REVISED LETTER REPORT

DATE: March 19, 2013

FILE: SU 13 012 00 SU

TO: **R.S. HARRIS TRANSPORT LTD.**
15-555 Hervo Street
Winnipeg, MB.
R3T 3L6
Attn: John Friesen c/o
Bob Harris, owner

FAX: 204-255-2230

FROM: **SILVESTRE S. URBANO JR., P.ENG.**
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FAX:

RE: GEOTECHNICAL REVIEW FOR AG CHEMICAL STORAGE BUILDING FOUNDATION RECOMMENDATION FOR THE PROPOSED NEW BUILDING

A total of three testholes were drilled on March 12, 2013 for the new AG Chemical Storage building located at 555 Hervo Street, Winnipeg. Based on these, it was requested that foundation and slab recommendations for a proposed new building be provided. The three testholes drilled between 7.6m and auger refusal (17.1m and 17.4m) revealed a general soil profile consisting of a layer of fill underlain by a clay layer over a glacial till layer which extended to the depth explored. *Seepage and caving conditions were observed in all of the testholes after completion of drilling; note that the seepage is coming from the till layer for both TH1 and TH3 and from the fill layer for TH2.* Detailed descriptions of the subsurface conditions are attached as well as the testhole location plan.

GEOTECHNICAL RECOMMENDATIONS

Foundation alternatives, which were considered, include cast-in-place (CIP) concrete friction piles and precast concrete driven piles end-bearing on the native undisturbed dense till or suspected bedrock/boulder.

The preferred foundation, which may be utilized for this structure, is a system of precast concrete driven piles end-bearing on the native undisturbed dense till or suspected bedrock/boulder. Alternatively, a system of cast-in-place friction pile with temporary sleeve (see TH2) could be used.

PRECAST, PRESTRESSED DRIVEN CONCRETE PILES

The preferred foundation for the proposed new building is a system of driven, prestressed, precast concrete piles. These units, when driven to practical refusal in the dense till with a heavy hammer capable of delivering a rated energy of 40672.4 N-m(30,000 ft-lbs) per blow, may be assigned the following allowable loads.

Pile Size mm(in)	Allowable Loads kN, (tons)
300(12) hex	443 (50)
350(14) hex	620 (70)
400(16) hex	797 (90)

With Limit State Design, the following loads at Serviceability Limit State (SLS) and Ultimate Value are tabled below. For factored Ultimate Limit State (ULS), the ULS can be obtained by multiplying the Ultimate Value by the resistance factor of 0.55.

Table 1

Pile Size, mm(in)	SLS, kN (tons)	Ultimate Value, kN (tons)	Resistance Factor
300 (12)	443 (50)	1107.5 (125)	0.55
350 (14)	620 (70)	1550.0 (175)	0.55
400 (16)	797 (90)	1992.5 (225)	0.55

Pile spacing should not be less than 3 pile diameters, centre to centre. Pile heaving at groups should be monitored and redriving done where pile heaving is found to be significant. The pile driving may induce some vibration and subsoil displacements. To avoid unjustified damage claim, a preconstruction survey of adjacent buildings in the form of inspection and taking photographic documentation should be enforced prior to the pile installation.

To reduce the effects of pile driving upon adjacent buildings and buried services, preboring to at least 3m below grade should be considered for all driven pile locations. The prebore hole should be equal to the nominal pile diameter.

To ensure that all piles can be driven adequately to a safe bearing stratum and to develop the recommended loads, full time pile inspection by qualified geotechnical personnel is recommended. Practical refusal can be defined as the final penetration resistance of 5, 8, and 12 blows per 25mm for the 300, 350 and 400mm sizes respectively. The final penetration resistances should be achieved at least 3 times for the final resistance. *Pile installation may also be adversely affected by existing underground cables, loose backfill, numerous silt seams inclusions, cobbles and boulders*. Thus, contract documents should properly cover these potential obstacles during pile installation.

The estimated pile refusal depths at this location are approximately 15.8 to 16.7m below grade on dense till or suspected bedrock/boulder. Precaution should be taken in determining the pile refusal depth as the dense till or suspected bedrock/boulder depth may vary from our testhole location.

