NRC·CNRC

Addendum / Addenda

No./No
2

Project Description / Description de projet		
M-38 Acoustics Facility - Phase 3		
Solicitation No./N° de solicitation	Project No./N° de projet	W.O. No./N° d'ordre de travail
18-22095	5310	A1-010300-01-01-01
Departmental Representative / représentant ministériel		Date
Allan Smith		January 30, 2019

Notice:	**Nota**:
This addendum shall form part of the tender documents and all conditions shall apply and be read in conjunction with the original plans and specifications.	Cet addenda fait partie intégrale des dossiers d'appel; toutes les conditions énoncées doivent être lues et appliquées en conjonction avec les plans et les devis originaux.

1 Within this addendum, if there is a conflict between the meaning of the english and french text, the english version will be accepted as correct.

2 General Contractor to carry controls work by Ainsworth Inc. Contact is Aaron Dobson 613-247-7938. Refer to attached mechanical addendum M1-R1. Mechanical contractor to carry all necessary coordination labour to support controls integration.

3 Refer to attached question and answer document.

4 Attached is specification section 08 11 14.

5 Refer to attached civil engineering site instruction and reference drawing C1. Drawing is provide for reference purposes.

6 Refer to attached structural engineering information bulletin IB-S17.

7 Electrical dwgs 5310-E01, E02, E03 were part of a different project.

8 Refer to drawing 5310-E04. All components shown in bold solid color are new and need to be provided by the contractor. E.g. 400A breakers in panel 'PD1', 20A breaker in panel "EP1', etc.

9 Refer to drawing 5310-E05. all EMT conduits in slab are existing. Contractor to pull new wires through these conduits.

10 Refer to drawing 5310-E06 detail #3. Fire alarm system to M1 requires Cat6 cable from fire alarm panel to server in storage room 118. Fire alarm system to BAS requires #18 twisted pair cable (Belden 9773) from fire alarm panel to BAS cabinet in strorage room 118. Leave 10m slack of cables inside room 118 for future termination by others.

11 Refer to drawing 5310-E07. As stated in note #1, all Data/Voice cables, devices and terminations are included in this contract.

12 Refer to drawing 5310-E06. Lighting control switch with 'M' equals to switch with 'MS' which means motion controled lighting switch.

13 Reference note #9 on ASK03. New granular B brought up to final asphalt grading elevation is by contractor. Civil Drawing C1 is included in this addendum along with a civil engineer site instruction.

14 Refer to notes 11 & 12 on ASK03. Overhead door operators are to be installed by the contractor. The make and model of the door including dimensions have been provided in notes 11 and 12 on the drawing. Contact for manufacturer of door has also been provided in note 11 and 12. Shop drawings are attached for reference.

15 Replace section 23 74 00 from the tender specification with the attached version.

16 Refer to attached mechanical addendums M1-R1 & M2.

17 Refer to attached Geotechnical report for phase 1 of building M-38 for information purposes. The report references building M-26 however after the report was produced the building number was changed to M-38.

18-22095 Addendum #2 Questions and answers

18-22095 Addenda #2 Questions et Réponses

1) Can we get a full size copy of the site plan?
   A: refer to ASK04 included with this addendum.
   Est-il possible d'obtenir une copie du plan du site en grandeur nature?
   R : Consultez le fichier ASK04, joint à cet addenda.

2) Confirm notes 1 and 4 are for the same bollards.
   A: Notes 1 and 4 are for the same bollards
   Pouvez-vous confirmer que les notes 1 et 4 portent sur les mêmes bollards?
   R : Les notes 1 et 4 s'appliquent aux mêmes bollards.

3) Can you confirm the height of the u/s of the roof deck?
   A: Ground floor elevation is 100.00. U/S of metal deck above Phase 1 building, Work Space 126, KIJ Floor Space 121 and the Floor Facility is 110.33. U/S of metal deck above the Four Room Facility is 111.33.
   Pouvez-vous confirmer la hauteur de la sous-face de la plate-forme du toit?
   R : La hauteur de la sous-face du plafond du rez-de-chaussée est de 100. La sous-face du support métallique au-dessus du bâtiment de la phase 1, de l'espace de travail 126, de l'espace KIJ 121 et de l'installation au sol se trouve à une hauteur de 110,33. La sous-face du support métallique au-dessus de l'installation à quatre salles se situe à une hauteur de 111,33.

4) Roofing to be done by roofer which holds warranty on the roof? If yes, can you provide roofers name?
   A: Roofing not necessary by roofer holding warranty.
   Est-ce que les travaux de toiture doivent nécessairement être réalisés par le couvreur qui a assuré la toiture? Si oui, pouvez-vous nous indiquer de quel couvreur il s'agit?
   R : Il n'est pas nécessaire que les travaux de toiture soient accomplis par le couvreur qui a assuré la toiture.

5) Do we need to re-roof in the two existing RTU curbs? Not noted on the drawings.
   A: Re-roofing at the existing RTU curbs is not needed
   Devons-nous refaire la toiture aux deux endroits où des appareils sont montés sur le toit? Ces travaux ne figurent pas sur les dessins.
   R : Il n'est pas nécessaire de refaire la toiture.
6) For the Control Room / Bathroom any painting of those new partitions? Colour scheme for all paint?
   A: Please refer to Painting Spec Section 09 91 23 for information related to painting and paint types as well as the attached revised Room Finish Schedule 09 00 00. In regards to paint scheme, refer to Spec Section 09 91 23 Item 3.6.9

Pour la salle de contrôle/salle de bain, aura-t-on à peinturer ces nouvelles cloisons? Quelle est la palette de couleurs pour ce travail?
R : Veuillez consulter la section 09 91 23 du devis sur la peinture pour connaître les types de peinture, ainsi que le calendrier 09 00 00 révisé de l'achèvement des salles ci-joint. En ce qui concerne le schéma des couleurs, se reporter à l'article 3.6.9 de la section des spécifications 09 91 23.

7) Acoustic doors GN6: only for door locations 124B and 125A or also for other locations (125B, 125C, 125D, 212A, 212B, 212C, 212D)?
A: GN-6 note shall only apply to Doors 125A, 125B, 125C, 125D, 212A, 212B, 212C, 212D. GN-6 note shall not apply to Door 124B
Portes acoustiques GN6 : est-ce seulement pour les portes 124B et 125A ou doit-on inclure les autres emplacements (125B, 125C, 125D, 212A, 212B, 212C, 212D)?
R : GN-6 ne concerne seulement que les portes 125A, 125B, 125C, 125D, 212A, 212B, 212C et 212D, et n'inclue pas la porte 124B

8) Phase 3 includes outdoor work? Just to confirm: bollards, granular B, MH collar adjustments? If included, any specs? DRWG ASK09, Geotech report?
A: Refer to detail 4/ASK03 for information related to Owner supplied bollards. For Civil information refer to Civil Site Instruction C-01.
Devra-t-on effectuer du travail à l'extérieur à la phase 3 du projet? Juste pour être sûr… Devra-t-on apporter des ajustements aux colliers de regard, aura-t-on des bornes de protection et des matériaux granulaires de classe B? Existe-t-il des spécifications? DRWG ASK09, rapport géotechnique?
R : Consulter les détails dans 4/ASK03 pour connaître les bornes de protection du fournisseur. Pour des renseignements de nature civile, reportez-vous à l'Instruction sur le site civil C-01.

9) Is paint for the staircase hall and corridor where drywall is being finished and sanded included in Phase 3 or paint only in electrical room and adjacent COMM & STOR?
A: Please refer to attached revised Room Finish Schedule 09 00 00 which clarifies the gypsum board paint in question along gridline 8 and D.
La peinture pour la cage d'escalier et le corridor où les cloisons sèches sont finies et poncées est-elle incluse dans la phase 3 ou est-elle seulement pour la salle électrique et la salle COMM et STOR adjacente?
R : Consultez le calendrier de finition de la salle 09 00 00 ci-joint, lequel précise la peinture des panneaux de plâtre en question le long des axes 8 et D.

PART 1 - GENERAL

1.1 RELATED WORK

.1	Building and grouting frames into masonry	Section 04 05 12
.2	Caulking of joints between frames and walls	Section 07 92 00
.3	Door Schedule	Refer to Drawings
.4	Door Hardware	Section 08 71 00
.5	Glazing	Section 08 80 50
.6	Building-in frames into steel stud	Section 09 22 16
.7	Painting	Section 09 91 23
.8	Door Louvres	Mechanical

1.2 DOOR AND FRAME SIZES

.1 Refer to drawings for Door Schedule for door and frame sizes.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International)
- .1 ASTM A 653/A653M-05a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)
- .1 G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59-M1989 (R2001), Welded Steel Construction (Metal Arc Welding) (Metric Version).

.4 Canadian Steel Door Manufacturers' Association, (CSDMA).
- .1 CSDMA, Specifications for Commercial Steel Doors and Frames, 2009.
- .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 2009.

.5 National Fire Protection Association (NFPA)
- .1 NFPA 80-2016, Standard for Fire Doors and Fire Windows.
- .2 NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)
.1 CAN4-S104-80 2010, Fire Tests of Door Assemblies.
.2 CAN4-S105-85 R1992, Fire Door Frames Meeting the Performance Required by CAN4-S104.

.7 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.8 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.

.9 CAN/ULC-S704, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.10 National Building Code of Canada, 2015.

1.4 DESIGN CRITERIA

.1 Steel frames, screens and anchoring shall be designed to withstand factored loads in accordance with NFPA and The National Building Code, 2015.

.2 Design shall be based on limited states design principles using factored loads and resistances.

.3 In addition to above items .1 and .2, frames and screens required to provide fire-resistance ratings or a non-rated fire separation shall be designed to meet requirement of The Building Code and NFPA 80.

.4 In addition to information identified in the Door Schedule, refer Floor Plan drawings for required fire separation and provide rating of frames accordingly. In the event of discrepancies, the more stringent will govern.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 00 10 00

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed arrangement of hardware, fire rating and finishes.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing fire rating and finishes.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

.5 Submit test and engineering data, and installation instructions.

1.6 WARRANTY

.1 Doors and frames shall be guaranteed against manufacturing defects for a period of three (3) years from the date of Certificate of Substantial Performance. Where defects occur, the Contractor shall

be responsible for all costs, including painting, hanging and installing hardware, associated with replacing the defective doors.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

.1 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A 653M, ZF75.

2.2 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

2.3 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 91 23 - Interior Painting. Protect weatherstripping from paint. Provide final finish shall be free of scratches or other blemishes.

2.4 MATERIALS

.1 Fire Rated Doors, Frames and Screens

.1 Door and frame assembly: material and construction approved by ULC. Door: sheet steel, 1.3 mm (18 gauge) minimum base thickness. Frame: sheet steel, 1.6 mm (16 gauge) minimum base thickness.

.2 Door cores: vertically stiffened with steel ribs and all voids filled with semi-rigid fibrous insulation minimum density 24 kg/m3, unless indicated otherwise on Door Schedule.

.3 Anchors for installation in masonry walls: corrugated steel frame tee anchors, thickness and design approved by ULC.

.4 Anchors for installation in concrete walls: tube and anchor (recessed head). All components and design approved by ULC.

.5 Anchors for installation in metal stud walls: "Z" steel anchors, thickness and design approved by ULC.

.6 Glazing stops: commercial grade sheet steel of thickness and design approved by ULC.

.2 Hollow Metal Doors

.1 Sheet steel: 1.3 mm (18 gauge) base thickness, commercial grade steel finished to ASTM A526 M-80a.

Provide Z275 zinc coating to ASTM A653 M-latest edition, for exterior doors and Door 115.

Provide (wiped) zinc finish to ASTM A653 M-latest edition,

for all interior doors.

.2 Glazing stops: minimum 1 mm base thickness sheet steel, tamperproof, screw fixed.

Provide W25 (wiped) zinc finish to ASTM A653-M-latest edition, for interior doors.

Provide Z275 zinc coating to ASTM A653 M-latest edition, for exterior doors

.3 Door Core:

.1 Unless indicated on Door Schedule, all doors shall be steel stiffened and insulated.

.2 Hollow steel: vertically stiffened with steel ribs and all voids filled with semi-rigid fibrous insulation minimum density 24 kg/m3.

.3 Hollow Metal Frames and Screens

.1 Sheet steel: commercial grade steel to ASTM A366-latest edition, Class 1 for paint, and to ASTM A526 M-latest edition.W25.

Provide Z275 zinc coating to ASTM A653M-M-latest edition, for exterior frames.

Provide (wiped) zinc finish to ASTM A653M M-latest edition, for interior frames.

.1 Frames: 1.6 mm (16 gauge) base thickness steel.

.2 Glazing stops: minimum 1 mm base thickness steel, screw fixed, tamperproof.

Provide Z275 zinc coating to ASTM A653M-latest edition, for exterior frames and Door 115..

Provide (wiped) zinc finish to ASTM A653M-latest edition, for interior frames.

.2 Reinforcing channel: to CAN/CSA G40-21-M-latest edition, type 300W.

.3 Door bumpers: black neoprene double stud.

.4 General

.1 Frame floor anchors and channel spreaders: minimum 1,6 mm thick base steel.

.2 Guard boxes: minimum 0.8 mm thick base steel.

.3 Hardware, strike, etc., reinforcing: minimum 3.5 mm thick base steel unless indicated otherwise.
Hinge reinforcing: minimum 6.4 mm thick base steel.

.4 Primer: to CGSB 1-GP-181M+Amdt-Mr-78.

.5 Exterior door top closures: flush type, steel.

2.5 FABRICATION

.1 Fabricate doors and frames as detailed, to Canadian Steel Door and Frame Manufacturers' Association (CSDFMA), Canadian Manufacturing Specifications for Steel Doors and Frames, Latest Edition; except where specified otherwise. Reinforce door and frames to suit hardware requirements specified in Section 08 71 00 - Finish Hardware.

.2 Fit and assemble work in shop where possible. Execute according to details and reviewed shop drawings. Where shop fabrication is not possible make trial assembly in shop.

.3 Welding shall conform to requirements of CSA W-59-M-latest edition, and shall be performed by a fabricator fully approved by the Canadian Welding Bureau. Fill or grind exposed welds to a smooth and flush finish. Exposed welds shall be continuous.

.4 Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastenings.

.5 Insulate to prevent contact between different metals and metal-to-masonry or concrete to obviate chemical or electrolytic corrosion.

.6 Fabricate work square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.7 Bond treat and shop prime with a rust inhibitive zinc chromate primer on all parts not specified to have zinc coating.

.8 Conceal fastenings except where exposed fastenings are indicated.

2.6 HOLLOW STEEL FRAMES AND SCREENS

.1 Provide hollow steel frames and screens for openings as indicated.

.2 Form frames and screens to profiles indicated of minimum 1.6 mm (1 gauge) hot rolled steel. Minimum zinc coating shall be in accordance with CSA G 164-M-latest edition (See Table 1 for minimum mass of zinc coating) and applied to exterior frames and screens.

.3 Frames and screens shall be provided with engineered mullion extensions. Such mullion extensions shall be fully concealed in drywall partitions, and shall extend to the underside of the steel structure or the concrete structure above. Provide bracing above the ceiling as required.

.4 Reinforce vertical and horizontal framing members as required to meet design requirements.

.5 Accurately cut mitres, weld corners continuously along inside frame profile. Grind welded corners to a smooth and flush finish. Fill corners of steel frames with metallic paste filler and sand to a smooth and uniform finish.

.6 Prepare frames for hardware as called for on the hardware schedule. Blank, reinforce for butts with minimum 6.4 mm steel plate. Drill and tap as required. Reinforce both sides of door frames for door closers and for hardware attachment in accordance with the approved hardware schedule.

.7 Cover reinforcement plates or attachments and cut-outs with light metal boxes to protect against mortar.

.8 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.9 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.10 Provide two (2) readily removable or concealed in floor type channel or angle spreaders. Finish shall be as in frames.

.11 Provide adjustable "Tee" anchors with heads of 1.6 mm (16-gauge) steel and body of 1.3 mm (18-gauge) corrugated steel, for frames in masonry construction. Supply three (3) anchors for jambs between 1200 mm and 2100 mm and four (4) for jambs exceeding 2100 mm height.

.12 Provide three (3) rubber bumpers in each jamb on strike side.

.13 Screens shall be anchored to the floor at 600 mm on centre. Anchor screen reinforcing firmly to structure.

.14 Provide removable glazing stops of formed steel complete with countersunk Phillips head screws. **Do not** locate removable glazing stops on corridor side of frames unless noted otherwise.

.15 Frame extrusion shown on Door Schedule shall meet ULC, and/or Building Code requirements. Certification of test performance in accordance with ASTM E90-617 or E90-66T shall be provided.

.16 For locations of frames installed in drywall or masonry walls refer to drawings and Door Schedule.

.17 Welding in accordance with CSA W59.

.18 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.19 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.20 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.21 Securely attach floor anchors to inside of each jamb profile.

.22 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.7 HOLLOW STEEL DOORS

.1 Provide hollow metal doors of types and sizes noted on Door Schedule and shown on drawings.

.2 Doors shall be flush, 44 mm thick, of 1.3 mm (18-gauge) cold rolled, stretcher leveled, sheet steel. Cold rolled steel shall be commercial

quality (ASTM A366-lated edition), wipe coated zinc to ASTM A525 for exterior doors and Door 115.

.3 Unless noted otherwise, interior doors and exterior doors shall have 1.6 mm (16 gauge) stiffeners at maximum 150 mm o.c., with all voids filled with rigid fibrous insulation. Where required, prepare doors to accept weatherstripping, gaskets and such accessories. All exterior doors shall have flush closed steel tops.

.4 Doors shall be mortised, reinforced, drilled, and tapped to receive template hardware. Reinforce for surface mounted hardware.

.5 Weld door components together by means of arc welding in accordance with CSA W-59 latest edition to provide integrated units, square, true, and free from distortion or waves.

.6 Clean, sand, flood coat with air drying paste filler, and again clean, and sand to eliminate all unevenness or irregularities.

.7 Glazed doors shall be provided with glazing stops of formed steel complete with countersunk Phillips head screws.

.8 Door style edges at openings shall be closed and reinforced. Caps with exposed laps onto door faces are not permitted.

.9 At double doors the clearance between leaves shall be a maximum of 2 mm when they are in the fully closed position.

.10 The maximum free clearance below doors in the closed position shall be 6 mm.

2.8 FIRE RATED STEEL DOORS AND FRAMES

.1 In all instances fire rated steel doors and frames shall bear an appropriate Underwriters' Laboratories of Canada label for the rating required.

2.9 ASTRAGALS

.1 Astragals associated with hollow metal doors as specified in the Door Schedule,
Section 08 00 00, shall be supplied under this section except where noted otherwise. All other hardware items shall be supplied under Finishing Hardware, Section 08 71 00.

.2 Astragals shall be the overlapping type and shall be manufactured of 2 mm, 14 gauge steel. Fastenings shall be concealed when doors are in the closed position.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install in accordance with design criteria and National Fire Codes, Volume 4, produced by National Fire Protection Association (NFPA) latest edition.

.2 Install doors and frames to CSDMA Installation Guide.

