

TECHNICAL MEMORANDUM

DATE February 2, 2023

Project No. 21466052-7

TO Gary Drennan, David Ducheck
WSP Canada Inc.

FROM Darcy Hansen, P.Eng.,
Lisa Coyne, P.Eng.

EMAIL darcy.hansen@wsp.com

**REINFORCED SOIL SYSTEM WALLS W1 NORTH, W2 NORTH AND W3 NORTH
EXTENDING FROM APPROXIMATELY SIMCOE STREET TO ALBERT STREET
HIGHWAY 401, OSHAWA
MTO G.W.P. 2298-13-00, CONTRACT 2022-2010
GEOCRETS NO. 30M14-547**

1.0 INTRODUCTION

WSP Golder (formerly Golder Associates Ltd., now a member of WSP Canada Inc., herein referenced as WSP Golder) has been retained by WSP Canada Inc. (WSP) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the Highway 401 replacement and rehabilitation works in the City of Oshawa, Regional Municipality of Durham, Ontario.

This Technical Memorandum presents geotechnical/foundation recommendations for Reinforced Soil System (RSS) walls along the north side of Highway 401 associated with the above-noted project, extending from west of Simcoe Street to approximately 100 m east of Albert Street. This memorandum is based on the geotechnical borehole investigation summarized in the *Foundation Investigation and Design Report, Retaining Walls, Simcoe Street to Albert Street Highway 401 Replacement of Three Underpasses and Rehabilitation of Oshawa Creek Bridge, Ministry of Transportation, Ontario, G.W.P. 2298-13-00 (MTO GEOCRETS No. 30M14-506)*, prepared by Golder Associates Ltd. and dated October 21, 2019; this memorandum is to be read as a supplement to that report.

2.0 SITE DESCRIPTION

At the site Highway 401 conveys eastbound and westbound vehicular traffic through the City of Oshawa, in the Regional Municipality of Durham, Ontario from the Simcoe Street Underpass to east of the Albert Street Underpass of Highway 401. There are presently no existing retaining walls along this section. Retaining Wall W1 North is proposed to be located between Simcoe Street and Albert Street; Wall W2 North is located immediately west of Simcoe Street, and Wall W3 North is located immediately east of Albert Street, at the locations shown in the attached design drawings (reference WSP's 90% Design Drawings).

The natural ground surface at the site is generally between about Elevations 100 m and 102 m. Highway 401 is constructed in a cut with the highway grade between about Elevations 95 m and 96 m, sloping down toward the east. The Simcoe Street grade ranges from about Elevations 101 m to 103 m, rising northward. Similarly, the grade of Albert Street at the site ranges from about Elevations 101 m to Elevation 102 m, also rising northward. Commercial businesses, a church and several houses are located along Lviv Boulevard, immediately north and

paralleling Highway 401, while the Oshawa Visitor Information Centre and a service station are located along Bloor Street East to the south of Highway 401, and residential dwellings are present along both sides of Albert Street approaching Bloor Street East.

3.0 SUBSURFACE CONDITIONS

In general, the subsurface conditions encountered in the boreholes advanced along the alignment of the proposed north retaining wall consist of non-cohesive and cohesive fill, underlain by an upper deposit of compact to very dense silt and sand to silty sand till. The upper non cohesive till deposit is underlain by a dense to very dense silty sand to gravelly sand deposit, which in turn is underlain by a lower deposit of very dense sandy silt to silty sand till and/or hard clayey silt till, underlain by shale bedrock.

Additional details about the investigation methods and subsurface conditions encountered in the vicinity of the proposed retaining walls can be found in the above-referenced Foundation Investigation and Design Report. The Borehole Location and Soil Strata drawings from the 2019 report are attached to this memorandum for ease of reference.

4.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

It is understood that as part of the improvements and widening of Highway 401 in the City of Oshawa, the existing Simcoe Street and Albert Street Underpasses will be replaced by longer span structures and retaining walls will be constructed along the north and south sides of the existing Highway 401 in the area between the new underpasses. The north retaining wall will extend from just west of Simcoe Street to about 100 m east of Albert Street and the south retaining wall will extend from about 50 m east of Simcoe Street to about 55 mm east of Albert Street to allow for highway widening through this area. Recommendations for the south retaining wall are provided in the 2019 Foundation Investigation and Design Report (GEOCREC No. 30M14-506); that report provided recommendations for secant pile (caisson) walls along the north side of Highway 401, and this memorandum provides additional geotechnical/foundation recommendations regarding design of RSS walls along the north side.

The following table summarizes the geometry of the proposed RSS walls on the north side of Highway 401, based on the latest details as shown in WSP's 90% Contract Drawings:

Retaining Wall Designation	Location	Approximate Wall Length (m)	Final Grade Elevation at Top of Wall (m)	Highway 401 Grade Elevation in front of Toe of Wall (m)	Wall Height (m)
W2 North	West of north abutment of Simcoe Street underpass	15	97.9 to 102.9	96.5	4.5 to 9.6
W1 North	Between north abutments of Simcoe Street and Albert Street underpasses	145	103.1 to 101.8	96.1	8.7 to 10.0
W3 North	East of north abutment of Albert Street underpass	113	102.7 to 100.5	97.0	6.5 to 8.7

4.1 Founding Elevations

A typical RSS wall has a front facing panel system that is supported on a strip footing placed at a shallow depth below the ground surface in front of the wall. The facing footing should be placed within a 500 mm thick levelling pad comprised of OPSS.PROV 1010 Granular ‘A’, placed in accordance with OPSS.PROV 501 (Compacting), as detailed in Figure 5.2 of MTO’s RSS Wall Design Guidelines (September 2008), with a minimum of 300 mm of Granular A below the facing footing. The compacted granular levelling pad should extend at least 1.0 m beyond the outside edge of the facing footing, then downward and outward at 1H:1V. Prior to placement of the levelling pad and the reinforced soil mass, any existing topsoil, organic and deleterious materials must be removed and the subgrade proof-rolled to identify any softened/disturbed areas for sub-excavation and replacement, where applicable, with compacted OPSS.PROV 1010 Granular ‘A”, placed in accordance with OPSS.PROV 501 (Compacting).

As shown on Figure 5.22 of MTO’s RSS Wall Design Guidelines, the underside of the levelling pad should be founded at a minimum depth of 1.0 m below the finished grade at the base of the RSS wall. Per the Guidelines, the minimum soil cover to the base of the wall and top of the footing/leveling pad should be 0.5 m below the finished grade in front of the base of the RSS wall. However, for this site and as shown on the 90% design drawings (see attached Sheets 382, 384 and 385) a minimum of 2.5 m of cover has been incorporated into the design finished grade in front of the RSS walls for the interim condition, as it is understood that excavations will take place at the wall toes to construct the ultimate configuration of Highway 401 in the future. The recommendations for bearing capacity and global stability provided in the sections below assumed the RSS wall footings will remain buried at the toe by at least 1.5 m of soil cover in the permanent condition. It is understood that the excavations may extend deeper in the temporary condition; however, at least 0.8 m of soil cover must be maintained at the toe during the temporary excavation condition.

As shown on the 90% drawings (attached), the bottom of the footing and top of the 500 mm thick Granular ‘A’ levelling pad/facing footing) will be founded at the following elevations:

Retaining Wall Designation	Maximum (Highest) Founding Elevation (m)	Anticipated Bearing Soil
W2 North	93.4	Dense to very dense sand to sand and gravel
W1 North	93.1	Very dense sandy silt to silty sand till or hard clayey silt with sand till
W3 North	94.0	Very dense sandy silt to silty sand till

4.2 Factored Geotechnical Resistance

Assuming that the RSS wall acts as a unit and uses the full width of the reinforced soil mass, the factored ultimate and serviceability geotechnical resistances given below may be used for assessment of the reinforced mass founded on the properly prepared subgrade at the founding elevations summarized above.

Retaining Wall Designation	Approximate Station Limits	Minimum Strip Length (m)	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance (kPa) (for 25 mm of settlement)
W2 North	2+000 to 2+015	3.6 m (Approximately 80% of wall height)	650	650
W1 North	1+000 to 1+045	5.5 m (Approximately 55% of wall height)	800	400
	1+045 to 1+143	7.0 m (Approximately 80% of wall height)	950	350
W3 North	3+000 to 3+113	5.2 m (Approximately 80% of wall height)	450	400

It is understood that the reinforcing strip length of retaining wall W1 North is limited to approximately 5.5 m (i.e., about 55% of the wall height) at the highest part of the wall between Station 1+000 to 1+045 due to the presence of an existing sanitary sewer located approximately 6.5 m to 8 m north of the proposed wall facing. As shown on the 90% design drawing (Sheet 384, attached), it is understood an approximately 1 m clearance will be maintained between the existing sanitary utility and the temporary protection system or retaining wall required to install the RSS wall, and ultimately the reinforcing strips of the wall.

The geotechnical resistances provided above are given for loads applied perpendicular to the surface of the subgrade/facing footing. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be considered in accordance with Section 6.10.5 of CHBDC (2019).

4.3 Resistance to Lateral Loads

Resistance to lateral forces / sliding between the granular fill of the RSS wall and the subgrade should be calculated in accordance with Section 6.10.4 of CHBDC (2019). The coefficient of friction, $\tan \phi$, between the compacted granular fill of the RSS wall and the properly prepared subgrade is provided below. The coefficient of friction value should be reviewed and revised, if necessary, by the proprietary RSS wall designer.

Subgrade Material	$\tan \phi$
Compacted granular fill on native very dense non-cohesive soils	0.67

4.4 Global Stability

Static global stability analyses of the proposed RSS retaining walls were completed using the parameters outlined in the 2019 Foundation Investigation and Design Report. A maximum retained soil height of 10 m and a reinforcing strip length of 5.5 m was used in the analyses to represent the critical case condition. The base of the RSS wall was assumed to be at least 1.5 m below ground surface at the toe in the permanent condition, and 0.8 m below ground surface in the temporary condition to represent potential critical conditions, although the initial

finished grade will be higher. The groundwater level was taken at approximately Elevation 96 m behind the retaining walls, as measured in the piezometers installed at the site.