CAST-IN-PLACE FRICTION PILE (CIP)

Alternatively, CIP friction pile system maybe used for the proposed new building. Due to weak shear strength of the clay beyond 9.1m depth, pile length longer than 9.1m is not recommended. Using pile lengths of 9.1m (30 ft) below grade, an allowable shaft adhesion value of 13.6 kPa (284 psf) applied to the pile circumference within the native clay may be used for the pile design. If needed, the allowable adhesion value for a pile length longer than 9.1m is calculated and shown in the LSD table. *Note that temporary sleeve might be needed to seal off any seepage from the till and fill seam layer. Temporary steel sleeves should be on hand and used if needed during pile installation; depth of temporary sleeves should be contractor's responsibility.*

Considering potential long-term soil shrinkage away from the pile face, the upper 1.5m (5 ft) of the piles

should be neglected in determining the capacity of all interior piles. For the exterior piles, the upper 3.0m(10 ft) of the piles should be ignored. If heavier loads are used, the utilization of a single, larger diameter friction pile is preferred.

With Limit State Design, the following loads at Serviceability Limit State (SLS) and Ultimate Value are shown in Table 2. *For factored Ultimate Limit State (ULS), the ULS can be obtained by multiplying the Ultimate Value by the resistance factor of 0.55.*

Table 2

Pile Length,m	SLS, kPa	Ultimate Value, kPa	Resistance Factor
3m to 7.6m	14.7	36.8	.55
3m to 9.1m	13.6	34.0	.55
3m to 10.7m	12.8	32.0	.55
3m to 12.2m	12.1	30.2	.55

Pile spacing should be at least three pile diameters, centre to centre. To minimize pile construction difficulties, the total number of pile holes left open at any given time should not be more than four and the pile holes should be poured with concrete as soon as they are drilled to the design diameters and depths. Pile inspection by qualified geotechnical personnel should therefore be employed to ensure a satisfactory foundation installation.

Piles located in unheated areas should be provided with full-length reinforcements, a minimum pile length of 7.62m(25 ft) and the top 2.1m(7 ft) of the pile should be wrapped with greased sono tube to reduce the potential for frost jacking.

Pile installation may be adversely affected also by loose backfill, seepage and the possible presence of existing concrete slabs(old building). Thus, contract documents should properly cover these potential obstacles during pile installation.

If any piles are subjected to highly repetitive or vibratory loads, the above capacities should be reduced by 50%. The allowable uplift capacities of piles may be assumed to be approximately 40% of the allowable pile capacity.

PROPOSED FLOOR SLAB

The anticipated floor slab structure is slab-on-grade. Due to the presence of significant fill/backfill material(average depth of fill is about 1.8m to 2.7m based on TH1 to TH3 conditions) and the swelling/shrinkage characteristics of the plastic clay at this location, a slab-on-grade floor without preparation will likely experience long term movements of about 100 to 150mm. For this reason, a structural floor supported on piles and separated from the underlying subsoils with a minimum 300mm void space is recommended. A similar void should be provided under grade beams and pile caps.

Where potential long-term slab movements of about 25mm are deemed acceptable to the owner, the main floor of the proposed building where clay fill was measured over 600mm may be supported on clay fill subgrade. To minimize the rate and magnitude of total and differential floor movements, subgrade preparation for floor construction should include a complete removal of at least 600mm of clay fill and replaced with at least 450mm of well-grade subbase material and topped with 150mm of base course material. All of the granular materials are uniformly compacted in maximum 150mm lifts to 98% and 100% standard Proctor density, respectively. *The exposed fill subgrade should be proof rolled with a heavy sheepsfoot roller (min. 20 passes) which translates to at least 95% STD Proctor thereby exposing any soft areas. Any softened encountered areas should be excavated an additional 300mm, covered with non-woven geotextile and replaced with 100mm down, crushed, clean limestone.*

The anticipated clay fill subgrade is consisted of grey-black clay mixed with fine gravel. The estimated Modulos Subgrade Reaction of this material is 2.76 kg/cm^3 (100 pci).

Saturated soil conditions, if encountered, should be dried off by quickly excavating sump pit or installing permanent subdrains connected to a catch basin prior to placing the slab-on-grade structure. The base course and subbase materials should conform to City of Winnipeg grading limit specifications. For permanent drainage, filter-protected perimeter and under-floor weeping tiles should be provided at least 300 mm below the underside of the slab and connected to a positive outlet.

Where heavier loading is anticipated at any given floor area, proper construction joint between the heavier loaded floor area and lightly loaded floor area should be constructed to accommodate possible relative movements between the two. *The floor slab should have a minimum thickness of 225mm at the heavy area underlain by the required depth of granular fill.*

EXISTING BUILDING

The depth and extent of the existing building could not be determined during our field investigation, as inspection of these premises was not conducted. Based on local information, any floor slab with granular fill is likely constructed down to 1.2m below grade. The following recommendations are provided for subgrade preparation at the existing building location.