3.2 DOOR INSTALLATION

1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 10 – Finish Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
- .1 Hinge side: 1.0 mm.
- .2 Latchside and head: 1.5 mm.
- .3 Finished floor and thresholds: 6 mm.

.3 Adjust operable parts for correct function.

.4 Install louvers; refer to mechanical drawings for location.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

3.4 FINISH REPAIRS

.1 Touch up with primer galvanized finish damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.5 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION

SITE INSTRUCTION

TO:	M. Sullivan & Son Ltd.	**DATE:**	December 10, 2018
	C/o Edward J. Cuhaci & Associates Architects	**PROJECT:**	NRC Acoustics Building
		PROJECT NO.:	17M-01656-00
ATTENTION:	Tim Brazeau	**SI NO.:**	C-01

Site Instructions are issued only for the purpose of recording any clarification or interpretation of the contract documents or giving direction on problems resulting from field conditions. These instructions are subject to the provisions of the contract documents and unless stated herein and specifically authorized by the client, will not affect the contract. Should the Contractor require a change in the contract price or project schedule, he shall submit to the Consultant an itemized proposal. If the proposal is accepted by the Client, this Site Instruction will be superseded by a Change Order. When used as a Field Order, the instruction should clearly state the accounting basis on which the work is to proceed and whether there is a change to the proposed schedule.

TITLE: Height Adjustment for Existing Storm and Sanitary Manholes

REFERENCES: N/A

DESCRIPTION OF WORK:

Provide and install risers and adjusters to the existing storm manhole and existing sanitary manhole located outside the southwest corner of Building M-38.

For each manhole, provide and install one 305mm high riser, manufactured in accordance with OPSD 701.031, with steps in accordance with OPSD 405.010, and one 100mm high adjustment unit, in accordance with OPSD 704.010.

Supply and install one 50mm high adjustment unit, and one 75mm high adjustment unit, designed as per OPSD 704.010. Location of these smaller adjustment units is to be determined at the site.

Riser and adjustment units are to be installed in accordance with OPSS 407 instructions.

Provide new Granular B Type II brought up to final asphalt grading elevation at location shown on Architectural Drawing ASK03. Granular B Type II to be placed in maximum 200mm thick lifts, compacted to 100% SPD. Civil Drawing C1 dated 2018-03-21 'Revised Grading' is attached for reference only in determining final asphalt grading elevations.

ORIGINATOR:

PER: _____

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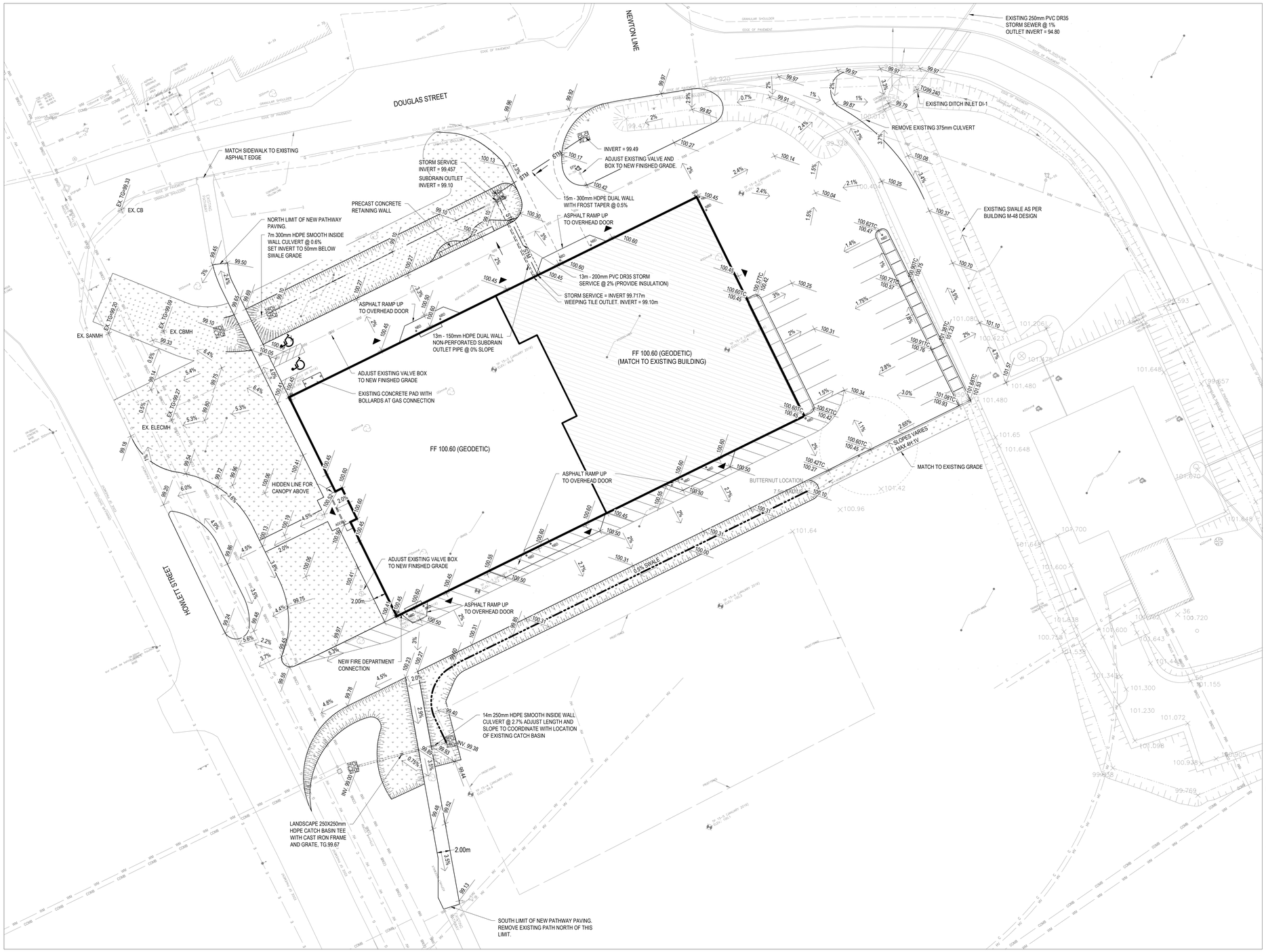


1 / C1 SERVICING AND GRADING
SCALE= 1:250

SCALE: N.T.S.

LEGEND

100.404X	EXISTING GRADE ELEVATION
100.14TC 99.99	PROPOSED TOP AND BOTTOM OF CURB
100.14	PROPOSED GRADE ELEVATION
TG100.14	PROPOSED TOP OF GRATE
2.4%	PROPOSED GRADE SLOPE
STM	PROPOSED STORM SERVICE
	PROPOSED TYPE A RIP RAP AS PER OPSD 810.010.
	PROPOSED 3H:1V TERRACED SLOPE

NOTES: GENERAL

1. ALL SERVICES, MATERIALS, CONSTRUCTION METHODS AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE LATEST STANDARDS AND REGULATIONS OF THE: CITY OF OTTAWA STANDARD SPECIFICATIONS AND DRAWINGS, ONTARIO PROVINCIAL SPECIFICATION STANDARD SPECIFICATION (OPSS) AND ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD), UNLESS OTHERWISE SPECIFIED, TO THE SATISFACTION OF THE NRC AND THE ENGINEER.
2. THE POSITION OF EXISTING POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVEGROUND UTILITIES, STRUCTURES AND APPURTENANCES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL SATISFY HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM DURING THE COURSE OF CONSTRUCTION.
3. THE CONTRACTOR MUST NOTIFY ALL EXISTING UTILITY COMPANY OFFICIALS PRIOR TO START OF CONSTRUCTION AND HAVE ALL EXISTING UTILITIES AND SERVICES LOCATED IN THE FIELD OR EXPOSED PRIOR TO THE START OF CONSTRUCTION, INCLUDING BUT NOT LIMITED TO GAS, POWER, COMMUNICATIONS, WATER, SANITARY, AND STORM. ABIDE BY REQUIREMENTS OF REGULATORY AUTHORITIES.
4. ALL TRENCHING AND EXCAVATIONS TO BE IN ACCORDANCE WITH THE LATEST REVISIONS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS.
5. REFER TO ARCHITECTS PLANS FOR BUILDING DIMENSIONS AND LAYOUT. REFER TO LANDSCAPE PLAN FOR LANDSCAPE DETAILS AND OTHER RELEVANT INFORMATION. ALL INFORMATION SHALL BE CONFIRMED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
6. REFER TO M. SULLIVAN & SON LIMITED DWG. SKMS-009 FOR EXISTING TOPOGRAPHIC DATA. CONTRACTOR TO DETERMINE EXISTING CONDITIONS PRIOR TO CONSTRUCTION OF ANY WORK AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
7. ALL ELEVATIONS ON THIS PLAN ARE GEODETIC AND UTILIZE METRIC UNITS.
8. ALL GROUND SURFACES SHALL BE EVENLY GRADED WITHOUT PONDING AREAS AND WITHOUT LOW POINTS EXCEPT WHERE APPROVED SWALE OR CATCH BASIN OUTLETS ARE PROVIDED.
9. ALL EDGES OF DISTURBED PAVEMENT SHALL BE SAW CUT TO FORM A NEAT AND STRAIGHT LINE PRIOR TO PLACING NEW PAVEMENT. PAVEMENT REINSTATEMENT SHALL BE WITH STEP JOINTS OF 500mm WIDTH MINIMUM.
10. ALL DISTURBED AREAS OUTSIDE PROPOSED GRADING LIMITS TO BE RESTORED TO ORIGINAL ELEVATIONS AND CONDITIONS UNLESS OTHERWISE SPECIFIED. ALL RESTORATION SHALL BE COMPLETED IN ACCORDANCE WITH THE GEOTECHNICAL REQUIREMENTS FOR BACKFILL AND COMPACTION.
11. ALL MATERIAL SUPPLIED AND PLACED FOR PARKING LOT AND ACCESS ROAD CONSTRUCTION SHALL BE TO OPSS STANDARDS AND SPECIFICATIONS UNLESS OTHERWISE NOTED. CONSTRUCTION TO OPSS 206, 310 & 314, MATERIALS TO OPSS 1001, 1003 & 1010.
12. ABUTTING PROPERTY GRADES TO BE MATCHED.
13. MINIMIZE DISTURBANCE TO EXISTING VEGETATION DURING THE EXECUTION OF ALL WORKS.
14. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL UNLESS OTHERWISE DIRECTED FROM THE ENGINEER. EXCAVATE AND REMOVE ALL ORGANIC MATERIAL AND DEBRIS LOCATED WITHIN THE PROPOSED BUILDING, PARKING AND ROADWAY LOCATIONS.
15. AT PROPOSED UTILITY CONNECTION POINTS AND CROSSINGS (I.E. STORM SEWER, SANITARY SEWER, WATER, ETC.) THE CONTRACTOR SHALL DETERMINE THE PRECISE LOCATION AND DEPTH OF EXISTING UTILITIES AND REPORT ANY DISCREPANCIES OR CONFLICTS TO THE ENGINEER BEFORE COMMENCING WORK.
16. PRIOR TO CONSTRUCTION, A GEOTECHNICAL ENGINEER REGISTERED IN THE PROVINCE OF ONTARIO IS TO INSPECT ALL SUB-SURFACES FOR SERVICES AND PAVEMENT STRUCTURES.
17. FOR ANY SOILS RELATED INFORMATION, REFER TO THE GEOTECHNICAL INVESTIGATION REPORT. GOLDER ASSOCIATES, REPORT 1543311, JANUARY 2016.
18. LIGHT DUTY PAVEMENT STRUCTURE SHALL CONSIST OF:
    150 mm GRANULAR B TYPE II COMPACTED TO 100% SPD.
    150 mm GRANULAR A COMPACTED TO 100% SPD.
    50mm HL3 OR SUPERPAVE 12.5 COMPACTED TO 96% MARSHALL DENSITY
19. HEAVY DUTY PAVEMENT STRUCTURE SHALL CONSIST OF:
    450 mm GRANULAR B TYPE II COMPACTED TO 100% SPD.
    150 mm GRANULAR A COMPACTED TO 100% SPD.
    50mm HL8 OR SUPERPAVE 19.0 COMPACTED TO 96% MARSHALL DENSITY
    40mm HL3 OR SUPERPAVE 12.5 COMPACTED TO 96% MARSHALL DENSITY
20. EXISTING SERVICES FOR BUILDING TO REMAIN IN OPERATION. PROTECT EXISTING SERVICES DURING INSTALLATION OF NEW BUILDING. SHUT DOWNS WILL ONLY BE PERMITTED WHEN SCHOOL IS CLOSED.
21. MAINTAIN 2m CLEARANCE BETWEEN BURIED UTILITIES AND TREES.
22. CONTRACTOR TO PROVIDE ENGINEERED SHOP DRAWINGS FOR PRECAST CONCRETE RETAINING WALL. AT NORTH EDGE OF NORTH DRIVEWAY, BOTTOM OF WALL GRADE TO MATCH EXISTING CONDITION AT BASE OF TREE BEING PROTECTED. WALL FACE HEIGHT IS LESS THAN 1000mm.

NOTES: STORM SEWERS AND STRUCTURES

1. ALL STORM SEWER MATERIALS AND CONSTRUCTION METHODS SHALL CONFORM TO THE CURRENT CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.
2. PVC STORM SEWERS SHALL BE PVC SDR-35, WITH RUBBER GASKET PER CSA A-257.3. HDPE CULVERTS TO CSA B182.8-02, WITH SMOOTH INSIDE WALL.
3. SEWER BEDDING AS PER CITY OF OTTAWA DETAIL S6. PROVIDE 150mm THICK BEDDING IN EARTH SUBGRADE AREAS. INCREASE BEDDING THICKNESS TO 300mm FOR ROCK SUBGRADE.
4. BUILDING PERIMETER FOUNDATION DRAIN TO CONSIST OF 150mm DIA. PERFORATED HDPE PIPE WITH FILTER SOCK SURROUNDED BY 150mm OF 19mm CLEAR STONE WRAPPED IN GEOTEXTILE ON ALL SIDES.
5. PROVIDE RIP-RAP TREATMENT AT CULVERT INLET AND OUTLET LOCATIONS SHOWN IN ACCORDANCE WITH TYPE A ON OPSD 810.010. MEAN DIAMETER FOR RIP-RAP SHALL BE 200mm.
6. HI40 RIGID INSULATION REQUIRED AT 300mm ABOVE NEW STORM SERVICE.

NOTES: EROSION AND SEDIMENT CONTROL

1. PRIOR TO START OF CONSTRUCTION:
    1.1. INSTALL FILTER SOCKS AT EXISTING AND PROPOSED CATCH BASINS AND MANHOLES IMPACTED BY PROPOSED WORK.
2. DURING CONSTRUCTION:
    2.1. MINIMIZE THE EXTENT OF DISTURBED AREAS AND THE DURATION OF EXPOSURE AND IMPACTS TO EXISTING GRADING.
    2.2. PROTECT DISTURBED AREAS FROM OVERLAND FLOW BY PROVIDING TEMPORARY SWALES TO THE SATISFACTION OF THE FIELD ENGINEER.
    2.3. PROVIDE TEMPORARY COVER SUCH AS SEEDING OR MULCHING IF DISTURBED AREA WILL NOT BE REHABILITATED WITHIN 30 DAYS.
    2.4. INSPECT ESC MEASURES WEEKLY AND WITHIN 24 HOURS AFTER A STORM EVENT. CLEAN AND REPAIR WHEN NECESSARY.
    2.5. EROSION CONTROL FENCING TO BE INSTALLED AROUND THE BASE OF ALL STOCKPILES.
    2.6. DO NOT LOCATE TOPSOIL PILES AND EXCAVATION MATERIAL CLOSER THAN 2.5m FROM ANY PAVED SURFACE, OR ONE WHICH IS TO BE PAVED BEFORE THE PILE IS REMOVED. ALL TOPSOIL PILES ARE TO BE SEEDED IF THEY ARE TO REMAIN ON SITE LONG ENOUGH FOR SEEDS TO GROW (LONGER THAN 30 DAYS).
    2.7. CONTROL WIND-BLOWN DUST OFF SITE BY SEEDING TOPSOIL PILES AND OTHER AREAS TEMPORARILY (PROVIDE WATERING AS REQUIRED AND TO THE SATISFACTION OF THE ENGINEER).
    2.8. NO ALTERNATE METHODS OF EROSION PROTECTION SHALL BE PERMITTED UNLESS APPROVED BY THE FIELD ENGINEER.
    2.9. ROADWAY TO BE CLEANED OF ALL SEDIMENT FROM VEHICULAR TRACKING AS REQUIRED.
    2.10. ANY MUD/MATERIAL TRACKED ONTO THE ROAD SHALL BE REMOVED IMMEDIATELY BY HAND OR RUBBER TIRE LOADER.
    2.11. TAKE ALL NECESSARY STEPS TO PREVENT BUILDING MATERIAL, CONSTRUCTION DEBRIS OR WASTE BEING SPILLED OR TRACKED ONTO ABUTTING PROPERTIES OR PUBLIC STREETS DURING CONSTRUCTION AND PROCEED IMMEDIATELY TO CLEAN UP ANY AREAS SO AFFECTED.
    2.12. ALL EROSION CONTROL STRUCTURE TO REMAIN IN PLACE UNTIL ALL DISTURBED GROUND SURFACES HAVE BEEN STABILIZED EITHER BY PAVING OR RESTORATION OF VEGETATIVE GROUND COVER.
    2.13. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

National Research Council Canada
Administrative Services and Property Management Branch
Conseil national de recherches Canada
Division des services administratifs et gestion de l'immobilier
NRC · CNRC

TRUE NORTH | PLAN NORTH

PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
March 21, 2018

wsp
300-2611 QUEENSVIEW DRIVE
OTTAWA ONTARIO CANADA K2B 8K2
TEL.: 1-613-829-2800 FAX: 1-613-829-8299 WWW.WSP.COM
PROJETC No: 17M-01656-00

No.	Date	Revision	By / Par:
2	2018-03-21	REVISED GRADING	BL
1	2018-02-26	ISSUED FOR TENDER	BL
0	2017-10-27	REVISED CONCEPT	BL

Date Printed / Date imprimée

- Verify all dimensions and site conditions and be responsible for same
- Vérifier toutes les dimensions et l'etat des lieux et en assumer la responsabilité

A Detail no. No. du détail
B Location drawing no. sur dessin no.
C Drawing no. dessin no.

project / projet
BUILDING M-38 ADDITION - ACOUSTICAL FACILITY
MONTREAL ROAD CAMPUS

drawing / dessin
SERVICING AND GRADING

designed / conçu	J JOHNSTON	date / date	2017-09-29
drawn / dessiné	BL	scale / échelle	AS NOTED
checked / vérifié		sheet / feuille	1 of/de 1
approved / approuvé		W.O.no.	D.T.no.

dwg.no. / dessin no. C1
dwg.no. / dessin no. C1

CUNLIFFE & ASSOCIATES

STRUCTURAL INFORMATION BULLETIN **IB-S17**

Issued to: EDWARD J CUHACI & ASSOCIATE ARCHITECTS

DEC 18, 2018

Project: **BUILDING M-38 ADDITION ACOUSTICAL FACILITY** **Project No.:** 17-109

Client: EDWARD J CUHACI & ASSOCIATE ARCHITECTS

The following Information Bulletin is issued to the Construction Manager to record additional information, or a change or revision to, previously issued documentation. The Construction Manager shall review this Information Bulletin and issue to the effected trade contractors, in the form of an addendum, site instruction, or change order. The Construction Manager shall provide to the consultant a copy of this Information Bulletin in the form it was issued to the Trade Contractor for their records.