The stability analysis results indicate the proposed RSS walls will have a Factor of Safety equal to or greater than 1.5 against global instability in the permanent condition based on the founding elevation and soils as detailed above, for a reinforcing strip length of 5.5 m and assuming the toe of the wall is buried at least 1.5 m below ground surface (i.e., below the ultimate configuration of Highway 401). This design for the proposed retaining walls is intended to consider the future temporary excavations for the installation of a future storm sewer and pavement subgrade associated with the ultimate configuration of Highway 401. When these future excavations are considered in the stability analysis, the results indicate the proposed critical section of RSS wall (i.e., W1 North at 10.0 m height with 5.5 m reinforcing strip length) will have a Factor of Safety equal to or greater than 1.3 against global instability in the temporary condition, provided the toe of the wall remains buried at least 0.8 m below the excavation bottom. Figures 1 and 2 show examples of the global stability analysis in the permanent and temporary conditions, respectively.

5.0 CONSTRUCTION CONSIDERATIONS

The proposed RSS walls are to be designed for high performance and appearance in accordance with MTO Special Provision (SP) 599S22 (Retained Soil System). It is understood that temporary protection systems will be required to allow for construction of both the W1 North and W3 North RSS walls while protecting the roadway and existing utilities along Lviv Boulevard. Any temporary protection systems required to allow for RSS wall construction must be designed and constructed in accordance with OPSS.PROV 539 (Temporary Protection System).

As shown on Drawing 384, an existing sanitary sewer that will remain in service during construction is located as close as 1 m north of the proposed temporary protection system and below the slope of the temporary excavation required to construct RSS Wall W1 North. The utility is closest to the proposed construction at the northeast corner of the Simcoe Street underpass. Protection of this utility shall be incorporated into the design and construction of RSS Wall W1 North.

5.1 Open-Cut Excavations and Temporary Protection Systems

Excavations must be carried out in accordance with Ontario Regulation 213 of the Ontario Occupational Health and Safety Act for Construction Projects (OHSA), as amended. The soils to be excavated can be classified according to OHSA as Type 3 soils above the water table, and with appropriate dewatering where below the water table. Temporary open-cut excavations (i.e., those open for a relatively short time period) should be made with side slopes no steeper than 1H:1V based on the soil profile, provided appropriate dewatering is in place.

It is understood that excavation for RSS Wall W2 North will be carried out in open cut, and that temporary protection systems will be required to allow for construction of both the W1 North and W3 North RSS walls while protecting the roadway and existing utilities along Lviv Boulevard. As shown on the 90% design drawings (see Sheet 384, attached), the temporary protection system is anticipated to be located as close as 1.0 m from the existing sanitary sewer in the paved portion of Lviv Boulevard at the northeast corner of the Simcoe Street underpass. Temporary protection systems should be designed and constructed in accordance with OPSS.PROV 539 (Temporary Protection System), and the lateral movement should meet Performance Level 1b given the presence of this utility. Performance Level 1b specifies a maximum angular distortion of 1:1000 and a maximum horizontal displacement of 10 mm. Existing adjacent utilities should be checked to ensure that they can tolerate

this magnitude of deformation, and it is recommended that pre-construction and post-construction condition inspections be completed on the existing sanitary sewer that is located near the proposed temporary protection line.

The selection, design and performance of the protection system will be the responsibility of the Contractor. For this site, given the constraints associated with the existing sewer and the very dense soils into which the temporary protection systems must extend, it is anticipated that soldier pile and lagging systems will be used, and that driven steel sheet pile systems will not be practicable. Driven sheet piles would also generate greater vibrations as compared with soldier pile and lagging installation, which may affect the existing sewer. It is recommended that vibration monitoring of the existing sanitary sewer and for nearby residences be included if driven sheet piles are used in this area on the contract.

5.2 Control of Groundwater

The groundwater level in the standpipe piezometers installed at the time of investigation ranged from Elevations 95.9 m to 93.2 m; however, it is expected that the groundwater level will be higher during periods of heavy/sustained precipitation or during the wet seasons.

Excavations for these sections of RSS wall are expected to extend below the groundwater level, and will require dewatering measures to ensure the retaining walls are constructed in dry conditions. The control of water from dewatering operations should be managed in accordance with OPSS.PROV 517 (Dewatering), and SP 517F01 (Dewatering System; Temporary Flow Passage System), with the groundwater level lowered to approximately 1 m below the subgrade level for the proposed RSS walls.

Dewatering for the retaining walls and other elements of this project has been assessed by WSP and is presented in their report titled "Highway 401 Albert Street and Simcoe Street Underpasses (Oshawa Contract 4), Hydrogeological Assessment" prepared by WSP, WSP project No. 171-04557-00, dated January 13, 2023. Based on this assessment, a Permit to Take Water (PTTW) is required for the overall project. The anticipated drawdown of approximately 4 m and associated radius of influence for construction of the retaining walls is expected to result in settlements of less than 5 mm in the generally very dense water-bearing soils in this area.

5.3 Obstructions

The native site soils are glacially derived and as such should be expected to contain cobbles and boulders as inferred present from auger grinding in various boreholes at the site, which could affect the installation of temporary protection systems. Similarly, the existing fill may contain cobble and boulder size materials. The construction equipment should be capable of advancing through such obstructions. An NSSP has already been included in the Contract Documents and will be applicable to construction of the required protection systems for this retaining wall construction.

6.0 CLOSURE

We trust this technical memorandum provides sufficient geotechnical engineering information for design of the RSS walls north of Highway 401 for this contract. If you have any questions regarding the contents of this memorandum or require additional information, please do not hesitate to contact this office.

WSP GOLDER



Darcy Hansen, P.Eng.
Geotechnical Engineer



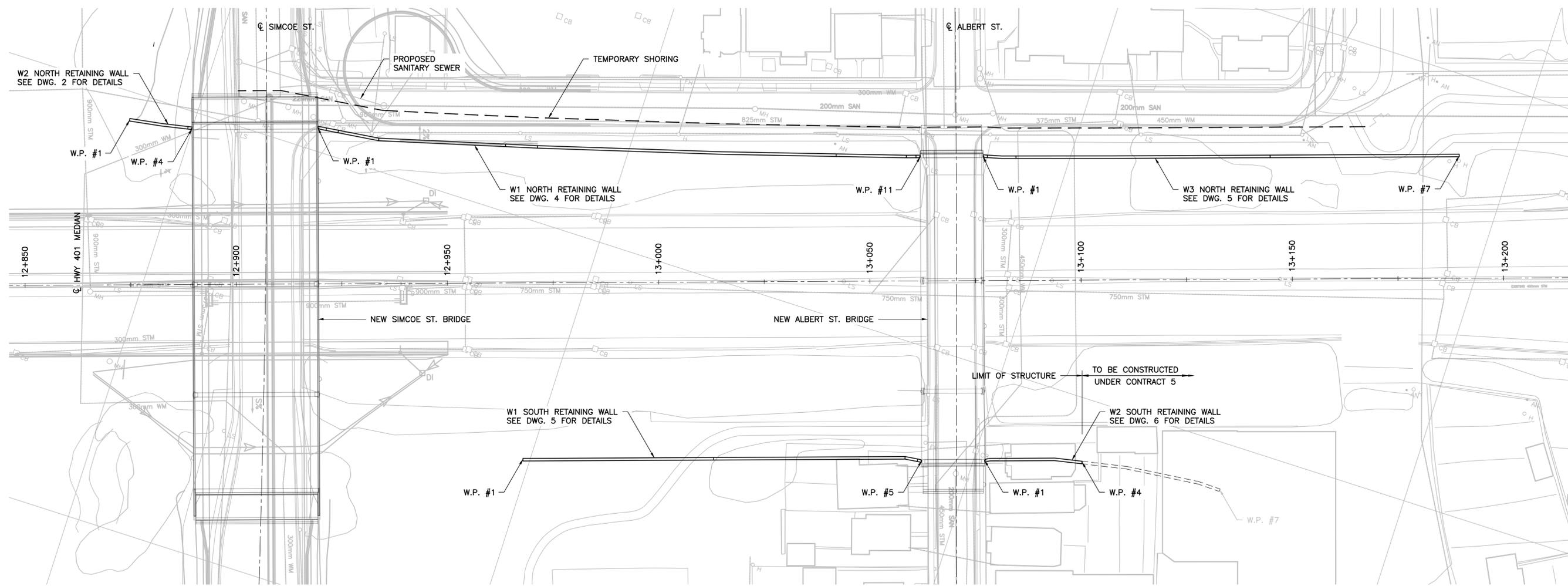
Lisa Coyne, P.Eng.
Fellow, MTO Designated Foundations Contact

DH/LCC/ljv

Attachments: WSP 90% Design Drawings – Sheets 381 to 385
Drawing 1 – Retaining Walls, Borehole Locations
Drawing 2 – Retaining Walls, Soil Strata
Figure 1 – Retaining Wall W1 North, Global Stability Analysis – Permanent Condition
Figure 2 – Retaining Wall W1 North, Global Stability Analysis – Temporary Condition

Distribution (via electronic copy): MTO Central Region, MTO Foundations Section

[https://golderassociates.sharepoint.com/sites/146559/project files/4 deliverables/7- retaining walls/21466052_memo_rss foundations_20230202.docx](https://golderassociates.sharepoint.com/sites/146559/project%20files/4%20deliverables/7-retain%20walls/21466052_memo_rss%20foundations_20230202.docx)



PLAN
1:500

- LIST OF DRAWINGS:**
1. SITE PLAN
 2. W2 NORTH - GENERAL ARRANGEMENT
 3. W2 NORTH - INSPECTOR GUARD DETAILS
 4. W1 NORTH - GENERAL ARRANGEMENT
 5. W3 NORTH - GENERAL ARRANGEMENT
 6. W1 SOUTH - GENERAL ARRANGEMENT
 7. W2 SOUTH - GENERAL ARRANGEMENT

NOT FOR CONSTRUCTION

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION

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 MINISTRY OF TRANSPORTATION, ONTARIO

HWY 401
CONT. No. 2022-2010
WP No. 2154-21-01



RETAINING WALL
W2 NORTH
GENERAL ARRANGEMENT

SHEET
382



METRIC

NOTES:

- ENTIRE FACE OF RSS WALL IS WITHIN SPLASH ZONE, AND REINFORCEMENT SHOULD BE EITHER STAINLESS STEEL OR GFRP.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH GRADING DRAWINGS.
- CONTRACTOR SHALL CONFIRM ALL DIMENSIONS PRIOR TO COMMENCING CONSTRUCTION.
- CLASS OF CONCRETE 35 MPa
- CLEAR COVER TO REINFORCING STEEL 55±10
- REINFORCING STEEL

STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

TENSION LAP SPLICES SHALL BE CLASS B, UNLESS SHOWN OTHERWISE.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWINGS SS12-1 UNLESS INDICATED OTHERWISE.