- All concrete foundations, walls, floor slab and softened soils or soft backfill should be removed; the final excavation floor may range from 1.0 to 1.5m m from grade.

- Call for subgrade inspection and approval of the final excavation bottom by the designated geotechnical engineer, prior to backfilling.

- Once the final excavation bottom is approved and subject to dewatering (if water is present), the excavation may be backfilled with durable granular subbase fill (75 mm maximum well-graded pit run aggregate) in maximum 300 mm lifts. Each fill lift should be compacted uniformly with a proper roller to

at least 95% Standard Proctor density (ASTM D698). The gradation limits for the granular subbase should conform to the City of Winnipeg specification.

- To ensure that the granular subbase materials can be uniformly compacted to a dense mass, the old floor slab should be backfilled first up to the underside of the pavement.

ADDITIONAL CONSIDERATIONS

For any concrete apron, sidewalk, curbs, the pavement structure should consist of 150mm reinforced concrete followed by 150mm of compacted (98% Standard Proctor Density) base course over the compacted subgrade. If a silt layer was encountered as subgrade, the application of non-woven geotextile over the silt layer is recommended. Exterior, grade supported concrete slabs will be subjected to some seasonal vertical movements related to frost. Exterior concrete slabs should not be tied into rigid structures such as grade beams, pile caps or interior slabs. To minimize the movements, consideration should be given to the use of rigid synthetic insulation, outward laterally (minimum 1.8m length and about 100mm thick) and beneath the structure. In addition, localized subsurface drainage should be provided around the structure.

To ensure adequate site drainage, the following recommendations are made:

- A 10% slope (8 in. in 6.5 ft) should be considered for the first 1.8m(6 ft) from the foundation wall. It may be necessary to regrade at the end of the first year.
- Make sure that downspout extensions direct water away from walls. Provide splashblocks away from walls to prevent erosion and ponding.
- On a sloping site, grade from the centre out to the corners of the building. Provide a swale.

Concrete should be manufactured with sulphate-resistant (Type 50) cement, minimum compressive strength of 32 mPa and air content between 4% and 7%. Any concrete subject to cycles of freezing and thawing should be air entrained in accordance with the latest edition of CSA A23.1, Concrete Materials and Methods of Concrete Construction.

CLOSURE

The findings and geotechnical recommendations provided in this report were prepared by SILVESTRE S. URBANO(the Consultant) in accordance with generally accepted professional engineering principles and practices. The recommendations are based on the results of field and laboratory investigations and are reflective only of the actual testhole(s) and/or excavation(s) examined. If conditions encountered during construction appear to be different than those shown by the testhole(s) and/or excavation(s) at this site, the Consultant should be notified immediately in order that the recommendations can be reviewed and modified as necessary to address actual site conditions.

This report is limited in scope to only those items that are specifically referenced in this report. Environmental or Phase 2 Environmental Site Assessment is not included in our scope of work. There may