STRUCTURAL ITEMS

1. Title: STRUCTURAL REVISIONS & CLARIFICATIONS

2. Attachments:

IB-S17-SK1, SK2,

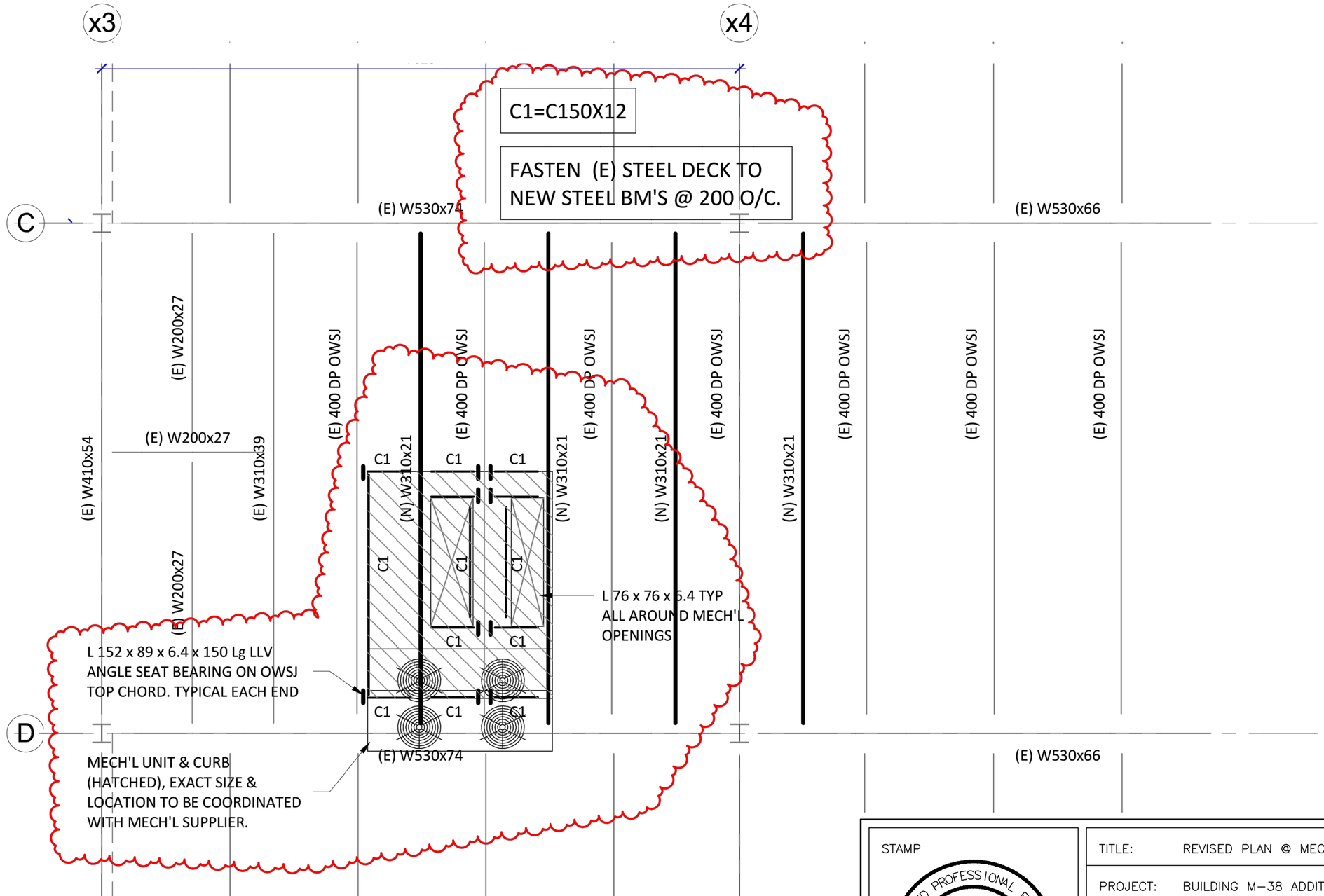
3. Description:

Revised mechanical unit framing on S103

Prepared By:

Paul Dolan

END OF INFORMATION BULLETIN



/ MECH'L UNIT FRAMING ON EXISTING ROOF

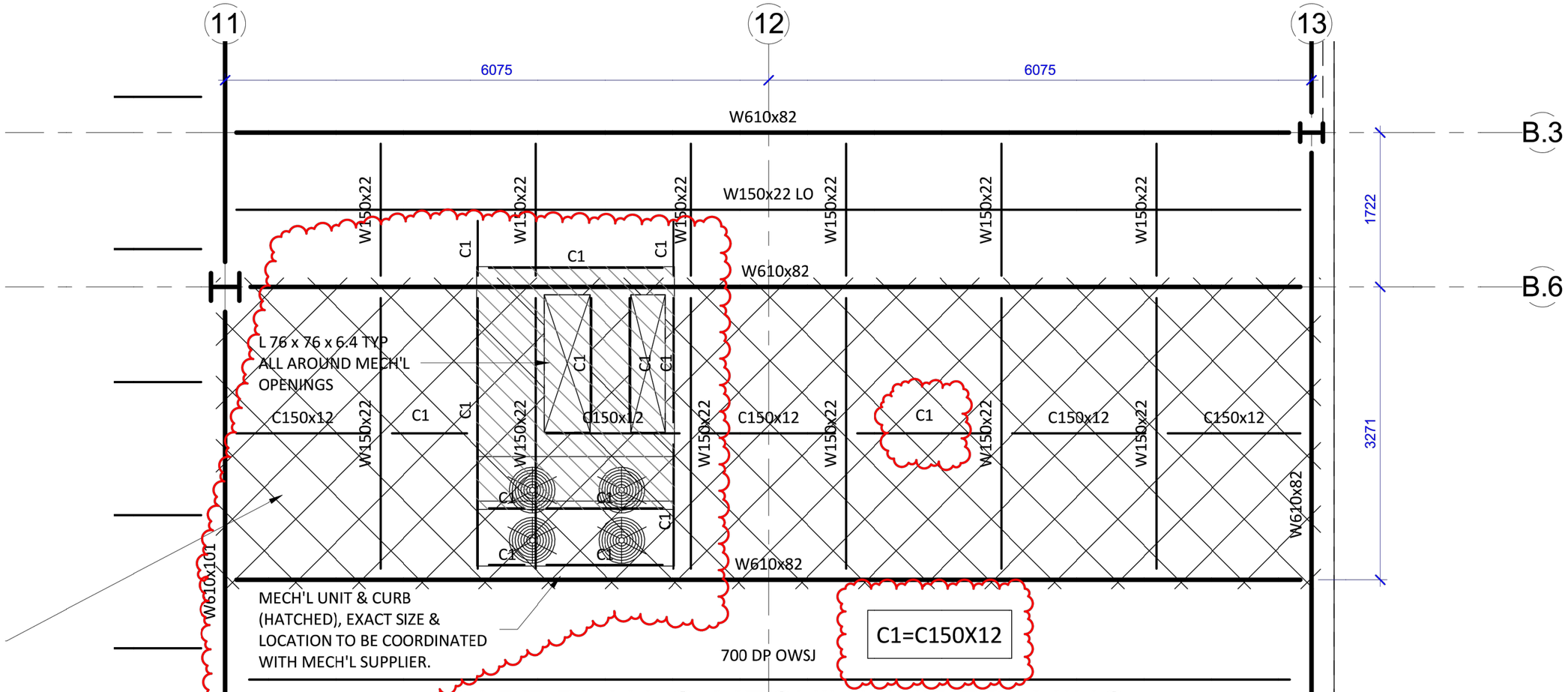
STAMP

LICENSED PROFESSIONAL ENGINEER
2018-12-18
R . I. CUNLIFFE
PROVINCE OF ONTARIO

TITLE:	REVISED PLAN @ MECH'L UNIT FRAMING – S103
PROJECT:	BUILDING M–38 ADDITION ACOUSTICAL FACILITY
CLIENT:	EDWARD J CUHACI & ASSOCIATE ARCHITECTS

CUNLIFFE
TEL 729–7242
FAX 728–1461
CUNLIFFE & ASSOCIATES
CONSULTING STRUCTURAL ENGINEERS
102–1737 WOODWARD DR. OTTAWA ON. K2C 0P9

DATE:	DEC 18, 2018
PROJ No.:	17–109
DWG. No.:	IB–S17–SK1



PART PLAN @ MECH'L UNIT FRAMING

1 : 50

13

STAMP

LICENSED PROFESSIONAL ENGINEER
2018-12-18
R . I. CUNLIFFE
PROVINCE OF ONTARIO

TITLE:	REVISED PLAN @ MECH'L UNIT FRAMING – S103
PROJECT:	BUILDING M–38 ADDITION ACOUSTICAL FACILITY
CLIENT:	EDWARD J CUHACI & ASSOCIATE ARCHITECTS

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CUNLIFFE & ASSOCIATES
CONSULTING STRUCTURAL ENGINEERS
102–1737 WOODWARD DR. OTTAWA ON. K2C 0P9

DATE:	DEC 18, 2018
PROJ No.:	17–109
DWG. No.:	IB–S17–SK2

MOTOR SPECIFICATIONS:

ELECTRICAL EQUIPMENT LIST:

BOTTOM BAR LOCKING:

Cylinder locking device located at both jambs with shop installed Best Keyed cylinder, 1" lg. x 1 5/32" dia., not masterkeyed. Hardware contractor to replace construction core with masterkeyed core in the field when required.

Operable coil side only.

QUANTITY & MARK:

(1) 001 E12E

MATERIAL & FINISH:

Front slat - Galvanized steel, phosphatized, polyester powder coating, color Ral 9004

Back slat - Galvanized steel with GalvaNex™ coating system. Finish color: Gray

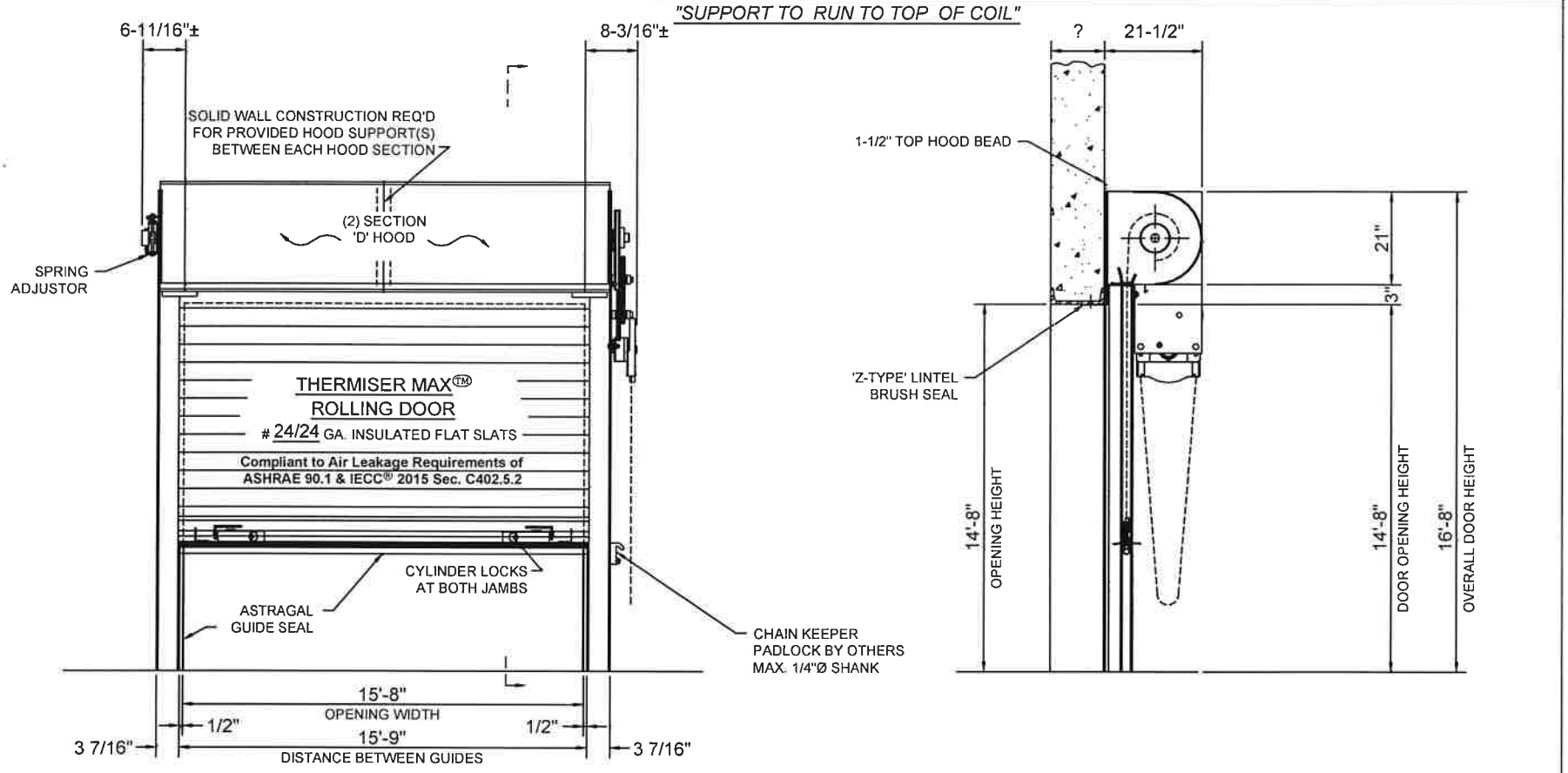
Bottom Bar - Extruded aluminum, polyester powder coating, color Ral 9004

Guides - Structural steel, polyester powder coating, color Ral 9004

Hood - Galvanized steel with GalvaNex™ coating system. Finish color: Gray

Plain Steel - Powder coated gray

M. SULLIVAN & SON LIMITED
Received and Reviewed for Submission To Consultant.
Log Number: 08.33.00-1.0
Date: Apr 18, 2018
Signature:
Sub-Contractor's Responsibility For Dimensions, Omissions, Errors Etc. Is Not Hereby Relieved.



ELEVATION (COIL SIDE) AND SECTION VIEW

See drawing # E 01200612 002 B for guide detail.

03-21-2018	PRODUCT CODE: CFW 6F 44GC
BSE_STDR	

—	ORIGINAL DRAWING	04/13/18	AL4L
#	REVISION	DATE	BY

CORNELL Innovative door solutions.

CONTROLGARD DOUBLE COMPOUND CHAIN OPERATED ROLLING DOOR

JOB: ARES

MODEL #: ESD30

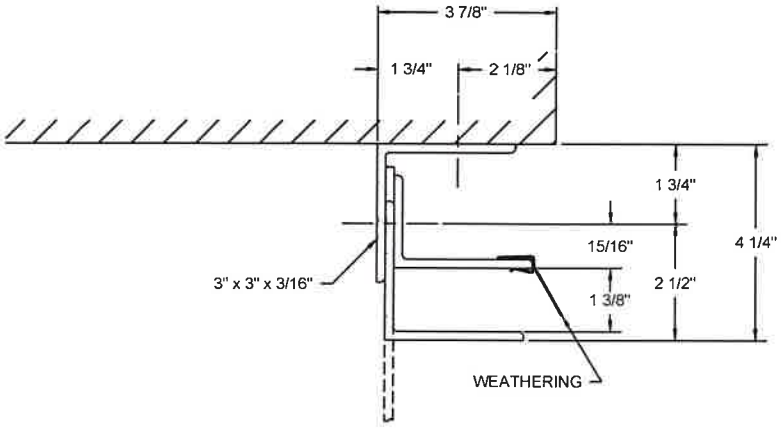
JOB #: * E 01200612 002 A

AGENT: ATLAS ROLLING ENTRY SYSTEMS

CONTRACTOR:

ARCHITECT:

NOTE: Wall construction detail shown is for illustrative purposes only, does not imply compliance with building requirements, and must meet architectural specifications to properly support product. Products designed with wind load requirements must be properly fastened to structural members as specified in order to avoid catastrophic failure. Wall construction and closure installation shall be in accordance with the local authority having jurisdiction requirements.



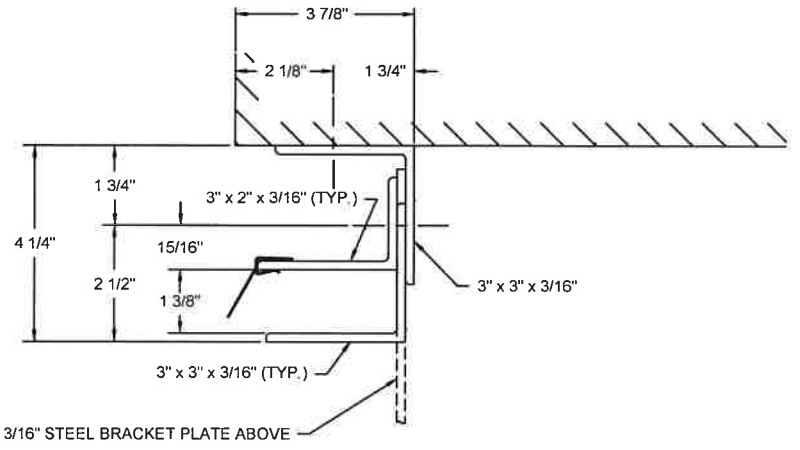
GA0415 - 4 1/4"

WALL FASTENERS:

AT 36" ON CENTER
- 1/4" FILLET WELD ENTIRE PERIMETER OF WALL FASTENER SLOT

ASSEMBLY FASTENERS:

AT 36" ON CENTER
- Ø3/8-16 x 1 1/2" HEX HEAD CAP SCREW, GR. 5
- HEX HEAD NUT, GR. 5
- HARDENED FLAT WASHERS



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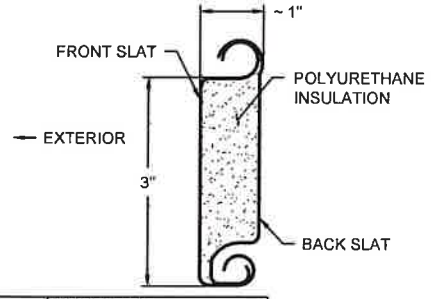
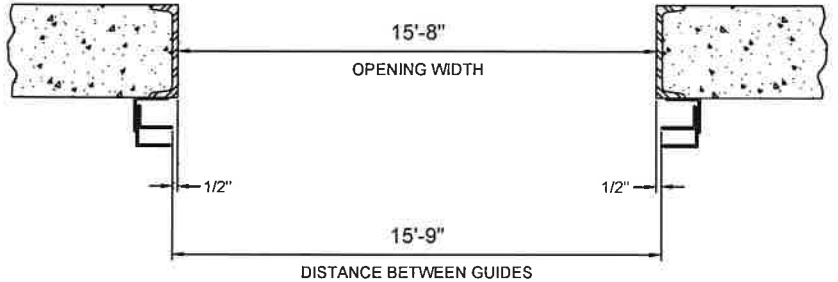
- HARDENED FLAT WASHERS

CP0001 SLAT



MK: 002

PLAN OF OPENING



INSTALLERS NOTE:

MAINTAINING FACTORY SET GUIDE GAPS IS CRITICAL TO THE PROPER OPERATION OF THE DOOR AND IT'S ABILITY TO WITHSTAND THE DESIGNED WINDLOAD!