- GLASS FIBRE REINFORCED POLYMER (GFRP)

GLASS FIBRE REINFORCED POLYMER (GFRP) REINFORCING BARS SHALL BE GRADE III AS SPECIFIED IN THE CONTRACT DOCUMENTS.

THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GFRP BARS.

- RETAINED SOIL SYSTEM (RSS) SHALL HAVE THE FOLLOWING ATTRIBUTES:

APPLICATION: WALL/SLOPE
GEOMETRY: VERTICAL
PERFORMANCE: HIGH
APPEARANCE: HIGH

- SOIL CAPACITY AT BEARING ELEVATION:

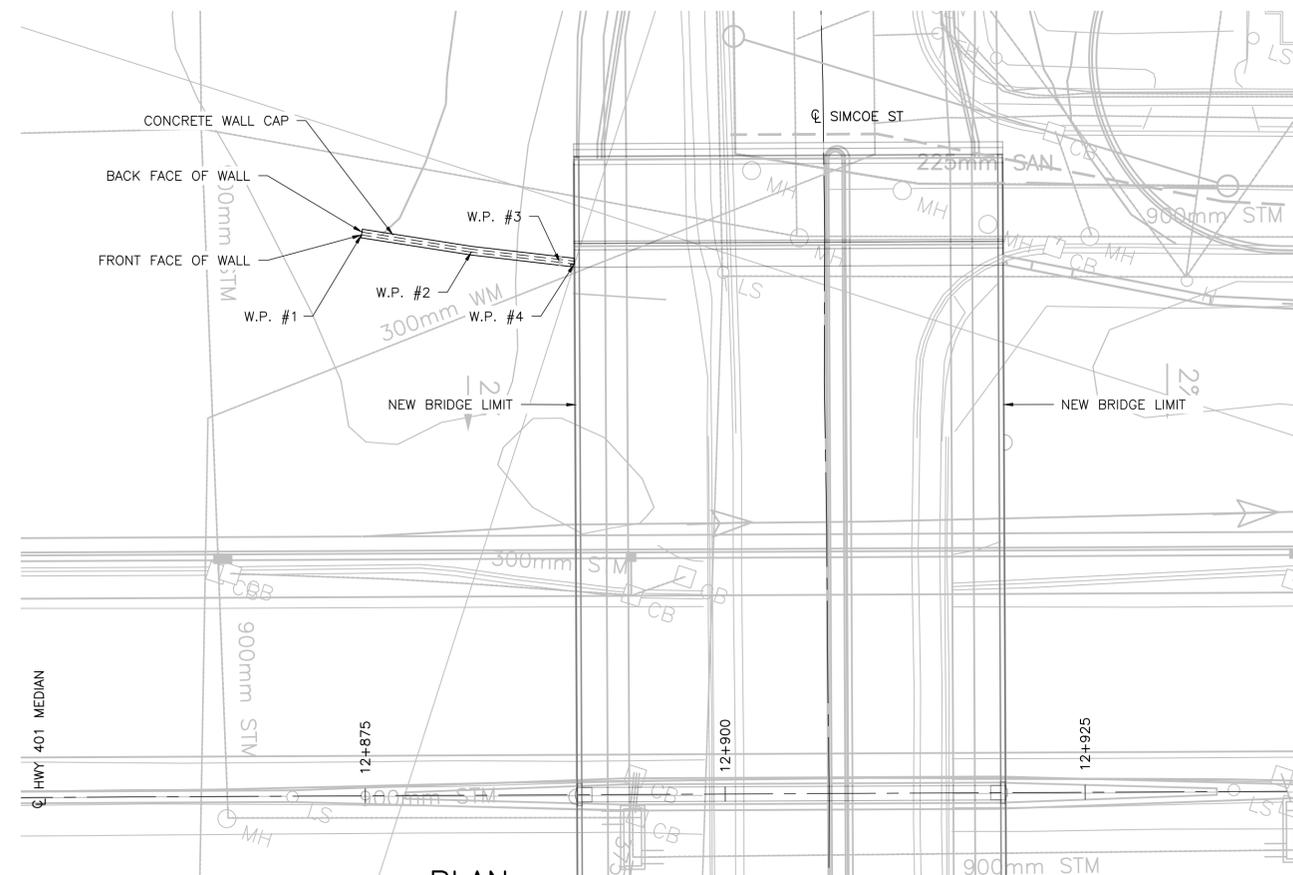
- SLS 275 KPa
- ULS 500 KPa

LIST OF ABBREVIATIONS:

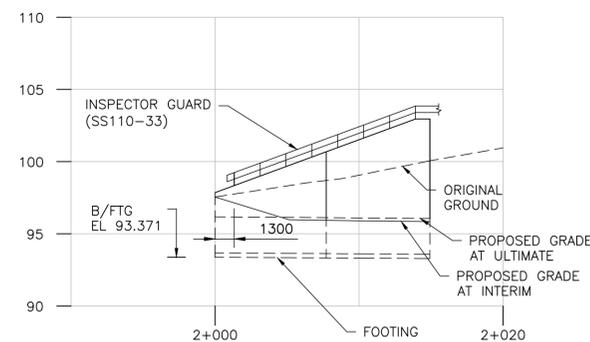
B/FTG DENOTES BOTTOM OF FOOTING
EL. DENOTES ELEVATION
W.P. DENOTES WORKING POINT

WORKING POINTS

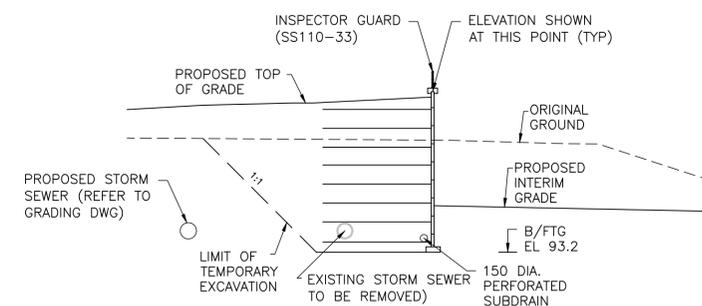
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W.P. #2	356492.920	4860394.681
W.P. #3	356498.999	4860395.880
W.P. #4	356499.980	4860396.073



PLAN
1:250



ELEVATION
1:250



TYPICAL SECTION
1:200

NOT FOR CONSTRUCTION

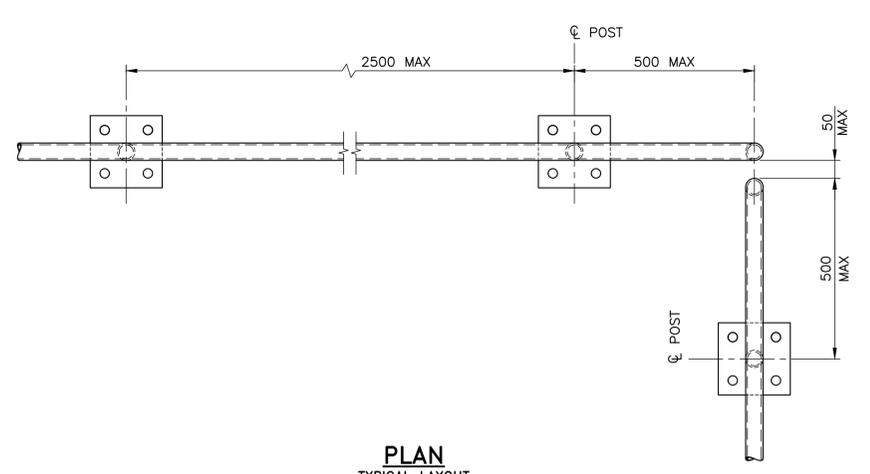
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REVISIONS	DESCRIPTION

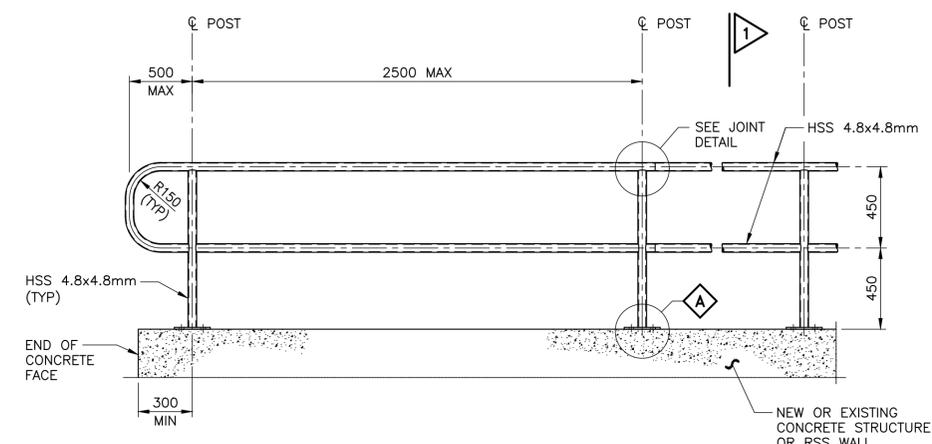
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HWY 401 CONT. No. 2022-2010 WP No. 2154-21-01	SHEET 383
RETAINING WALL W2 NORTH INSPECTOR GUARD DETAILS	METRIC
wsp	

