt inclusions, trace coarse sand below 12.8 m.	S9		
13						
			SILT TILL - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.	S10		
14						
			POWER AUGER REFUSAL AT 14.9 m	S11	50	
15						
	50					
16			Notes: 1. Test hole remained open to 14.0 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.			
	55					
17						
	60					
18						
	65					
19						
	70					
20						
21						

SAMPLE TYPE ☒ Auger Grab ☒ Split Spoon

CONTRACTOR
Paddock Drilling Ltd.

INSPECTOR
N. BRAY

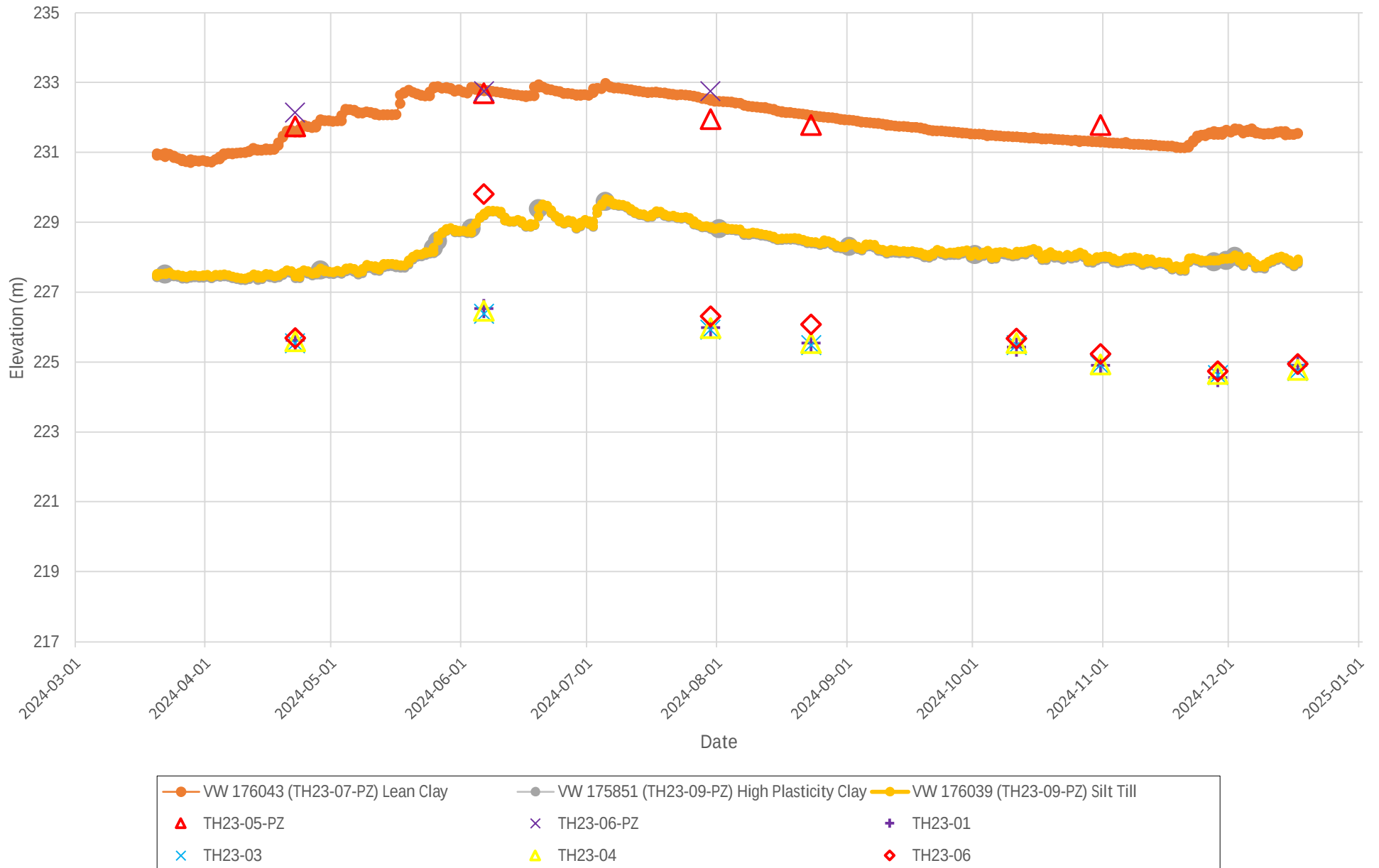
APPROVED
TE

DATE
2/19/20

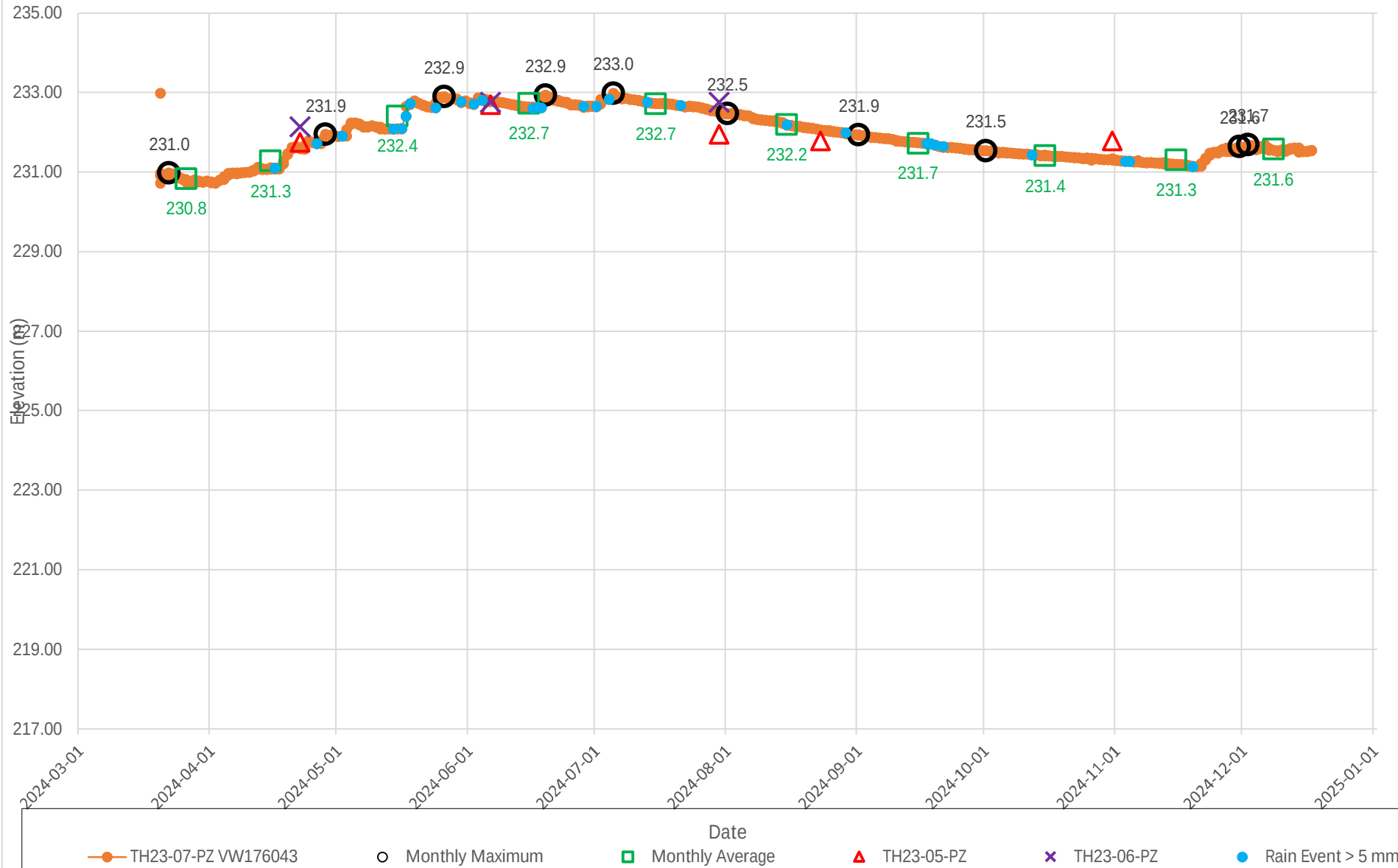
APPENDIX C

Groundwater Monitoring Plots

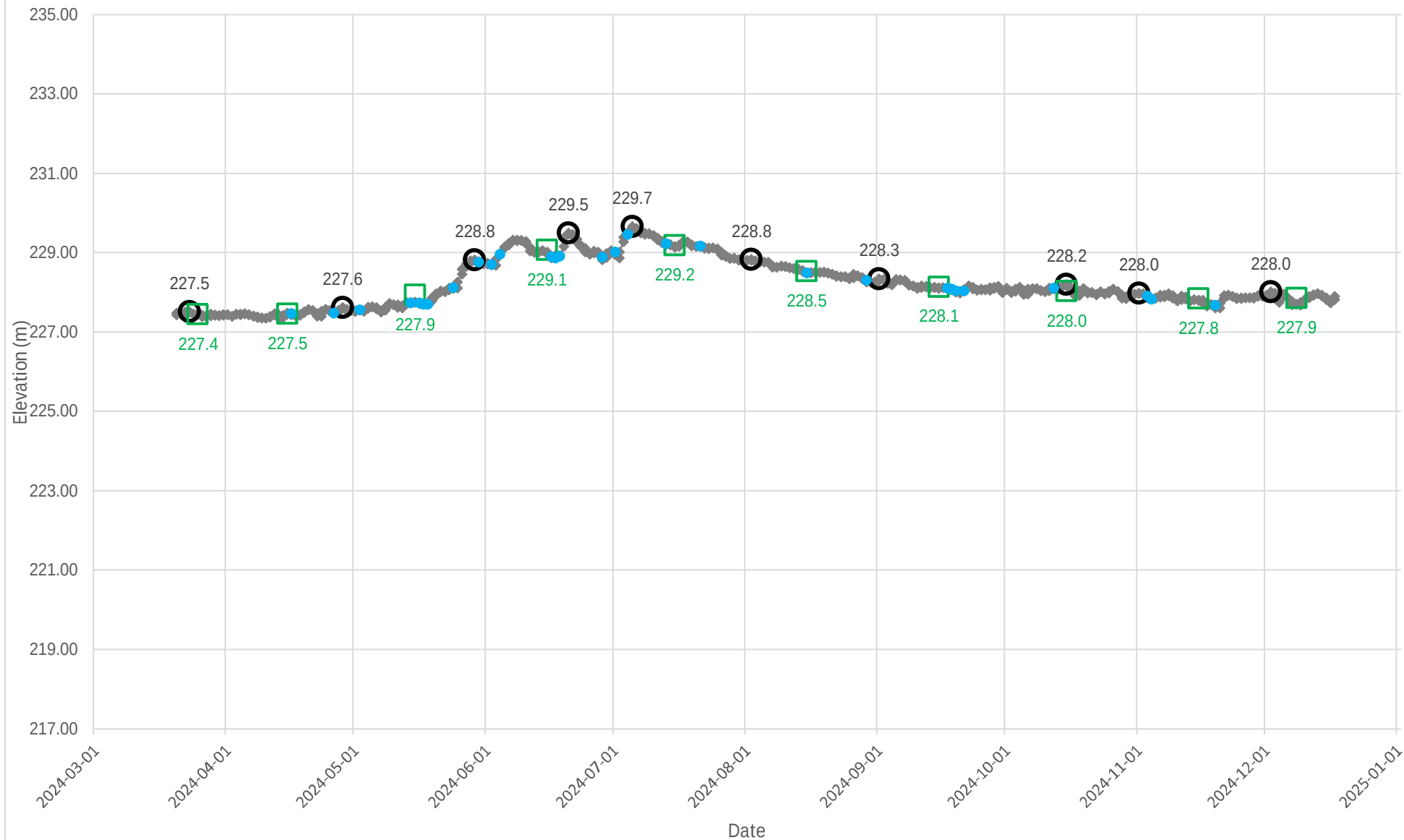
Combined Standpipe and Vibrating Wire Piezometer Data