ENDLOCK DETAIL

CP0212 CAST IRON ENDLOCK ON ALTERNATING SLATS WITH 2 x 1/4" RIVETS.

CP0212

06-15-2016	PRODUCT CODE:
TD7_425	CFW 6F 44GC

—	ORIGINAL DRAWING	04/13/18	AL4L
#	REVISION	DATE	BY

CORNELL Innovative door solutions.

INSULATED SERVICE DOOR GUIDE ASSEMBLY, 4-1/4" PACKOFF

JOB: ARES

MODEL #: ESD30	JOB #: * E 01200612 002 B
AGENT: ATLAS ROLLING ENTRY SYSTEMS	
CONTRACTOR:	
ARCHITECT:	

MOTOR SPECIFICATIONS:

M. SULLIVAN & SON LIMITED
Received and Reviewed for Submission To Consultant.

Log Number:

Date:

Signature:

Sub-Contractor's Responsibility For Dimensions, Omissions, Errors Etc. Is Not Hereby Relieved.

08.33.00-2.0

Apr 18, 2018

ELECTRICAL EQUIPMENT LIST:

BOTTOM BAR LOCKING:

Cylinder locking device located at both jambs with shop installed Best Keyed cylinder, 1" lg. x 1 5/32" dia., not masterkeyed. Hardware contractor to replace construction core with masterkeyed core in the field when required.

Operable coil side only.

QUANTITY & MARK:

(1) 001 E 121 D

MATERIAL & FINISH:

Front slat - Galvanized steel, phosphatized, polyester powder coating, color Ral 9004

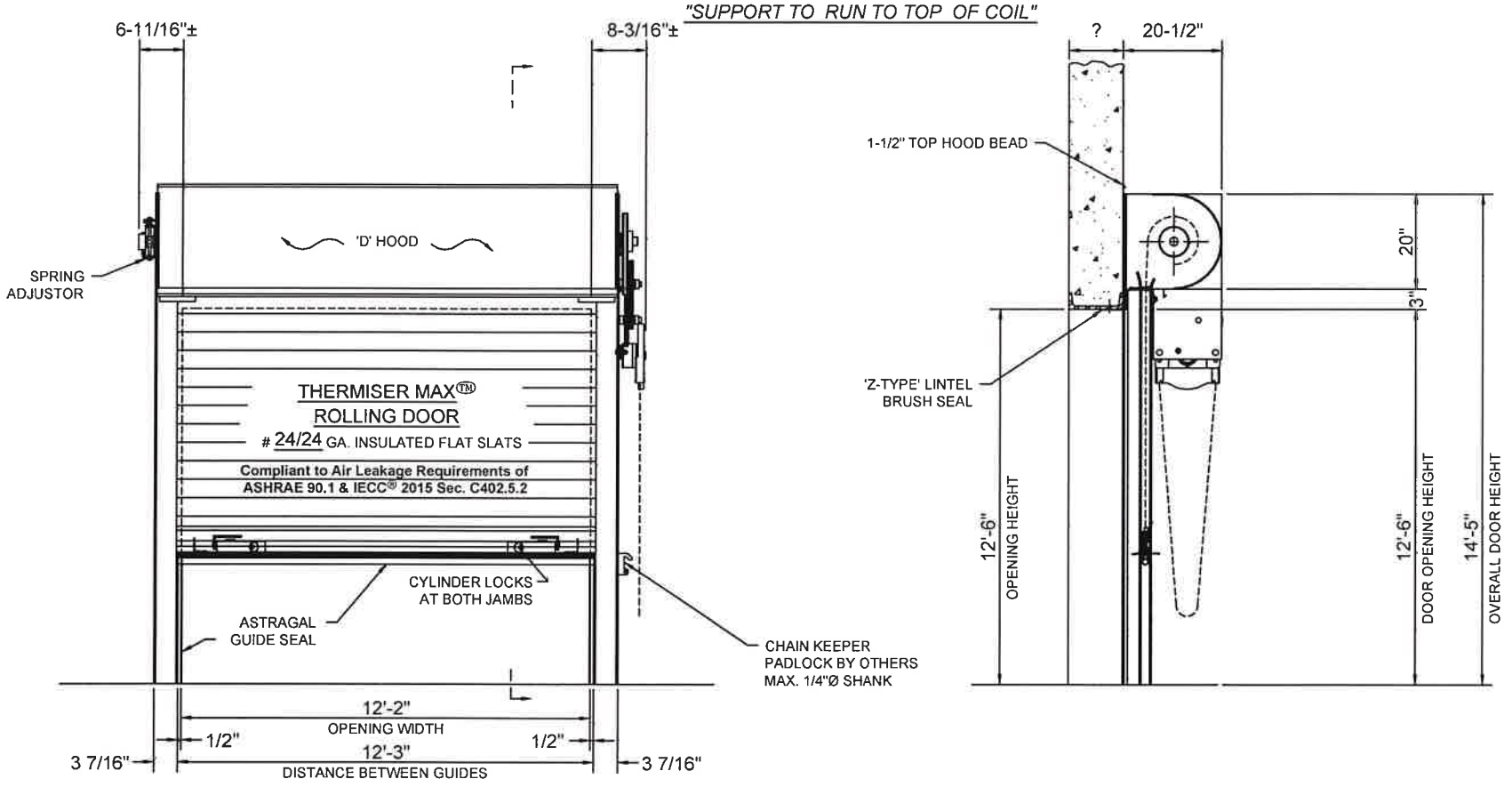
Back slat - Galvanized steel with GalvaNex™ coating system. Finish color: Gray

Bottom Bar - Extruded aluminum, polyester powder coating, color Ral 9004

Guides - Structural steel, polyester powder coating, color Ral 9004

Hood - Galvanized steel with GalvaNex™ coating system. Finish color: Gray

Plain Steel - Powder coated gray



ELEVATION (COIL SIDE) AND SECTION VIEW

See drawing # E 01200612 001 B for guide detail.

03-21-2018	PRODUCT CODE
BSE_STDR	CFW 6F 44GC

MODEL #:	JOB #:
ESD30	* E 01200612 001 A

#	REVISION	DATE	BY
---	ORIGINAL DRAWING	04/13/18	AL4L

CORNELL Innovative door solutions.

CONTROLGARD DOUBLE COMPOUND CHAIN OPERATED ROLLING DOOR

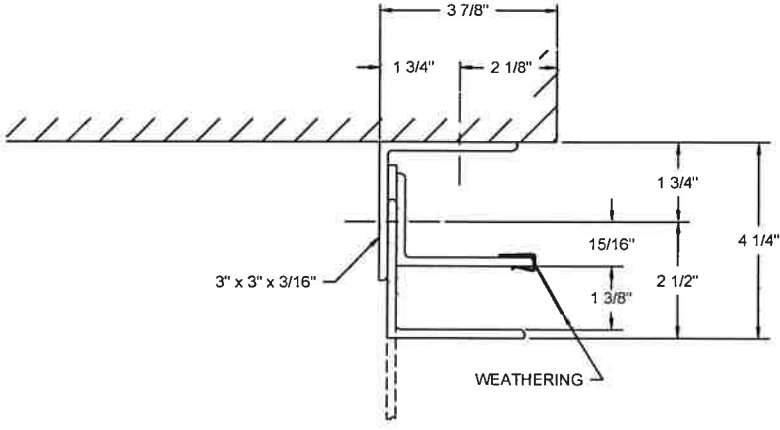
JOB: ARES

AGENT: ATLAS ROLLING ENTRY SYSTEMS

CONTRACTOR:

ARCHITECT:

NOTE: Wall construction detail shown is for illustrative purposes only, does not imply compliance with building requirements, and must meet architectural specifications to properly support product. Products designed with wind load requirements must be properly fastened to structural members as specified in order to avoid catastrophic failure. Wall construction and closure installation shall be in accordance with the local authority having jurisdiction requirements.



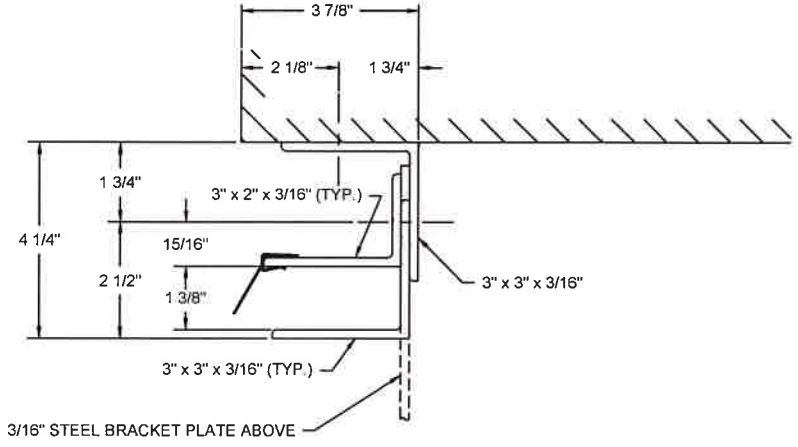
GA0415 - 4 1/4"

WALL FASTENERS:

AT 36" ON CENTER
- 1/4" FILLET WELD ENTIRE PERIMETER OF WALL FASTENER SLOT

ASSEMBLY FASTENERS:

AT 36" ON CENTER
- Ø3/8-16 x 1 1/2" HEX HEAD CAP SCREW, GR. 5
- HEX HEAD NUT, GR. 5
- HARDENED FLAT WASHERS



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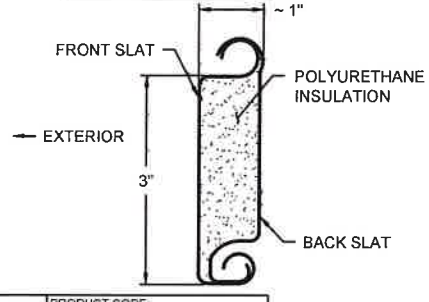
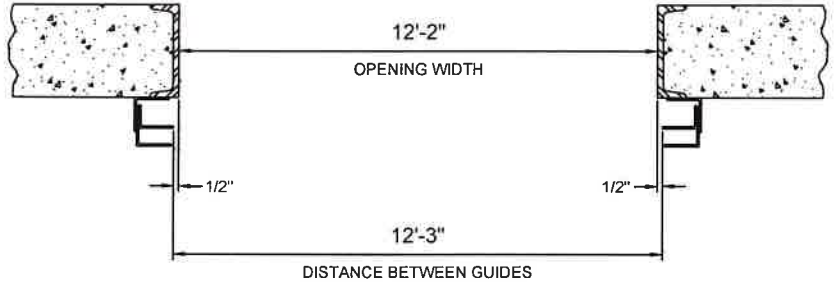
- HARDENED FLAT WASHERS

CP0001 SLAT



MK: 001

PLAN OF OPENING

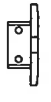


INSTALLERS NOTE:

MAINTAINING FACTORY SET GUIDE GAPS IS CRITICAL TO THE PROPER OPERATION OF THE DOOR AND IT'S ABILITY TO WITHSTAND THE DESIGNED WINDLOAD!

ENDLOCK DETAIL

CP0212 CAST IRON ENDLOCK ON ALTERNATING SLATS WITH 2 x 1/4" RIVETS.



CP0212

06-15-2016	PRODUCT CODE:
TD7_425	CFW 6F 44GC

—	ORIGINAL DRAWING	04/13/18	AL4L
#	REVISION	DATE	BY

CORNELL Innovative door solutions.

INSULATED SERVICE DOOR GUIDE ASSEMBLY, 4-1/4" PACKOFF

JOB: ARES

MODEL #:	ESD30
JOB #: *	E 01200612 001 B
AGENT:	ATLAS ROLLING ENTRY SYSTEMS
CONTRACTOR:	
ARCHITECT:	

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

.1 Air-Conditioning, Heating, and Refrigeration Institute (formerly ARI)
- .1 ARI 210/240-2008, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 ARI 340/360-2007, Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

.2 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Canadian Standards Association (CSA)
- .1 CSA ANSI Z21.47-2016/CSA 2.3-2016, Gas-Fired Central Furnaces.

.5 Underwriters Laboratories (UL)
- .1 UL 1995, Heating and Cooling Equipment.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

1.5 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 20 05 01 - Mechanical General Requirements.

1.6 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by Mechanical General Requirements. manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Factory assembled components to form unit supplying air at design conditions as indicated.

.2 Acceptable material: Lennox, Trane, York, Carrier, Aaon, McQuay.

2.2 UNIT PERFORMANCE

.1 See schedule on drawings for rooftop unit performances.

.2 Unit cooling capacities shall be in accordance with and tested to ARI 210/240 or ARI 340/360

.3 Units up to 20 tons shall carry the ARI compliance label.

.4 Unit MINIMUM cooling efficiency, including the standard supply air blower motor shall be as shown on the plans.

.5 Unit shall have a minimum heating system efficiency of 80%.

.6 Units shall be safety certified in accordance with UL 1995, and CSA ANSI Z21.47/CSA 2.3.

.7 Unit shall be safety certified by an accredited testing laboratory.

.8 Unit nameplate shall carry the label of the certification agency.

.9 Unit shall be shipped completely assembled by the manufacturer including all standard items and optional items.

.10 Unit shall be 100% run tested by the manufacturer with a copy of the run test report shipped with the unit.

.11 All units shall comply with the prescriptive requirements of ASHRAE 90.1 and OBC SB-10.

2.3 UNIT CONSTRUCTION

.1 Unit shall be completely factory assembled, piped, wired and shipped in one piece.

.2 Unit shall be specifically designed for outdoor rooftop application with a fully weatherproof cabinet.

.3 Unit design shall be dedicated bottom or side supply/return air style system for mounting of a roof curb.

.4 Cabinet shall be constructed entirely of G90 wt. galvanized metal with the exterior construction of 18 gauge.

.5 The unit roof shall be cross broken and/or sloped to assure drainage.

.6 Access to compressor(s), controls, filters, blower, heating section, and other items needing periodic checking or maintenance shall be through hinged access doors with a quarter turn latch (door fastening are not acceptable).

.7 Air side service access doors shall be fully gasketted with rain break overhangs.

.8 Air side access doors will have an internal metal liner to protect the door insulation.

.9 Unit exterior shall be painted with two-part polyurethane paint over a wash primer and a paint grip type galvanized steel.

.10 Wiring shall be colour coded and marked with identification on each end.

.11 The interior air side of the cabinet shall be entirely insulated on all exterior panels with ½" thick, coated, fibreglass insulation.

.12 All openings through the base pan of the unit shall have upturned flanges of a least ½" in height around the opening through the base pan.

.13 Unit shall have decals and tags to indicate unit lifting - rigging, service areas and caution areas.

.14 Wiring diagrams shall be in colour and marked to match the colour and markings of the wires and shall be both "point-to-point" and "ladder" diagrams.

.15 Diagrams shall also be laminated in plastic and permanently fixed to the control compartment door.

.16 Installation and maintenance manuals shall be supplied with each unit, located in a metal pocket in the control access compartment.

.17 Unit exterior to be manufacturer’s standard colour.

2.4 BLOWERS

.1 Blower shall be entirely self-contained on a slide deck for service and removal from the cabinet.

.2 All belt drive blower(s) shall have backward inclined or forward curved airfoil blades.

.3 Adjustable V-belt drive shall be provided with a minimum rating of 140% of the motor nameplate brake horsepower when the adjustable pulley is at the minimum RPM.

.4 Blowers, drives and motors shall be dynamically balanced.

.5 Provide variable speed drives where required by ASHRAE 90.1 or as noted in schedule.

2.5 ECONOMIZER

.1 Economizer shall be 0-100% with a motor operated outside air damper constructed of extruded aluminum, hollow core, air foil blade with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure.

.2 Economizer shall be controlled by a field adjustable dual enthalpy controller.

2.6 POWER EXHAUST

.1 Exhaust fan, centrifugal type, c/w inlet damper. Actuator, damper & controls by rooftop unit manufacturer.

2.7 CONDENSING SECTION

.1 The condensing section shall be equipped with direct drive, vertical discharge condenser fan(s). The condenser coil shall be sloped at least 30° from horizontal to protect the coil from damage.

2.8 EVAPORATOR COIL

.1 Evaporator coil(s) shall be copper tube with aluminum fins mechanically bonded to the tubes.

.2 Evaporator coils to have galvanized steel end casings.

.3 Evaporator coils to have equalizing type vertical tube distributors with a top suction connection.

.4 Evaporator coils for multi-compressor units shall be circuited with one circuit and expansion valve per compressor.

2.9 CONDENSER COIL

.1 Condenser coil(s) shall be copper tube with aluminum fins mechanically bonded to the tubes.

.2 Condenser coil(s) to be sized for a minimum of 10° sub-cooling.

2.10 REFRIGERATION SYSTEM

.1 Compressor(s) shall be of the hermetic scroll type with internal thermal overload protection and mounted on the compressor manufacturer's recommended rubber vibration isolators.

.2 All units over 7 tons shall be multiple stage and shall have a minimum of 2 stages of capacity control. One (1) compressor shall have hot gas bypass.

.3 Compressor(s) shall be mounted in an isolated compartment to permit operation of the unit without affecting air flow when the compressor compartment is open.

.4 Compressor(s) shall be isolated from the base pan and supply air to avoid any transmission of noise from the compressor into the building area.

.5 System shall be equipped with thermostatic expansion valve(s) type refrigerant flow control.

.6 System shall be equipped with automatic re-set low pressure and manual reset high pressure refrigerant controls.

.7 Unit shall be equipped with Schrader type service fittings on both the high side and low pressure sides of the system.

.8 Unit shall be equipped with refrigerant liquid line driers.

.9 Unit shall be fully factory charged with refrigerant R-410A.

.10 Unit shall be equipped with a 5 minute anti-short cycle delay timer for each compressor.

.11 Unit shall be equipped with 20 second between stage delay timer for each compressor (if applicable).

.12 Stage compressors to match fan speed reduction as required by ASHRAE 90. 1 or as noted on drawing schedule.

.13 On specific units, as noted in equipment schedule, lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal

terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

2.11 GAS HEATING SECTION

.1 Unit shall heat using natural gas fuel and with two (2) stage of heat capacity or as indicated on performance schedule.

.2 Unit shall be provided with a gas heating furnace consisting of an aluminized steel heat exchanger with multiple concavities, and induced draft blower and an electric pressure switch to lockout the gas valve until the combustion chamber is purged and combustion air flow is established. Heat exchanger tubes with separate internal turbulators are not acceptable.