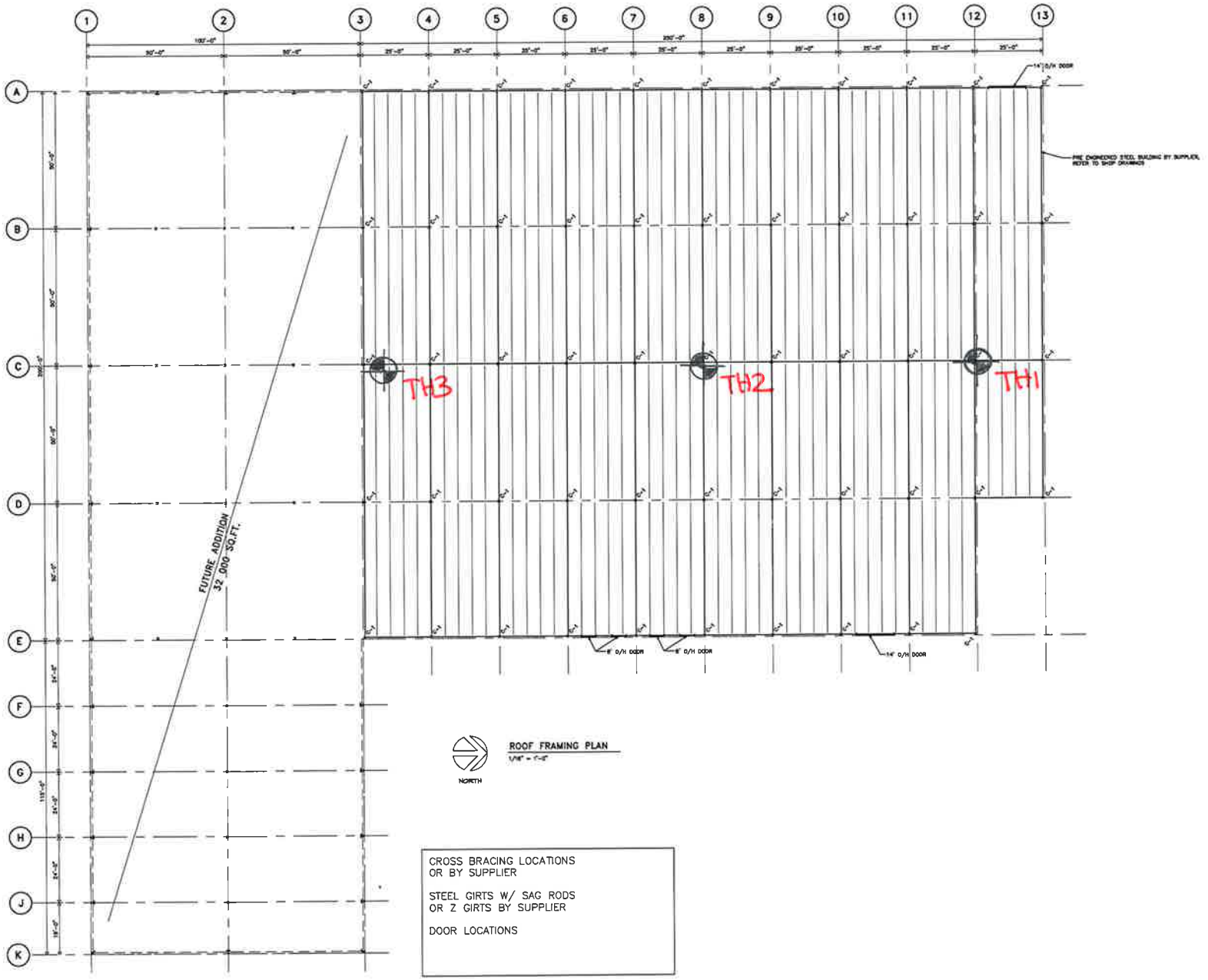
be existing conditions that were not recorded in this report. Such conditions were not apparent to the Consultant due to the limitations imposed by the scope of work. The Consultant, therefore, accepts no liability for any costs incurred by the Client for subsequent discovery, manifestation or rectification of such conditions.

This report is intended solely for the Client named as a general indication of the visible or reported physical condition of the items addressed in the report at the time of the geotechnical investigation. The material in this report reflects the Consultant's best judgment in light of the information available to it at the time of preparation.

This report and the information and data contained herein are to be treated as confidential and may be used only by the Client and its officers and employees in relation to the specific project that it was prepared for. Any use a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. The Consultant accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The report has been written to be read in its entirety, do not use any part of this report as a separate entity.

All files, notes, source data, test results and master files are retained by the Consultant and remain the property of the Consultant.



ROOF FRAMING PLAN

1/16" = 1'-0"

CROSS BRACING LOCATIONS
OR BY SUPPLIER

STEEL GIRTS W/ SAG RODS
OR Z GIRTS BY SUPPLIER

DOOR LOCATIONS

No.	REVISION	DATE	BY

WOLFROM ENGINEERING LTD
CONSULTING ENGINEERS
340 WARDLAW AVENUE
WINNIPEG, CANADA R3L 0L5
PHONE (204) 783-3894
E-MAIL

PRELIMINARY
NOT FOR CONSTRUCTION

AG CHEMICAL STORAGE
555 HERVO ST.
WINNIPEG, MANITOBA

ROOF FRAMING PLAN

	SCALE: AS NOTED	DRAWING NO.: S-3
FILE NO.: W13034	DATE: FEB. 2013	REVISION NO.: 0

Project No: SU-13-012-00-SU

TH1

Project: AG Chemical Storage

Client: R.S. Harris Ltd.