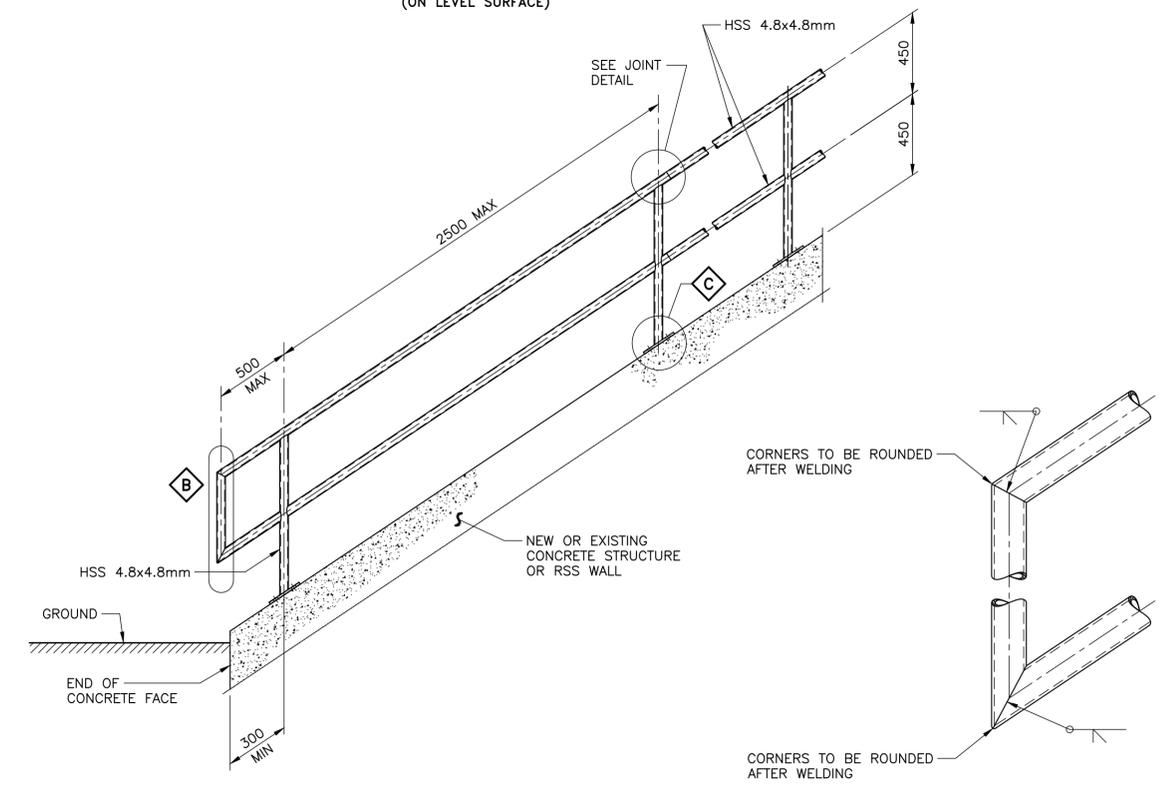
- NOTES:**
- FOR THE LOCATION AND EXTENT OF INSPECTOR GUARD SEE DRAWING 2.
 - THE INSPECTOR GUARD, AS SHOWN HERE, IS NOT DESIGNED FOR USE IN AREAS WITH PEDESTRIAN ACCESS.
 - THE INSPECTOR GUARD IS DESIGNED TO RESIST A CONCENTRATED LOAD OF 1.0 KN APPLIED AT ANY POINT ON THE GUARD ACCORDING TO ONTARIO BUILDING CODE.
 - WHEN THE INSPECTOR GUARD IS INSTALLED ON A NEW RSS SYSTEM, THE CONTRACTOR SHALL DESIGN THE RSS PANELS AND COPING TO CARRY THE LOADS TRANSFERRED TO THEM FROM THE GUARD.
 - ALL STRUCTURAL STEEL SHALL BE ACCORDING TO CAN/CSA G40.20-13/G40.21-13 GRADE 300W OR DSTM A500, GRADE C STRUCTURAL TUBING.
 - ANCHOR RODS, WASHERS AND NUTS SHALL BE ASTM F1554 GRADE 55.
 - RAILS AND POSTS SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION AS PER OPSS 911.
 - GALVANIZING ON MATING SURFACES OF RAIL JOINTS SHALL HAVE UNIFORM THICKNESS NOT EXCEEDING 0.15mm TO ENSURE SLIDING FIT.
 - PLATES, WASHERS AND NUTS SHALL BE HOT-DIP GALVANIZED AS PER OPSS 911. LOCK NUTS SHALL BE ZINC-PLATED ACCORDING TO ASTM B695.
 - RAIL SECTIONS MAY BE CUT AS REQUIRED IN THE FIELD. CUT TO BE SURFACE TREATED WITH A ZINC TOUCH-UP SOLDER, GALVAGUARD OR AN APPROVED EQUIVALENT.
 - GROUT SHALL NOT BE USED UNDER BASE PLATES. A 3mm ELASTOMERIC PAD OR THIN LAYER OF EPOXY GROUT MAY BE USED WHEN REQUIRED.
 - ANCHOR RODS SHALL BE STAINLESS STEEL WITH A MINIMUM YIELD STRENGTH OF 448 MPa AND A MINIMUM TENSILE STRENGTH OF 690 MPa.



PLAN
TYPICAL LAYOUT
AT CORNER



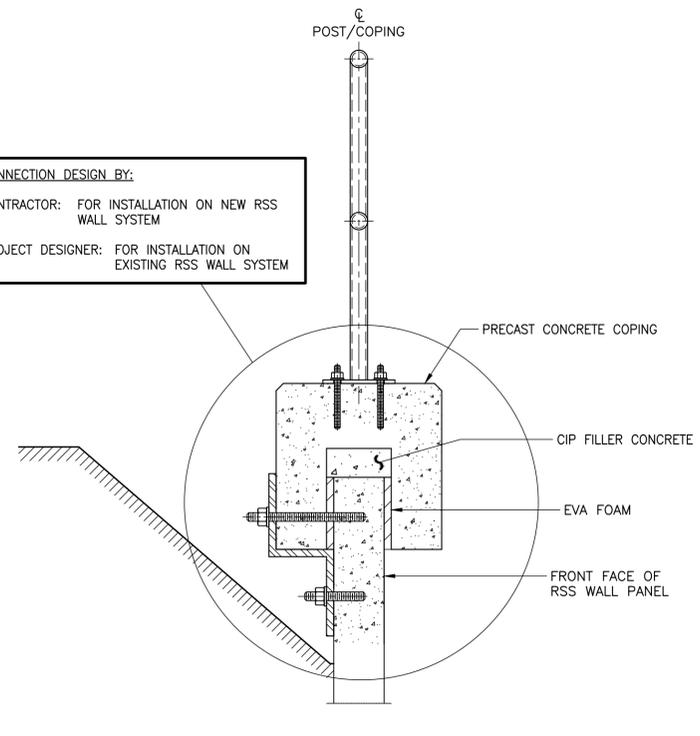
ELEVATION
(ON LEVEL SURFACE)



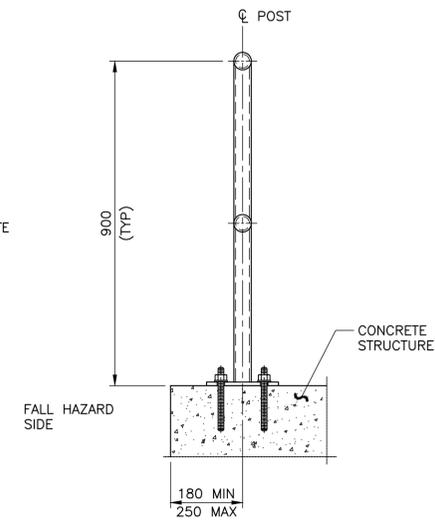
ELEVATION
(ON SLOPED SURFACE)

END DETAIL
(SLOPED RAILING)

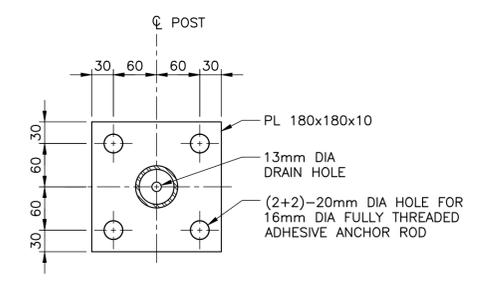
CONNECTION DESIGN BY:
CONTRACTOR: FOR INSTALLATION ON NEW RSS WALL SYSTEM
PROJECT DESIGNER: FOR INSTALLATION ON EXISTING RSS WALL SYSTEM



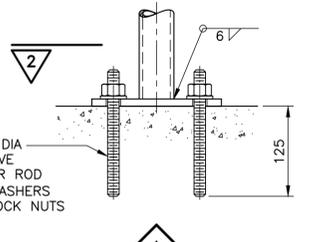
ON RSS WALL



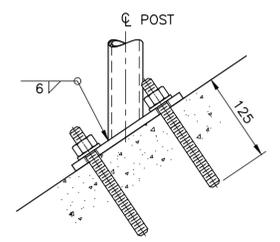
ON CONCRETE STRUCTURE



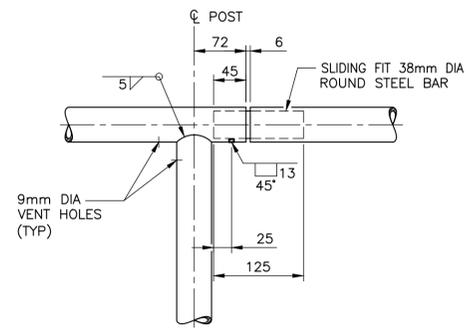
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A



C



JOINT DETAIL

NOT FOR CONSTRUCTION

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

STANDARD DRAWING DECEMBER 2018	SS110-33
INSPECTOR GUARD DETAILS	

REVISIONS	DESCRIPTION

DESIGN H.A.	CHK M.Z.	CODE CHBDC-19	LOAD CL-625-ONT	DATE DEC/22
DRAWN F.Y.	CHK M.Z.	SITE		DWG 3

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 BY: YAZDIAN, FARHAD

PR-D-707
 BB-05
 MINISTRY OF TRANSPORTATION, ONTARIO



NOTES:

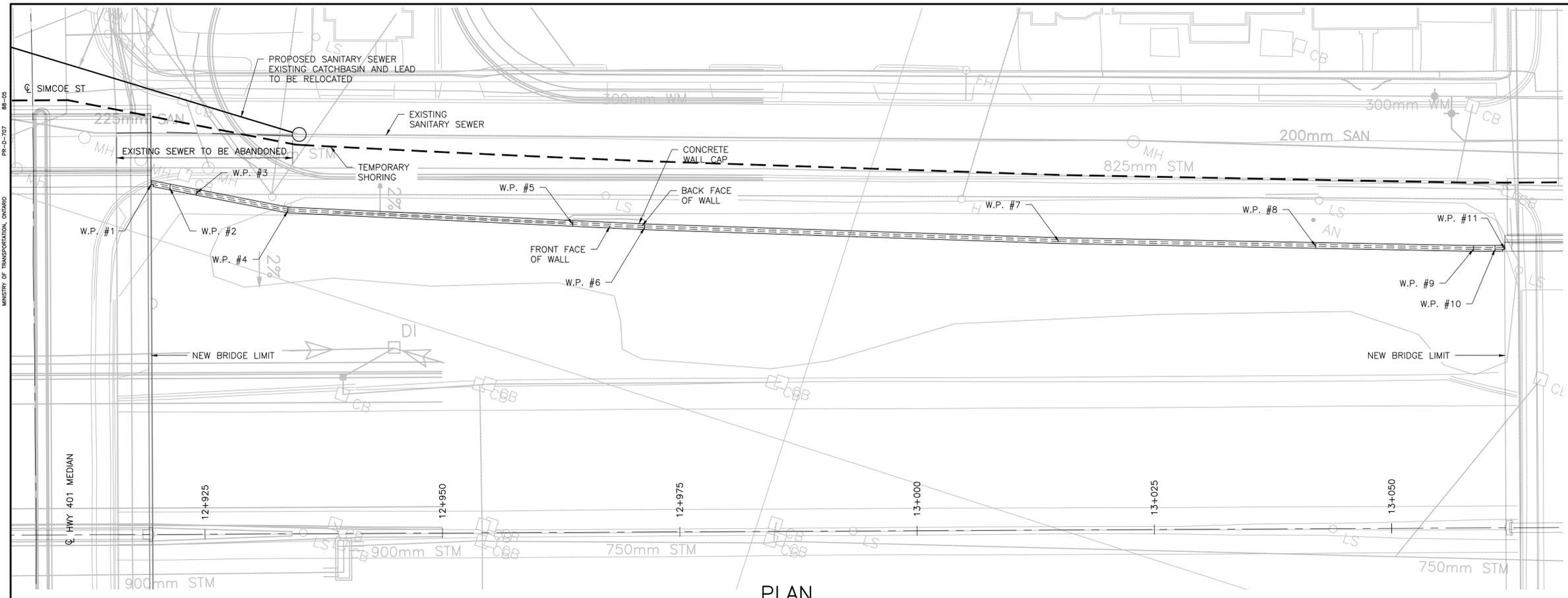
- TEMPORARY SHORING SHALL BE DESIGNED BY CONTRACTOR, IN ORDER TO RETAIN THE EXISTING UTILITIES.
- ENTIRE FACE OF RSS WALL IS WITHIN SPLASH ZONE, AND REINFORCEMENT SHOULD BE EITHER STAINLESS STEEL OR GFRP.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH GRADING DRAWINGS.
- CONTRACTOR SHALL CONFIRM ALL DIMENSIONS PRIOR TO COMMENCING CONSTRUCTION.
- CLASS OF CONCRETE 35 MPa
- CLEAR COVER TO REINFORCING STEEL 55±10
- REINFORCING STEEL
STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.
TENSION LAP SPLICES SHALL BE CLASS B, UNLESS SHOWN OTHERWISE.
- GLASS FIBRE REINFORCED POLYMER (GFRP)
GLASS FIBRE REINFORCED POLYMER (GFRP) REINFORCING BARS SHALL BE GRADE III AS SPECIFIED IN THE CONTRACT DOCUMENTS.
THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.
BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GFRP BARS.
- RETAINED SOIL SYSTEM (RSS) SHALL HAVE THE FOLLOWING ATTRIBUTES:
APPLICATION: WALL/SLOPE
GEOMETRY: VERTICAL
PERFORMANCE: HIGH
APPEARANCE: HIGH
- SOIL CAPACITY AT BEARING ELEVATION:
- SLS 275 KPa
- ULS 500 KPa

CONSTRUCTION NOTES:

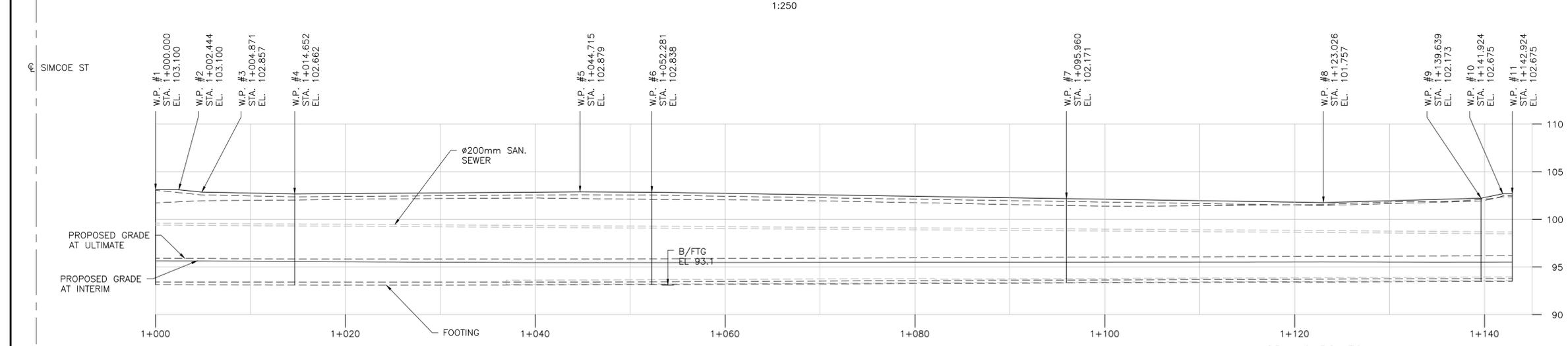
- CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF TEMPORARY SHORING.
- HEIGHT OF TEMPORARY SHORING SHALL BE SUFFICIENT TO PREVENT DISTURBANCE OF THE EXISTING SANITARY SEWER.
- CONTRACTOR SHALL DETERMINE ALIGNMENT AND ELEVATION OF THE EXISTING SANITARY SEWER THROUGH SUE INVESTIGATION PRIOR TO THE DESIGN OF TEMPORARY SHORING.
- ANY DAMAGE TO SANITARY SEWER SHALL BE REPAIRED TO THE SATISFACTION OF THE CONTRACT ADMINISTRATOR AND AT THE CONTRACTOR'S EXPENSE.
- TEMPORARY SHORING SHALL NOT BE DRIVEN, IN ORDER TO PREVENT IMPACT ON THE EXISTING UTILITIES. SOLDIER PILES SHALL BE AUGURED.
- THE ELEVATION OF B/FTG IS BASED ON THE FUTURE TEMPORARY EXCAVATION IN FRONT OF THE WALL FOR PAVEMENT CONSTRUCTION OF ULTIMATE CONFIGURATION OF HWY 401. RSS WALL TO BE DESIGNED BY THE FABRICATOR FOR THE PERMANENT CONDITION.

LIST OF ABBREVIATIONS:

B/FTG	DENOTES BOTTOM OF FOOTING
EL.	DENOTES ELEVATION
W.P.	DENOTES WORKING POINT



PLAN
1:250



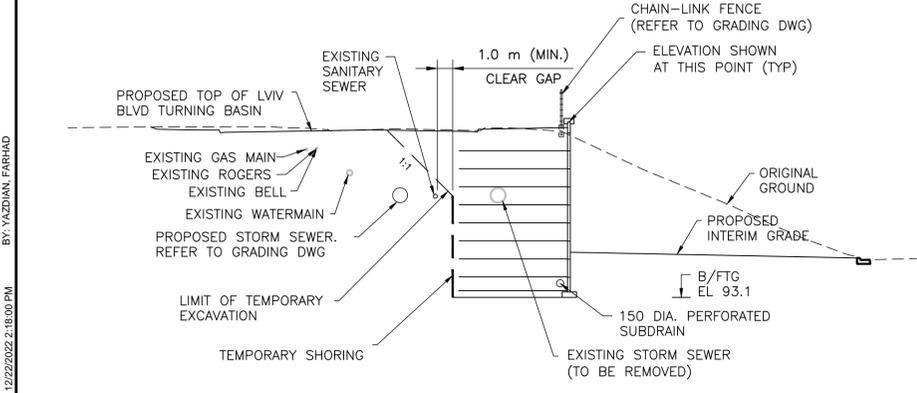
ELEVATION
1:250

WORKING POINTS

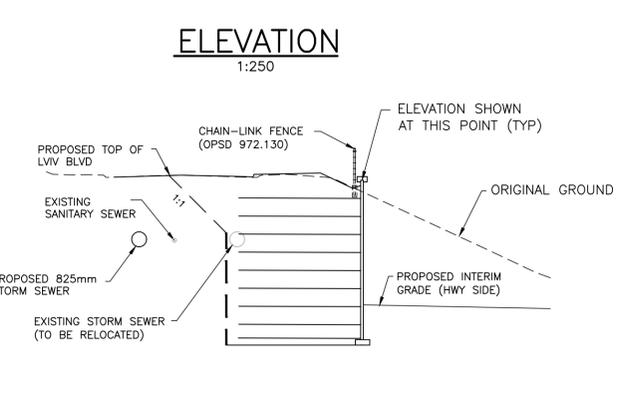
	EASTING (m)	NORTHING (m)
W.P. #1	356528.304	4860405.334
W.P. #2	356530.291	4860405.569
W.P. #3	356533.142	4860405.906
W.P. #4	356542.855	4860407.053
W.P. #5	356579.883	4860414.876
W.P. #6	356579.188	4860416.845
W.P. #7	356621.204	4860428.781
W.P. #8	356647.130	4860436.556
W.P. #9	356663.042	4860441.328
W.P. #10	356665.215	4860442.036
W.P. #11	356666.166	4860442.346

NOT FOR CONSTRUCTION

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING



TYPICAL SECTION
1:200 (STA. 1+000 TO STA. 1+045)



TYPICAL SECTION
1:200 (STA. 1+045 TO STA. 1+143)

CAD FILE LOCATION AND NAME: X:\DIV\16007171-04557-00 Hwy401WB Rehab.Streets\Structural\CAD\Retaining Walls\Hwy 401-Retaining Walls-GA.dwg
 MODIFIED: 12/22/2022 2:15:07 PM
 DATE PLOTTED: 12/22/2022 2:18:00 PM
 BY: YAZDIAN, FARHAD