.3 Unit shall be provided with a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

.4 Unit shall have gas supply piping entrances in the unit base for through the curb gas piping and in the outside cabinet wall for across the roof gas piping.

.5 Units tubular gas heat exchanger will carry a 10 year warranty.

2.12 FILTERS

.1 Unit to be furnished with 4", 30% efficient, MERV 8, pleated, throw away supply air filters and clogged filter switch.

2.13 ROOF CURBS

.1 Roof curb to suit basis of design unit is existing installed on site. Alternate manufacturers must provide curb adapter to suit.

.2 The rooftop unit must be solidly fastened to the curb, and the curb anchored to the roof structure.

.3 Roof curb construction to conform to requirements of National Roofing Contractors Association (NRCA).

.4 Provide seismic restraint calculations from P.Eng. For all equipment connections to the structure.

2.14 CONTROLS AND OPTIONS

.1 Factory installed options as follows:
- .1 OA flow control
- .2 High performance economizer
- .3 Disconnect weatherproof

.4 Humiditrol
.5 Phase monitor
.6 Standard cap
.7 2 in. MERV4 filter
.8 Dual enthalpy economizer with hood
.9 Blower proving switch
.10 IMC prodigy LONTALK
.11 Multi-stage air volume
.12 Hinged access doors
.13 Environ coil system
.14 MSAV blower bypass
.15 STD static power exhaust fan with hood

.2 Field installed options as follows:
.1 Copper drain trap kit
.2 Remote humidity sensor kit
.3 Outdoor air volume control kit
.4 Standalone zone temperature sensor

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Fabricate to provide smooth air flow through all components. Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.

.2 Apply sealer into all seams prior to assembly. Secure toe angles on 300 mm centres for full length of casing.

.3 Paint inside casing surfaces with zinc coating to CAN/CGSB-1.181, 0.075 mm minimum thickness when dry.

3.2 FANS

.1 Provide sheaves and belts required for final air balance.

.2 Install flexible connections at fan inlets as indicated. Ensure metal bands of connectors are parallel and not touching when fan is running and when fan is stopped. Ensure that fan outlet and duct are aligned when fan is running.

3.3 DRIP PAN

.1 Install deep deal P-trap on drain lines. Depth of water seal to be in accordance with manufacturer's recommendations and not less than 1.5 times static pressure at this point.

- END OF SECTION -

ABBREVIATIONS

CB	CONCRETE BLOCK
CT-1	CERAMIC TILES - 300x600mm - EPOXY GROUT
CTB	CERAMIC TILE BASE - 600 X 160 MM HIGH - EPOXY GROUT
E	EXISTING
EC	EXISTING CONCRETE
ECB	EXISTING CONCRETE BLOCK
ECS	EXISTING CONCRETE AND CLEAR SEALER
EGBA	EXISTING GYPSUM BOARD - ABUSE RESISTANT TYPE
EIMWP	EXISTING INSULATED METAL WALL PANEL
ESTSTR	EXISTING STEEL STRUCTURE AND METAL DECK
GB	GYPSUM BOARD
GBA	GYPSUM BOARD - ABUSE RESISTANT TYPE
GBM	GYPSUM BOARD - MOISTURE RESISTANT TYPE
GT-1	GLAZED CERAMIC WALL TILE
P	PAINT FINISH
R	RUBBER BASE
TC	SPECIAL ACRYLIC PAINT COATING FOR HUMID AREAS

IN ADDITION TO WORK INDICATED IN THE FINISH SCHEDULE, NOTE THE FOLLOWING:

1 EXCEPT WHERE NOTED OTHERWISE ALL BASES SHALL BE 100 mm HIGH.

2 PAINT ALL PRESSED METAL DOOR FRAMES AND FRAMES FOR GLAZED SCREENS.

3 THE FINISH SCHEDULE SHALL BE READ IN CONJUNCTION WITH INFORMATION INDICATED ELSEWHERE ON DRAWINGS AND IN SPECIFICATIONS. IN THE EVENT OF DISCREPANCIES THE MOST STRINGENT REQUIREMENT SHALL GOVERN.

4 PAINT ACCESS DOORS AND PANELS SAME COLOUR AS WALL, CEILING OR BULKHEAD IT IS INSTALLED IN.

5 IN THE EVENT A ROOM IS NOT IDENTIFIED IN THE FINISH SCHEDULE, SUCH ROOMS SHALL BE FINISHED TO A MINIMUM STANDARD AS FOLLOWS: FLOOR: CS; BASE: R; WALLS: P; CEILING:AT.

6 COORDINATE CEILING HEIGHTS INDICATED IN FINISH SCHEDULE WITH HEIGHTS INDICATED ON REFLECTED CEILING PLANS AND SECTION DETAILS.

7 PAINT ALL GYPSUM BOARD BULKHEADS AND SOFFITS.

8 PAINT ALL STEEL ITEMS, EXCEPT FACTORY FINISH OR STAINLESS STEEL.

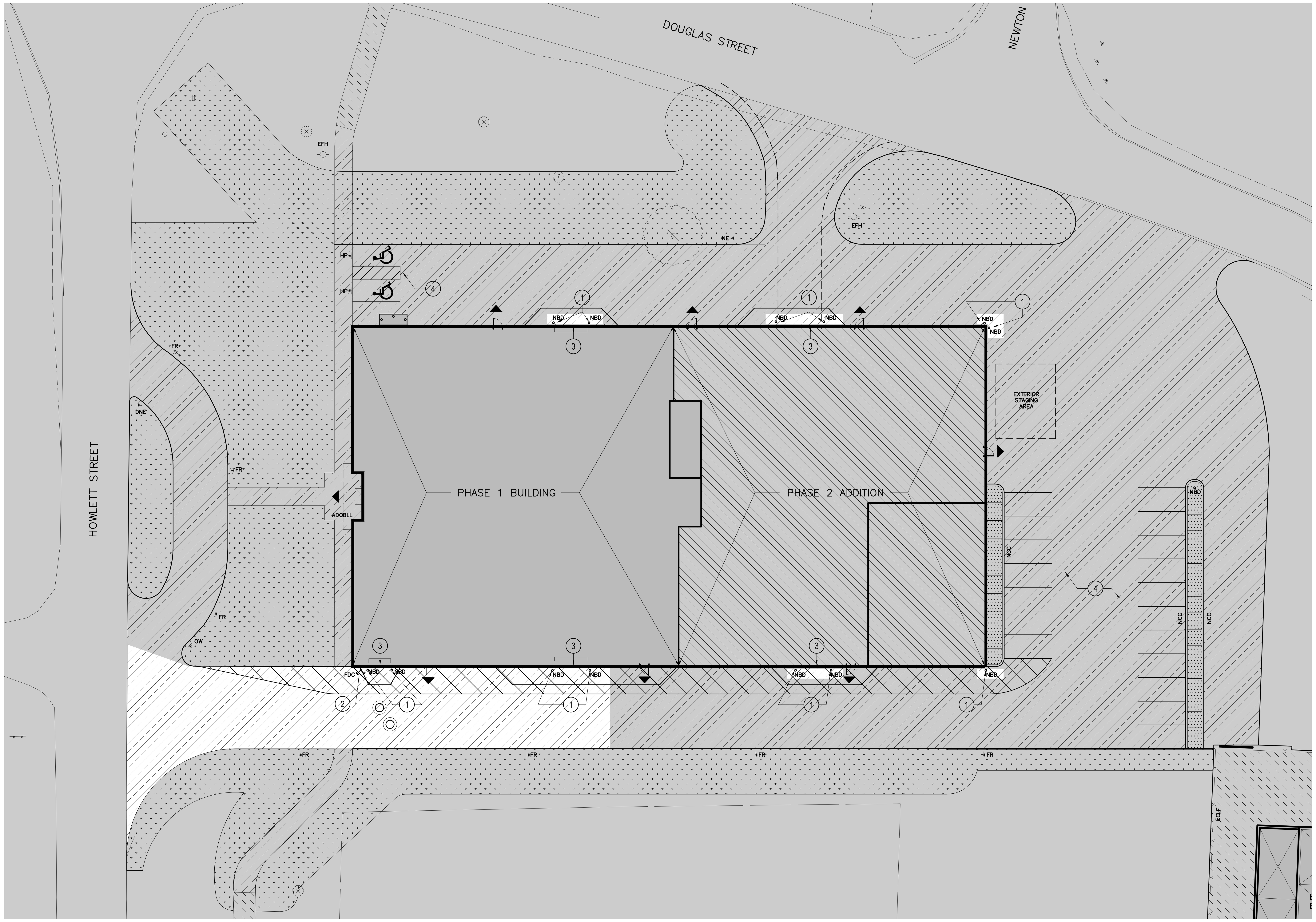
9 IN JUNCTION BETWEEN ALL CT FLOORING, & CONCRETE, PROVIDE EXTRUDED ALUMINUM TRANSITION TRIM.

10 AT THE JUCTION OF DISSIMILAR FLOOR FINISHES, PROVIDE FLOOR LEVELING AS REQUIRED TO ACHIEVE SMOOTH AND LEVEL FINISH BETWEEN THE TWO MATERIALS.

11 DO NOT PAINT FACTORY PRE-FINISHED SURFACES UNLESS NOTED OTHERWISE.

TYPICAL NOTES

NO.	NAME	FLOOR			WALL			CEILING			REMARKS
		MAT.	FIN.	BASE		MATERIAL	FIN.	MAT.	FIN.	HEIGHT	
117	Electrical Room	ECS		R	N:	EGB	P	ESTSTR	-	-	
					E:	ECB	P				
					S:	EGB	P				
					W:	ECB	P				
118	Comm & Stor	ECS		R	N:	EGB	P	ESTSTR	-	-	
					E:	EGB	P				
					S:	ECB	P				
					W:	EGB	P				
123	Control Room	ECS		R	N:	GBA	P	GB	P	2310	
					E:	GBA	P				
					S:	GBA	P				
					W:	GBA	P				
123A	B.F. WC	CT-1		CTB	N:	GBM	TC	GBM	TC	2310	
					E:	GBM	TC				
					S:	GBM	TC				
					W:	GBM	TC				
126	Work Space	ECS			N:	GBA/EIMWP	P/-	ESTSTR	-	-	
					E:	GBA/EIMWP	P/-				
					S:	GBA/ECB	P/-				
					W:	EGBA/ECB	P/-				



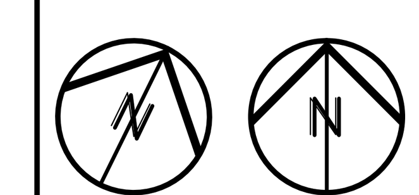
1 SITE PLAN
ASK03 1:250

DRAWINGS NOTES

1. INSTALL OWNER PROVIDED NEW STEEL BOLLARDS AT LOCATIONS INDICATED ON PLAN TO PROTECT OVERHEAD DOOR JAMBS.
2. EXISTING FIRE DEPARTMENT CONNECTION
3. EXISTING OVERHEAD DOOR
4. FUTURE PARKING

- PHASE 3 SCOPE OF WORK
- NOT IN SCOPE OF WORK
- FUTURE TYPE 1 ASPHALT – HEAVY DUTY
- FUTURE TYPE 2 ASPHALT – LIGHT DUTY
- FUTURE CONCRETE WALK
- FUTURE SOD AND TOPSOIL

ISSUE NO.	REV. NO.	DATE YY/MM/DD	ISSUE
1	0	2019/01/24	ISSUED FOR ADDENDUM



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PROJECT TITLE/TITRE DU PROJET
M-38 ACOUSTIC FACILITY
PHASE 3
MONTREAL ROAD CAMPUS

NATIONAL RESEARCH COUNCIL CANADA
1200 MONTREAL ROAD
OTTAWA, ONTARIO

DRAWING TITLE/TITRE DU DESSIN
PHASE 3 SCOPE OF WORK

SCALE / ÉCHELLE	AS SHOWN	PROJ. No 1735	ISSUE No 1	REV. No 0
DRAWN BY / DESSINÉ PAR	TB/LS	DRAWING/DESSIN		
CHECKED BY / VÉRIFIÉ PAR	TB	**ASK04**		
DATE	JANUARY 2019	ACAD FILE/FICHIER: 1735-M-38 PH3 Tender.dwg		

The following additions, deletions & revisions form part of the drawings and specifications for the above referenced project:

DRAWINGS

1. Reference Drawing 5310-M202

.1 Delete Natural Gas connection and associated piping downstream of 50MM isolation valve on branch service to 38RTU01, shown on Drawing 5310-M202.

2. Drawings 5310-M401, M5310-M402 & 5310-M403

.1 Delete 38RTU01 c/w associated ductwork, grilles and controls.

.2 38RTU02 to be DDC controlled.

.3 Hire the services of Ainsworth to complete the controls scope of work associated with this job.

.1 Controls scope of work shall include installation of NRC standard Master Network Controller (located in Storage 118) and associated application specific controllers, field devices, conduit, wiring and programming to accommodate:

- One (1) 38ERV01 start/stop, status, defrost, and discharge are temperature monitoring.
- One (1) 38EF01 start/stop, status.
- One (1) 38RTU02, enable/disable, heating modulation, mixed air damper modulation, economizer, alarm, return air CO_2 monitoring, return air temperature monitoring, space temperature monitoring, cooling stage control c/w dehumidification sequence (hot gas reheat), SF speed control.
- Three (3) return damper modulations with user selectable push button at 4 room facility.
- Boiler plant controls field wiring and integration to BAS for monitoring of pump operation, speed, loop temperature and status with loop temperature reset. Coordinate with boiler supplier.
- Field wiring and remote monitoring of radiant floor zones, coordinated with radiant floor supplier.
- Field wiring and remote monitoring of the domestic hot water production.
- Four (4) field wirings and controls of electronic trap seal primer stations.
- Monitoring of water meter.
- Two (2) sump pump control panel monitoring, and high level alarm. Refer to shop drawings included with specifications.

- END OF MECHANICAL ADDENDUM NO. M1-R1 -

Goodkey, Weedmark & Associates Limited

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Derek Foot (NRC)
Allan Smith (NRC)
Jordan Giberson (GWA – Mechanical)

The following additions, deletions & revisions form part of the drawings and specifications for the above referenced project:

DRAWINGS

1. Reference Drawing 5310-M201

.1 Provide two (2) sprinkler heads and associated piping to accommodate NFPA 13 coverage within new Barrier Free Washroom 123A and new Control Room 123. Hire the services of Lowe Fire Protection Inc., the current warranty holder for installed sprinkler system, to accommodate.

- END OF MECHANICAL ADDENDUM NO. M2 -

January 2016

REPORT ON

Geotechnical Investigation
Proposed Flexible Laboratory Facility M-26
National Research Council Canada (NRC)
Montreal Road Campus
1200 Montreal Road
Ottawa, Ontario

Submitted to:
Mr. Robin Craig
National Research Council Canada
1200 Montreal Road
Ottawa, Ontario
K1A 0R6

REPORT

Report Number: 1543311
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APPENDICES

APPENDIX A

Results of MASW Shear Wave Velocity Testing

APPENDIX B

Results of Basic Chemical Analysis
EXOVA Laboratories Report No. 1524472

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for a proposed flexible laboratory facility (Building M-26) to be located at 1200 Montreal Road on the National Research Council Canada (NRC) Montreal Road Campus in Ottawa, Ontario.

The purpose of this geotechnical investigation was to assess the general subsurface conditions in the area of the proposed building by means of eight test pits. Based on an interpretation of the factual information obtained, a general description of the subsurface conditions is presented. These interpreted subsurface conditions and available project details were used to prepare engineering guidelines on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

2.0 DESCRIPTION OF PROJECT AND SITE

Plans are being prepared for the construction of a flexible laboratory facility (Building M-26) to be located at 1200 Montreal Road on the NRC Montreal Road Campus in Ottawa, Ontario. The approximate location of the site is shown on the Key Map inset provided on the attached Site Plan (Figure 1).

The following is known about the project and site:

- The proposed site is located at the north end of the Montreal Road Campus between Douglas Street and Howlett Street.
- The building is planned to be constructed in three stages (the initial building will have two additions/expansions constructed in the future). Initially, the building will be about 36 metres wide and 35 metres long in plan area. The subsequent two additions will increase the length of the building in the north direction by about 35 and 27 metres, respectively. The width of the building will remain unchanged.
- The building will be about 12 metres in height and will be of slab-on-grade construction (i.e., no basement level).
- The site of the "initial" building is vegetated with grass and is currently occupied by a fenced-in area containing two satellite dishes. To the north, where the future extensions will be located, the site is undeveloped and vegetated with grass and a small forested area.
- The ground surface is relatively flat to gently sloping, with ground surface elevations ranging from about 99 to 101 metres.

Golder Associates has carried out several previous geotechnical investigations on the NRC Montreal Road Campus. Based on the results of those previous investigations, as well as published geological mapping, the subsurface conditions at this site are expected to consist of glacial till overlying shallow limestone bedrock. The bedrock is indicated to be at depths of about 0 to 1 metre below the ground surface. Bedrock geology mapping published by the Geological Survey of Canada indicates that the bedrock at the site consists of interbedded limestone and dolomite of the Gull River Formation. However, the site is also indicated to be in close proximity to an area mapped as shale of the Rockcliffe Formation (adjacent to the north portion of the site). A fault is also mapped to the north, at the boundary between the two rock formations.

3.0 PROCEDURE

3.1 Subsurface Investigation

The fieldwork for this investigation was carried out on December 4, 2015. At that time, eight test pits (numbered 15-1 to 15-8, inclusive) were excavated at the approximate locations shown on the attached Site Plan (Figure 1).

The test pits were advanced to practical refusal on the bedrock, which was encountered at depths ranging from about 0.5 to 1.7 metres below the existing ground surface.

The test pits were excavated using a rubber-tired backhoe supplied and operated by Glenn Wright Excavating of Ottawa, Ontario. The soils exposed on the sides of the test pits were classified by visual and tactile examination. The groundwater seepage conditions were observed in the open test pits (during the short time that they remained open), and the test pits were loosely backfilled upon completion of excavating and sampling.

The fieldwork was supervised by an experienced technician from our staff who located the test pits, directed the excavating operations, logged the test pits and samples, and took custody of the samples retrieved. On completion of the excavating operations, samples of the soils obtained from the test pits were transported to our laboratory for examination by the project engineer.

One sample of soil from test pit 15-5 was submitted to EXOVA Laboratories for chemical analysis related to potential corrosion of buried steel elements and potential sulphate attack on buried concrete elements.

The test pit locations were selected in consultation with the NRC, and subsequently marked in the field and surveyed by Golder Associates personnel. The coordinates and ground surface elevations at the test pit locations were determined using a Trimble R8 GPS survey unit. The Geodetic reference system used for the survey is the North American datum of 1983 (NAD83). The test pit coordinates are based on the Universal Transverse Mercator (UTM Zone 18) coordinate system. The elevations are referenced to Geodetic datum (CGVD28).