Lean Clay (CL) Standpipe and Vibrating Wire Piezometer Data



Fat Clay Vibrating Wire Piezometer Plot



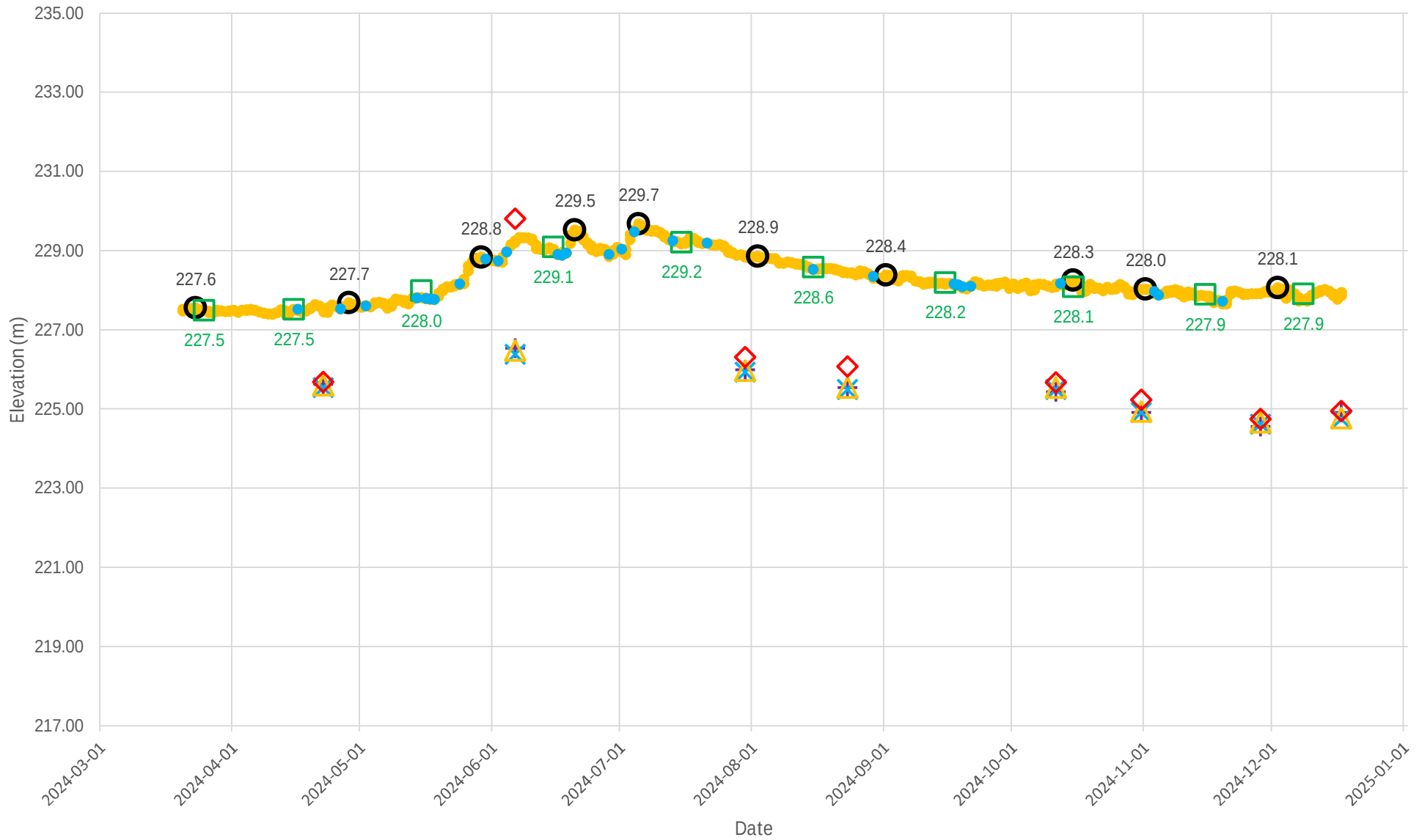
—◆— TH23-09-PZ VW175851

● Monthly Maximum

□ Monthly Average

● Rain Event > 5 mm

Silt Till Standpipe and Vibrating Wire Piezometer Data



TH23-09-PZ VW176039 Monthly Maximum Monthly Average TH23-01 TH23-03 TH23-04 TH23-06 Rain Event > 5 mm