REVISIONS	DESCRIPTION

DESIGN H.A. CHK M.Z. CODE CHBDC-19 LOAD CL-625-ONT DATE DEC/22
 DRAWN F.Y. CHK M.Z. SITE 22X-0176/W1 DWG 4



NOTES:

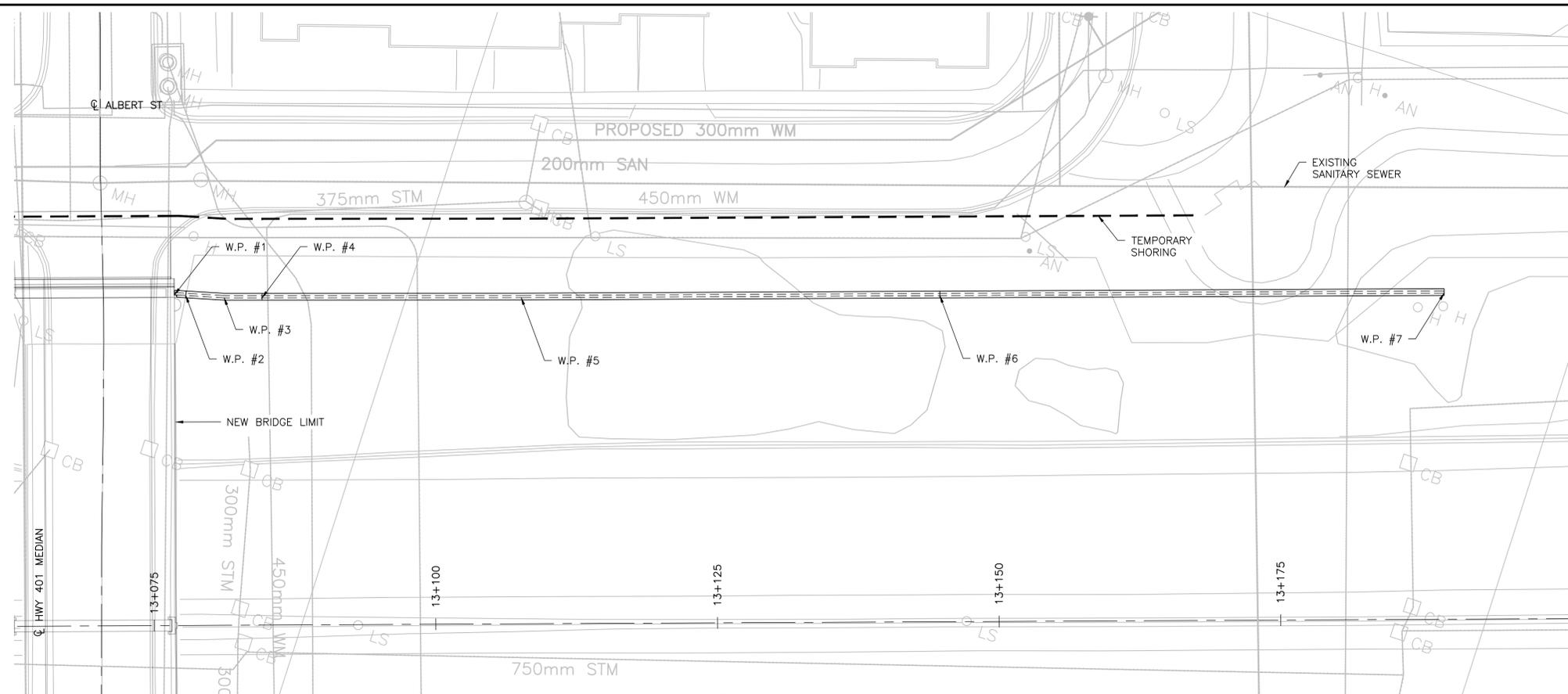
- TEMPORARY SHORING SHALL BE DESIGNED BY CONTRACTOR, IN ORDER TO RETAIN THE EXISTING UTILITIES.
- ENTIRE FACE OF RSS WALL IS WITHIN SPLASH ZONE, AND REINFORCEMENT SHOULD BE EITHER STAINLESS STEEL OR GFRP.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH GRADING DRAWINGS.
- CONTRACTOR SHALL CONFIRM ALL DIMENSIONS PRIOR TO COMMENCING CONSTRUCTION.
- CLASS OF CONCRETE 35 MPa
- CLEAR COVER TO REINFORCING STEEL 55±10
- REINFORCING STEEL
STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.
TENSION LAP SPLICES SHALL BE CLASS B, UNLESS SHOWN OTHERWISE.
BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWINGS SS12-1 UNLESS INDICATED OTHERWISE.
- GLASS FIBRE REINFORCED POLYMER (GFRP)
GLASS FIBRE REINFORCED POLYMER (GFRP) REINFORCING BARS SHALL BE GRADE III AS SPECIFIED IN THE CONTRACT DOCUMENTS.
THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.
BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GFRP BARS.
- RETAINED SOIL SYSTEM (RSS) SHALL HAVE THE FOLLOWING ATTRIBUTES:
APPLICATION: WALL/SLOPE
GEOMETRY: VERTICAL
PERFORMANCE: HIGH
APPEARANCE: HIGH
- SOIL CAPACITY AT BEARING ELEVATION:
- SLS 275 KPa
- ULS 500 KPa

CONSTRUCTION NOTES:

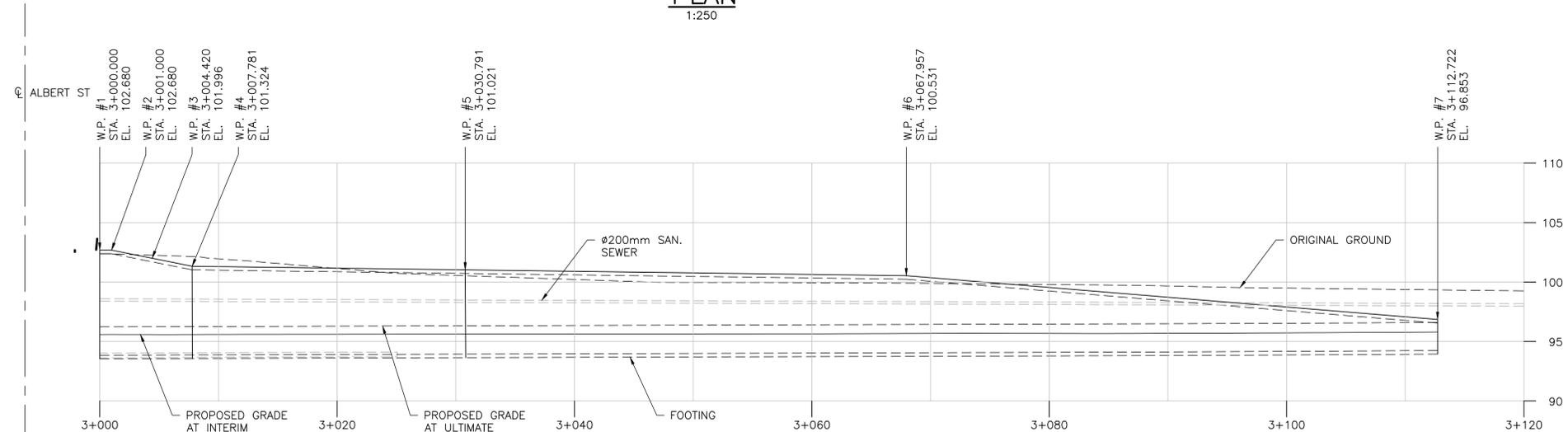
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- HEIGHT OF TEMPORARY SHORING SHALL BE SUFFICIENT TO PREVENT DISTURBANCE OF THE EXISTING SANITARY SEWER.
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LIST OF ABBREVIATIONS:

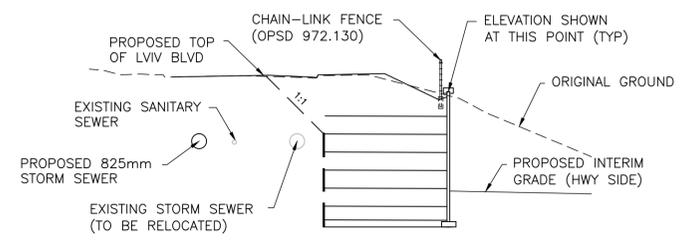
W.P. WORKING POINT
B/FTG BOTTOM OF FOOTING



PLAN
1:250



ELEVATION
1:250



TYPICAL SECTION
1:200

WORKING POINTS

	EASTING (m)	NORTHING (m)
W.P. #1	356680.330	4860446.972
W.P. #2	356681.299	4860447.218
W.P. #3	356684.614	4860448.058
W.P. #4	356687.814	4860449.086
W.P. #5	356709.724	4860456.118
W.P. #6	356745.061	4860467.633
W.P. #7	356787.623	4860481.501

NOT FOR CONSTRUCTION

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION

DESIGN H.A.	CHK M.Z.	CODE CHBDC-19	LOAD CL-625-ONT	DATE DEC/22
DRAWN F.Y.	CHK M.Z.	SITE 22X-0177/W3		DWG 5

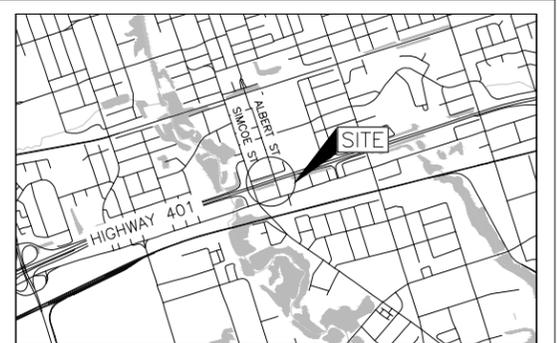
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 2298-13-00