3.2 Geophysical Testing

In addition to the subsurface investigation, shear wave velocity testing was carried out at the site for the purpose of determining the site classification for seismic site response, in accordance with the 2010 National Building Code of Canada (NBCC). The testing was completed using the Multichannel Analysis of Surface Waves (MASW) technique. The MASW fieldwork was carried out on November 26, 2015, by personnel from Golder's Mississauga office. For this testing, a series of 24 low frequency (4.5 Hz) geophones were laid out at approximately 3 metre intervals. A seismic weight-drop of 45 kilograms and a 9.9 kilogram sledge hammer were used as seismic sources for this testing. Seismic records were collected with seismic sources located approximately 5, 10, 15 and 20 metres from and collinear to the geophone array. The results of the MASW test include the calculated shear wave velocity profile measured from the field testing and a graphical representation of the shear wave velocity profile with depth.

4.0 SUBSURFACE CONDITIONS

Information on the subsurface conditions is presented as follows:

- The Record of Test Pits are provided in Table 1.
- The results of the MASW shear wave velocity testing are provided in Appendix A.
- The results of the basic chemical analysis are provided in Appendix B.

In general, the overburden soils at this site consist of about 100 to 400 millimetres of topsoil overlying thin, discontinuous deposits of silty clay, silty sand, and glacial till. These deposits generally range from about 0.1 to 0.5 metres in thickness. The glacial till at TP 15-8 is up to about 1.5 metres in thickness. The glacial till generally consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand. A possible layer of silty sand fill, which extends to about 0.6 metres depth, was also encountered at test pit 15-5.

The overburden is underlain by limestone bedrock, which was encountered in all of the test pits at depths ranging from about 0.1 to 1.7 metres below the existing ground surface. Bedrock outcrops are also visible in other areas of the site. The bedrock surface was uneven/stepped in test pit 15-8, where it ranged in depth from about 0.8 to 1.7 metres below the existing ground surface.

At test pit 15-4, the upper bedrock was fractured and could be excavated (in boulder sized slabs) from about 0.1 to 0.5 metres depth, before encountering practical refusal to excavating. A thin layer of fractured bedrock, about 0.1 metres in thickness, was also encountered at test pit 15-2 at about 0.5 metres depth. Elsewhere, and below the fractured bedrock at test pits 15-2 and 15-4, practical refusal to excavating was encountered on a sound/competent bedrock surface. A summary of the depths and elevations of practical refusal to excavating at each of the test pits is provided in the following table:

Test Pit Number	Ground Surface Elevation (m)	Practical Refusal on Sound Bedrock	
		Depth (m)	Elevation (m)
15-1	100.1	0.7	99.4
15-2	99.9	0.6	99.3
15-3	100.2	0.7	99.5
15-4	99.4	0.5	99.4
15-5	100.1	0.9	99.2
15-6	100.3	0.8	99.5
15-7	100.4	0.8	99.6
15-8	100.7	0.8 / 1.7[(1)]	99.9 / 99.0[(1)]

Notes: [(1)] A step in the bedrock was encountered within TP 15-8.

All of the test pits were observed to be dry at the time of excavation (i.e., the groundwater level was not encountered). However, groundwater levels are expected to fluctuate seasonally, and higher groundwater levels are expected during wet periods of the year, such as spring.

One sample of soil from test pit 15-5 was submitted to EXOVA Laboratories for chemical analysis related to potential corrosion of buried steel elements and potential sulphate attack on buried concrete elements. The results of this testing are provided in Appendix B and are summarized in the table below.

Test Pit/Sample Number	Sample Depth (m)	Chloride (%)	SO_4 (%)	pH	Resistivity (ohm-cm)
15-5 / Sa 2	0.6 – 0.9	<0.002	0.03	8.0	3,120

5.0 DISCUSSION

5.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the available information described herein and project requirements.

Reference should be made to the "Important Information and Limitations of this Report" which follows the text of this report but forms an integral part of this document.

The foundation engineering guidelines presented in this section have been developed in a manner consistent with the procedures outlined in Part 4 of the 2010 NBCC for Limit States Design.

5.2 Site Grading

In general, the overburden soils at this site consists of about 100 to 400 millimetres of topsoil overlying thin, discontinuous deposits of silty clay, silty sand, and glacial till. The overburden is underlain by limestone bedrock, which is generally less than 1 metre deep across the site.

Based on the results of this investigation, there is no practical limit on the amount of grade raise fill that can be placed on this site (from the perspective of the compressibility of the underlying soil).

As a more general guideline regarding the site grading, the preparation for filling of the site should include stripping the topsoil and fill from within the footprint of the proposed structure. The topsoil should also be removed from beneath pavement areas (if planned). The topsoil and fill should be stockpiled separately for re-use in landscaping applications only.

5.3 Excavations

No unusual problems are anticipated in excavating the overburden soils using conventional hydraulic excavating equipment, recognizing that large cobbles and boulders should be expected within the glacial till deposit. Large slabs of fractured bedrock may also need to be excavated near the bedrock surface. Boulders larger than 0.3 metres in size should be removed from the walls of the excavations for worker safety.

Provided that the groundwater level is not encountered during excavation (which is expected to be the case), the Occupational Health and Safety Act (OHSA) of Ontario indicates that side slopes in the overburden soils could be sloped at 1 horizontal to 1 vertical (i.e., Type 3 soils), or flatter.

Excavations will likely be carried out above the groundwater level; therefore, significant groundwater infiltration to the excavations is not anticipated. Water that accumulates in the bottom of the excavations (e.g., from perched groundwater, surface water, or precipitation) can be handled by pumping from well filtered sumps established in the floor of the excavations. The pumping volumes are anticipated to be less than 50,000 litres per day; therefore, the requirement for a Permit-To-Take-Water (PTTW) is not anticipated.

If excavation of the bedrock is required (e.g., for service pipe connections or deeper footigns), it is anticipated that the bedrock removal could be carried out using mechanical methods (e.g., hoe ramming), potentially in conjunction with closely spaced line drilling. Blasting could also be considered as a means of bedrock removal; however, it is anticipated that hoe ramming will likely be the most economical method of bedrock removal for the anticipated relatively small bedrock excavations required for this project.

Loose rock should be removed from the sidewalls of the excavations. Relatively steep to near-vertical walls in the bedrock should stand unsupported for the construction period. However, the rock walls should be inspected at the time of excavation so the rock wall stability guidelines can be confirmed.

Significant caution should be exercised in carrying out bedrock removal because of the near proximity of underground services and existing buildings, which may contain vibration-sensitive equipment. Hoe-ramming and/or blasting should be controlled to limit the peak particle velocities at all adjacent structures and services such that vibration induced damage will be avoided. The frequency dependent peak vibration limits from Ontario Provincial Standard Specification for Municipal projects (OPSS.MUNI) 120 should be specified in the contract for *all* construction activities (including blasting, hoe-ramming, etc.). The vibration limits from OPSS.MUNI 120 are summarized as follows:

Frequency Range (Hz)	Vibration Limits (mm/s)
≤ 40	20
> 40	50

The vibration limits given above are intended to prevent *structural* damage to nearby structures and utilities. If vibration-sensitive equipment is located in proximity to the construction, more stringent vibration limits may be required. Further guidance regarding vibration limits can be provided, if requested.

Regardless of the method of bedrock removal, a pre-construction survey should be carried out on all of the surrounding structures. Selected existing interior and exterior cracks in the adjacent structures should be identified during the survey and should be monitored during construction for lateral or shear movements by means of pins, glass plate telltales, and/or movement telltales.

If blasting is the chosen method of construction, a blast design by a specialist in this field will be required. If blasting, the contractor should be limited to only small controlled shots. Blasting should be carried out in accordance with OPSS.MUNI 120, which provides the requirements for blast design and submissions, including pre-construction surveys.

The contractor should be required to submit a complete and detailed bedrock excavation/blasting and monitoring proposal prepared by a blasting/vibrations specialist prior to commencing blasting or other bedrock excavation activities (such as hoe-ramming). This would have to be reviewed and accepted in relation to the requirements of the vibration specifications given above.

If practical, blasting or hoe-ramming should commence at the furthest points from the closest structure or service to assess the ground vibration attenuation characteristics and to confirm the anticipated ground vibration levels based on the contractor's proposal.

5.4 Foundations

5.4.1 Axial Bearing Resistance

The proposed building at this site can be supported on conventional spread footings founded on or within the limestone bedrock.

Footings constructed on or within competent bedrock can be sized using an Ultimate Limit States (ULS) factored bearing resistance of 1,000 kilopascals. Any weathered or highly fractured bedrock, which includes bedrock which can be excavated using hydraulic excavating equipment with only moderate effort, should first be removed from the footing areas. Provided the bedrock surface is acceptably cleaned of soil and loose bedrock, and that any weathered bedrock has been removed, the settlement of footings at the corresponding service (unfactored) load levels will be less than 25 millimetres and therefore Serviceability Limits States (SLS) need not be considered in the foundation design.

The ULS factored bearing resistance given above assumes that the bedrock below founding level may contain some limited voids, mud seams, and zones of fracturing and/or weathering within the depth of influence of the footings. If desired, bedrock coreholes could be carried out in advance of construction to confirm the presence/absence of these features. If the bedrock is fresh and free of voids and mud seams, a higher ULS factored bearing resistance value could be given (potentially in the range of 2,000 to 3,000 kilopascals).

It is anticipated that the bedrock surface is generally flat to gently sloping at this site. At the test pit locations, the competent bedrock surface elevation ranges between about 99 and 100 metres. However, there may be locations where the competent bedrock subgrade elevation is lower than the underside of footing elevation (e.g., in the area of TP 15-8). Where this is the case, the native soils below the footings should be sub-excavated down to the bedrock surface and then either:

- Spread footings constructed directly on the deeper bedrock surface; or
- The excavation filled back up to a higher founding level using a levelling mat of mass lean concrete with a compressive strength of at least 5 megapascals.

In addition to these two options, footings could also potentially be placed on the native soil (e.g., glacial till) or engineered fill that extends to the bedrock surface; however, in either of these cases differential settlement of the foundations will occur due to the varying stiffnesses of the different bearing stratums (e.g., soil versus bedrock). Also, footings bearing on soil will have a much lower ULS factored bearing resistance and SLS conditions would need to be considered. In general, the volume of sub-excavation is anticipated to be low and therefore not a detriment to the overall cost of construction. For predictable performance of the structure, a single bearing stratum (bedrock) is recommended. Additional guidelines regarding multiple bearing stratums can be provided, if requested.

If the first option is chosen, and sloping bedrock is encountered, a stepped footing may be required. The dimensions of the steps should be determined at the time of construction in consultation with the geotechnical and structural engineer, once the bedrock subgrade is exposed.

5.4.2 Resistance to Sliding

A coefficient of friction (i.e., tan δ) of 0.7 (unfactored) may be used in the assessment of sliding resistance between cast-in-place concrete footings and the bedrock surface. If insulation is used between the concrete footing and the bedrock subgrade, the potential for shearing across the interface with the insulation should also be checked using a coefficient of friction of 0.45. If greater resistance is required, the footings could be provided with shear keys or prestressed rock anchors could be used to increase the normal stress level across the concrete/bedrock interface. Further guidelines on shear key and prestressed rock anchor design can be provided, if required.

5.5 Seismic Design

The seismic design provisions of the 2010 NBCC depend, in part, on the shear wave velocity of the upper 30 metres of soil and/or rock below founding level. To support a Site Class designation, MASW shear wave velocity testing was carried out at this site. The results of the shear wave velocity testing are provided in Appendix A. Interpretation of the shear wave velocity data indicates that the average shear wave velocity to 30 metres depth is 1,536 metres per second (interpreted from ground surface). Accordingly, a Site Class A designation is appropriate for this site.

5.6 Frost Protection

Unless confirmed to be otherwise, the bedrock at this site is presumed to be frost susceptible. Therefore, all exterior foundation elements should be provided with a minimum of 1.5 metres of earth cover for frost protection purposes. Isolated, unheated footings adjacent to surfaces which are cleared of snow cover during winter months should be provided with a minimum of 1.8 metres of earth cover. Insulation could also be considered as an alternative to earth cover, as discussed below.

Shallow bedrock may be frost susceptible, especially in the upper highly fractured zone, where it may contain joints filled with frost susceptible soil. If/where the earth cover requirements over the rock bearing surface cannot be provided, the absence of soil-filled seams in the underlying rock should be confirmed at the time of construction. This assessment can be carried out by drilling 50 millimetre diameter probe holes within the footing areas at a 3 metre spacing and to at least 1.8 metres below the finished grade level. In the case that soil-filled seams are encountered, the following two options could be considered:

- The footing and bearing surface could be insulated; or,
- The potentially frost-susceptible bedrock could be removed (sub-excavated) and replaced with mass concrete, or the footing founded at that new lower depth.

For planning purposes, a typical detail for the use of high density polystyrene rigid foam insulation is provided on Figure 2. In preparation for the insulation, a levelling mat consisting of 25 millimetres of concrete sand or 50 millimetres of lean concrete should be placed on the approved bearing surface. Care must be taken to ensure that the insulation is not damaged during construction. Joints should be carefully lap jointed and glued where and if possible. Footings may then be constructed on the surface of the insulation. The type of insulation should be selected such that the bearing pressure on the insulation placed under the footings does not exceed about 35 percent of the insulation's quoted compressive strength. This is due to the time dependant creep characteristics of this material. For example, bearing resistance values for several strengths of insulation for SLS and ULS design are provided below:

Insulation Type	SLS Resistance (kPa)	ULS Factored Resistance (kPa)
Dow SM	65	100
Dow Styrofoam Highload 40	90	135
Dow Styrofoam Highload 60	145	205
Dow Styrofoam Highload 100	240	340

The insulation which projects beyond the edge of the footings can consist of Dow SM (or equivalent), except beneath flexible pavements, where Highload 60 (or equivalent) should be used beyond the footing.

If sub-excavation of the frost-susceptible bedrock is carried out, the depth of sub-excavation will need to be sufficient so as to expose a non-frost susceptible bedrock surface or bring the subgrade level down to the frost penetration depth (i.e., 1.5 metres), whichever is shallowest.

5.7 Rock Anchors

If required, passive rock anchors can be considered to resist seismic overturning moments. The anchors could consist of either grouted or mechanical anchors.

In designing grouted rock anchors, consideration should be given to four possible anchor failure modes.

i) Failure of the steel tendon or top anchorage.

ii) Failure of the grout/tendon bond.

iii) Failure of the rock/grout bond.

iv) Failure within the rock mass, or rock cone pull-out.

Potential failure modes i) and ii) are structural and are best addressed by the structural engineer. Adequate corrosion protection of the steel components should be provided to prevent potential premature failure due to steel corrosion.

For potential failure mode iii), the factored bond stress at the concrete/rock interface may be taken as 750 kilopascals for ULS design purposes. If the response of the anchor under SLS conditions needs to be evaluated, for a preliminary assessment it may conservatively be taken as the elastic elongation of the unbonded portion of the anchor under the design loading.

For potential failure mode iv), the resistance should be calculated based on the buoyant weight of the potential mass of rock which could be mobilized by the anchor. This is typically considered as the mass of rock included within a cone (or wedge for a line of closely spaced anchors) having an apex at the tip of the anchor and having an apex angle of 60 degrees. For each individual anchor, the ULS factored geotechnical resistance can be calculated based on the following equation:

$$Q_r = \phi \frac{\pi}{3} \gamma' D^3 \tan^2(\theta)$$

Where: Q_r = Factored uplift resistance of the anchor, kilonewtons;

ϕ = Resistance factor, 0.3;

γ' = Effective unit weight of rock, use 17 kilonewtons per cubic metre;

D = Anchor length in metres; and,

θ = ½ of the apex angle of the rock failure cone, use 30 degrees.

Where the anchor load is applied at an angle to the vertical, the anchor capacity should be reduced as follows:

$$Q_r' = Q_r \cos(\alpha)$$

Where: Q_r' = Factored uplift resistance of the anchor subject to inclined load in kilonewtons;

Q_r = Factored uplift resistance of the anchor, kilonewtons; and,

α = Angle between the load direction and the vertical.

For a group of anchors or for a line of closely spaced anchors, the resistance must consider the potential overlap between the rock masses mobilized by individual anchors. In the case of group effects for a series of rock anchors in a rectangle with width "a" and length "b" installed to a depth "D", the equation for the volume of the truncated trapezoid failure zone would be as follows:

$$V = \frac{4}{3} D^3 \sin^2\varphi + aD^2 \sin\varphi + bD^2 \sin\varphi + abD$$

Where: V = Volume of the truncated trapezoid failure zone in cubic metres;

D = Depth of anchor group in metres;

a = Width of anchor group in metres;

b = Length of the anchor group in metres; and,

φ = ½ of the apex angle of the rock failure cone, use 30 degrees.

The ULS factored geotechnical resistance for the truncated trapezoid failure formed by the group of anchors can then be calculated based on the following equation:

$$Q_r = \phi\ \gamma'\ V$$

Where: Q_r = Factored uplift resistance of the anchor, kilonewtons;

ϕ = Resistance factor, use 0.3;

γ' = Effective unit weight of rock, use 17 kilonewtons per cubic metre; and,

V = Volume of truncated trapezoid in cubic metres.

It is suggested that proof-load tests be carried out on the anchors. The proof-load tests should be carried out to 1.3 times the anchor service loads, and at least 10 percent of the anchors should be tested in this manner.

The installation and testing of the anchors should be supervised by the geotechnical engineer. Care must be taken during grouting to ensure that the grouting pressure is sufficient to bond the entire length of the grout area with a minimum of voids. It is also suggested that the anchor holes be thoroughly flushed with water to remove all debris and rock flour. It is essential that rock flour be completely removed from the anchor holes to be grouted to ensure an adequate bond between the grout and the rock.

5.8 Slab on Grade

Conventional slab on grade construction can be used for the proposed building at this site.

In preparation for construction of the slab on grade, the topsoil, fill, and all loose, wet, and disturbed material should be removed from within the building footprint. Provision should be made for at least 150 millimetres of OPSS Granular A to form the base for the slab on grade. Any bulk fill required to raise the grade to the underside of the Granular A should consist of OPSS Granular B Type II. The underslab fill should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

5.9 Foundation Wall Backfill

The soils at this site are frost susceptible and should not be used as backfill against exterior or unheated foundation elements. To avoid problems with frost adhesion and heaving, these foundation elements should be backfilled with non-frost susceptible sand or sand and gravel conforming to the requirements for OPSS Granular B Type I.

In areas where pavement or other hard surfacing will abut the building, differential frost heaving could occur between the granular fill and the adjacent areas. To reduce this differential heaving, the backfill adjacent to the wall should be placed to form a frost taper. The frost taper should be brought up to pavement subgrade level from 1.5 metres below finished exterior grade, or to the bedrock surface (whichever is shallower), at a slope of 3 horizontal to 1 vertical, or flatter, away from the wall. The granular fill should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

The pavement or hard surfacing could be expected to perform better in the long term if the granular backfill against the foundation walls is drained by means of a perforated pipe subdrain in a surround of 19 millimetre clear stone, fully wrapped in a geotextile, which leads by gravity drainage to a positive outlet.