Enclosure:

Location: 555 Hervo Street

Engineer: SSU

SUBSURFACE PROFILE

Depth (ft / m)	Symbol	Description	Elevation, m	Field Vane(m-kg)	Blows/0.3m	Pocket Penetrometer Test kPa	Water Content %
0 / 0		Ground Surface	100				
0–6 / 0–2		***FILL*** 2m thick; 300mm of LIMESTONE GRANULAR, 20mm down over 1.7m thick of CLAY FILL, black, trace of fine gravel; sandy at 1.8 to 1.85m, greasy; FROST DOWN TO 1.2M	98.1				
6–52 / 2–16		***CLAY*** stiff, brown, fissured; SILTY at 2.9m to 3m, tan-brown, firm; stiff below 3m; grey at 8.5m; trace of fine gravel and till inclusions at 13.7m	84.6				
52–56 / 16–17		***TILL*** medium dense to dense, beige, trace of fine gravel; DENSE below 15.8m. EOH at 17.3m. WATER WAS MEASURED AT 16.4M B.G. AFTER COMPLETION OF DRILLING.	82.7	N/A N/A	55 80		
56 / 17		End of Testhole					

Pocket Penetrometer Test kPa: 50, 150, 250, 350

Water Content %: Wp 20 40 60 80 Wl

Pocket Penetrometer values: 175, 175, 100, 85, 85, 60, 60, 50, 35, 35

Drill Method: Continuous Auger

Datum: Assumed 100.0M

Drill Date: 03/12/13

Checked by: SSU

Hole Size: 125mm

Sheet: 1 of 1

Project No: SU-13-012-00-SU

TH2

Project: AG Chemical Storage

Client: R.S. Harris Ltd.

Enclosure:

Location: 555 Hervo Street

Engineer: SSU

SUBSURFACE PROFILE

Depth (ft / m)	Symbol	Description	Elevation, m	Field Vane (m-kg)	Blows/0.3m	Pocket Penetrometer Test kPa	Water Content %
0 / 0		Ground Surface	100				
0–9 / 0–2.9		***FILL*** 2.9m thick; 100mm of LIMESTONE GRANULAR, 20mm down over 2.8m thick of CLAY FILL, black, trace of fine gravel; sandy, black below 0.45m, traces of coal; FROST DOWN TO 1.2M; WET BELOW 1.8M, black	97.2	n/a	7	150	
9–24 / 2.9–7.5		***CLAY*** stiff, brown, fissured. WATER AND SLOUGHING CONDITIONS WERE MEASURED AT 2.4M B.G. AFTER COMPLETION OF DRILLING.	92.5			100; 85; 85	
24 / 7.5		End of Testhole					

Pocket Penetrometer Test kPa: 50 | 150 | 250 | 350

Water Content %: Wp 20 | 40 | 60 | Wl 80

Drill Method: Continuous Auger

Drill Date: 03/12/13

Hole Size: 125mm

Datum: Assumed 100.0M

Checked by: SSU

Sheet: 1 of 1

Project No: SU-13-012-00-SU

TH3

Project: AG Chemical Storage

Client: R.S. Harris Ltd.

Enclosure:

Location: 555 Hervo Street

Engineer: SSU

SUBSURFACE PROFILE

Depth (ft / m)	Symbol	Description	Elevation, m	Field Vane (m-kg)	Blows/0.3m	Pocket Penetrometer Test kPa	Water Content %
0 / 0		Ground Surface	100				
1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 11 / 12 / 13 / 14 / 15 / 16 / 17 / 18 / 19 / 20 / 21 / 22 / 23 / 24 / 25 / 26 / 27 / 28 / 29 / 30 / 31 / 32 / 33 / 34 / 35 / 36 / 37 / 38 / 39 / 40 / 41 / 42 / 43 / 44 / 45 / 46 / 47 / 48 / 49 / 50 / 51 / 52 / 53 / 54 / 55 / 56 / 57 / 58 / 59 / 60 / 61 / 62 / 63 / 64 / 65	1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 11 / 12 / 13 / 14 / 15 / 16 / 17 / 18 / 19 / 20							
		FILL 2.4m thick; 300mm of LIMESTONE GRANULAR, 20mm down over 2.1m thick of CLAY FILL, black, trace of fine gravel; trace of steel parts at 1.4m; FROST DOWN TO 1.2M	97.7			100	
		CLAY stiff, grey-black, fissured; trace of organic at 4.6m, swamp-like structure; brown at 5.2m; grey at 8.2m; trace of fine gravel at 13.7m	84.6			60 85 85 60 60 40 35 35	
		TILL medium dense to dense, beige, trace of fine gravel; DENSE below 15.8m. EOH at 17m. WATER WAS MEASURED AT 16.4M B.G. AFTER COMPLETION OF DRILLING.	83				
		End of Testhole					

Pocket Penetrometer Test kPa: 50 150 250 350

Water Content %: Wp 20 40 60 80 Wl

Drill Method: Continuous Auger

Drill Date: 03/12/13

Hole Size: 125mm

Datum: Assumed 100.0M

Checked by: SSU

Sheet: 1 of 1