RETAINING WALLS
HIGHWAY 401 WIDENING, SIMCOE STREET TO ALBERT STREET, OSHAWA
BOREHOLE LOCATIONS

SHEET



KEY PLAN
SCALE
500 0 500 1000 m

LEGEND

- Borehole - Current Investigation
- ⊕ Borehole - Previous Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
A1	102.1	4860447.6	356680.2
A2	102.0	4860377.6	356679.4
AS-2	101.6	4860377.8	356697.2
AS-7	102.1	4860444.2	356672.9
NRW-1	102.2	4860427.8	356592.0
NRW-2	101.3	4860477.8	356731.9
S1	101.3	4860398.8	356528.6
SRW-1	103.0	4860350.5	356620.6
SS-8	101.2	4860396.0	356523.4
SS-9	101.1	4860394.2	356513.4

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

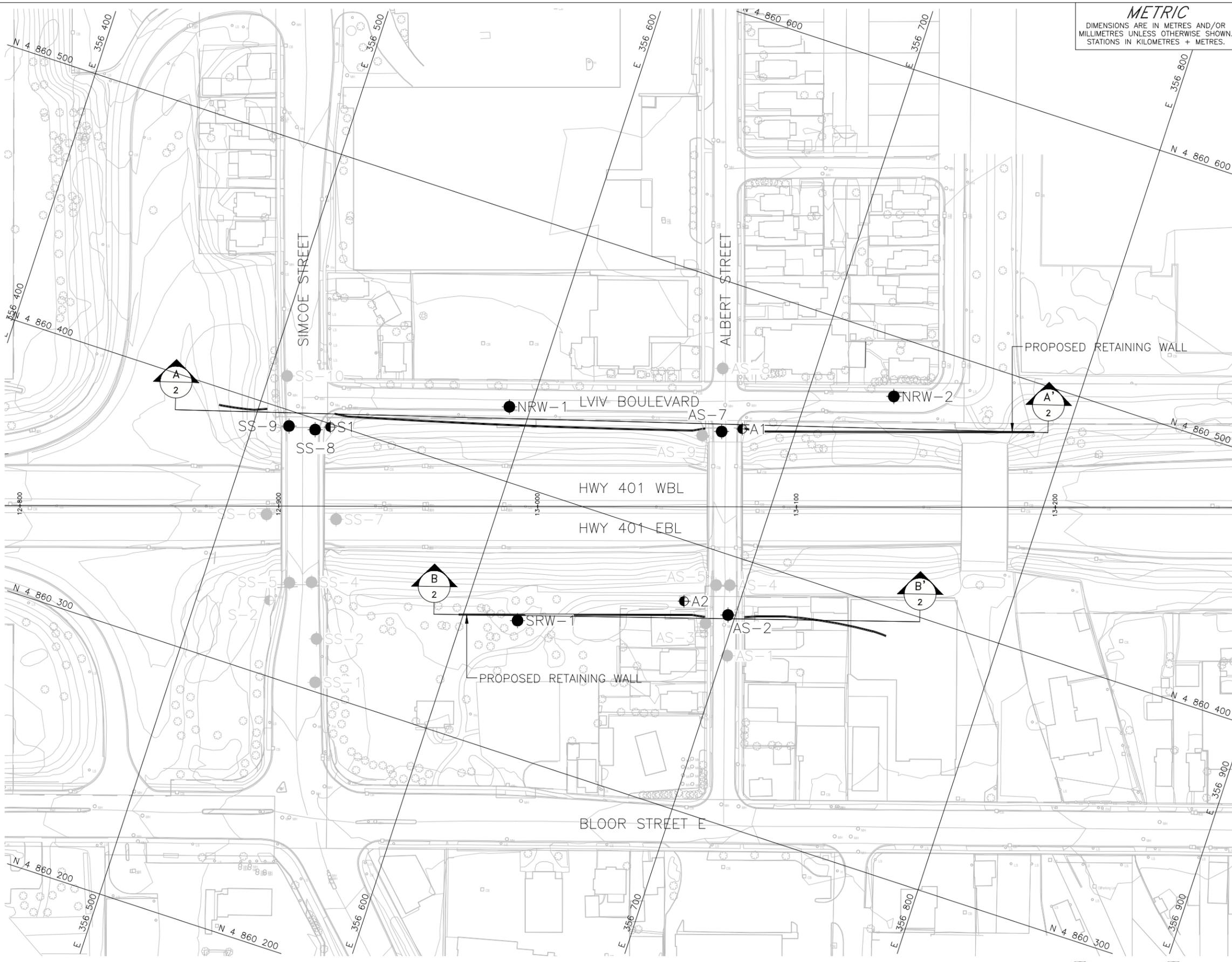
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plans provided in digital format by URS, drawing file nos. X-Base.dwg and X-Property.dwg, received April 11, 2014.
Retaining walls provided in digital format by WSP, drawing no. 171-04557-00_XR_Retaining Walls.dwg, received July 09, 2018.

NO.	DATE	BY	REVISION

Geocres No. 30M14-506		PROJECT NO. 1662582		DIST.
HWY. 401	CHKD. ACK	DATE: 10/16/2019	SITE:	
SUBM'D. ACK	CHKD. ARV	APPD. JMAC	DWG. 1	