5.10 Site Servicing

At least 150 millimetres of OPSS Granular A should be used as pipe bedding for sewer and water pipes. If bedrock is present at the subgrade level (which is expected to be the case at this site), the bedding should be thickened to 300 millimetres. Where unavoidable disturbance to the subgrade surface occurs during construction, it may be necessary to place a sub-bedding layer consisting of 300 millimetres of compacted OPSS Granular B Type II beneath the Granular A, or the Granular A could be thickened. The bedding material should in all cases extend to the spring line of the pipe and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density. The use of clear crushed stone as a bedding layer should not be permitted anywhere on this project since fine particles from the sandy backfill materials and native soils could potentially migrate into the voids in the clear crushed stone and cause loss of lateral pipe support.

Cover material, from the spring line of the pipe to at least 300 millimetres above the top of pipe, should consist of OPSS Granular A or Granular B Type I with a maximum particle size of 25 millimetres. The cover material should be compacted to at least 95 percent of the material's standard Proctor maximum dry density.

It should generally be possible to re-use the excavated inorganic soils as trench backfill. Where the trench will be covered with hard surfaced areas (e.g., pavements and sidewalks), the type of material placed in the frost zone (between subgrade level and 1.8 metres depth) should match the soil exposed on the trench walls for frost heave compatibility. Trench backfill should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

Excavated bedrock could also potentially be used as trench backfill for the lower portion of the trench in areas where the excavations are in rock, provided that the rock fill is broken/crushed to form a well-graded material. However, the reuse of such rock fill should be reviewed and approved by the geotechnical engineer at the time of construction once the grading of the material proposed for reuse can be determined. The rock fill should only be placed higher than at least 300 millimetres above the pipe to minimize damage due to impact or point load. The pieces of the rock fill used as trench backfill should be limited to a maximum of 300 millimetres in nominal size and the rock fill should be disseminated throughout (i.e., nests of large rock pieces should not be permitted).

5.11 Pavement Design

In preparation for pavement construction (if required), all topsoil and any unsuitable fill (i.e., fill containing organic matter) should be excavated from the pavement areas for predictable pavement performance.

Areas requiring grade raising to proposed subgrade level should be filled using acceptable (compactable and inorganic) earth borrow or OPSS Select Subgrade Material. Grade raise fill should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

The surface of the subgrade or fill should be crowned to promote drainage of the pavement granular structure. Perforated pipe subdrains should be provided at subgrade level extending from the catch basins for a distance of at least 3 metres in four orthogonal directions, or longitudinally where parallel to a curb. Alternatively, the subdrains could outlet into a nearby drainage swale.

The pavement structure for access roadways and truck traffic areas should consist of the following:

Pavement Component	Thickness (mm)
Asphaltic Concrete	90
OPSS Granular A Base	150
OPSS Granular B Type II Subbase	450

The pavement structure for car parking areas should consist of the following:

Pavement Component	Thickness (mm)
Asphaltic Concrete	50
OPSS Granular A Base	150
OPSS Granular B Type II Subbase	300

The granular base and subbase materials should be uniformly compacted to at least 100 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment. The asphaltic concrete should be compacted in accordance with OPSS 310.

The composition of the asphaltic concrete pavement in car parking areas should be as follows:

- Superpave 12.5 Surface Course – 50 millimetres

The composition of the asphaltic concrete pavement in access roadways and truck traffic areas should be as follows:

- Superpave 12.5 Surface Course – 40 millimetres
- Superpave 19.0 Binder Course – 50 millimetres

The pavement design should be based on a Traffic Category of Level B. The asphalt cement used on this project should be made with PG 58-34 asphalt cement on all lifts.

The above pavement designs are based on the assumption that the pavement subgrade has been acceptably prepared (i.e., where the trench backfill and grade raise fill have been adequately compacted to the required densities and the subgrade surface not disturbed by construction operations or precipitation). Depending on the actual conditions of the pavement subgrade at the time of construction, it could be necessary to increase the thickness of the subbase and/or to place a woven geotextile beneath the granular materials.

The bedrock at this site could be encountered at depths shallower than the proposed pavement structure thicknesses given above. If the bedrock surface is encountered above the proposed subgrade level, and is flat to gradually sloping, the thickness of the Granular B Type II subbase can be reduced accordingly to avoid the requirement for rock removal/shattering. If a step in the bedrock is encountered, a transition between the different pavement structure thicknesses will be required. For planning purposes, a transition sloped at 3 horizontal to 1 vertical would likely be adequate; however, this should be confirmed by the geotechnical engineer at the time of construction once the pavement subgrade is completely exposed.

5.12 Corrosion and Cement Type

One sample of soil from test pit 15-5 was submitted to EXOVA Laboratories for chemical analysis related to potential corrosion of buried steel elements and potential sulphate attack on buried concrete elements. The results of this testing are provided in Appendix B and are summarized in Section 4.0.

The results indicate that concrete made with Type GU Portland cement should be acceptable for substructures. The results also indicate a potential for corrosion of exposed ferrous metal.

6.0 ADDITIONAL CONSIDERATIONS

The test pits excavated and filled on site constitute zones of disturbance to the surficial soils. These disturbed areas could affect the performance of surface structures and hard surfacing (e.g., slabs on grade and pavements). If the test pit locations are located within these areas, the backfill soil in the test pits will need to be removed and replaced with engineered fill.

The soils at this site are sensitive to disturbance from ponded water, construction traffic, and frost.

All footing and subgrade areas should be inspected by experienced geotechnical personnel prior to filling or concreting to ensure that soil having adequate bearing capacity has been reached and that the bearing surfaces have been properly prepared. The placing and compaction of any engineered fill should be inspected to ensure that the materials used conform to the specifications from both a grading and compaction view point.

At the time of the writing of this report, only preliminary details for the proposed building were available. Golder Associates should be retained to review the final drawings and specifications for this project prior to tendering to ensure that the guidelines in this report have been adequately interpreted.

7.0 CLOSURE

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

Stephen Dunlop, P.Eng.
Geotechnical Engineer

Troy Skinner, P.Eng.
Associate, Geotechnical Engineer

SD/TMS/ob

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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

TABLE 1

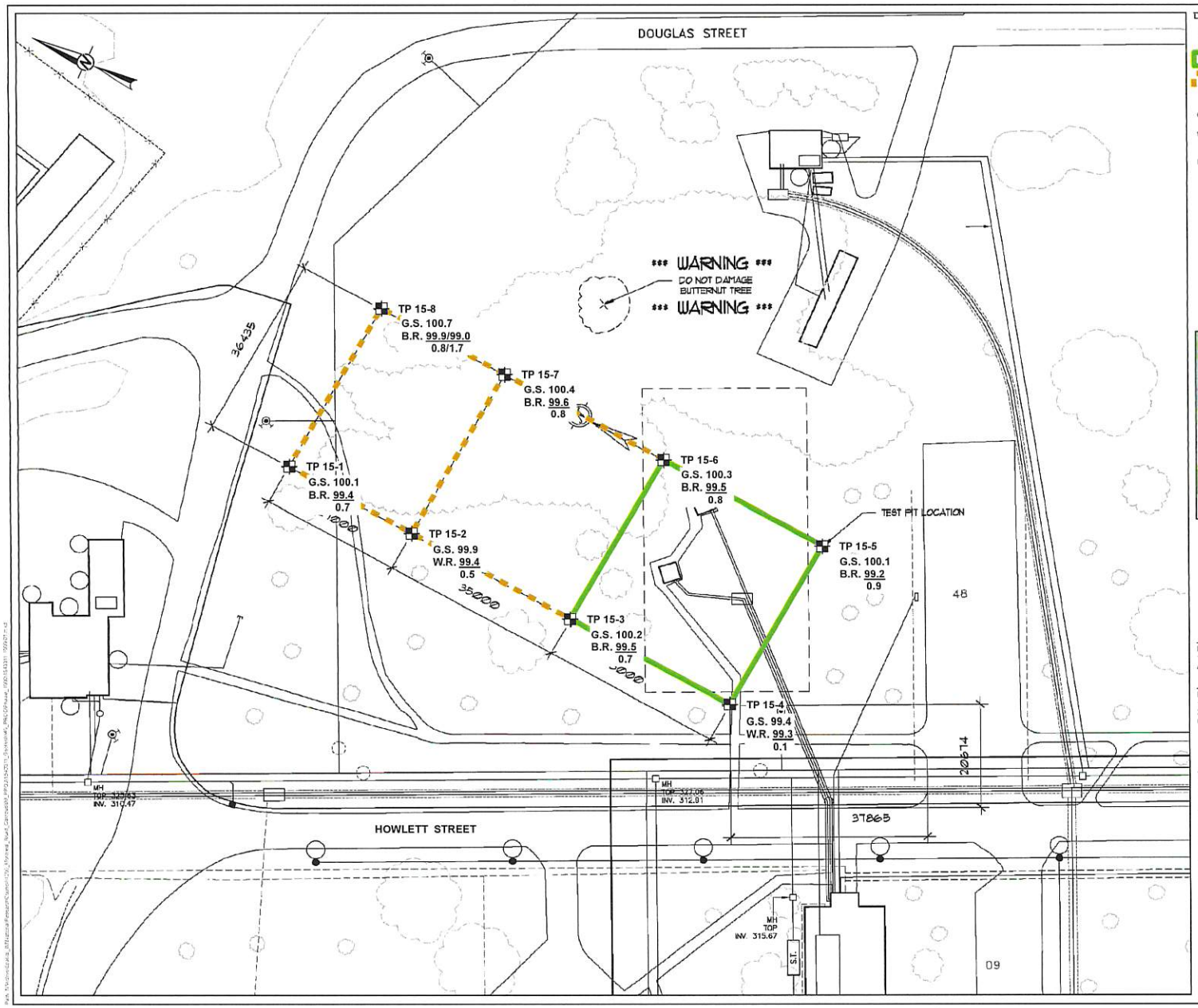
RECORD OF TEST PITS

Test Pit Number (Elevation)	Depth (metres)	Description
15-1 (100.1 metres)	0.0 – 0.1	TOPSOIL
	0.1 – 0.3	(CI) SILTY CLAY; grey-brown, (WEATHERED CRUST); cohesive, moist
	0.3 – 0.5	(SM) gravelly SILTY SAND; dark brown to black, with cobbles and organic matter, (GLACIAL TILL); non-cohesive, moist
	0.5 – 0.7	(SM) gravelly SILTY SAND; red-brown, with cobbles, (GLACIAL TILL); non-cohesive, moist
	0.7	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
15-2 (99.9 metres)	0.0 – 0.1	TOPSOIL
	0.1 – 0.2	(CI) SILTY CLAY; grey-brown, (WEATHERED CRUST); cohesive, moist
	0.2 – 0.5	(SM) SILTY SAND; red-brown; non-cohesive, moist
	0.5 – 0.6	Fractured BEDROCK
	0.6	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
		Sample 1 – Depth (m) 0.1 – 0.2
		Sample 2 – Depth (m) 0.2 – 0.5
		Sample 3 – Depth (m) 0.5 – 0.6
15-3 (100.2 metres)	0.0 – 0.2	TOPSOIL
	0.2 – 0.7	(SM) gravelly SILTY SAND; grey-brown, with clay seams and cobbles, (GLACIAL TILL); non-cohesive, moist
	0.7	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
		Sample 1 – Depth (m) 0.2 – 0.7
15-4 (99.4 metres)	0.0 – 0.1	TOPSOIL
	0.1 – 0.5	Fractured BEDROCK slabs/boulders and cobbles; grey to brown, with organic matter and silty sand; non-cohesive, dry to moist
	0.5	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion

TABLE 1

RECORD OF TEST PITS

Test Pit Number (Elevation)	Depth (metres)	Description
15-5 (100.1 metres)	0.0 – 0.2	TOPSOIL
	0.2 – 0.6	(SM) gravelly SILTY SAND; red-brown, (Possible Fill); non-cohesive, moist
	0.6 – 0.9	(SM) gravelly SILTY SAND; grey-brown, with clay seams and cobbles, (GLACIAL TILL); non-cohesive, moist
	0.9	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
		Sample 1 – Depth (m) 0.2 – 0.6
		Sample 2 – Depth (m) 0.6 – 0.9
15-6 (100.3 metres)	0.0 – 0.2	TOPSOIL
	0.2 – 0.4	(CI) SILTY CLAY; grey-brown, (WEATHERED CRUST); cohesive, moist
	0.4 – 0.8	(SM) gravelly SILTY SAND; red-brown; with cobbles and boulders (GLACIAL TILL); non-cohesive, moist
	0.8	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
		Sample 1 – Depth (m) 0.2 – 0.4
		Sample 2 – Depth (m) 0.4 – 0.8
15-7 (100.4 metres)	0.0 – 0.4	TOPSOIL
	0.4 – 0.8	(SM) gravelly SILTY SAND; brown, with cobbles, (GLACIAL TILL); non-cohesive, moist
	0.8	Practical refusal on BEDROCK
		Notes: Test pit dry upon completion
		Sample 1 – Depth (m) 0.4 – 0.8
15-8 (100.7 metres)	0.0 – 0.2	TOPSOIL
	0.2 – 0.8/1.7	(SM) gravelly SILTY SAND; brown, with cobbles and boulders, (GLACIAL TILL); non-cohesive, moist
	0.8/1.7	Practical refusal on BEDROCK
		Notes: 1) A step in the bedrock was encountered within the test pit. The depth to rock varied between 0.8 and 1.7 m
		2) Test pit dry upon completion
		Sample 1 – Depth (m) 0.2 – 0.8



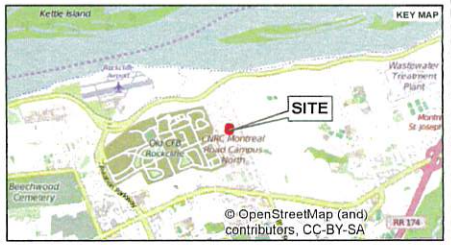
LEGEND

- APPROXIMATE TEST PIT LOCATION
- PROPOSED BUILDING M-26
- FUTURE EXPANSION

G.S. 100.4 GROUND SURFACE ELEVATION, METRES

W.R. 100.0 WEATHERED ROCK - ELEVATION, METRES
0.4 WEATHERED ROCK - DEPTH, METRES

B.R. 100.0 REFUSAL ON BEDROCK - ELEVATION, METRES
0.4 REFUSAL ON BEDROCK - DEPTH, METRES



0 5 10 20 30 40 50
1:750 METRES

NOTE(S)
1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 1543311

REFERENCE(S)
1. SITE PLAN PROVIDED BY NRC.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

CLIENT
NATIONAL RESEARCH COUNCIL CANADA (NRC)

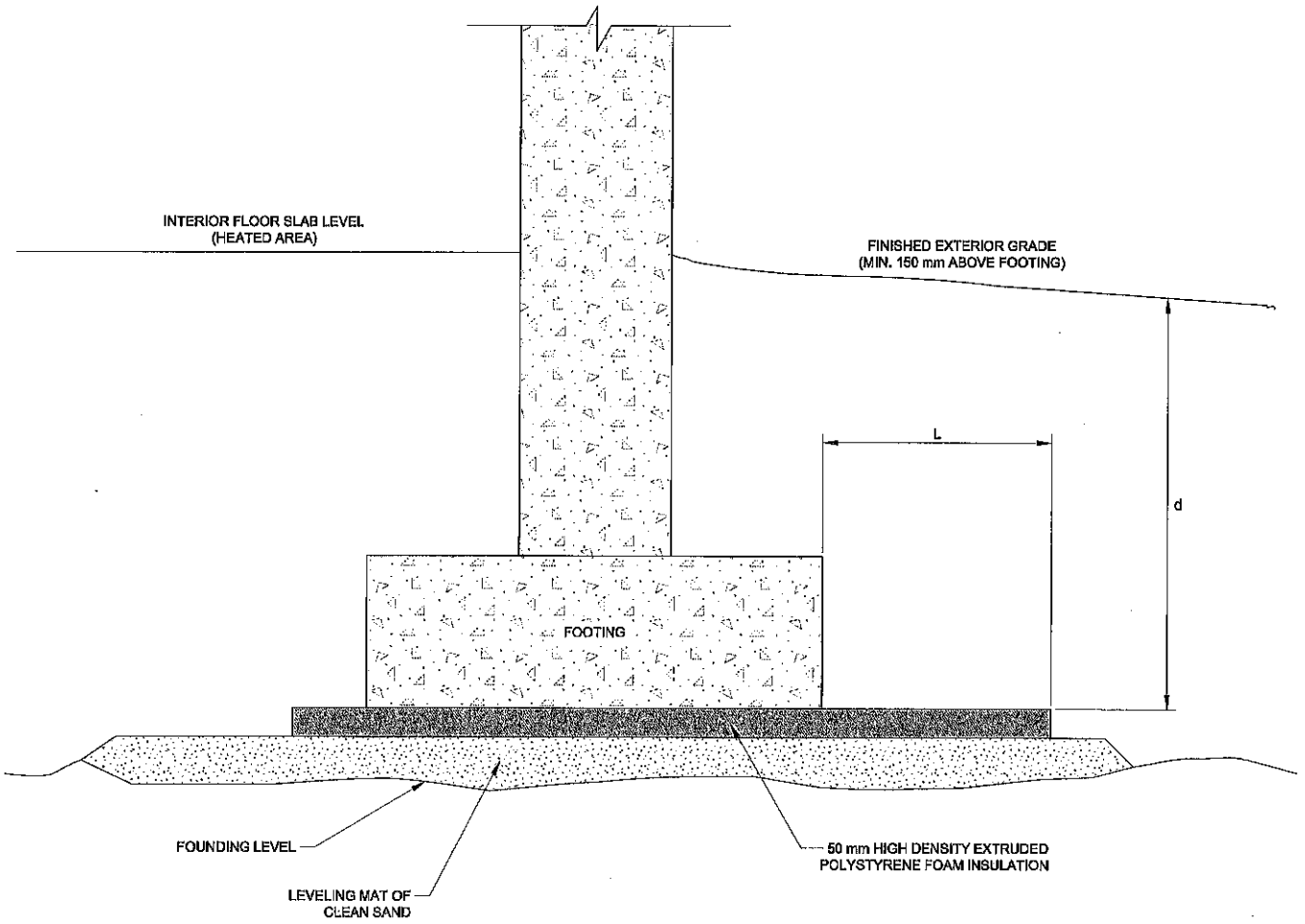
PROJECT
GEOTECHNICAL INVESTIGATION, PROPOSED FLEXIBLE LABORATORY FACILITY (M-26), NRC MONTREAL ROAD CAMPUS
1200 MONTREAL ROAD, OTTAWA, ONTARIO

TITLE
SITE PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-04
DESIGNED	---
PREPARED	PJM
REVIEWED	SD
APPROVED	TMS

PROJECT NO.	PHASE	REV.	FIGURE
1543311	---	A	1



LEGEND

d THICKNESS OF EARTH COVER ABOVE TOP OF INSULATION
L PROJECTED LENGTH OF INSULATION

NOTES

1. INSULATION JOINTS TO BE GLUED AND / OR LAPPED
2. FOR ADEQUATE FROST PROTECTION d + L ≥ 1.5 m
3. FOR d > 0.9 m, INSULATION THICKNESS OF 25 mm IS ADEQUATE
4. ALLOWABLE BEARING PRESSURE FOR FOOTING DESIGN IS DEPENDANT ON INSULATION TYPE - SEE REPORT FOR BEARING PRESSURE INFORMATION.
5. FOR ISOLATED UNHEATED FOUNDATIONS, ADDITIONAL DETAILS ARE REQUIRED
6. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 1543311
7. NOT TO SCALE

CLIENT
NATIONAL RESEARCH COUNCIL CANADA (NRC)

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-20
PREPARED	PJM
DESIGN	SD
REVIEW	SD
APPROVED	TMS

PROJECT
GEOTECHNICAL INVESTIGATION, PROPOSED FLEXIBLE LABORATORY FACILITY (M-26), NRC MONTREAL ROAD CAMPUS
1200 MONTREAL ROAD, OTTAWA, ONTARIO

TITLE
TYPICAL FOOTING INSULATION DETAIL

PROJECT No.	PHASE	Rev.	FIGURE
1543311	---	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25 mm

0

Path: \\golder.gds\gal\ottawa\Active\Spatial_IM\National Research Council\1200_Montreal_Road_Campus\06_PRO\1543311_GeotechM0_PRO\3\Phase_1000\ | File Name: 1543311-1000-02.dwg

APPENDIX A

Results of MASW Shear Wave Velocity Testing

TECHNICAL MEMORANDUM

DATE December 23, 2015 **PROJECT No.** 1543311

TO Stephen Dunlop
Golder Associates Ltd.