PLAN SCALE
15 0 15 30 m

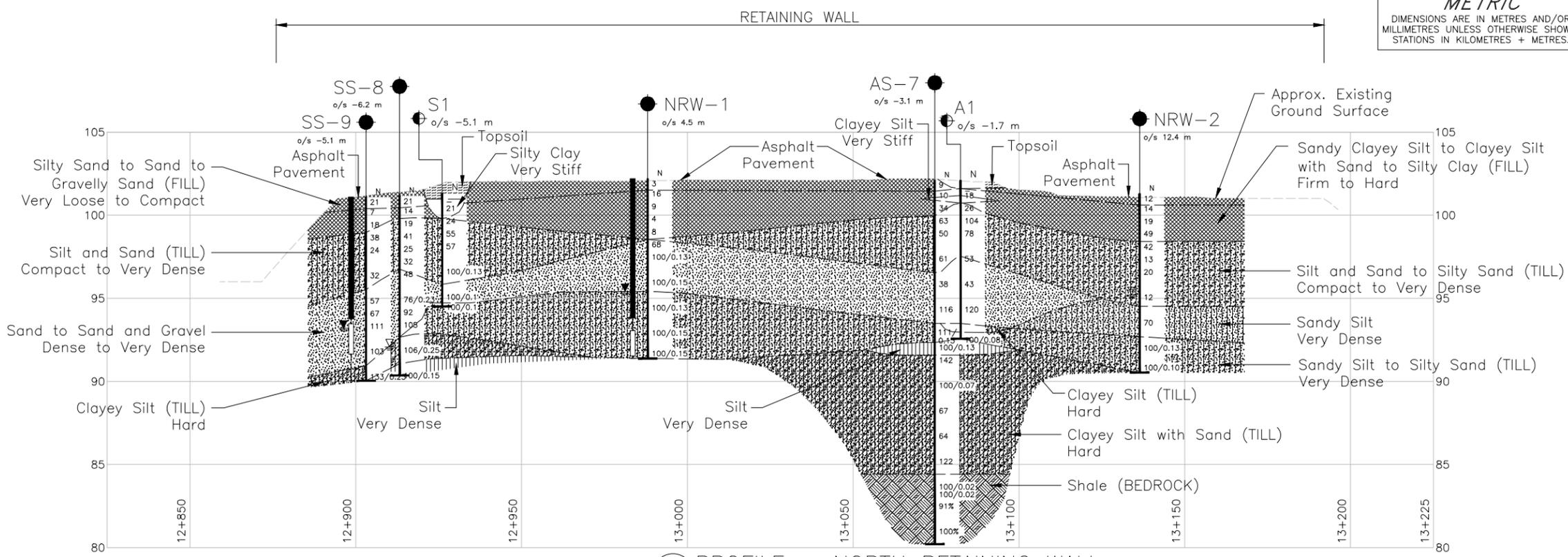


METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

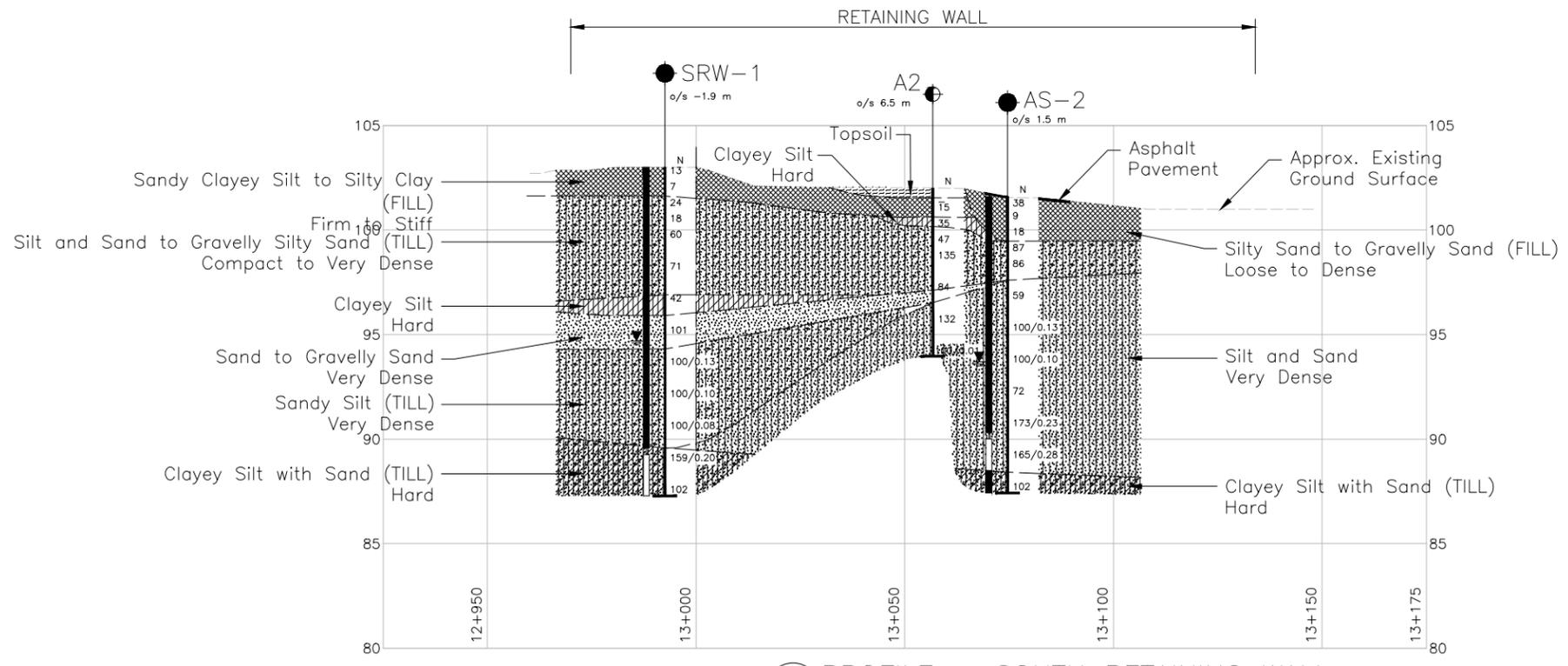
CONT No. GWP No. 2298-13-00

RETAINING WALLS
HIGHWAY 401 WIDENING, SIMCOE STREET TO ALBERT STREET, OSHAWA
SOIL STRATA

SHEET



A-A PROFILE - NORTH RETAINING WALL



B-B PROFILE - SOUTH RETAINING WALL



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- ⊥ WL in piezometer, measured on August 13, 2018
- ⊥ WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
A1	102.1	4860447.6	356680.2
A2	102.0	4860377.6	356679.4
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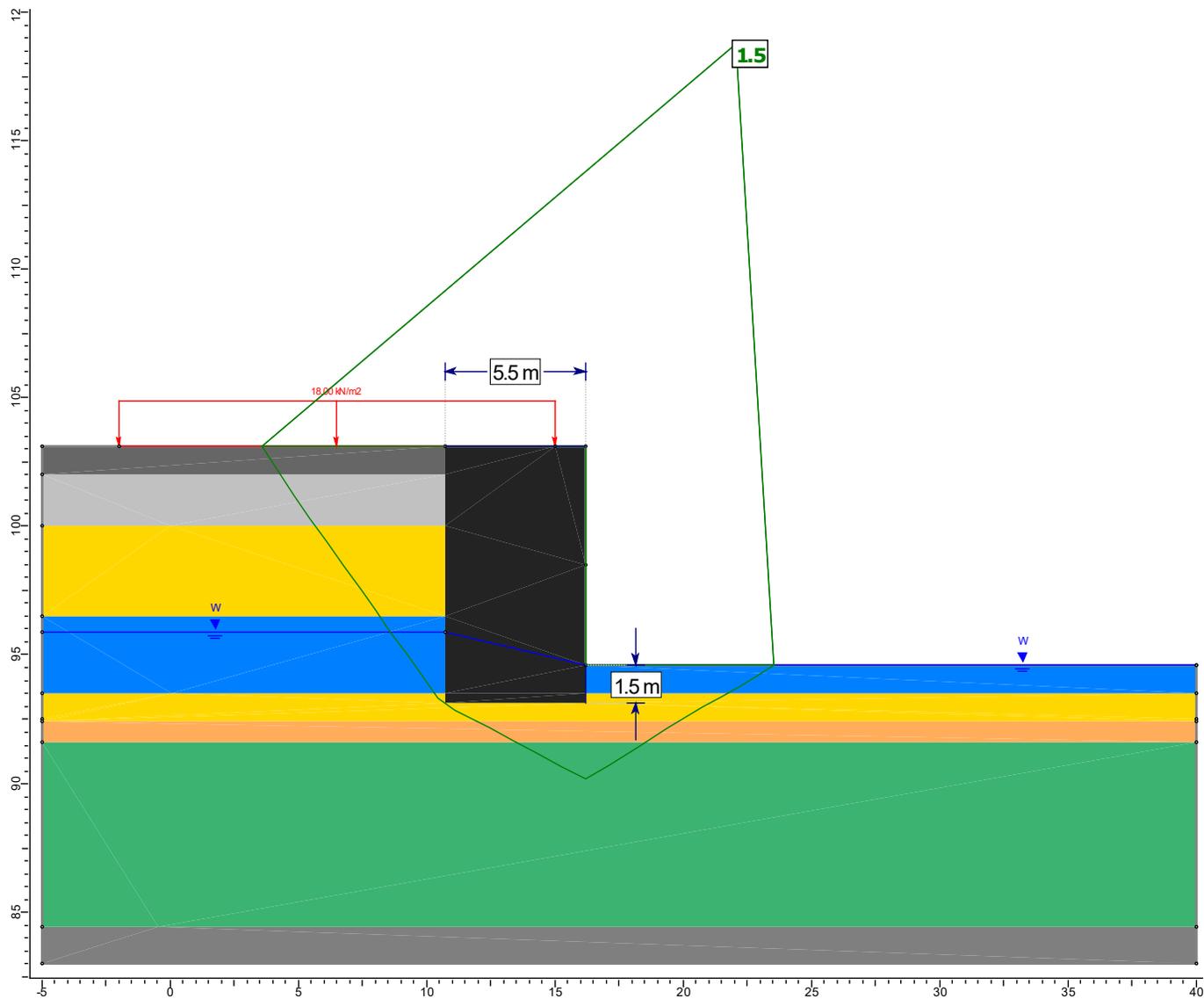
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NO.	DATE	BY	REVISION

Geocres No. 30M14-506

HWY. 401	PROJECT No. 1662582	DIST. .
SUBM'D. ACK	CHKD. ACK	DATE: 10/15/2019
DRAWN: DD	CHKD. ARV	APPD. JMAC
		SITE: .
		DWG. 2



CLIENT
 MINISTRY OF TRANSPORTATION ONTARIO
 G.W.P. 2298-13-00

PROJECT
 HIGHWAY 401 REHABILITATION AT SIMCOE STREET AND
 ALBERT STREET, OSHAWA

CONSULTANT

YYYY-MM-DD 2023-01-20

TITLE

**RETAINING WALL W1 NORTH
 GLOBAL STABILITY ANALYSIS
 PERMANENT CONDITION**

wsp GOLDER

PREPARED DH

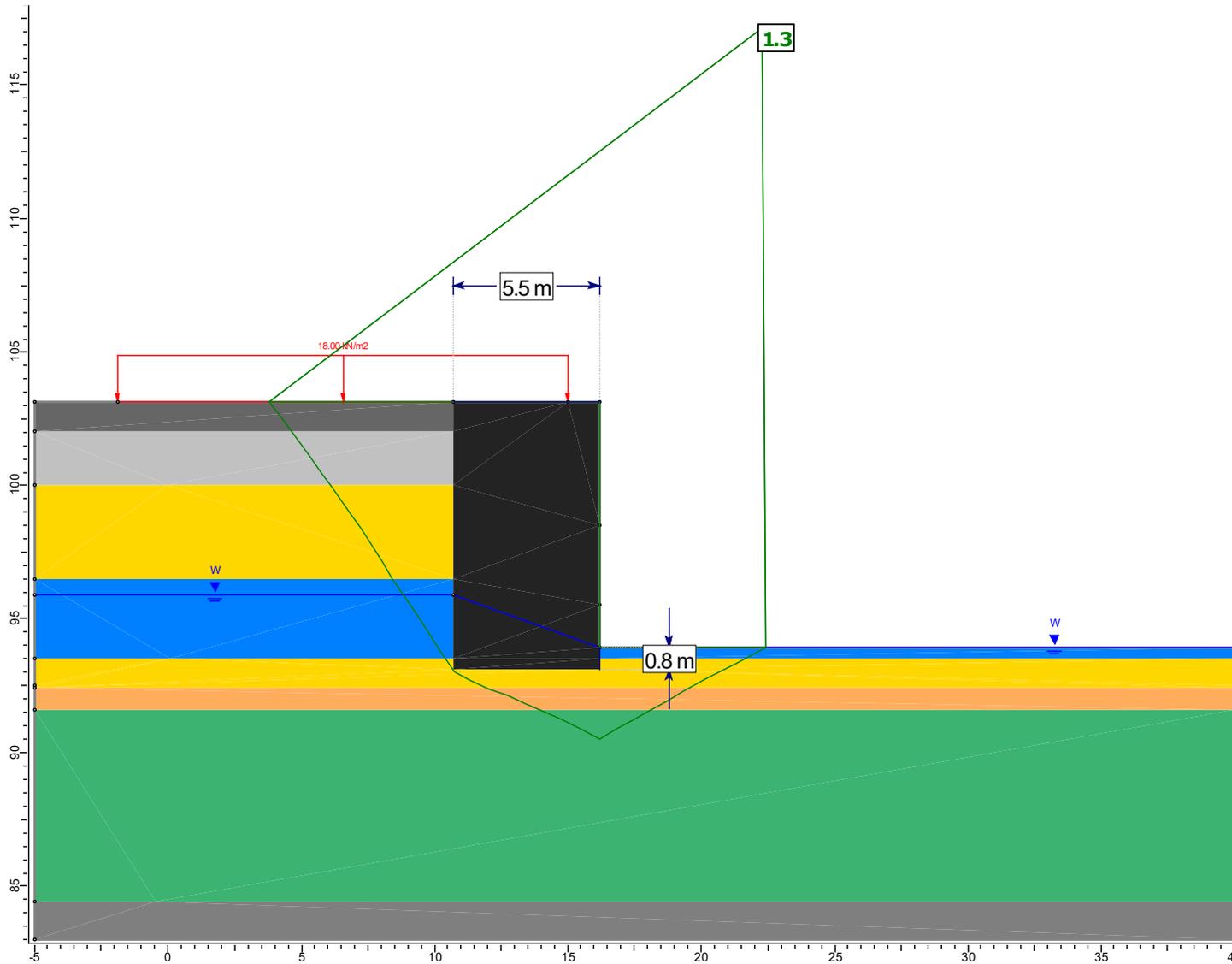
DESIGN XX

REVIEW LCC

APPROVED LCC

PROJECT No.

21466052



CLIENT
 MINISTRY OF TRANSPORTATION ONTARIO
 G.W.P. 2298-13-00

PROJECT
 HIGHWAY 401 REHABILITATION AT SIMCOE STREET AND
 ALBERT STREET, OSHAWA

CONSULTANT

YYYY-MM-DD 2023-01-20

TITLE

**RETAINING WALL W1 NORTH
 GLOBAL STABILITY ANALYSIS
 TEMPORARY CONDITION**

wsp GOLDER

PREPARED DH

DESIGN XX

REVIEW LCC

APPROVED LCC

PROJECT No.
21466052