FROM Stephane Sol, Christopher Phillips **EMAIL** ssol@golder.com;cphillips@golder.com

NBCC SEISMIC SITE CLASS TESTING RESULTS PROPOSED FLEXIBLE RESEARCH FACILITY 1200 MONTREAL ROAD, OTTAWA

This technical memorandum presents the results of a Multichannel Analysis of Surface Waves (MASW) test performed for the purpose of the 2010 National Building Code of Canada (NBCC2010) Seismic Site Classification for a proposed research facility, NRC Montreal Road Campus at 1200 Montreal Road in Ottawa, Ontario. The geophysical testing was performed by Golder personnel on November 26, 2015.

Methodology

The MASW method measures variations in surface-wave velocity with increasing distance and wavelength and can be used to infer the rock/soil types, stratigraphy and soil conditions.

A typical MASW survey requires a seismic source, to generate surface waves, and a minimum of two geophone receivers, to measure the ground response at some distance from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium.

The depth of penetration of a surface wave into a medium is directly proportional to its wavelength. In a non-homogeneous medium, surface waves are dispersive, i.e., each wavelength has a characteristic velocity owing to the subsurface heterogeneities within the depth interval that particular wavelength of surface wave propagates through. The relationship between surface-wave velocity and wavelength is used to obtain the shear-wave velocity and attenuation profile of the medium with increasing depth.

The seismic source used can be either active or passive, depending on the application and location of the survey. Examples of active sources include explosives, weight-drops, sledge hammer and vibrating pads. Examples of passive sources are road traffic, micro-tremors, and water-wave action (in near-shore environments).

The geophone receivers measure the wave-train associated with the surface wave travelling from a seismic source at different distances from the source.

The participation of surface waves with different wavelengths can be determined from the wave-train by transforming the wave-train results into the frequency domain. The surface-wave velocity profile with respect to wavelength (called the 'dispersion curve') is determined by the delay in wave propagation measured between the geophone receivers. The dispersion curve is then matched to a theoretical dispersion curve using an

iterative forward-modelling procedure. The result is a shear-wave velocity profile of the tested medium with depth, which can be used to estimate the dynamic shear-modulus of the medium as a function of depth.

Field Work

The MASW field work was conducted on November 26, 2015, by personnel from the Golder Mississauga office. The MASW line, a series of 24 low frequency (4.5 Hz) geophones, was laid out at 3-metre intervals. Both active and passive readings were recorded at this site. For the active investigation, a seismic drop of 45 kg and a 9.9 kg sledge hammer were used as seismic sources. Active seismic records were collected with seismic sources located 5, 10, 15, and 20 metres from and collinear to the geophone array. An example of an active seismic record collected is shown in Figure 1 (below).

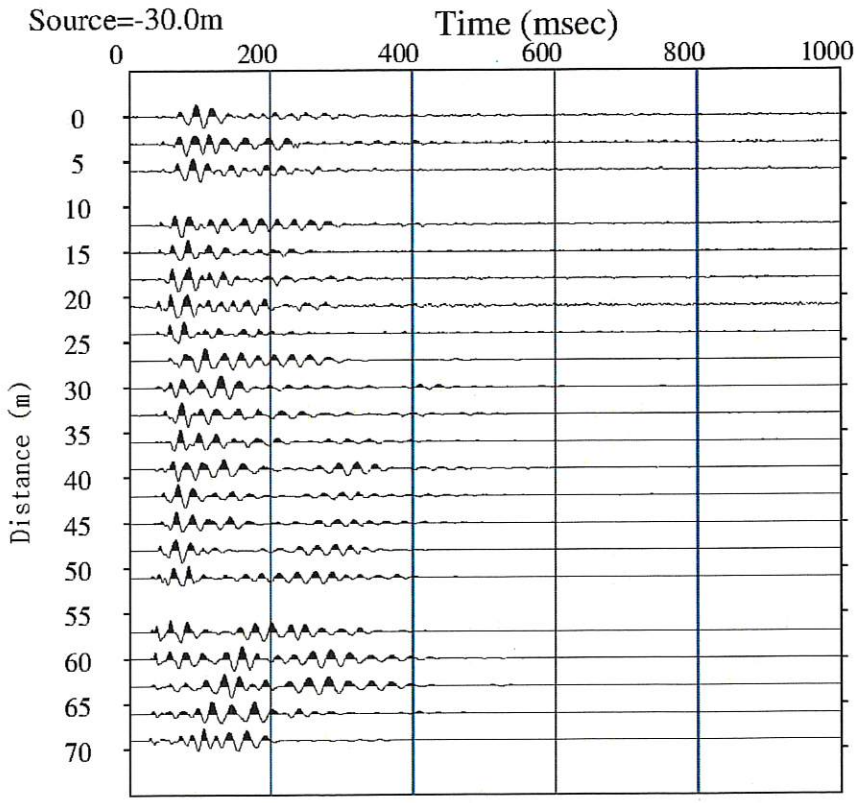


Figure 1: Typical seismic record collected at the site.

Data Processing

Processing of the MASW test results consisted of the following main steps:

1) Transformation of the time domain data into the frequency domain using a Fast-Fourier Transform (FFT) for each source location;

2) Calculation of the phase for each frequency component;

3) Linear regression to calculate phase velocity for each frequency component;

4) Filtering of the calculated phase velocities based on the Pearson correlation coefficient (r2) between the data and the linear regression best fit line used to calculate phase velocity;

5) Generation of the dispersion curve by combining calculated phase velocities for each shot location of a single MASW test; and,

6) Generation of the stiffness profile, through forward iterative modelling and matching of model data to the field collected dispersion curve.

Processing of the MASW data was completed using the SeisImager/SW software package (Geometrics Inc.). The calculated phase velocities for a seismic shot point were combined and the dispersion curve generated by choosing the minimum phase velocity calculated for each frequency component as shown on Figure 2. Shear-wave velocity profiles were generated through inverse modelling to best fit the calculated dispersion curves. The active survey provided a dispersion curve with a suitable frequency range (12 to 41 Hz), providing information for both shallow and deeper depths. The minimum measured surface-wave frequency with sufficient signal-to-noise ratio to accurately measure phase velocity was approximately 12 Hz.

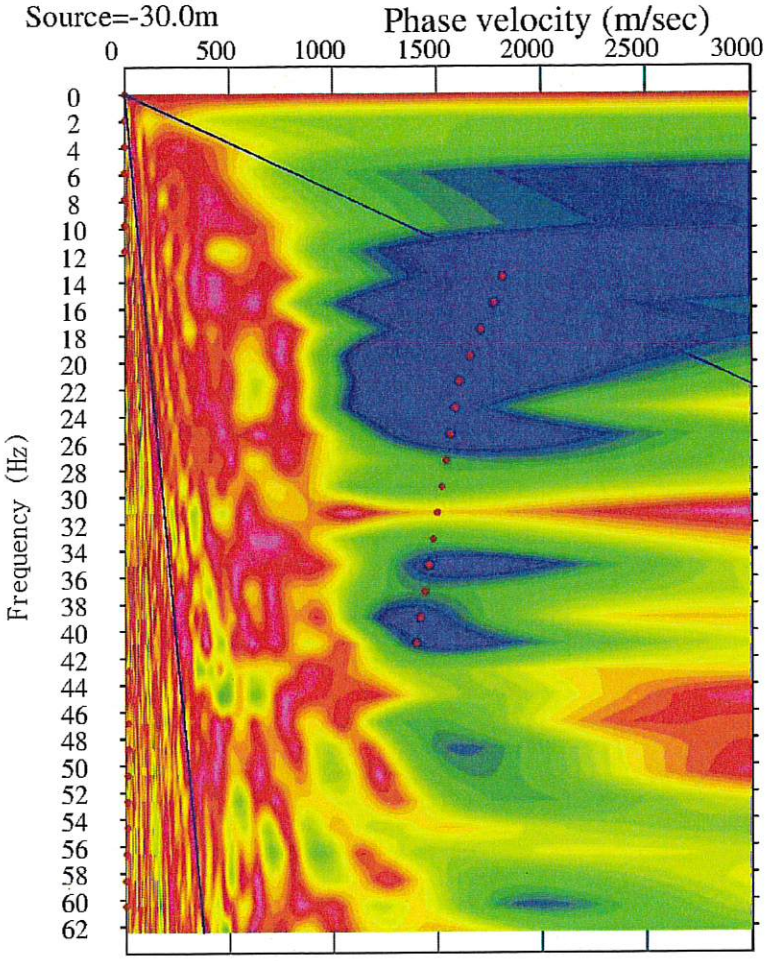


Figure 2: Active MASW Dispersion Curve Picks (red dots).

Results

The MASW test results are presented in Figure 3, which presents the calculated shear-wave velocity profile derived from the field testing. The results have been inferred using weight-drop located at 10 metres from the last geophone. The field collected dispersion curves are compared with the model generated dispersion curves on Figure 4. There is a good correlation between the field collected and model calculated dispersion curves, with a root mean squared error of less than 1%.

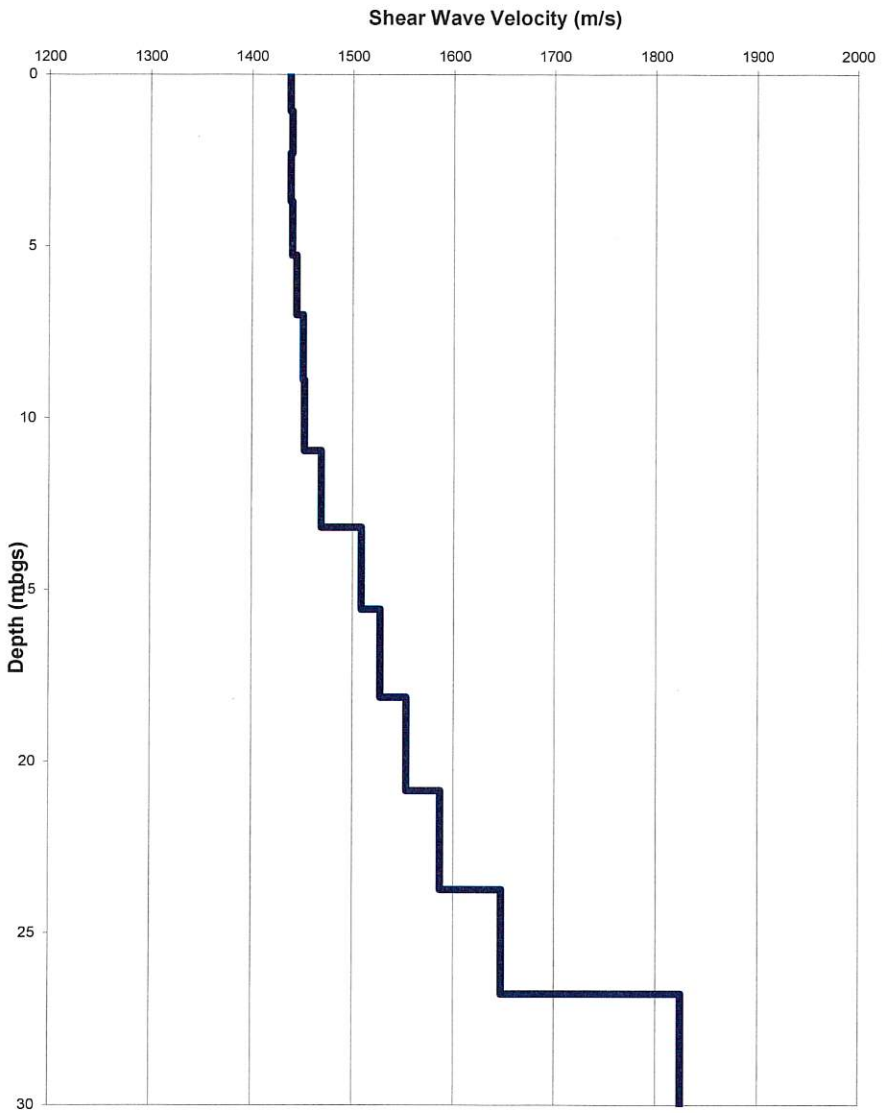


Figure 3: MASW Modelled Shear-Wave Velocity Depth profile.

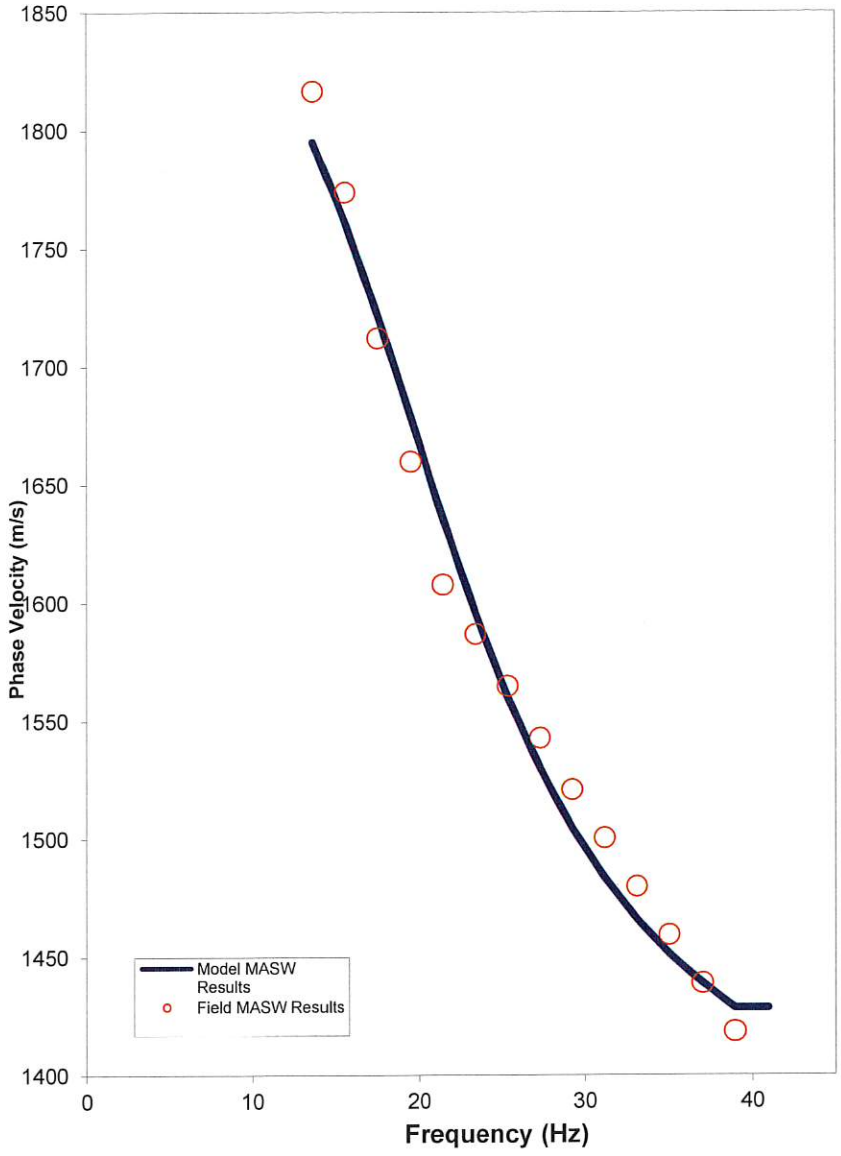


Figure 4: Comparison of Field (red dots) vs. Modelled Data (blue line).

To calculate the average shear-wave velocity as required by the NBCC2010, the results were modelled to 30 metres below ground surface. The average shear-wave velocity was found to be 1536 m/s (Table 1).

Table 1: Shear-Wave Velocity Profile

Model Layer (mbgs)		Layer Thickness (m)	Shear Wave Velocity (m/s)	Shear Wave Travel Time Through Layer (s)
Top	Bottom			
0.00	1.07	1.07	1439	0.000745
1.07	2.31	1.24	1441	0.000858
2.31	3.71	1.40	1439	0.000974
3.71	5.27	1.57	1441	0.001087
5.27	7.01	1.73	1445	0.001198
7.01	8.90	1.90	1451	0.001306
8.90	10.96	2.06	1453	0.001418
10.96	13.19	2.23	1470	0.001514
13.19	15.58	2.39	1509	0.001584
15.58	18.13	2.55	1528	0.001672
18.13	20.85	2.72	1554	0.001750
20.85	23.74	2.88	1587	0.001817
23.74	26.79	3.05	1648	0.001851
26.79	30.00	3.21	1825	0.001762
			Vs Average to 30 mbgs (m/s)	**1536**

Closure

We trust that this technical memorandum meets your needs at the present time. If you have any questions or require clarification, please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.

Stephane Sol, Ph.D, P. Geo.
Senior Geophysicist

Christopher Phillips, M. Sc., P. Geo.
Senior Geophysicist, Associate

SS/CRP/jl

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APPENDIX B

Results of Chemical Analysis
EXOVA Laboratories Report No. 1524472

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Mr. Steve Dunlop
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1524472
Date Submitted: 2015-12-15
Date Reported: 2015-12-18
Project: 1543311
COC #: 804149

Group	Analyte	MRL	Units	Guideline	Lab I.D. 1219053 Sample Matrix Soil Sample Type Sampling Date 2015-12-14 Sample I.D. TP 15-5 SA 2/0.6-0.86m
Agri. - Soil	pH	2.0			8.0
General Chemistry	Cl	0.002	%		<0.002
	Electrical Conductivity	0.05	mS/cm		0.32
	Resistivity	1	ohm-cm		3120
	SO4	0.01	%		0.03

Guideline = *** = Guideline Exceedence**
All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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